CURRICULUM VITAE

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Education:

1972	B. Tech., Chemical Engineering, Indian Institute of Technology, Kanpur, India
1974	M.S., Chemical Engineering, University of Delaware, Newark, DE
1976	Ph.D., Chemical Engineering, University of Delaware, Newark, DE

PRIMARY APPOINTMENTS:

1976-1978	Assistant Professor of Chemical and Biomedical Engineering Columbia University, New York, NY
1978-1979	Assistant Professor of Chemical and Biomedical Engineering
1979-1983	Associate Professor of Chemical and Biomedical Engineering
1983-1991	Professor of Chemical and Biomedical Engineering Carnegie Mellon University, Pittsburgh, PA
1991-	**Andrew Werk Cook Professor of Radiation Oncology (Tumor Biology)** **Harvard Medical School, Boston, MA**
1991-	**Director, Edwin L. Steele Laboratories for Tumor Biology** **Department of Radiation Oncology, Massachusetts General Hospital, Boston, MA**
1991-	Affiliated Faculty, Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA
2001-	Member, Biological and Biomedical Sciences Program, Harvard Medical School

VISITING PROFESSORSHIPS (SABBATICALS):

7/83 - 12/83	Visiting Professor of Chemical Engineering Massachusetts Institute of Technology, Cambridge, MA
1/84 - 4/84	Visiting Professor of Bioengineering University of California, San Diego, La Jolla, CA
4/84 - 6/84	Visiting Professor of Radiology Stanford University Medical School, Stanford, CA
8/90 - 1/91	Visiting Professor of Pathophysiology University of Mainz, Mainz, Germany
2/91 - 5/91	Visiting Professor of Surgical Research University of Munich, Munich, Germany

AWARDS AND HONORS

1979	George Tallmann Ladd Award, Carnegie Mellon University
1980-1985	Research Career Development Award, National Cancer Institute
1983	B.F. Ruth Lecturer, Iowa State University, Ames
1983	Allan P. Colburn Lecturer, University of Delaware, Newark
1983-1984	**Guggenheim Fellow**
1984	Research Award, International Institute for Microcirculation
1986	Hugh C. Muldoon Lecturer, Duquesne University, Pittsburgh
1990	Abbott Microcirculation Award, European Society for Microcirculation
1990-1991	Senior Scientist Award, Alexander von Humboldt Foundation, Germany
1992	**Founding Fellow, American Institute for Medical and Biological Engineering**
1992	Kurt Wohl Lecturer, University of Delaware, Newark
1993	Instrumentation for Physiology and Medicine Award, Microcirculation Society
1993-2000	**Outstanding Investigator Grant, National Cancer Institute**
1994	Distinguished Alumnus Award, Indian Institute of Technology, Kanpur
1994	Instrumentation for Physiology and Medicine Award, Microcirculation Society
1995	Whitaker Distinguished Lecturer, Biomedical Engineering Society
1996	Eugene M. Landis Award, Microcirculatory Society

1996-1999 Board of Directors, Biomedical Engineering Society
1999 William D. Kaplan Lecturer in Nuclear Medicine, Harvard Medical School
1999 Berkeley Lecturer, University of California, Berkeley
2000 Pharmaceutical and Bioengineering Award, American Institute of Chemical Engineers
2001 Honorary Fellow, Indian Institute of Chemical Engineers
2002 Gerritsen Award, Microcirculatory Society
2003 Alumni Wall of Fame, University of Delaware
2003 Elected to the National Academy of Medicine (formerly Institute of Medicine) (NAM)
2004 Elected to the National Academy of Engineering (NAE)
2004 Robert Bras Lecturer, Princess Margaret Hospital and National Cancer Institute of Canada
2005 John S. Laughlin Lecturer, Memorial Sloan-Kettering Cancer Center, New York
2005 Academic Scientist of the Year, 2005 Pharmaceutical Achievement Awards
2005 Distinguished Service Award, Nature Biotechnology-Miami Symposium on Angiogenesis
2006 Outstanding Achievement Award, Society of American Asian Scientists in Cancer Researc
2006 Robert L. Krigel Lecture, Fox Chase Cancer Center, Philadelphia
2006 Alpha Chi Sigma Research Award, American Institute of Chemical Engineers
2006 Benjamin Zweifach Distinguished Lecture, The City College, New York
2007 Research Team Award, Clinical Research Day, MGH
2007 Sam Gerson Leadership Chair of Research, Brain Tumor Society
2008 Richard D. Frisbee III Oncology Lecture, Yale University
2008 Sir Godfrey Hounsfield Medal and Lecture, Imperial College, London
2008 Peter C. Reilly Lectures, University of Notre Dame, Indiana
2008 Charles G. Moertel Lecture, Mayo Clinic, Rochester, Minnesota
2008 Ashland Distinguished Lecture, University of Kentucky, Lexington, Kentucky
2008 William E. Schiesser Lecture, Lehigh University, Bethlehem, Pennsylvania
2008 Elected to the American Academy of Arts and Sciences
2009 Benjamin Zweifach Lecture, University of California, San Diego, California
2009 Eli Ruckenstein Lecture, State University of New York, Buffalo
2009 Elected to the National Academy of Sciences (NAS)
2010-15 Breast Cancer Research Innovator Award, Department of Defense
2010 Joseph Martin Prize for Excellence in Clinical Research, MGH
2010 Pirkey Lecture, University of Texas at Austin
2010 Kelley Lectures, Purdue University
2010 William B. Lowrie Lecture, Ohio State University
2010 Wagner Lecture, University of Michigan
2011 Distinguished Research Lecturer, Carnegie Mellon University
2011 Roland T. Lakey Award, Wayne State University
2011 American Cancer Society Basic Science Lecture, Society of Surgical Oncology
2011 Rous-Whipple Award, American Society of Investigative Pathology
2011 Irving O. Shoichet Lecture, University of Toronto, Canada
2012 One of the 18 Indians Doing Cutting-Edge Research, Forbes (India)
2012 Herman Schwan Lecture, University of Pennsylvania
2012 ASCO Science of Oncology Award and Lecture, American Society of Clinical Oncology
2013 Gerritsen Award, Microcirculation Society (for the most cited review in the past 5 years)
2014 Fellow, National Foundation for Cancer Research
2014 Earl Bakken Distinguished Lecture, Amer. Institute for Medical and Biological Engineering
2014 Gerritsen Award, Microcirculation Society (for the most cited review in the past 5 years)
2014 AACR-Princess Takamatsu Lecture/Award, American Association for Cancer Research
2014 One of 50 Oncology Luminaries, American Society of Clinical Oncology (ASCO)
2014 **One of the top 1% cited researchers in Clinical Medicine, Thomson Reuters**
2014 Most cited paper (2013), Annals of Biomedical Engineering
2014 **Fellow, American Association for the Advancement of Science (AAAS)**
2015 Foreign Fellow, Indian National Science Academy (INSA)
2015 Honorary Doctorate, Katholieke Universiteit Leuven, Belgium
2015 Methusalem Lecture, Katholieke Universiteit Leuven, Belgium

2015 Honorary Doctorate, Indian Institute of Technology (IIT), Kanpur, India
2015 Arabindo Nath Bose Distinguished Lecture, IIT-Kanpur, India
2015 Alan S. Michaels Distinguished Lecture in Medical and Biological Engineering, MIT
2015 ASGBI Lecture, Association of Surgeons of Great Britain & Ireland, Manchester, UK
2015 Honorary Doctorate, Duke University
2015-22 Outstanding Investigator Award, National Cancer Institute
2015 Fredrickson Lecture, University of Minnesota
2015 **One of the top 1% cited researchers in Clinical Medicine, Thomson Reuters**
2016 Princess Takamatsu Cancer Research Fund International Lecturer, Japan
2016 One of the Most Influential/Cited Authors on the 75th Anniversary of Cancer Research
2016 R. B. Trull Lecture, University of Texas, Austin
2016 **One of the top 1% cited researchers in Clinical Medicine, Thomson Reuters**
2016 United States National Medal of Science (for 2013)
2017 Lifetime Achievement Award, American Assoc. of Indian Scientists in Cancer Research
2017 Ramzi Cotran Lecture, Harvard Medical School/Boston Children's Hospital
2017 New England Choice Award
2017 **One of the top 1% cited researchers in Clinical Medicine**
2017 **Elected to the National Academy of Inventors**
2018 Maud Menten Lecture, University of Pittsburgh
2018 Earl Benditt Award, North American Vascular Biology Organization
2018 **One of the top 1% cited researchers in Clinical Medicine**
2019 Judah Folkman Lecture, Harvard Medical School/Boston Children's Hospital
2019 Jeffrey M. Isner Memorial Lecture, Tufts University School of Medicine
2019 **One of the top 1% cited researchers in Clinical Medicine**
2020 Fellow, American Association for Cancer Research (AACR) Academy

MEMBER, EDITORIAL BOARD

1985- Biotechnology Progress
1985-2000 Microvascular Research
1986-1995 CRC Critical Reviews in Biomedical Engineering
1987-2007 Cancer Research
1991- Drug Delivery
1994-2001 Microcirculation
1997- Angiogenesis
1997-2010 British Journal of Cancer
1997- International Journal of Oncology
1997-2005 Journal of Theoretical Medicine
2002- Molecular Imaging
2002- Clinical Cancer Research
2003- Lymphatic Research and Biology
2004- 2012 Nature Reviews Cancer (Highlights Section)
2004-2012 Molecular Cancer Research (Senior Editor)
2005-2007 Computational and Mathematical Methods in Medicine
2008- Nature Clinical Practice Oncology/Nature Reviews Clinical Oncology
2010-2015 Journal of Clinical Oncology
2009- Nanomedicine
2012- IntraVital
2013- The Keio Journal of Medicine
2014- Molecular Cancer Therapeutics
2015- JAMA Oncology
2015- PNAS

GOVERNMENT AND INDUSTRIAL ADVISORY ROLE (SELECTED)

1976-1984 Consultant, Laboratory of Pathophysiology, NCI
1988-1990 Consultant, DuPont Merck Pharmaceuticals, Wilmington
1988-1993 Consultant, Hybritech-Lilly, San Diego
1989-1991 Member, Advisory Board, Pittsburgh Biomedical Development Corp.

1991-1994 Member, Radiation Study Section, NIH
1993-1995 Member, Board of Directors, American Cancer Society (Massachusetts Division)
1994-1997 Member, Scientific Advisory Board, CytoTherapeutics, Providence, RI
1994-1997 Member, Scientific Advisory Board, Peregrine Pharmaceuticals, Princeton, NJ
1996-1999 Member, Board of Directors, Biomedical Engineering Society
1997-1998 Member, Scientific Advisory Board, Oncologic, Boston, MA
1998 -2001 Consultant, Alkermes, Cambridge, MA
1999-2002 Member, Scientific Advisory Board, Sangart, San Diego, CA
2000 Consultant, Bracco Research USA, Princeton, NJ
2000 Consultant, Janssen Pharmaceutical Research Foundation, Titusville, NJ
2000 Member, Oncology Advisory Board, AMGEN Inc., Thousand Oaks, CA
2000-2004 Member, Scientific Advisory Board, American Biosciences Inc., Santa Monica, CA
2001-2010 Consultant, AstraZeneca, London, UK
2001-2002 Member, Genentech BioOncology Advisory Board, So. San Francisco, CA
2002 Consultant, Advanced Research Technologies, Inc., Montreal, Canada
2002 Consultant, Genetic Therapy, Inc., Gaithersburg, MD
2003-2008 Member, Board of Associates, Whitehead Institute for Biomedical Research
2003 Consultant, Archemix Corporation, Cambridge, MA
2004 Consultant, FibroGen, South San Francisco, CA
2004 Consultant, Domantis, London, UK
2004 - Consultant, Gershon Lehman Group, New York, NY
2004 -2009 Member, Scientific Advisory Committee on Biotechnology, Government of India
2005 -2011 Consultant, Dyax, Cambridge, MA
2005 Consultant, SKBP, Fairfield, NJ
2005 Consultant, Novartis, Basel, Switzerland
2006 Consultant, Nektar Therapeutics, San Carlos, CA
2006 Consultant, ThromboGenics, New York, NY
2006-2007 Consultant, Pfizer, New York, NY
2007-2014 Member, Board of Trustees, H&Q Healthcare Investors, Boston, MA
2007-2014 Member, Board of Trustees, H&Q Life Sciences Investors, Boston, MA
2007- Member, Scientific Advisory Board, Enlight Biosciences, Boston, MA
2007- Member, Scientific Advisory Board, SynDevRx, Boston, MA
2008 Consultant, Millennium Pharmaceuticals, Inc., Cambridge, MA
2009 Consultant, MorphoSys AG, Martinsried, Germany
2009 Consultanat, Regeneron Pharmaceuticals, Inc., Tarrytown, NY
2010 Consultant, Genzyme, Waltham, MA
2010 Consultant, Astellas Pharma Europe, Leiderdorp, the Netherlands
2010-13 Consultant, Noxxon, Berlin, Germany
2012-18 Co-Founder & Member, Board of Directors, XTuit Pharmaceuticals, Inc., Waltham, MA
2012-17 Advisory Committee for International Research-Intensive Center of Excellence, Taiwan
2012 WebMD Global
2012 Zyngenia, Gaithersburg, MD
2014-19 Ophthotech, Consultant, New York, NY
2014- Member, Board of Trustees, Tekla Healthcare Opportunities Fund, Boston, MA
2014- Member, Board of Trustees, Tekla Healthcare Investors, Boston, MA
2014- Member, Board of Trustees, Tekla Life Sciences Investors, Boston, MA
2015- Member, Board of Trustees, Tekla World Healthcare Fund, Boston, MA
2015- Consultant, Sun Pharma Advanced Research Company, Ltd. (SPARC), India
2016 Consultant, Pfizer, Cambridge, MA
2017 Consultant, Merck, Kenilworth, NJ
2017 Scientific Advisory Board, Center for Cancer Biology, VIB - KU Leuven, Belgium
2020- Member, Scientific Advisory Board, Accurius Therapeutics, Boston, MA

OTHER PROFESSIONAL ACTIVITIES (SELECTED)

1986- Director, Continuing Medical Education course on “Critical Issues in Tumor

	Microenvironment: Angiogenesis, Metastasis and Immunology." Carnegie Mellon University (1986-1990); Harvard Medical School (1991-)
1993	Vice-Chair, Gordon Research Conference on "Exchange in the Microvasculature," Plymouth State College, NH, June 14 - 18, 1993.
1995	Co-Chair, Keystone Symposium on "Drug Delivery," Hilton Head, SC, January 7-13, 1995.
1995	Founding Chair, Gordon Research Conference on "Angiogenesis and Microcirculation," Salve Regina College, Newport, RI, August 13-18, 1995.
1997	Chair, NCI Workshop, on "Physiological Resistance to Solid Tumor Treatment," Washington, D.C., July 25 - 27, 1997.
1997-1998	Chair, 1998 AACR Annual Meeting Program Committee, Section BL4 on "Tumor Biology: Host Tumor Interaction."
1998	Co-Chair, Forbeck Foundation Workshop on "Angiogenesis and Accessibility," Hilton Head, North Carolina, November 5 - 7, 1998.
2000, 2002	Chair, AACR Annual Meeting Program Committee, Section BL4 on "Tumor Biology: Angiogenesis and Microcirculation."
2001	Chair, 2001 Boston Angiogenesis Meeting, MA, November 2, 2001.
2002	Chair, Keystone Symposium on "Angiogenesis in Cancer and Other Diseases," Banff, Canada, February 8-13, 2002.
2002-2003	Member, 2003 AACR Annual Meeting Program Committee, Section BL4 on "Tumor Biology: Angiogenesis and Microcirculation."
2003-2004	Co-Chair, 2004 AACR Annual Meeting Program Committee, Orlando, FL.
2005	Chair, AACR Symposium on Antiangiogenesis and Drug Delivery, Boston, MA.
2005	Co-Chair, NCI Special Review Panel on Centers of Cancer Nantotechnology Excellence
2006	Co-Chair, ASCO Satellite Symposium on Breakthroughs in Targeted Cancer Therapy, Atlanta, GA
2006	Selection Panel, Albert Szent-Gyorgyi Prize, National Foundation for Cancer Research
2007	Chair, AACR Annual Meeting Program Committee, Section BL4 on "Tumor Biology: Angiogenesis and Microcirculation."
2007	Member, Landon-AACR Basic Science Award Committee
2008-	Review Panel, Grand Challenges Explorations, the Gates Foundation
2009	Chair, Folkman Young Investigator Award Committee, AACR
2010	Co-Chair, NCI Special Review Panel on Centers of Cancer Nantotechnology Excellence
2010	Member, Gertude Elion Young Investigator Award Committee, AACR
2011	Co-Chair, AACR Frontiers in Basic Cancer Research Conference, San Francisco
2011-2012	Co-Chair, 2012 AACR Annual Meeting Program Committee, Chicago, IL.
2011, 14	Member, Selection Committee for the AACR Princess Takamatsu Memorial Lectureship
2010-	Member, AACR Special Conferences Committee
2014-2015	Member, 2015 AACR Annual Meeting Program Committee, Philadelphia, PA,
2015	Chair, AACR Special Conference on Tumor Angiogenesis and Vascular Normalization: Bench to Bedside to Biomarkers, March 5-8, 2015, Orlando, FL.
2015-2016	Member, AACR Clinical and Translational Cancer Research Grants Scientific Review Committee
2016	Chair, AACR Special Conference on Engineering and Physical Sciences in Oncology, June 25-28, 2016, Boston, MA.
2016-	Member, Advisory Board, USA-India Chamber of Commerce
2017	Member, Evaluation Panel, Kuwait Prize for Applied Medical Sciences
2018	Chair, Forbeck Forum on Tumor Microenvironment, Colorado Springs, (Nov 2-4, 2018)
2018	Member, AACR-Women in Cancer Research Charlotte Friend Lectureship Committee
2018-	Member, AACR Publications Committee
2019	Chair, Major Symposium on "Vascular Regulation of Anti-tumor Immunity," AACR Annual Meeting, Atlanta, GA, April 2, 2019.
2019	Chair, Education Session on "Reprogramming the Tumor Microenvironment to Improve Immunotherapy," ASCO Annual Meeting, Chicago, IL, June 1, 2019.

CONTRIBUTIONS TO SCIENCE

For four decades, my research has focused on one challenge: improving the delivery and efficacy of anti-cancer therapeutics by normalizing the tumor microenvironment. Working on the hypothesis that the abnormal tumor microenvironment fuels tumor progression and treatment resistance, we developed an array of sophisticated imaging technologies and animal models as well as mathematical models to unravel the complex biology of tumors. Using these tools, we demonstrated that the blood and lymphatic vasculature, fibroblasts, immune cells and the extracellular matrix associated with tumors are abnormal, and these collaborate together to create a hostile tumor microenvironment characterized by hypoxia, low pH and high interstitial fluid pressure and solid stress. We next hypothesized that agents that induce "normalization" of the microenvironment can improve the treatment outcome. Indeed, we demonstrated that judicious use of antiangiogenic agents—originally designed to starve tumors—could transiently "normalize" tumor vasculature, alleviate hypoxia, increase delivery of drugs and anti-tumor immune cells, and improve the outcome of various therapies, including immunotherapy (Science 2005, 2019). In parallel, we provided compelling evidence for vascular normalization in cancer patients treated with antiangiogenic agents. In fact, vascular normalization and the resultant improvement in tumor perfusion and oxygenation associated with longer survival in patients (J Clinical Oncology 2013; Cancer Cell 2014; PNAS 2015). Our preclinical finding that vascular normalization can improve immunotherapy (PNAS 2012) was confirmed by others in randomized phase III trials on combining antiangiogenic therapy with immune-checkpoint inhibitors for lung, kidney, liver and endometrial cancers (New England J Medicine 2018, 2019, 2020), and led to the FDA approvals of five such combinations of antiangiogenic therapy and immune-checkpoint inhibitors for these cancers (Science 2019).

The normalization hypothesis also opened doors to treating various non-malignant diseases characterized by abnormal vasculature that afflict >500 million people worldwide, such as, tuberculosis (PNAS 2015) and neurofibromatosis-2 (NF2) (New England J. Medicine 2009). Based on our findings, bevacizumab was approved for NF2-schwannoma patients in UK in 2014. This hypothesis has also been validated by a number of laboratories worldwide and has changed the thinking about how antiangiogenic agents work alone and in combination with conventional and emerging therapeutics (Science 2005; New England J. Medicine 2009; Nature Rev Drug Discovery 2011; Physiological Rev 2011; Cancer Cell 2014; Nature Reviews Clinical Oncology 2018; Science 2019).

Finally, we discovered that anti-hypertensive drugs capable of "normalizing" the tumor matrix and stromal cells can reprogram the tumor microenvironment to an immunostimulatory milieu and improve the delivery and efficacy of cancer therapies, including immunotherapy (Nature Comm 2013; Cancer Discovery 2016; Science Translational Medicine 2017; PNAS 2019, 2020). A phase II trial (NCT01821729) led by my clinical collaborators provided compelling evidence in support of this emerging concept for improving the treatment outcome for patients with pancreatic ductal adenocarcinoma – a uniformly fatal disease (JAMA Oncology 2019).

Development of Innovative Imaging Technologies: For four decades, we have investigated solid tumors as complex organs, and not just a collection of malignant cells and mutated genes. To unravel the complex pathophysiology of this aberrant organ, we developed and/or employed an array of cutting-edge and innovative technologies as well as animal and mathematical models. These include transparent windows to visualize biological events in tumors growing in various organs of mice (Nature Reviews Cancer 2002; Cell 2013), multi-photon intravital microscopy (Nature Medicine 2001), second-harmonic generation microscopy (Nature Medicine 2003; Nature Methods 2009), fluorescence correlation microscopy (Nature Medicine 2004), optical frequency domain imaging (Nature Medicine 2009), wide-field endoscopy (Nature Methods 2010) and quantum dot nanotechnology (Nature Medicine 2005, Nature Nanotechnology 2012, Nature Biomedical Engineering 2017, 2020). These tools provided unprecedented molecular, cellular, anatomical and functional insight into the inner workings of solid tumors and ways to harness this insight for improving treatment with radio-, chemo- and immuno-therapies.

Discovery of the Vascular Normalization Principle: After realizing that the abnormal structure and function of tumor vessels is a result of the imbalance between endogenous pro- and anti-angiogenic molecules, I proposed a novel hypothesis: By restoring balance, anti-angiogenic therapy can transiently "normalize" the abnormal tumor vasculature, resulting in improved delivery of drugs and oxygen (a known radiation sensitizer and immunostimulator) in tumors. I also hypothesized that chemo-, immuno- and/or radiation therapy given during this window of normalization is likely to yield the best outcome for combination therapy (Nature Medicine 2001; Science 2005). This hypothesis offered a potential explanation for why drugs, such as Avastin (whose goal is to destroy tumor vessels) improve the outcome of therapeutics (that require blood vessels for delivery), and importantly, offered guidelines to improve such combination therapies (Nature Clinical Practice Oncology 2006, Cancer Cell 2014).

We first tested this hypothesis in a variety of pre-clinical models (PNAS 1996; 1998; Nature 2002; Cancer Research, 2004; Cancer Cell, 2004; Nature Nanotechnology 2012). Our work demonstrated that blockade of VEGF-signaling or upregulation of Thrombospondin transiently prunes the immature and leaky vessels of tumors in mice and actively remodels the remaining vasculature so that it more closely resembles the normal vasculature. This "normalized" vasculature is characterized by less leaky, less dilated, and less tortuous vessels, with a more normal basement membrane and greater vessel coverage by pericytes. These morphological changes are accompanied by functional changes: decreased interstitial fluid pressure, decreased tumor hypoxia, and improved penetration of drugs and immune cells in these tumors. The outcome of combination therapy was found to be synergistic when the cytotoxic therapy was given during the normalization window (Cancer Cell 2004).

We also dissected the molecular and cellular mechanisms of vascular normalization (Cancer Cell, 2004). We discovered that the Tie-2 activation contributes to the increased pericyte coverage and an increase in MMP activity contributes to the basement membrane normalization. We further showed that the kinetics of vascular normalization determines the outcome of combined antiangiogenic and radiation therapy (Cancer Cell, 2004).

After careful and rigorous characterization of tumor vasculature in pre-clinical models, in collaboration with medical, surgical and radiation oncologists, we evaluated the molecular, structural and functional changes in the vasculature of rectal carcinomas in patients receiving bevacizumab (Avastin) with radiation and chemotherapy. This study, published in February 2004, provided the first glimpse of how anti-angiogenic therapy actually works in patients (Nature Medicine, 2004), and supported our pre-clinical findings on vascular normalization. In collaboration with neuro-oncologists and radiologists, we also demonstrated the benefits of vascular normalization in glioblastoma patients receiving an oral antiangiogenic agent cediranib (Cancer Cell, 2007; Nature Medicine 2013; PNAS 2013), and lung or breast cancer patients receiving Avastin (PNAS 2015). We also showed that vascular normalization can improve immunotherapy (PNAS 2012) – a finding confirmed in multiple phase III trials in lung, kidney, liver and endometrial cancers by others (New England J Medicine 2018, 2019, 2020), *which led to 5 FDA approvals of checkpoint blockers with antiangiogenic agents for these patients*. We also demonstrated that Avastin can improve hearing in NF2 patients (New Engl J of Medicine 2009), which was approved for these patients in UK in 2014.

Our lab has led to and/or collaborated in 45+ multi-disciplinary translational trials in various malignancies, e.g., sarcomas, liver, ovarian, breast, lung, pancreatic, head and neck carcinomas, at MGH/DFCI (Nature Reviews Clinical Oncology 2009, 2019). We identified Ang2 as a potential biomarker of evasive resistance to anti-VEGF therapies (Nature Medicine 2004; Cancer Cell, 2007). Indeed, blocking both VEGF and Ang2 improves survival more than either agent alone in GBM (PNAS 2016 a, b) and has led to a clinical trial in GBM patients.

Discovery of the Matrix Normalization Principle: Our laboratory is most widely known for the discovery that the high interstitial fluid pressure is a universal characteristic of tumors in rodents and in humans, and it can impair the delivery of drugs to tumors and facilitate metastasis (Cancer Research 1988, 2007; Nature Medicine 1998, Science 2020). We also uncovered the underlying mechanisms: high vascular permeability, lack of functional lymphatics, and mechanical forces generated by tumor growth (Nature Biotechnology 1997, PNAS 1998, Science 2002, Nature 2004, PNAS 2012). Our measurement of pO2 and pH profiles around individual tumor vessels revealed how abnormal structure and function of tumor vessels lead to a hostile metabolic microenvironment in tumors that fuels malignant behavior and creates resistance to various therapies (Nature Medicine 1997, 2001; Nature 2011). Our laboratory provided the first measurements of interstitial convection and diffusion in vivo and thus demonstrated how the matrix can pose a barrier to delivery of nanomedicine (PNAS 1989, 1997, 2001, 2011). Finally, by imaging collagen in vivo (Nature Medicine 2003) and measuring drug delivery, we discovered how the extracellular matrix can impede drug delivery, and that angiotensin inhibitors, such as losartan, can improve the delivery and efficacy of therapeutics in tumors by "normalizing" the matrix and "decompressing" blood vessels (PNAS 2011; Nature Communications 2013; Cancer Discovery 2016). Confirmed in a successful phase II clinical trial on losartan and chemo-radio-therapy in pancreatic ductal adenocarcinoma patients (NCT01821729; JAMA Oncology 2019), this concept offers new hope for improving delivery and efficacy of therapeutics in highly fibrotic tumors.

Discovery of the Role of Host Cells: Our laboratory discovered that cancer cells co-opt the host stromal cells into producing blood vessels and matrix. By revealing that host cells are active participants rather than passive bystanders in tumor angiogenesis, metastasis, and therapeutic response (Cell 1998, 2013; Nature Medicine 1999, 2001; Nature 2002; Nature Methods 2009; PNAS 2011, 2012; Cancer Discovery 2016), we identified the host cells as a critical target for cancer therapy (Nature Medicine 2003; Cancer Cells 2014). We also discovered that by engaging the host cells, Herceptin, an anti-her2/neu antibody, down-regulates five different angiogenic pathways and acts as an anti-

angiogenic cocktail (Nature 2002). Whereas Herceptin lowers VEGF expression in cancer cells, it also induces compensatory upregulation of VEGF in the host stromal cells. This surprising finding on the role of host cells led to a preclinical study in mice with brain metastasis from Her2+ breast cancer where we combined Herceptin and Avastin and observed dramatic tumor responses and improved survival (PNAS 2012). These results provided a compelling rationale for a clinical trial to evaluate the efficacy of Avastin in combination with Herceptin in breast cancer patients with active brain metastases from their HER2-positive disease and showed promising results (NCT01004172). More recently, we discovered that the brain microenvironment confers resistance to HER2/PI3K inhibitors in brain metastasis from luminal breast cancers, and blocking HER3/NRG1 can overcome this resistance (Science Tranlational Medicine, 2017) – a preclinical finding also confirmed by an idependent clinical trial (DOI: 10.1200/JCO.2016.70.6267).

Our work also offered new insights into the treatment of prostate and breast cancers by revealing that hormone withdrawal from a hormone-dependent tumor leads to apoptosis of endothelial cells prior to the death of cancer cells and normalizes their vessels (PNAS 1998). Furthermore, the finding from our laboratory *that angiogenic molecules regulate adhesion molecules on the vasculature provided the first link between these two disparate fields – angiogenesis and cell adhesion – and revealed novel mechanisms by which tumors evade host immune response (*Nature Medicine 1996, PNAS 2012) and metastasize to specific sites in the lungs (PNAS 2011).

Discovery of a New Paradigm for Vascular Engineering: A rate-limiting step in the field of regenerative medicine is to engineer blood vessels that persist and function for the lifespan of the patient. Although genetic manipulations can prolong the survival of engineered vessels, such manipulations have oncogenic potential. Our lab provided a new approach that does not require genetic manipulations and results in a vasculature in the mouse cranium that is stable and functional for one year (Nature 2004). By generating endothelial and smooth muscle cells from human embryonic stem (hES) cells and induced pluripotent stem (iPS) cells, our work brings this approach closer to translation into the clinic for engineering functional and long-lasting vessels (Nature Biotechnology 2007; Blood 2008; PNAS 2013; Science Translational Medicine 2015).

Revealing Underlying Principles Using Systems Approach: As a chemical engineer by training, I have always relied on mathematical modeling to complement our experimental studies. This systems approach has allowed me to analyze the complex biology of tumors and to extract simple principles useful for developing novel diagnostic and therapeutic agents. For example, to gain insight into the origins and implications of the elevated interstitial fluid pressure in tumors, we developed a mathematical model to simulate fluid and macromolecular transport in tumors (Cancer Research 1988). The most striking prediction of this mathematical model - confirmed experimentally in 1990 - was that the pressure is relatively uniform throughout the tumor and drops precipitously in the tumor margin (Cancer Research 1990). Subsequent experimental work further validated our model predictions, showing that fluid flow rates from the tumor boundary were of the same order of magnitude as those calculated by our model for transplanted tumors in rodents (Cancer Research 1991) as well as human cancers in patients (Microcirculation 1997). This model allowed us to predict the effect of vascular normalization on decreasing interstitial fluid pressure and edema in tumors that we subsequently confirmed in rectal, brain, lung and breast cancer patients (Cancer Research 2007; PNAS 2013, PNAS 2015). This seamless integration between bench and bedside and application of engineering/physical science principles remains a hallmark of my research (Science 2020).

Educational Contributions: My educational goals are to train basic scientists, engineers and physicians in the integrative biology of cancer. I have had the good fortune of mentoring more than 220 doctoral and postdoctoral fellows from diverse backgrounds including engineering, mathematics, physics, chemistry, molecular and cellular biology, immunology, pathology, radiology, radiation, medical and surgical oncology – many are now leaders in academia and industry (see Table on the next page). I have also had productive collaborations with a similar number of basic scientists and clinicians from Harvard, MIT and elsewhere. Findings from these collaborative efforts are summarized in >700 publications, including four in *Scientific American* to reach out to a broader audience (WoS citations >116,000; h-index= 163, November 1, 2020; ranked among the top 1% cited authors since 2014).
To foster closer interactions between cancer researchers and physical scientists/engineers, I designed a week-long intensive course, in 1986, entitled, "Critical Issues in Tumor Microenvironment: Angiogenesis, Metastasis and Immunology". There were no textbooks on this subject and this topic was not covered in any courses at any of the universities. Now in its 35th year, this course is ranked among the top of all courses offered by Harvard Medical School Department of Continuing Medical Education (https://steelelabs.mgh.harvard.edu/tumorcourse).

POST-DOCTORAL FELLOWS, JUNIOR FACULTY AND STUDENTS MENTORED

Post-Doctoral Fellows and Junior Faculty

Ager E 2011-13
Alexandrakis G 2001-04
Amoozgar Z 2015-
Andersson P 2017-
Askoxylakis V 2013-16
Babykutty S 2013-15
Badeaux M 2012-17
Batista Ana 2010-15
Baxter L 1991-98
Berk D 1992-98
Bhaumik J 2010-11
Bockhorn M 2000-02
Booth M 2003-06
Boucher Y 1988-98
Brown E 1999-05
Burton K 1999-01
Campbell R 1999-02
Chae S 2004-10
Chang Y 1998-00
Chauhan V 2012-17
Chatterjee S 2014-
Chen I 2018-19
Chen Y-L 2004-06
Cheng G 2005-09
Chung E 2007-10
Cruzeiro G 2019-
Datta M 2018-
Dawson M 2005-08
Dellian M 1993-95
Demou Z 2001-2006
Dimitrov D 1983-84
DiTomaso E 1998-09
Dong X 2020-
Duda D 2001-12
Dull R 1998-99
Endo M 1994-97
Fenton B 2000-02
Ferrara G 2013-
Finn A 2005-06
Forbes N 2000-02
Friedrich S 1996-97
Fukumura D 1994-99
Garkavtsev I 2002-10
Ghosh, M 2016-17
Gohongi T 1997-00
Gralla O 2000-01
Griffin G 1996-98
Han X 2012-15
Hansen N 1997-98
Hartford A 1997-00
Hoshida T 2003-07
Heijn M 1997-99
Helmlinger G 1994-97
Hiratsuka S 2007-10
Huang P 1992-10
Huang Y 2008-13
Isaaca H 2002-05
Izumi Y 1999-02
Jeong H 2009 – 11
Jung K 2013-18
Junker N 2002-03
Kadambi A 1998-01
Kamoun W 2006-11
Kashiwagi S 2003-07
Kawaguchi K 2016-18
Kirkpatrick N 2008-12
Kodack D 2010-14
Koike C 1999-00
Koike N 2001-4
Kohno M 2003-6
Kozak K 2005-8
Kozin S 1998-15
Krishnan S 2016-
Kristensen C 1995-97
Kristjansen P 1992-94
Kumra H 2020-
Kuo A 2006-09
Kwanten W 2017-19
Lacorre D 2005-11
Lahdenranta J 2005-08
Larrouquere L 2015-17
Lee I 1991-94
Leu A 1993-94
Leunig M 1991-93
Ley C 2006-07
Liao S 2007-13
Lichtenbeld H 1997-00
Lu-Emerson C 2010-12
Luong M 2003-08
Melder R 1989-98
Migliorini C 2000-01
Miyazaki J 2004-05
Monsky W 1996-98
Mouta C 1999-01
Moutardier V 1999-00
Mulivor A 2004-07
Munn L 1993-98
Nelson G 2004-07
Netti P 1994-97
Ng R 2013-18
Nia H 2014-19
Nozue M 1993-95
Ohkubo C 1989
Ohtaka K 1997-98
Padera T 2003-11
Patan S 1994-99
Pinter M 2015-17
Pluen A 1997-00
Posada J 2018-
Rahbari N 2011-13
Ramanujuan S 1998-00
Reiberger T 2012-15
Ren J 2016 - 20
Riedemann L 2011-15
Roh H 1989-91
Roose T 2001-2002
Samuel R 2008-11
Sasaki A 1987-89
Sckell A 1996-97
Seano G 2013-18
Shah S 1979-82
Snuderl M 2008-12
Stock R 1987-91
Stohrer M 1993-94
Stroh M 2002-05
Stylianopoulos T 08-10
Sun C 2002-06
Suzuki Y 2003-04
Tanda S 1994-96
Taylor J 2012-14
Traykov T 1984-85
Tsukada K 2007-09
Tsuzuki Y 1998-01
Tyrrell J 2006-8
Ushiyama A 2000-01
Vardam T 2012-15
Wang N 2016-18
Ward K 1986-87
Willsey L 1996-97
Winkler F 2003-05
Wong C 2016-19
Xu L 2000-8
Yamada S 1993-94
Yamashita H 2007-2010
Yan S 2014 -15
Yuan F 1990-96
Yuan J 1997-00
Yue C 2017-19
Yun C-O 1998-00
Zhao Y 2015-17
Zlotecki R 1992-93

M.D. Students

Alt A 2001-02
Ang J 1998-99
Awad M 2001-03
ChandawarkarA 2009-11
Demhartner T 1992
Greif D 1995
Hoffman S 2019-20
Lawenda B 2005-06
Losken A 1995-96
Safabakhsh N 1995-96
Salehi H 1993-94
Witwer B 1994-95

Visiting Scholars

Baish J '94-95; '13-14
Davies C 1997-98
Ivanov I 1977-78
Park K R 1997-99
Tarbell J 1997-98

Ph.D. Students

Au P 2002-08	Eskey C 1988-92	Lanning R 2003-09	Peterson T 2009 -15
Baxter L 1985-90	Gazit Y 1993-96	Li Chong 2012-15	Sevick E 1985-89
Chary S 1984-89	Gerlowski L 1979-84	Liu H 2012-17	Stoll B 1998-03
Chen I 2013-18	Goel S 2009-2012	Maldarelli C 1977-81	Swartz M 1994-98
Clauss M 1983-90	Hagendoorn J 2003-06	Martin GR 1986-91	Tam J 2002-09
Chauhan V 2006-12	Ho W 2013-20	Martin J 2009-15	Tong R 2001-05
Cochran D 2001-05	Hobbs S 1992-97	McKee T 2000-05	Tse J 2004 -10
Datta M 2013-18	Incio J 2010-16	Mok W 2003-07	Ward K 1980-86
Diop B 2006-10	Kaufman E 1988-92	Naxerova K 2009 -13	Weissbrod J 1976-79
Dolmans D 2000-02	Kloepper J 2012-16	Nugent L 1978-82	Zawicki D 1976-79
Dudar T 1978-82	Koenig G 1994-98	Padera T 1998-03	Zhu H 1992-96
Duyverman A 2006-10	Kumar AS 2018-	Perentes J 2004-07	Znati C 1990-95

RESEARCH SUPPORT (CURRENT AND COMPLETED WITHIN LAST 5 YEARS)

Current Support

1) **NIH/NCI 1R35CA197743 (PI: Jain**) 09/14/2015 – 08/31/2022

Dissecting Pediatric Brain Tumor Microenvironment to Improve Treatment

The goal of this Outstanding Investigator Award is to study novel approaches targeting the interaction between pediatric brain tumors with the developing brain in which they grow. Our findings will directly inform the design of potential clinical trials in pediatric brain tumor patients and help interpret the results, beginning with studies of placental growth factor blockade as a potentially broad and safer approach in medulloblastoma and other pediatric brain tumors.

Role: Principal Investigator

2) **NIH/NCI 1R01CA208205 (Co-PIs: Fukumura & Jain)** 06/15/2017 – 6/14/2022

Reengineering obesity-induced abnormal microenvironment to improve PDAC treatment

The goal of this project is to determine the effect of obesity on PDAC desmoplasia and mechanical properties, and develop and test new therapeutic approaches that reverse the abnormal PDAC biomechanics in obesity.

Role: Co-PI

3) **NIH/NCI U01CA224348 (Co-PIs: Jain & Pittet)** 09/01/2017 - 08/31/2022

Reprogramming PDAC tumor microenvironment to improve immunotherapy

The goal of this U01 is to provide novel mechanistic insights into reprogramming the immunosuppressive tumor microenvironment of pancreatic ductal adenocarcinoma (PDAC) and improve efficacy of cytotoxic agents and immune checkpoint blockers. The resulting data will directly inform the design of a multi-institutional clinical trial.

4) **Bill and Melinda Gates Foundation (OPP1140482) (PI: Jain)** 11/23/2015-10/31/2020

Normalizing Tuberculosis Granuloma Vasculature and Matrix to Improve Drug Delivery and Efficacy

The goal of this project – in collaboration with Drs. Clif Barry and Laura Via (Tuberculosis Research Section, NIAID) and Dr. Veronique Dartois (Rutgers) – to test the hypothesis that bevacizumab (Avastin) and losartan can "normalize" the blood vessels and matrix, respectively, of TB granulomas in the lungs of rabbits, and thus, improve drug delivery and treatment outcome.

Role: Principal Investigator

5) **Entertainment Industry Foundation (SU2C) (PI: Ryan)** 01/1/2018-12/31/2021

Developing Novel Approaches to Detect and Treat Early Pancreatic Cancer

The goal of this multi-institutional trial to evaluate if losartan can improve the outcome of chemo-radiation and surgery of locally advanced pancreatic ductal adenocarcinoma with or without combined immune and targeted therapies.

Role: Co-Investigator

Completed Research Support within Last 6 Years

1) **DoD W81XWH-10-1-0016 Research Innovator Award (P: Jain)** 09/01/2010-08/31/2016
Strategies for Personalized Treatment of Metastatic Breast Cancer: Vascular Normalization and Sensitization
The goal of this Breast Cancer Research Innovator Award is to improve survival of metastatic breast cancer patients by applying two complementary strategies - "vascular normalization" and "vascular sensitization" – and by identifying biomarkers for personalizing these treatment approaches.
Role: Principal Investigator

2) **NIH/NCI - R01 CA163815 (PI: Jain)** 08/06/2012-05/31/2016
Role of PlGF in Medulloblastoma (MB) Progression and Treatment
The goal of this project is to reveal the mechanisms of response to anti-PlGF therapy in MB using genetically engineered mouse models, characterized human MB cell lines and state-of-the-art intravital imaging.
Role: Principal Investigator

3) **NIH/NCI R01 CA126642-05 (PI: Jain)** 05/07/2008 – 02/28/2014
Probing Tumor Microenvironment Using Nanotechnology
This BRP developed nanotechnology for drug delivery, microenvironment and cell phenotype studies in collaboration with Dr. Dai Fukumura of MGH and Dr. Moungi Bawendi of MIT.
Role: Principal Investigator

4) **NIH/NCI Federal Share/NCI Proton Beam Program Income (PI: Jain)** 04/01/11 – 12/31/2014
Novel Approaches *to Anti-Metastasis Therapy in Breast Cancer*
The goal of this umbrella grant is to develop three novel approaches to treat breast cancer metastasis.
Role: Principal Investigator

5) **Bill and Melinda Gates Foundation (OPPGH5250) (PI: Jain)** 1/21/2009-7/31/2016
The Impact of Antiangiogenic Treatment on the Efficacy of Treatment for Tuberculosis
The goal of this project – in collaboration with Drs. Clif Barry and Laura Via of Tuberculosis Research Section, NIAID – to test the hypothesis that bevacizumab (Avastin) can "normalize" the blood vessels of TB granulomas in the lungs of rabbits, and thus, improve the treatment outcome.
Role: Principal Investigator

6) **NIH/NCI P01 CA080124 (PI: Jain)** 08/11/2000-04/30/2018
Integrative Pathophysiology of Solid Tumors
The goal of this Program Project is to improve the outcome of anti-angiogenic treatment in glioblastoma (Project 1), colorectal cancer (Project 2), hepatocellular carcinoma (Project 3) and pancreatic ductal adenocarcinoma (Project 4) with the support of 4 Cores: Bioengineering, Imaging and Biostatistics (Core A); Molecular and Cellular Biology (Core B); Small Animal and Surgery (Core C) and Administrative (Core D).
Role: Principal Investigator; Project 1 Leader; Project 4 Co-Leader; Core D Director

7) NIH/NCI R01 CA129371 (PI: Batchelor) 09/01/2013-03/31/2019
Angiogenesis-Targeting Therapy for Glioblastoma
The goal of this project is to evaluate if bevacizumab achieves a therapeutic benefit in a subset of GBM patients by transient normalization of tumor vessels. Furthermore the project tests whether imaging and biospecimen markers of vessel normalization are useful in the identification of responsive versus resistant GBM subpopulations and if bevacizumab resistance eventually develops due to the activation of alternative pro-angiogenic or pro-invasive signal transduction pathways.
Role: Co-Investigator

8) **NIH/NCI P50CA165962 (PI: Batchelor)** 09/01/2013-08/30/2019
Targeted Therapies of Glioma (SPORE grant)

The goal of this SPORE grant is the development of new targeted therapies for glioma. **Project one** targets the tumor vascular system and will test the hypothesis that responses to VEGF pathway inhibitors can be augmented by suppression of the angiopoietin-2 signal transduction pathway.
Role: Co-Leader of Project 1

9) **National Foundation for Cancer Research (PI: Jain)** 1/1/2018-9/31/2021

Reprogramming the tumor microenvironment to improve immunotherapy of GBM

The goal of this project is to improve the efficacy of immune checkpoint blockers (ICBs) with reduced immune related adverse events in GBMs by targeting the tumor microenvironment.

INVITED SEMINARS IN ACADEMIA, INDUSTRY & GOVERNMENT (1990 - present)

Department of Radiation Oncology, Massachusetts General Hospital, Boston, MA (January 1990)
The Ontario Cancer Institute, Toronto, Canada (January 1990)
Department of Biophysics, University of Arizona, Tucson, AZ (February 1990)
Magee Women's Hospital, University of Pittsburgh, Pittsburgh, PA (June 1990)
Department of Physiology, University of Tokyo, Tokyo, Japan (July 1990)
Biological Response Modifiers Program, National Cancer Institute, Frederick, MD (November 1990)
Department of Chemical Engineering, University of California, Berkeley, CA (November 1990)
Immunology Division, Merck and Co., Darmstadt, Germany (December 1990)

Institute for Anatomy and Cell Biology, University of Marburg, Germany (January 1991).
Institute for Physiology, University of Munich, Munich, Germany (February 1991).
Institute for Surgical Research, University of Munich, Munich, Germany (May 1991).
Department of Pharmacology/Medicine, Dana Farber Cancer Institute, Boston, MA (November 1991)
Joint Center for Radiation Therapy, Harvard Medical School, Boston (December 1991).

Wellman Labs for Photomedicine, Massachusetts General Hospital, Boston, MA (March 1992)
Radiation Oncology, University of Chicago Medical Center, Chicago, IL (May 1992)
Distinguished Lecture Series in Bioengineering, University of Illinois, Urbana, IL (May 1992)
Department of Pathology, Beth Israel Hospital, Boston, MA (May 1992).
Committee on Research, Massachusetts General Hospital, Boston, MA (June 1992)
Sterling Winthrop, Philadelphia, PA (August 1992)
Respiratory Intensive Care Unit, MGH, Boston, MA (September 1992)
B.A.S.F., Tumor Pathology, Cambridge, MA (October 1992)
Chemical Engineering Department, Princeton University, Princeton, NJ (October 1992).
Annual Funds Dinner, MGH, Boston, MA (October 1992)
Bristol-Myers Squibb, Wallingford, CT (November 1992)
University of Delaware [Kurt Wohl Lecturer], Newark, DE (November 1992).
Vascular Research Division, Brigham and Women's Hospital, Boston, MA (December 1992).
Department of Biology, Boston University, Boston, MA (December 1992).
Gynecology Grand Rounds, MGH, Boston, MA (December 1992)

Du Pont Merck, Wilmington, Delaware (February 1993).
Sunnybrook Health Science Center, Toronto, Canada (February 1993).
Department of Pathology, MGH, Boston, MA (April 1993)
Alkermes, Cambridge, MA (August 1993)
Health Sciences and Technology, MIT, Cambridge, MA (September 1993)
Hybritech, La Jolla, CA (September 1993)
Surgical and Respiratory Intensive Care Units, Mass General Hospital, Boston, MA (September 1993)
Department of Hematology, MGH, Boston, MA (October 1993)
IGEN Inc., Rockville, MD (October 1993)
Nuclear Medicine, Sloan Kettering, New York, NY (October 1993)
Hematology Oncology, Beth Israel Hospital, Boston, MA (October 1993)
Angiology Division, University of Zurich Medical School, Zurich, Switzerland (November 1993)

ETH, Zurich, Switzerland (November 1993)
Chemical Engineering, Georgia Tech, Atlanta, GA (November 1993)
Department of Biology, Boston University, Boston, MA (December 1993)

Zeneca Pharmaceuticals, Manchester, UK (February 1994)
Yale University Cancer Center, New Haven, CT (March 1994)
Cancer Center and Department of Physiology, University of South Alabama, Mobile, AL (March 1994)
Genentech, Inc., South San Francisco, CA (April 1994)
Hemosol, Inc., Ontario, Canada (May 1994)
Vascular Medicine, Brigham and Women's Hospital, Boston, MA (May 1994)
Prizm Pharmaceuticals, San Diego, CA (November 1994)
Department of Biology, Smith College, Northampton, MA (December 1994)

Yale University Cancer Center, New Haven, CT (March 1995)
Dana Farber Cancer Institute, Boston, MA (May 1995)
Vical, Inc., San Diego, CA (August 1995)
Mallinckrodt Medical Center, St. Louis, MO (September 1995)
University of Massachusetts Cancer Center, Worcester, MA (November 1995)

Preuss Foundation, Coronado, CA (January 1996)
Gastrointestinal Unit, MGH, Boston, MA (February 1996)
Joint Center for Radiation Therapy, Boston, MA (March 1996)
Institute for Surgical Research, University of Munich, Munich, Germany (March 1996)
Johns Hopkins Oncology Center, Baltimore, MD (May 1996)
Wellman Lab, Massachusetts General Hospital, Boston, MA (May 1996)
Gray Laboratory Cancer Research Trust, United Kingdom (October 1996)
Georgetown University Lombardi Cancer Center, Washington, D.C. (November 1996)
Texas A & M University, College Station, TX (December 1996)

U.S. Surgical, New Haven, CT (January 1997)
Keio University, Tokyo, Japan (February 1997)
St. Jude Children's Hospital, Memphis, TN (March 1997)
Department of Pathology, Beth Israel Hospital, Boston, MA (April 1997)
ISIS Pharmaceutical, Carlsbad, CA (April 1997)
Department of Chemical Engineering, University of Salerno, Salerno, Italy (June 1997)
National Institutes of Health, Rockville, MD (July, 1997)
Merck and Company, Rahway, NJ and West Point, PA (September 1997)
Dana-Farber/Partners Cancer Care Joint Venture, Boston, MA (September 1997)
Department of Cardiovascular Research, St. Elizabeth's Hospital, Boston, MA (September 1997)
Department of Molecular Biology, University of Helsinki, Helsinki, Finland (September 1997)
Rhone-Poulenc Rorer, Paris, France (October 1997)
Department of Biology, Northeastern University, Boston, MA (October 1997)
Onyx Pharmaceutical, Berkley, CA (November 1997)
Abbott Pharmaceutical, Chicago, IL (November 1997)
Smith Kline & Beecham, Philadelphia, PA (December 1997)

Department of Pathology, Yale University, New Haven, CT (March 1998)
Dana Farber, Department of Nuclear Medicine, Boston, MA (April 1998)
Chiron Corporation, San Francisco, CA (April 1998)
Sugen, San Francisco, CA (April 1998)
Glaxo Wellcome, Durham, NC (May 1998)
Pharmacopia, Princeton, NJ (August 1998)

Dept. of Nuclear Medicine, William D. Kaplan Lecture, Harvard Medical School, Boston, MA (March 1999)
Dept. of Chemical Engineering, Berkeley Lecture, University of California, Berkeley, CA (April 1999)

Genzyme, Framingham, MA (November 1999)
Department of Pathology, Brigham and Women's Hospital, Boston, MA (November 1999)

Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (January 2000)
Bristol-Myer Squibb, Princeton, NJ (March 2000)
Department of Pathology, Seminar in Vascular Biology, Harvard Medical School (March 2000)
Department of Nuclear Medicine, Memorial Sloan Kettering Cancer Center, New York (May 2000)
Millennium Pharmaceuticals, Cambridge, MA (August 2000)
Novartis, Basel, Switzerland (September 2000)
Amgen, Los Angeles, CA (September 2000)
American Biosciences, Inc., Los Angeles, CA (November 2000)
DuPont Plenary Lectures in Bioengineering-American Institute of Chemical Engineers Annual Meeting, Los Angeles, CA (November 2000)
MIT, Controlled Drug Release Lab, Cambridge, MA (December 2000)
Harvard Medical School, Neuro-Oncology CME Course, Boston, MA (December 2000)

University of Massachusetts Medical School, Worcester, MA (January 2001)
Genentech, Bio Oncology Meeting, Sonoma Valley, CA (May 2001)
Harvard Medical School, Neuro-Oncology CME Course, Boston, MA (December 2001)

UTSW Medical School, Distinguished Univ. Lecturer, Dallas, TX (March 2002)
Beth Israel Deaconess Medical Center, Dept. of Surgery, Boston, MA (May 2002)
Massachusetts General Hospital, Spring 2002 Bulfinch Society Lecture, Boston, MA (May 2002)
MGH Renal Unit, Charlestown, MA (Dec 2002)
Harvard Medical School, Tumors of the Central Nervous System Course, Boston, MA (Dec 2002)
Advanced Research Technologies, Montreal, Canada (Dec 2002)

AstraZeneca, Macclesfield, England (February 2003)
Cancer Center, Johns Hopkins University, Baltimore, MD (May 2003)
Archemix, Cambridge, MA (July 2003)
Department of Pathology, Beth Israel Deaconess Medical Center, Boston, MA (October 2003)
Harvard-Dana Farber Cancer Center, Boston, MA (November 2003)
Center for Matrix Biology, Beth Israel Deaconess medical Center, Boston, MA (November 2003)
Joint Neurosurgery, Neuroscience and Psychiatry Grand Rounds, MGH, Boston, MA (November 2003)
Dana-Farber Partners Cancer Care Grand Rounds, Boston, MA (November 2003)

AstraZeneca, Waltham, MA (July 30, 2004)
Harvard Medical School, Tumors of the Central Nervous System Course, Boston, MA (December 2003)
Emery A. Wilson Dean's Lecture Series, University of Kentucky, Lexington, KY (November 12, 2004)
AstraZeneca, Macclesfield, England (November 2004)
Harvard Medical School, Tumors of the Central Nervous System Course, Boston, MA (November 2004)

NIH, Radiology Retreat, Bethesda, MD (April 2005)
Stanford University, Bio-X Program Interdisciplinary Seminar Series, Stanford, CA (May 2005)
Memorial Sloan Kettering Cancer Center, Laughlin Lecture in Medical Physics, New York, NY (May 2005)
New York University, Cancer Center Retreat, New York, NY (June 2005)
Harvard Medical School, Tumors of the Central Nervous System Course, Boston, MA (November 2005)
Novartis, Philadelphia, PA (November 2005)
Harvard School of Dental Medicine Grand Rounds, Boston, MA (December 2005)

MGH Cancer Center Grand Rounds, Boston, MA (January 2006)
MGH GI Division, Boston, MA (January 2006)
Cardiovascular Research Center, MGH, Charlestown, MA (January 2006)
MIT, Cambridge, MA (April 25, 2006)
Fox Chase Cancer Center, Krigel Lecture, Philadelphia, PA (April 27, 2006)

City College of City of New York, Zweifach Lecture, New York City (October 24, 2006).
Harvard Medical School, Tumors of the Central Nervous System Course, Boston, MA (December 5, 2006)

Boston University, Distinguished Lecture in Bioengineering, Boston (January 24, 2007).
The Children's Hospital, Vascular Biology Seminar, Boston (February 15, 2007)
Dana Farber/Brigham and Women's Hospital, NeuroOncology Series, Boston (February 23, 2007)
Memorial Sloan Kettering Cancer Center, President's Seminar Series, New York (March 7, 2007)
Collins Lecture Series, MGH Radiation Oncology, Boston, MA (April 24, 2007)
Keynote Lecture, UMASS Cancer Center Retreat, Oganquit, ME (May 3, 2007)

Richard D. Frisbee III Oncology Lecture, Yale University, New Haven, CT (March 6, 2008)
Sir Godfrey Hounsfield Lecture, Imperial College, London, UK (March 10, 2008)
Peter C. Reilly Lectures, University of Notre Dame, Indiana (March 25, 26, 2008)
HemOnc Grand Rounds, Beth Israel Deaconess Medical Center, Boston (May 7, 2008)
Kidney Cancer Program, Dana Farber Harvard Cancer Center, Boston (May 19, 2008)
Hambrecht & Quist Capital Management, Boston, MA (June 2009)
William E. Schiesser Lecture, Lehigh University, Bethlehem, PA (September 24, 2008)
Charles G. Moertel Lecture, Mayo Clinic, Rochester, MN (October 23, 2008)
Ashland Distinguished Lecture, University of Kentucky, Lexington, KY (October 24, 2008)

Grand Rounds, Georgetown Univ Cancer Center, Washington, DC (January 9, 2009)
Pfizer, La Jolla, CA (Jan 15, 2009)
Benjamin Zweifach Lecture, Department of Bioengineering, UCSD, La Jolla, CA (Jan 16, 2009)
Department of Systems Biology, Harvard Medical School, Boston (February 19, 2009)
Eli Ruckenstein Lecture, State University of New York at Buffalo, NY (May 4, 2009)
Alnylam, Cambrdge, MA (June 10, 2009)

Vascular Biology Program, Children's Hospital, Boston (March 18, 2010)
Pirkey Lecture, University of Texas at Austin (March 23, 2010)
Kelley Lectures, Purdue University (March 30 and 31, 2010)
William B. Lowrie Lecture, Ohio State University (May 13, 2010)
Wagner Lecture, University of Michigan (October 27, 2010)

Distinuished Research Lecturer, Carnegie Mellon University (January 26, 2011)
Roland T. Lakey Award, Wayne State University (March 14, 2011)
Irving Shoichet Lecture, University of Toronto (October 19, 2011)

Herman Schwan Lecture, University of Pennsylvanina (May 2012)
CCR Eminent Lecture Series, NCI (September 24, 2012)

ImClone/Lilly, New York, NY (January 21, 2013)
Breast Oncology Seminar Series, DFCI (February 2013)
Hematology Seminar Series, DFCI (March 5 2013)
Jiaotong University and Ruijin Hospital, Shanghai, China (July 19, 2013)
Cancer Institute and Hospital, Chinese Academy of Medical Sciences, Beijing, China (July 24, 2013)
Guangdong General Hospital, Guangzhou, China (July 25, 2013)
Pediatric Brain Tumor Series, DFCI/Children Hospital, Boston (October 17, 2013)
Department of Bioengineering, Cornell University, Ithaca, NY (October 24, 2013)
Department of Pathology, MGH (October 31, 2013)
Hematology/Oncology, Beth Israel Deaconess Medical Center (BIDMC), Boston (December 4, 2013)
Cancer Center, Dartmouth College, Dartmouth (December 10, 2013)
Center for Vascular Biology Research, BIDMC, Boston (December 11, 2013)

Cutaneous Biology Research Center, MGH (January 13, 2014)
MGH, Collins Lecture Series (May 20, 2014)

DoD, Congressionally Directed Medical Research Program **(**CDMRP), Ft. Detrick, MD (July 7, 2014)
CSHL, Brain Tumors Course, Cold Spring Harbor, NY (July 8, 2014)
NIH, Wednesdy Afternoon Lecture Series (WALS), Bethesda, MD (October 22, 2014)

Methusalem Lecture, KU Leuven, Belgium (Feb 3, 2015)
Arabindo Nath Bose Distinguished Lecture, IIT-Kanpur, India (Feb 23, 2015)
Alan S. Michaels Distinguished Lecture in Medical and Biological Engineering, MIT (April 10, 2015)
Cancer Center, Oregon Health Sciences University, Portland, OR (june 29, 2015)
Fredrickson Lecture, University of Minnesota (November 17, 2015)

Sun Phrama Advanced Research Corporation, Vadodara, India (January 27, 2016)
Princess Takamatsu Cancer Research Fund Lecture, National Cancer Center, Tokyo (February 12, 2016)
Princess Takamatsu Cancer Research Fund Lecture, Tohoku University, Sendai (February 15, 2016)
Princess Takamatsu Cancer Research Fund Lecture, Kyoto University, Kyoto (February 19, 2016)
University of Texas Engineering Foundation Lecture, UT Austin, Texas (December 1, 2016)

Sun Phrama Advanced Research Corporation, Vadodara, India (February 6, 2017)
Tata Memorial Center, Mumbai, India (February 8, 2017)
Laura and Isaac Perlmutter Cancer Center at NYU Langone, New York (February 22, 2017)
Meyer Cancer Center of Weill Cornell Medicine and NewYork-Presbyterian Hospital (March 15, 2017)
Danny Thomas Lecture Series, St. Jude Children's Research Hospital, Memphis, TN (May 19, 2017)
Ramzi Cotran Lecture, Boston Children's Hospital/Harvard Medical School, Boston (October 12, 2017)

AMGEN, Cambridge, MA (February 5, 2018)
Sun Phrama Advanced Research Corporation, Mumbai, India (February 12, 2018)
Department of Pharmacology, UCSD, La Jolla, CA (February 27, 2018)
Biomedicum, Univ of Helsinki, Helsinki, Finland (June 4, 2018)
Grand Rounds, BIDMC, Department of Surgery, Boston (June 18, 2018)
Maud Menten Lecture, Univ of Pittsburgh, Pittsburgh, PA (September 26, 2018)

Sun Phrama Advanced Research Corporation, Vadodara, India (February 11, 2019)
Tata Memorial Center, Mumbai, India (February 15, 2019)
Judah Folkman Lecture, Boston Children's Hospital/Harvard Medical School, Boston (May 23, 2019)
Department of Pathology, Northwestern University Medical School, Chicago (October 14, 2019)

INVITED PRESENTATIONS AT MEETINGS (1990 - present)

"Transport of Macromolecules and Effector Cells in Tumor Microcirculation," *Gordon Conference on Microcirculation*, New Hampshire (June 11-15, 1990)
"Tumor Physiology and Antibody Delivery," *Society for Nuclear Medicine Annual Meeting*, Washington, DC (June 18-21, 1990)
"Delivery of Novel Therapeutic Agents in Tumors: Physiological Barriers and Strategies," *Gordon Conference on Drug Delivery*, New Hampshire (July 8-13, 1990)
"Delivery of Novel Therapeutic Agents to Tumors: Microcirculatory Barriers and Strategies," *International Congress of Mucosal Immunology*, Tokyo, Japan (July 22-27, 1990)
"Determinants of Tumor Blood Flow," *15th International Cancer Congress*, Hamburg, Germany (August 16-22, 1990)
"Tumor Microcirculation: Role in Cancer Detection and Treatment," *16th European Conference on Microcirculation*, Zurich, Switzerland (August 28-31, 1990).
"Tumor Vascular Architecture and Hemodynamics," *16th L.H. Gray Conference on Vasculature as a Target for Anti-Cancer Therapy*, Manchester, United Kingdom (September 17-21, 1990)

"Delivery of Genetically Engineered Molecules and Cells in Tumors: Physiological Barriers and Strategies," *Molecular Therapeutics: Cancer Therapy into the 21st Century*," Research Triangle Park, NC (March 3-6, 1991).
"Tumor Microcirculation," *International Symposium on Angiogenesis*, St. Gallen, Switzerland (March 13-15, 1991).

"Delivery of Novel Therapeutic Agents in Tumors. Physiological Barriers and Strategies," *German Nuclear Medicine Society Annual Meeting*, Tubingen, Germany (April 11-13, 1991)
"Interstitial Hypertension in Tumors: Etiology and Therapeutic Implications," *9th International Congress of Radiation Research*, Toronto, Canada (July 7-12, 1991).
"Tumor Microcirculation," *Gordon Conference on Cancer*, Newport, RI (August 11-16, 1991).
"Delivery of Genetically Engineered Molecules and Cells in Tumors: Barriers and Strategies," *Whitaker Foundation Symposium*, Snow Bird, UT (August 16-19, 1991).
"Transport of Genetically Engineered Molecules and Cells in Tumors," *5th World Congress for Microcirculation*, Louisville, KY (August 31-September 5, 1991)
"Tumor Microcirculation: Both a Barrier and a Target for Cancer Therapy," *NCI Workshop on Magnetic Resonance Spectroscopy and Tumor Cell Biology,"* Bethesda, MD (December 11-13, 1991).

"Tumor Microcirculation - Both a Barrier and a Target for Cancer Therapy," *Keystone Symposium on Molecular Biology of Endothelial Cells,* Keystone, CO (January 17 - 19, 1992)
"Delivery of Macromolecules to Normal and Neoplastic Tissues: Problems and Strategies," *Workshop on Strategies for Delivery of Therapeutic Proteins in Inherited Metabolic Diseases*, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD (January 29 - 31, 1992).
"Delivery of Therapeutic Agents to Tumors," *Preuss Foundation Symposium on "Delivery of Treatment to Brain Tumors,"* Dallas, TX (March 11 - 13, 1992)
"Tumor Physiology and Drug Delivery," *Gordon Conference on Chemotherapy of Experimental and Clinical Cancer,* New London, NH (July 13 - 17, 1992)
"Delivery of Therapeutic Agents to Solid Tumors: Physiological Barriers and Strategies," *19th International Symposium on Controlled Release of Bioactive Materials*, Orlando, FL (July 26 - 29, 1992).
"Delivery of Genetically Engineered Molecules and Cells to Tumors," *American Cancer Society's Seventh Annual Round Table*, Charlestown, MA (August 20, 1992).

"Interstitial Pressure in Tumors," *41st Annual Radiation Research Society Meeting*, Dallas, TX (March 20-24, 1993)
"Role of Rheology of Cytotoxic Lymphocytes in Immunotherapy," *The North American Society of Biorheology*, New Orleans, LA (March 29, 1993)
"Delivery of Novel Diagnostic and Therapeutic Agents to Tumors: Physiological Considerations," workshop on Quantitative Evaluation of Tissue Function with Contrast-Enhanced MRI, *National Cancer Institute*, Bethesda, MD (April 1-2, 1993).
"Pharmacokinetics Considerations in Two-Step Therapies of Solid Tumors," *10th International Meeting of Advances in the Applications of Monoclonal Antibodies in Clinical Oncology*, Paphos, Cyprus (May 3-5, 1993)
"Vascular and Interstitial Biology of Solid Tumors," *Modern Surgical Oncology for the General Surgeon*, Deaconess Hospital, Boston, MA (May 20, 1993)

"Delivery of Drugs to Tumors," *5th International Liposome Conference*, Princeton, NJ (May 24-25, 1993)
"Convection, Diffusion and Binding in the Tumor Interstitium," *Gordon Conference on Microcirculation*, Plymouth, NH (June 14-18, 1993).
"How does the Tumor Vasculature Become Arterialized," *International Union Against Cancer Meeting*," Woods Hole, MA (September 19-20, 1993).
"Tumor Microcirculation -- Role in Cancer Diagnosis and Treatment," *1st Asian Congress for Microcirculation*, Osaka, Japan (September 27-29, 1993)
"Delivery of Therapeutic Agents to Solid Tumors," *Current Concepts in Medical Oncology 1993*, Memorial Sloan-Kettering Cancer Center, New York, NY (October 25-29, 1993)
"Delivery of Antibodies to Solid Tumors: Physiologic and Pharmacokinetic Considerations," *Fourth International Conference on Antibody Engineering*, Coronado, CA (December 8-10, 1993).
"Extravasation of Proteins *In Vivo*," *NIH Vascular Leak Syndrome Workshop,* Bethesda, MD (December 17, 1993)

"An *In Vivo* Look at Microcirculation in Health and Disease," *Keystone Symposia Conferences on "Inflammation, Growth Regulatory Molecules & Atherosclerosis" and "Molecular Biology of the Endothelial Cell,"* Keystone, CO (January 16-23, 1994).
"Delivery of Therapeutic Agents to Solid Tumors: Role of Vascular and Interstitial Physiology," *Eight-fifth Annual Meeting of the American Association for Cancer Research*, San Francisco, CA (April 10 - 13, 1994).

"Vascular and Interstitial Biology of Solid Tumors," *Modern Surgical Oncology for the General Surgeon*, Cambridge, MA (May 12-14, 1994)
"Interstitial Transport in Tumors: Role of Binding," *18th European Conference on Microcirculation,"* Rome, Italy (September 4 - 8, 1994).
"Tumor Microcirculation," *Fifth International Congress of the Metastasis Research Society,* Bethesda, MD (September 28 - October 1, 1994).
"Interstitial Transport: Role of Binding," *Fifth Conference on Radioimmuno-detection and Radioimmunotherapy of Cancer,* Princeton, NJ (October 6-8, 1994).
"Delivery of Novel Therapeutic Agents to Solid Tumors," *AAPS Ninth Annual Meeting,* San Diego, CA (November 6-10, 1994)
"Intravital Studies of Leukocyte Endothelial Interactions in Tumors," *MGH-BWH Symposium on Cell Adhesion*, Boston, MA (November 21, 1994)

"Physiological Barriers to Transport in Tumors," *Keystone Symposium on Drug Delivery*, Hilton Head Island, SC (January 7-13, 1995)
"Tumor Microcirculation; Transport in Tumours; Interstitial Transport in Tumours; Scale-Up of Biodistribution from Mouse to Man," *ICMS Workshop: Tumour Growth and Development*, Edinburgh, United Kingdom (February 13 - 17, 1995).
"Tumor Angiogenesis and Delivery of Therapeutic Agents to Tumors," *International Seminar on Controversies in Chemotherapy and Biological Therapy in Cancer*, Buenos Aires, Argentina (May 4-6, 1995)
"Tumor Angiogenesis and Microcirculation: From Bench to Bedside," *Frontiers in Medicine Symposium*, Venice, Italy (May 26-28, 1995).
"New Insights Into The Structure of Tumor Vasculature: From Fractal Dimensions to Intussusception," *9th Congress of Biorheology/2nd Congress on Clinical Hemorheology,* Big Sky, MT (July 23-28, 1995).
"Tumor Microcirculation: Role of Microenvironment," *Gordon Conference on Angiogenesis and Microcirculation*, Newport, RI, (August 13-18, 1995).
"Delivery of Effector Cells to Tumors," *2nd International Conference on Cellular Engineering*, La Jolla, CA (August 19-22, 1995)
"Leukocyte-Endothelial Interactions in Tumor Microcirculation," *31st Annual Meeting of the Society for Leukocyte Biology*, Marco Island, FL (September 13-16, 1995)
"Delivery of Molecules and Cells to Solid Tumors," *Cap Cure Annual Meeting on Prostate Cancer*, Santa Barbara, CA (September 21-24, 1995).
"Delivery of Molecules and Cells to Solid Tumors," *BMES Annual Meeting*, Boston, MA (October 6-8, 1995)
"Role of Tumor Physiology in Cancer Therapy," *Monoclonal Antibodies & Cancer Therapy Symposium*," New York, NY (October 16-18, 1995)

"Delivery of Molecular Medicine to Solid Tumors: Physiological Barriers and Strategies," *AACR Special Conference on Cancer: The Interface Between Basic and Applied Research*, Baltimore, MD (November 5-8, 1995).
"Role of Microenvironment in Tumor Angiogenesis and Microcirculation," *AACR Special Conference on Novel Strategies Against Resistant Cancers*, Sanibel, FL (November 17-21, 1995)

"Gene Therapy and Brain Tumors," *The Preuss Foundation,* Coronado, CA (January 17 - 19, 1996)
"Strategies for Improving Drug Delivery to Solid Tumors," *Gordon Conference on Drug Carriers in Biology and Medicine*, California (February 25-March 1, 1996)
"Vascular and Interstitial Physiology of Tumors - Implications for Therapy," *Isolated Limb and Organ Perfusion Workshop*, Berlin, Germany (March 1-2, 1996)
"Physiological Resistance to Treatment of Solid Tumors," *9th NCI-EORTC Symposium on New Drugs in Cancer Therapy,*" Amsterdam, Holland (March 12-15, 1996)
"Tumor Physiology," *87th Annual Meeting of AACR*, Washington, D.C., (April 20-24, 1996)
"New Perspectives in Microvascular Fluid Exchange: A Hundred Years after Starling," *The Wellcome Trust,* United Kingdom (April 21-25, 1996).
"Delivery of Molecular Medicine to Solid Tumors," *Worcester Foundation for Biomedical Research Symposium*, Worcester, MA (May 4, 1996)
"Microcirculation and Transport Phenomena in Tumors," *Wenner-Gren Symposium*, Stockholm, Sweden (June 16-19, 1996)

"Delivery of Molecular Medicine in Solid Tumors," *Sixth World Congress for Microcirculation*, Munich, Germany (August 25-30, 1996)
"Delivery of Molecular Medicine to Solid Tumors: Physiological Barriers and Strategies," *NCI Symposium on Renal Carcinoma: Recent Progress and Future Directions*, Washington, D.C. (September 12-21, 1996).
"Delivery of Molecular Medicine to Solid Tumors," *Boehringer Ingelheim Fonds International Titisee Conferences*, Titisee, Germany (October 2-6, 1996)
"Delivery of Molecular Medicine to Solid Tumors: Pathophysiological Considerations," *BIOTEC-Congress Symposium*, Dusseldorf, Germany (November 20-23, 1996).

"Delivery of Molecular and Cellular Medicine to Solid Tumors," *Eighth International Symposium on Recent Advances in Drug Delivery Systems*, Salt Lake City, UT (February 24-27, 1997).
"Delivery of Molecular Medicine to Solid Tumors," *22nd Annual Meeting of the Japanese Society for Microcirculation*, Tokyo, Japan (February 28 - March 1, 1997)
"Tumor Microcirculation Role in Drug and Nutrient Delivery," *1997 - Current Issues in Blood Substitute Research and Development*, San Diego, CA (March 16-19, 1997)
"Cellular and Molecular Basis of Capillary Permeability," *Experimental Biology 1997 Meeting,* New Orleans, LA (April 7, 1997)
"Tumor Microenvironment and Microcirculation: A Dynamic Interplay," *An International Tumor Microenvironment Workshop*, Martha's Vineyard, MA (April 28 - May 2, 1997).
"Angiogenesis Suppression by Circulating Angiogenesis Inhibitors Released by PC-3: A New Model," *Joint Venture Prostate Cancer Retreat*, Dedham, MA (May 1997).
"Delivery of Molecular Medicine in Solid Tumors," *AAPS 1997 Midwest Regional Meeting*, Chicago, IL (May 19, 1997)
"Tumor Microcirculation," *Ninth Pezcoller Symposium*, Rovereto, Italy (June 4-7, 1997).
"Role of VEGF in Vascular Permeability and Adhesion," *Gordon Conference on Angiogenesis and Microcirculation*, Newport, RI (August 17 - 22, 1997)
"Integrative Pathophysiology of Solid Tumors: Role in Detection and Treatment," *Oncology Frontiers Conference, Hoechst Marion Roussel*, Grand Cayman, British West Indies (October 16 - 19, 1997).
"Angiogenesis, Vascular Permeability and Leukocyte-Adhesion in Tumors," *MDACC Annual Basic Science Research Symposium*, Houston, TX (October 28-31, 1997)
"Delivery of Molecular and Cellular Medicine to Solid Tumors," *AIChE Annual Meeting,* Los Angeles, CA. (November 11-16, 1997)

"Tumor Angiogenesis and Microcirculation," *AACR Special Conference on Angiogenesis and Cancer*, Orlando, FL (January 24-28, 1998)
"Tumor Angiogenesis and Microcirculation," *Workshop on Angiogenesis*, Toronto, Canada (February 6, 1998)
"Delivery of Molecular and Cellular Medicine in Tumors," *National Institutes of Health Conference on Bioengineering Research: Building the Future of Biology and Medicine*, Bethesda, MD (February 27-28, 1998).
"Tumor Microcirculation," *Cold Spring Harbor Conference on Pathways to Cancer*, Cold Spring Harbor, NY (March 11-14, 1998).
"Angiogenesis and Microcirculation," *AACR Annual Meeting*, New Orleans, LA (March 28-April 1, 1998)
"Angiogenesis and Microcirculation in Tumors: Role of Microenvironment," ASIP *President's Symposium on Angiogenesis and Microcirculation*, San Francisco, CA (April 20, 1998).
"Tumor Angiogenesis and Microcirculation: Role of Host Organ," *The Sigrid Jusélius Foundation*, Helsinki, Finland (June 4 - 7, 1998).
"Tumor Microenvironment and Microcirculation: Role in Drug Delivery," *10th NCI-EORTC Symposium on New Drugs in Cancer Therapy,* Amsterdam, Holland (June 16-19, 1998).
"Delivery of Molecular and Cellular Medicine to Tumors," *International Conference on Advances in Biomaterials and Tissue Engineering*, Capri, Italy (June 14-19, 1998).
"Tumor Angiogenesis and Microcirculation," *British Oncological Association Lecture,* Nottingham, United Kingdom (July 5 - 7, 1998)
"Tumor Angiogenesis and Microcirculation: New Insights," *Gordon Conference on Angiogenesis and Microcirculation*, Newport, RI (August 2 - 7, 1998).
"Transport in Lymphatics," *20th European Conference on Microcirculation,* Paris, France (Aug 30-Sept 2, 1998).

"The Role of Brain Microenvironment in Vascular Physiology," *National Institutes of Health, NINDS AIDS Meeting*, Alexandria, VA (September 24 - 26, 1998)
"Integrative Pathophysiology of Solid Tumors: Novel Techniques and Treatment Relevance," *Advances in Neuro-Oncology*, Boston, MA (September 28, 1998).
"Role of Host-Tumor Interaction on Angiogenesis and Microcirculation," *Forbeck Research Foundation Forum on Angiogenesis an Accessibility,* Hilton Head, NC (November 5 - 7, 1998).
"The New Frontier of Molecular Medicine: Delivery of Therapeutics," *Nature Medicine Meeting on the Molecular Medicine Revolution,* Tokyo, Japan (November 8 - 10, 1998).
"Delivery of Molecular Medicine to Solid Tumors," *XXXI World Meeting of the International College of Surgeons*, Buenos Aires, Argentina (November 15-19, 1998)

"Imaging Gene Expression at Cellular Level," *Quantitative In Vivo Functional Imaging in Oncology,* Bethesda, MD (January 6 - 8, 1999)
"New Insights into Tumor Angiogenesis and Microenvironment from In Vivo Microscopy," *Gordon Conference on Radiation Oncology*, Ventura, CA (January 31 - February 5, 1999)
"Tumor Microcirculation," *AACR Special Conference on Molecular Determinants of Sensitivity to Anti-Tumor Agents*, Whistler, British Columbia, Canada (March 4 - 8, 1999)
"Delivery of Molecular Medicine to Solid Tumors" *AIMBE Meeting*, Washington, D.C. (March 12-14, 1999).
"Role of Physiology in Drug Delivery Into Tumors," *Controlled Release Society*, Boston, MA (June 20 - 25, 1999).
"Tumor Angiogenesis and Microcirculation," *4th Cancer Research Campaign - Beatson International Cancer Conference*, Glasgow, United Kingdom (June 27 - 30, 1999)
*"*Tumor Angiogenesis and Microcirculation: New Insights," *Gordon Research Conference on "Angiogenesis and Microcirculation,"* Salve Regina College, Newport, RI (August 15 - 19, 1999).
"In Vivo Microscopy of Gene Expression and Function using Intravital Microscopy," Inter-*Institute Workshop on In Vivo Optical Imaging*, NIH, Bethesda, MD (September 16-17, 1999)
"Micro-environment and Tumor Angiogenesis," 2nd *Dutch Association of Gastro-Intestinal Surgery Symposium*, Utrecht, The Netherlands (September 23-24, 1999)
"Tumor Angiogenesis and Microcirculation," *13th International Conference on Brain Tumour Research and Therapy*, Lake Toya, Hokkaido, Japan (October 3 - 6, 1999)
"Tumor Angiogenesis and Microcirculation," *Boston Angiogenesis Meeting,* Boston, MA (Nov. 1, 1999)

"Tumor Angiogenesis and Microcirculation: Role of Host Microenvironment," *2nd International Symposium on Anti-Angiogenic Agents*, Dallas, TX (January 28-29, 2000).
"Role of Physiology in Drug Delivery into Tumors," *Gordon Research Conference on Drug Carriers on Medicine and Biology*, Ventura, CA (February 20-25, 2000)

"Role of Host-Tumor Interactions in Angiogenesis and Vascular Function," *Keystone Symposium on Experimental and Clinical Regulation of Angiogenesis*, Salt Lake City, Utah (March 2-7, 2000)
"Imaging Angiogenesis and Vascular Function", *91st Annual Meeting of AACR*, San Francisco, CA (April 1-5, 2000)
"Tumor Angiogenesis and Microcirculation: Lessons from In Vivo Microscopy of Gene Expression and Function," *Eppley Institute Short Course in Cancer Biology*, Omaha, NE (May 8-12, 2000).
"Tumor Angiogenesis and Microcirculation: Role of Host-Tumor Interaction," *Conference on Vascular Biology of Diabetic Microangiopathy*, Var Gard, Saltjsobaden, Sweden (May 17-19, 2000).
"In Vivo Molecular and Functional Imaging of Tumors: New Insights from Intravital Microscopy," *Gordon Research Conference on Lasers in Medicine and Biology*, New London, CT, June 10-15, 2000).
"Vascular Heterogeneity in Tumors: Lesson from Intravital Microscopy," *UICC Study Group Meeting on Basic and Clinical Cancer Research: Tumor Angiogenesis II*, Woods Hole, MA (June 16-18, 2000).
"Tumor Angiogenesis and Microcirculation," *Gordon Research Conference on Vascular Cell Biology,* Plymouth, NH (July 2-7, 2000)
"Tumor Angiogenesis," *NCI Epithelial-Stromal Interactions and Tumor Progression Workshop*, Bethesda, MD (September 13-15, 2000).
"Real Time Imaging of Gene Expression and Function in Tumors," *42nd Symposium of the Society for Histochemistry,* Les Diablerets/Switzerland (September 20-23, 2000)
"Delivery of Molecular Medicine to Tumors: Lessons from In Vivo Imaging of Gene Expression and Function," *NIH International Symposium on Tumor-Targeted Delivery Systems*, Bethesda, MD (September 25-28, 2000).

"Tumor Angiogenesis and Microcirculation," *AACR Special Conference in Cancer Research Angiogenesis & Cancer: From Basic Mechanisms to Therapeutic Applications,* Traverse City, MI (October 11-15, 2000).
"Role of Host-Tumor Interactions in Tumor Angiogenesis and Response to Therapy," *The 3rd Annual Jack Little Symposium: Genetic and Cellular Factors in Human Cancer Therapy*, Boston, MA (Oct. 20-21, 2000).
"Tumor Angiogenesis and Microcirculation: Role of Host-Tumor Interactions," *The First Hematology-Oncology/Charlestown Cancer Center Retreat,* Boston, MA (October 21, 2000).
"Imaging Gene Expression in Tumors" *American Society for Therapeutic Radiology and Oncology,* Boston, MA (October 22-26, 2000)

"Imaging Gene Expression, Angiogenesis and Microcirculation in Tumor: Role of Microenvironment" *Keystone Symposium Cell Migration*, Tahoe City, CA (March 12-17, 2001).
"Tumor Angiogenesis & Therapeutic Response: Role of Host Tumor Interaction" *American Society of Investigative Pathology at Experimental Biology 2001,* Orlando, FL (April 2, 2001).
Keynote Address: "Delivery of Therapeutics to Solid Tumors: Role of Host-Tumor Interactions" *14th International Research Group in Immunoscintigraphy and Immunotherapy (IRIST) Meeting*, Nijmegen, the Netherlands (May 18-19, 2001).
"Tumor Angiogenesis and Vascular Function: Lessons from In-Vivo Imaging" *Society of Nuclear Medicine Meeting*, Toronto, Canada (June 23-27, 2001).
"Tumor Angiogenesis and Vascular Function: Role of Host-Tumor Interactions" *Gordon Conference Chemotherapy of Experimental and Clinical Cancer,* New London, NH (July 15-19, 2001).
"In Vivo Imaging of Gene Expression, Physiological Function and Therapeutic Response in Tumors" *Imaging Life: From Cells to Whole Animals*, *Microscopy Society of America*, Long Beach, CA (August 4-5, 2001).
"Tumor Angiogenesis and Microcirculation" *Gordon Conference Angiogenesis & Microcirculation*, Newport, RI (August 12-17, 2001).
"Leakiness of Tumor Vessels: Functional Abnormalities" & "Discussion of Blood Vessel Leakiness in Cancer," *Forbeck Foundation Meeting*, Napa Valley, CA (October 5-6, 2001).
"Gene Expression, Angiogenesis and Vascular Function in Tumors: Lessons from Intravital Microscopy," *International Conference on New Treatments for Brain Tumor: Gene Therapy & Neural Stem Cells,* Parma, Italy (October 17-20, 2001).
"Imaging Gene Expression and Function in Tumors: Implications for Angiogenesis and Metastasis" *AACR/NCI/EORTC International Conference*, Miami Beach, Florida (October 29-November 2, 2001).
"Chemical Engineering and Cancer Medicine in the Post-Genomic Era," *AIChE Annual Meeting*, Reno, NV (November 4-9, 2001)
"Gene Expression, Angiogenesis and Physiological Function in Tumors: Novel Insights from In Vivo Microscopy" *43rd Annual American Society for Therapeutic Radiology and Oncology (ASTRO),* San Francisco (November 4-8, 2001).
"Gene Expression, Angiogenesis and Vascular Function in Tumors: Lessons from Intravital Microscopy," *1st Merck Symposium on Advances on Cancer Biotherapy*, Barcelona, Spain (November 29-30, 2001).

"Molecular, Anatomic and Functional Imaging of Tumors using Intravital Microscopy," *Keystone Meeting on Angiogenesis in Cancer and Other Diseases: From Genes to Function to Therapy*, Banff, Canada (Feb 8-13, 2002)
"In Vivo Imaging of Gene Expression, Angiogenesis and Physiological Function in Tumors," *AACR 93rd Annual Meeting*, San Francisco, CA (April 6-10, 2002)
"Angiogenesis and Lymphangiogenesis in Tumors: New Insights from Intravital Microscopy," *67th Cold Spring Harbor Symposium on Quantitative Biology*, Cold Spring Harbor, NY (May 29-June 3, 2002).
"Lymphatic Metastasis: New Insights," *International Union Against Cancer Workshop on Metastasis*, Woods Hole, MA (June 6-9, 2002).
"Imaging Tumor Vessels and Lymphatics," *1st Int'l Conference on Vascular Targeting*, Cambridge, MA (June 12-14, 2002)
"Angiogenesis and Lymphangiogenesis in Tumors: New Insights from Intravital Microscopy," *18th UICC Intl Cancer Congress*, Oslo, Norway (June 30-July 5, 2002).
"Angiogenesis and Lymphangiogenesis in Tumors: New Insights from Intravital Microscopy," *Int'l Society for Oncodevelopmental Biology & Medicine*, Boston, MA (September 8-12, 2002).
"Intravital Microscopy of Tumors," *Gordon Conference on Lasers in Biology and Medicine*, Meriden, N.H. (July 14-19, 2002)

"Angiogenesis and Lymphangiogensis in Tumors: New Insights from Intravital Microscopy," *First Annual Meeting of the Society for Molecular Imaging*, Boston, MA (August 24-26, 2002).
"Angiogenesis and Lymphangiogenesis in Tumors: New Insights from Intravital Microscopy," *NABTT Meeting*, Boston, MA (October 24, 2002).
"Imaging the Inner Workings of Solid Tumors," *CIMIT Forum*, Boston, MA (November 5, 2002).

"Molecular and Physiological Rationale for Combined Anti-angiogenic and Radiation Therapy," *Gordon Research Conference on Radiation Oncology,* Ventura, CA (January 29, 2003)
Keynote Address: "Imaging the Inner Workings of Solid Tumors: A Twenty Five Year Odyssey," *Fourth National Forum on Biomedical Imaging in Oncology,* Bethesda, MD (February 6, 2003).
"Angiogenesis and Lymphangiogenesis in Tumors: New Insights from Intravital Microscopy", *Thirty Years of Angiogenesis Research*, Boston, MA (February 28, 2003).
Keynote Address: "A Journey through the Inner World of Tumors", *Modeling and Computers in Cancer Therapy*, Turin, Italy (March 3-4, 2003).
"Dissecting Tumor-Host Interactions Using In Vivo Imaging", *Genes, Environment& Disease,* Boston, MA (June 7-9. 2003)
"Normalizing Tumor Vasculature Using Anti-VEGF Therapy: Pre-Clinical and Clinical Evidence," *Gordon Research Conference on Angiogenesis and Microcirculation*, Newport, RI (August 10-15, 2003)
"Dissecting tumor angiogenesis and pathophysiology", *European Cancer Conference*, Copenhagen, Denmark (September 21-23, 2003)

"Angiogenesis and lymphangiogenesis in tumors: New insights from intravital microscopy," *Keystone Symposium on Angiogenesis,* Santa Fe, NM (January 13-19, 2004)
"Inaugural Robert Bras Lecture - Imaging the Inner Workings of Solid Tumors: A 25 Year Odyssey," *National Cancer Institute of Canada Meeting on Strategic Directions in Cancer Therapy*, Nassau, Bahamas (February 12-14, 2004)
"Formation and Function of Tumor-Associated Lymphatics", *Gordon Research Conference on Lymphatics,* Ventura, CA (March 7-11, 2004)
"Tumor as an Aberrant Organ: Insights from Intravital Microscopy", *95th Annual Meeting of AACR*, Orlando, FL (March 27-31, 2004)
"Angiogenesis and Lymphangiogenesis in Tumors: New Insights from Intravital Microscopy", *Annual Meeting of Experimental Biology/ASIP*, Washington, DC (April 17-21, 2004)

Keynote Address: "A Journey into the World of Solid Tumors", *International Conference for Mathematics in Biology and Medicine: Annual Meeting of the Society for Mathematical Biology*, Ann Arbor, MI (July 25-28, 2004)
"Imaging the Inner Workings of Solid Tumors", *Experimental Genetics of the Laboratory Mouse in Cancer Research*, The Jackson Laboratory, Bar Harbor, ME (August 22- September 2, 2004)
Keynote Address: "Imaging the Inner Workings of Solid Tumors: A 25-Year Odyssey", *Gordon Conference on Drug Carriers in Medicine and Biology*, Blue Sky, MT (September 5-10, 2004)
"Imaging the Inner Workings of Solid Tumors: A 25-Year Odyssey", *ARENA Conference*, Oslo, Norway (September 24-25, 2004)
Keynote Address: "Angiogenesis and Lymphangiogenesis in Tumors: New Insights and Clinical Translation", *46th Annual Meeting of the American Society for Therapeutic Radiology and Oncology*, Atlanta, GA (October 6, 2004)
NABTT Lecture: " Normalization of Tumor Vasculature and Microenvironment using Anti-Angiogenic Agents," *NABTT CNS Consortium Meeting*, Cleveland, OH (November 11, 2004)
"Imaging the Inner Workings of Solid Tumors," *Charles River Symposium on Modeling Disease: New Windows on a Hidden World*, Harvard Medical School, Boston, MA (November 17, 2004)

"Interactions of Angiogenic Therapy with Cytotoxic Chemotherapy," *GOG Symposium*, San Diego, CA (January 13, 2005)
"Normalization of Tumor Vasculature: An Emerging Concept in Antiangiogenic Therapy of Cancer," *96th Annual AACR Meeting,* Anaheim, CA (April 16, 2005).

"Interstitial Transport in Tumors: Barriers and Strategies," *96th Annual AACR Meeting*, Anaheim, CA (April 16, 2005).
"Normalization of Tumor Vasculature: An Emerging Concept in Antiangiogenic Therapy of Cancer," *Whitehead Institute Press Seminar*, Cambridge, MA (May 13, 2005).
"Normalization of Tumor Vasculature: An Emerging Concept in Antiangiogenic Therapy of Cancer," *Gordon Conference on Angiogenesis and Microcirculation*, Newport, RI (August 18, 2005).
"Normalization of Tumor Vasculature: An Emerging Concept in Antiangiogenic Therapy of Cancer," *U.S. Oncology Meeting*, Dallas, TX (August 19, 2005).
"Normalization of Tumor Microenvironment: An Emerging Concept in Antiangiogenic Therapy of Cancer," *2nd International Conference on Tumor Progression and Drug Resistance*, Boston, MA (September 19, 2005).
Plenary Session: "Normalization of Tumor Microenvironment by Antiangiogenic Therapy: From Bench to Bedside and Back," *13th European Union Gastroenterology Week*, Copenhagen, Denmark (October 18, 2005).
"Normalization of Tumor Vasculature by Antiangiogenic Therapy: From Bench to Bedside and Back," *AACR Special Meeting on Anti-Angiogenesis and Drug Delivery to Tumors: From Bench to Bedside and Back*, Boston, MA (November 9, 2005).
"Normalization of Tumor Microenvironment by Antiangiogenic Therapy: From Bench to Bedside and Back," *AACR Special Meeting on Cancer, Proteases and Microenvironment"*, Bonita Springs, FL (December 1, 2005).

Keynote Lecture: "Normalization of Tumor Microenvironment by Antiangiogenic Therapy: From Bench to Bedside and Back,"*8th International Meeting on Anti-Angiogenesis Agents*, La Jolla, CA (February 3, 2006).
Distinguished Service Award Lecture: "Normalization of Tumor Vasculature: An Emerging Concept in Antiangiogenic Therapy of Cancer," *Nature Biotechnology Winter Symposium,* Miami, FL (February 7, 2006).
"Normalization of Tumor Microenvironment by Antiangiogenic Therapy: From Bench to Bedside and Back," *17th Annul Cancer Progress Conference,* New York, NY (March 7, 2006).
Plenary Session/Keynote Talk: "Normalization of Tumor Microenvironment by Antiangiogenic Therapy: From Bench to Bedside and Back," *4th International Symposium on Targeted Anticancer Therapies*, Amsterdam, the Netherlands (March 16, 2006).
"Normalization of Tumor Microenvironment: An Emerging Concept in Antiangiogenic Therapy of Cancer," *97th AACR Annual Meeting,* Washington, DC (April 2, 2006).
Plenary Lecture: "Molecular, Cellular, Anatomical and Functional Imaging of Tumors In Vivo: From Bench to Bedside and Back," *International Symposium on Biomedical Imaging*, Washington, DC (April 6, 2006).
Keynote Lecture: "Normalization of Abnormal Vessels: An Emerging Concept in Anti-angiogenic Therapy of Cancer and other Diseases," *Association for Research in Vision and Ophthalmology (ARVO) 2006 Annual Meeting*, Ft. Lauderdale, FL (April 30, 2006).
Keynote Lecture: "Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapy: From Bench to Bedside and Back," *4th Hematology & Oncology Tumor Targeting Symposium*, Melbourne, Australia (May 6, 2006).
Keynote Lecture: "Delivery of Nano-Medicine to Solid Tumors: Physiological Barriers and Strategies," *NCI/NSTI Symposium on Cancer Nanotechnology*, Boston, MA (May 9, 2006).
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapy: From Bench to Bedside and Back," *Pathways to Progress: Breakthroughs in Targeted Cancer Therapy* - an ASCO Satellite Symposium, Atlanta, GA (June 2, 2006).
"Normalization of Tumor Vasculature and Microenvironment Using Targeted Therapies: From Bench to Bedside and Back," *18th Pezcoller Symposium on Tumor Microenvironment: Heterotypic Interactions*, Trento, Italy (June 27-29, 2006).
"Normalization of Tumor Vasculature by Antiangiogenic Therapy: Implications for Engineering Functional Vasculature", *Gordon Research Conference on Endothelial Cell Phenotypes in Health and Disease*, Biddeford, ME (August 6-11, 2006).
"Imaging the Inner Workings of Solid Tumors", *17th Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 25, 2006).
"Dissecting Steps of Lymphatic Metastasis", *Gordon Research Conference on Molecular Mechanisms in Lymphatic Function and Disease*, Les Diablerets, Switzerland (September 3-8, 2006)
Keynote Lecture: "Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *10th International Workshop on Tumor Microenvironment: Hypoxia, Angiogenesis and Vasculature,* Boston (September 15-17, 2006).

"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *4th Annual Angiogenesis and Vascular Targeting Drug Discovery and Development Summit,* Boston (September 19-20, 2006).
Keynote Lecture: "Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *4th Asia Pacific Oncology Summit,* Sydney, Australia (October 7-8, 2006).
Keynote Lecture: "Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *5th International Colorectal Cancer Congress,* Naples, FL (October 12-15, 2006).
"Normalization of Tumor Vasculature and Microenvironment Using Targeted Therapies: From Bench to Bedside and Back," *37th Princess Takamatsu Cancer Symposium on Cancer Cells and their Microenvironment,* Tokyo, Japan (November 14-17, 2006).

"Normalization of Tumor Vasculature and Microenvironment Using Targeted Therapies: From Bench to Bedside and Back," *18th Annual Cancer Progress Conference,* New York, NY (March 6, 2007).
Opening Lecture: "Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *National Cancer Institute Early Drug Development Meeting,* Washington DC (March 12-13, 2007).
"Normalization of Tumor Vasculature and Microenvironment Using Targeted Therapies: From Bench to Bedside and Back," *40 Years of Metastasis Research: A Symposium in Honor of Dr. Fidler,* Houston, TX (March 23-24, 2007).
"Dissecting the Steps of Lymphatic Metastasis," *98th Annual AACR Meeting*, Los Angeles, CA (April 14-18, 2007).
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *Advances in Oncology,* New York, NY (April 21, 2007).
Keynote Lecture: "Normalization of Tumor Vasculature and Microenvironment Using Targeted Therapies: From Bench to Bedside and Back," *New England NeuroOncology Meeting*, Boston, MA (April 28, 2007).
Keynote Lecture: "How to Conduct a Multi-Disciplinary Clinical Trial," *NCI-Genentech Avastin Summit*, Washington, DC (May 11-12, 2007).
"Vascular Normalization by Antiangiogenic Therapy", *Days of Molecular Medicine – Nature Medicine Meeting*, Boston, MA (May 22-24, 2007).
"Vascular Normalization as a Mechanism of Antiangiogenic Therapy: Clinical Evidence and Implications", *ASCO Annual Meeting*, Chicago, IL (June 1-5, 2007).
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *25th Beatson International Cancer Meeting,* Glasgow, UK (June 18-20, 2007).
Keynote Lecture: "Creation of Functional Blood Vessels for Cancer Treatment and Tissue Engineering", *Gordon Research Conference on Biomaterials and Tissue Engineering,* Plymouth, NH (July 22-26, 2007).
"Normalization of Tumor Vasculature: Some New Insights", *Gordon Research Conference on Angiogenesis and Microcirculation,* Newport, RI (August 19- 23, 2007).
"Imaging the Inner Workings of Solid Tumors", *17th Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 25, 2007).
Keynote Lecture: "How deos bevacizumab work?," *Novel Agents in the Treatment of Lung Cancer, Fifth Cambridge Conference,* Cambridge, MA (October 1-2, 2007).
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *Boston Glioma Research & Therapy,* Boston, MA (October 10-11, 2007).
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *International Society of Biological Therapy*, Boston, MA (November 1, 2007).
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *AACR Centennial Conference on Translational Cancer Medicine*, Singapore (Nov 5-8, 2007).
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *AACR Meeting on Colon Cancer,* Boston, MA (Nov 15, 2007).
"Lymphangiogenesis and Lymphatic Metastasis," *9th Annual Boston Angiogenesis Meeting* (Nov 16, 2007)
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *Optical Imaging for Medicine and Biology: Applications Cancer,* Boston, MA (Nov 30, 2007).
"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: From Bench to Bedside and Back," *Eradicating Metastasis, NCI Workshop,* Bethesda, MD (December 5-6, 2007).

"Normalization of Tumor Vasculature and Microenvironment by Antiangiogenic Therapies: Lessons from Multi-Disciplinary Clinical Trials," *Canadian Phase I Research Meeting,* Ottawa, Canada (Dec 7, 2007).

"Vascular Biology of Brain Metastasis," *NCI-Biology of Brain Metastasis Meeting*, Bethesda, MD (January 30 – February 2, 2008)
"Tissue, Circulating and Imaging Biomarkers from Multidisciplinary Translational Trials on Antiangiogenic Therapy of Cancer," *NCI-CTEP Investigational Drug Steering Committee - Angiogenesis Task Force Meeting*, Rockville, MD (March 18, 2008)
"Lessons from Multi-Disciplinary Clinical Trials of Antiangiogenic Therapy of Cancer," *99th Annual AACR Meeting*, San Diego, CA (April 12-16, 2008)
"Normalization of Tumor Vasculature and Microenvironment by Targeted Therapies: From Bench to Bedside and Back," *4th Protein Engineering Summit*, Boston (April 28, 2008)
Opening Lecture: "Creation of Functional Vasculature for Cancer Treatment and Tissue Engineering," *Gordon Conference on Signal Transduction by Engineered Extracellular Matrix*, Bates College, Lewiston, ME (July 6-11, 2008).
Plenary Lecture: "Normalization of Tumor Vasculature and Microenvironment Using Targeted Therapies: From Bench to Bedside and Back," *35th Annual Meeting of Controlled Release Society,* New York, NY (July 14, 2008).
"Deconstructing Solid Tumors Using Intravital Microscopy," *Gordon Conference on Lasers in Biology and Medicine*, Holderness School, Holderness, NH (July 20-23, 2008)
"Angiogenesis in Brain Tumors," *5th Biannual Course on Mechanisms of Neural Differentiation and Brain Tumors*, Cold Spring Harbor, New York, NY (July 30, 2008)
"Imaging the Inner Workings of Solid Tumors", *17th Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 25, 2008).
"Delivery of macromolecules and nanoparticles in tumors." *Society of Advanced Therapeutics*, Boston, MA (September 18, 2008)
"Lessons from multidisciplinary translational trials on antiangiogenic therapy of cancer," *50th Annual Meeting of American Society of Therapeutic Radiation Oncology*, Boston, MA (September 22, 2008)
"Antiangiogenic Therapy of Brain Tumors," *8th Annual Carolyn Frye-Halloran Symposium*, Boston, MA (October 2, 2008)
Plenary Lecture: "Normalization of Tumor Vasculature and Microenvironment Using Targeted Therapies: From Bench to Bedside and Back," *National Cancer Research Institute Annual Meeting,* Birmingham, UK (October 5, 2008).
Future of Medicine Lecture: "Antiangiogenesis: Emerging Paradigms," *The M. Judah Folkman Conference on Antiangiogenesis: New Frontiers in Therapeutic Development,* Cambridge, MA (October 14, 2008).
"Normalization of Tumor Microenvironment for Cancer Treatment," *AACR Centennial Symposium*, Buffalo, NY (October 27, 2008)
"Molecular Markers of Response and Resistance to Angiogenesis Inhibitors," *ASCO-NCI-EORT Conference on Molecular Markers in Oncology*, Hollywood, FL (November 1, 2008)
"Delivery of Nano-Medicine to Solid Tumors: Physiological Barriers and Strategies," *Materials Research Society*, Boston, MA (December 1, 2008).

"Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside and Back," *NCI Executive Committee Retreat*, Bethesda, MD (January 27-28, 2009).
"Insights from Imaging Tumor Vessels during Antiangiogenic Therapy: Bench to Bedside to Biomarkers," *100th Annual AACR Meeting*, Denver, CO (April 18-19, 2009).
"Delivery of Nanotherapeutics to Tumors: Barriers and Strategies," *100th Annual AACR Meeting*, Denver, CO (April 18-19, 2009).
"Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside and Back," *ASIP Annual Meeting*, New Orleans, LA (April 20-21, 2009).
Nobel Forum: "Normalization of Tumor Microenvironment: Insights from Intravital Microscopy," *Nobel Forum on High Resolution In Vivo Imaging of Cell Biology*, Stockholm, Sweden (May 15-16, 2009).
"Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside and Back," *The Expanding Role of Angiogenesis in Cancer Therapeutics: The Folkman Legacy*, *New York Academy of Sciences*, Bethesda, MD (May 26, 2009).

"Predictors of Response and Resistance in Antiangiogenic Therapy," *45th Annual ASCO Meeting*, Orlando, FL (May 29-June 2, 2009)
"Anti-angiogenesis Therapy of Cancer: Lessons from Bench and Bedside," *Gordon Conference on Angiogenesis, Salve Regina University,* New Port, RI (August 2-6, 2009).
"Tumor Angiogenesis and Microenvironment", 18th *Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 22, 2009).

Keynote Lecture: "Delivery of Molecular and Nanomedicine to Solid Tumors," *Gordon Conference on Drug Carriers, Waterville Valley,* NH (August 16, 2010).
"Tumor Angiogenesis and Microenvironment", *19th Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 23, 2010)
"Seed and Soil Hypothesis Revisited," Metastasis and the Tumor Microenvironment, AACR-MRS Meeting, Philadelphia, PA (September 12, 2010)
Keynote Lecture: "Towards Personalizing Antiangiogenic Therapy of Cancer," *12th Boston Angiogenesis Meeting*, Boston (October 5, 2010).

American Cancer Society Basic Science Lecture: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *64th Society of Surgical Oncology Meeting*, San Antonio, TX (March 4, 2011).
Rous-Whipple Award Lecture: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *Annual Meeting of the American Society of Investigative Pathology*, Washington, DC (April 11-12, 2011).
Keynote Lecture: "Normalizing tumor microenvironment to treat cancer: From mathematical model to mouse to man," *23rd Pezcoller Symposium*, Trento, Italy (June 16-18, 2011).
"Tumor Angiogenesis and Microenvironment," *20th Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 24, 2011).
"Normalizing tumor microenvironment to improve the treatment outcome," *AACR Frontiers in Basic Cancer Research Meeting*, San Francisco, CA (September 16, 2011).

"Building and Managing a Multidisciplinary Program," *NCI Think Tank on Team Science*, Bethesda, MD (February 2012)
Keynote Lecture: "Lessons from Antiangiogenic Trials in Glioblastoma: Bench to Bedside to Biomarkers," 30th *German Cancer Congress*, Berlin, Germany (February 23, 2012)
Plenary Session Lecture: "Normalization of Tumor Microenvironment to Improve Cancer Treatment," *Annual Meeting of the AACR*, Chicago (April 2, 2012).
Science of Oncology Award Lecture: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *Annual Meeting of the American Society of Clinical Oncology*, Chicago (June 3, 2012).
"Tumor Angiogenesis and Microenvironment,"21st *Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 30, 2012).
Plenary Lecture: "Normalization of Tumor Microenvironment to Treat Cancer: Insights from Intravital Microscopy," *World Molecular Imaging Congress*, Dublin, Ireland (September 7, 2012).
Opening Lecture: "Delivering Nanomedicine to Solid Tumors: Challenges and Novel Strategies," *Workshop on Enhanced Permeability and Retention Effect,* NCI, Bethesda, MD (October 10, 2012).
Keynote Lecture: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *Targeting the Tumor Microenvironment* Conference, Boston (October 17-18, 2012).
Keynote Lecture: "Normalization of the Biochemical and Mechanical Tumor Microenvironment to Treat Cancer: Bench to Bedside," *The Fourth USNCB Symposium on Frontiers in Biomechanics: Mechanics in Oncology,* Atlanta, GA (October 24, 2012).
"Normalization of Tumor Vasculature and Microenvironment to Overcome Tumor Heterogeneity," *33rd Princess Takamatsu Cancer Symposium on Understanding Tumor Heterogeneity*, Tokyo, Japan (November 14-16, 2012)
"Treatment of Brain Metastasis," *17th Annual Society for Neuro-Oncology Scientific Meeting*, Washington, DC (November 18, 2012)

Plenary Lecture: "Re-engineering Tumor Microenvironment for Cancer Treatment: Bench to Bedside," Congress on NanoEngineering, ASME, Boston, MA (February 203, 2013)

"Trageting Stroma to Treat Barin Metastasis," *Annual Meeting of the AACR*, Washington, DC (April 9, 2013)
"Normalizing Biochemical and Mechanical Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside to Biomarkers," *Cancer Biology & Therapeutics Meeting*, Cold Spring Harbor Laboratory, NY (April 23-7, 2013).
"Normalizing Vasculature using Anti-angiogenic Agents for Treatment of Cancer and Other Diseases: Bench to Bedside to Biomarkers," *Trans-NIH Angiogenesis Workshop*, NIH, Bethesda, MD (May 20-21, 2013)
"Tumor Angiogenesis and Microenvironment", 22nd *Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 23, 2013).
Keynote Lecture: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *Chinese Society of Clinical Oncology (CSCO) Summit of Anti-Angiogenesis Treatment in Lung Cancer,* Shanghai, China (October 17-18, 2013).
Keynote Lecture: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *Chinese Society of Clinical Oncology (CSCO) Anti-Angiogenesis Expert Symposium,* Beijing, China (October 17-18, 2013).
"Overcoming treatment resistance by re-engineering tumor microenvironment," *29th Forbeck Research Foundation Forum of Resistance Mechanisms*, Hilton Head, S Carolins (Nov 7-10, 2013).
Kenote Speaker: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *African Organization of Research and Training in Cancer (AORTC),* Durban, S. Africa (November 21, 2013).
Keynote Lecture: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *Immuno Targeting and Delivery Symposium*, Dartmouth Center for Cancer Nanotechnology Excellence, Hanover, NH (December 10, 2013).

"Emerging role of RAS blockade in cancer treatment," *Gordon Conference on the Renin-Angiotensin System Beyond Angiotensin II*, Renaissance Tuscany Il Ciocco Resort, Lucca (Barga), Italy (March 2-7, 2014)
Keynote Lecture: "Normalization of Tumor Microenvironment for Cancer Treatment: Bench to Bedside to Biomarkers," *5th International Meeting on Angiogenesis, Amsterdam, Netherlands* (March 12-14, 2014).
Earl Bakken Distinguished Lecture: "Reengineering the Tumor Microenvironment for Cancer Treatment: Bench to Bedside," *AIMBE Annual Meeting*, Washington DC (March 24 2014).
AACR-Princess Takamtsu Memorial Lecture: "Reengineering the Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside to Biomarkers", *Annual Meeting of the AACR*, San Diego, CA (April 5, 2014).
"Emerging concepts in the treatment of metastasis: Insights from Intravital Microscopy" and "Solid stress and interstitial fluid pressure in tumors: Coevolution, implications and alleviation", *World Congress of Biomechanics*, Boston, MA (July 8-9, 2014).
"Tumor Angiogenesis and Microenvironment", 23rd *Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 21, 2014).
"Strategies to Improve Delivery and Efficacy of Cancer Nanomedicines," *Roche-Nature Biotechnology Forum*, Buonas, Switzerland (September 3-5, 2014).
Keynote Lecture: "Reengineering the Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside to Biomarkers", *US Oncology Science Forum*, Dallas, TX (September 19, 2014).
Keynote Lecture: "Reengineering the Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside to Biomarkers", ONCOLOGY *IMPACT Meeting,* Oslo, Norway (October 16, 2014).

Keynote Lecture: "Antiangiogenesis strategies revisited: From starving tumors to alleviating hypoxia", *AACR Special Conference on Tumor Angiogenesis and Vascular Normalization: Bench to Bedside to Biomarkers*, Orlando, FL (March 5-8, 2015).
"Insights from imaging biomarkers", *Current Concepts session on Biomarkers of Anti-Angiogenic Therapy, AACR Annual Meeting,* Philadelphia, PA (April 19-22, 2015).
ASGBI Lecture: "Taming vessels to treat cancer", *Association of Surgeons of Great Britain & Ireland* (ASGBI), Manchester, UK (April 23, 2015).
Plenary Lecture: "Reengineering the microenvironment to improve treatment of fibrotic diseases" *International Liver Congress,* Vienna (April 24, 2015)
Keynote Lecture: *Chinese Thoracic Oncology Group Meeting on Anti-Angiogenesis*, Guangzhou, China (August 1, 2015)

Keynote Lecture: *Chinese Society of Clinical Oncology (CSCO) Anti-Angiogenesis Summit,* Shanghai, China (August 2, 2015).
"Tumor Angiogenesis and Microenvironment", 24th *Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 27, 2015).
"Reengineering the tumor stroma to improve cancer treatment: Bench to bedside," *Innovation in Cancer Science and Therapy*, Sanofi, Cambridge, MA (October 15, 2015)
"Reengineering the tumor stroma to improve cancer treatment: Bench to bedside" *Chabner Colloquium: Collaboration in Clinical Trials*, Boston, MA (October 26, 2015)
Keynote Lecture: "Reengineering the Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside", *NSF Workshop on Cell-Matrix Mechanobiology: Current State and Future Directions,* Univ of Illinois, Urbana-Champaign (October 27, 2015).

Keynote Lecture: "Reengineering the Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside", Keystone Symposia on Antibodies as Drugs, Whistler, Canada (March 7, 2016).
Keynote Lecture: "Reengineering the Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside", 90th American Chemical Society Symposium, Harvard University, Cambridge, MA (June 7, 2016).
"Tumor Angiogenesis and Microenvironment: Bench to bedside", *25th Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 27, 2016).
"Reengineering the Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside", *Targeted Drug Delivery Symposoium*, Pfizer, Cambridge, MA (September 19, 2016).
Keynote Lecture: "Reengineering the Tumor Microenvironment to Enhance Delivery and Efficacy of Nanomedicine", *NCI INCA Cancer Nanomedicine Meeting*, Paris (November 9-11, 2016).
"Reprogramming the tumor microenvironment to improve survival of metastatic cancer patients", *Metastasis Cancer Research Task Force*, Murtha Cancer Center, Walter Reed National Medical Center, Bethesda, MD (December 12-13, 2016).

"Reprogramming the tumor microenvironment to improve immunotherapy of cancer", *Tumor Immune Microenvironment Workshop*, NCI, Rockville, MD (January 17-19, 2017).
Meet-the-Expert Lecture: "Reprogramming the tumor microenvironment using angiotensin system inhibitors to enhance cancer treatment: Bench to bedside", *AACR Annual Meeting*, Washington DC (April 1-5, 2017).
"Vascular normalization: Emerging strategy to enhance immunotherapy", *Angiogenesis/Immuno-Oncology Meeting*, Merck, Washington DC (April 5, 2017).
State-of-the-Art Lecture: "Insights from Intravital Microecopy of Tumors: Bench to bedside", *32nd Congress of the International Society for Advancement of Cytology*, Boston, MA (June 10-14, 2017)
"Reprogramming the tumor microenvironment to improve immunotherapy of cancer", *Evergrande Symposium on Immunity and Inflammation in Disease and Tissue*, Harvard Medical School, Boston (July 21, 2017).
"Reprogramming the tumor microenvironment to enhance cancer treatment: Bench and Bedside," *National Foundation for Cancer Research Symposium,* Washington, DC (August 2-4, 2017).
"Reprogramming the tumor microenvironment to enhance cancer treatment: Bench and Bedside," *Gordon Conference on Angiogenesis,* Salve Regina University*,* New Port, RI (August 6-11, 2017).
"Reengineering the tumor microenvironment to improve cancer treatment: Bench to bedside", *26th Annual Course of Experimental Models of Human Cancer*, Jackson Lab, Bar Harbor, ME (August 18, 2017).
"Translating insights from cancer treatment to improve TB Treatment," *Bill & Melinda Gates Foundation Grand Challenges Meeting*, Washington, DC (October 1-4, 2017).
"Reprogramming the tumor microenvironment to improve cancer treatment: Bench to bedside", *Next Generation Cancer Clinical Trials*, Cold Spring Harbor Lab, NY (October 14 -15, 2017).
Keynote Lecture: "Reengineering the tumor microenvironment to improve cancer treatment: Bench to bedside", *Physical Science of Oncology Network Meeting,* MIT, Cambridge, MA (October 17-19, 2017).
Keynote Lecture: "Reengineering the tumor microenvironment to enhance cancer treatment: Bench to bedside", *Antibody-Drug Conjugates: Oncology and Beyond*, New York Academy of Sciences Meeting, NYC (Nov 14, 2017)

"Reengineering the tumor microenvironment to improve cancer treatment: Bench to bedside", Nobel Forum, Karolinska Institute, Stockholm (March 8-9, 2018)

"Microenvironment determines the differential response of primary tumor versus metastasis", Annual AACR Meeting, Chicago (April 15-18, 2018)
Plenary Speaker: "Reengineering the tumor microenvironment to improve cancer treatment: Bench to bedside", Japanese Breast Cancer Society Meeting, Kyoto, Japan (May 16-17, 2018)
Special Lecture: "Microenvironment determines the therapeutic response of primary tumor versus metastasis", Kyoto Breast Cancer Society Meeting, Kyoto, Japan (May 17-18, 2018)
Plenary Speaker, "Reengineering the tumor microenvironment to improve cancer treatment: Bench to bedside", International Vascular Biology Meeting, Helsinki (June 3-7, 2018)
Keynote Speaker: "Reengineering the tumor microenvironment to improve cancer treatment: Bench to bedside", Controlled Release Society Meeting, NYC (July 22-23, 2018)
Earl Benditt Award/Lecture: "Reengineering the tumor microenvironment to improve cancer treatment: Bench to bedside", North American Vascular Biology Organization, Newport, RI (October 14-18, 2018)
Forbeck Forum on Tumor Microenvironment, Colorado Springs, Colorado (November 2-4, 2018)

"Reengineering the tumor microenvironment to improve cancer treatment: Bench to bedside", Cancer Fibroblasts and Therapies, Banbury Center, Cold Spring Harbor Lab, Lloyd Harbor, NY (March 10-13, 2019)
"Improving immunotherapy of cancer by normalizing tumor vessels" *AACR Annual Meeting*, Atlanta, GA (March 29 - April 3, 2019)
"Reprogramming the Tumor Microenvironment to Improve Immunotherapy: Bench to Bedside", Advances in Immunotherapy, Harvard Medical School, Boston (May 17, 2019)
"Reprogramming the Tumor Microenvironment to Improve Immunotherapy: Bench to Bedside", ASCO Annual Meeting, Chicago, IL (May 29-June 2, 2019)
Plenary Speaker: "Reengineering the tumor microenvironment to enhance cancer treatment: Bench to bedside", 17th International Photodynamic Association World Congress, Cambridge, MA (July 1, 2019)
"Improving Cancer Treatment by Normalizing the Tumor's Neighborhood," Congress of Future Medical Leaders, National Academy of Future Physicians and Medical Scientists, Lowell, MA (June 25, 2019)
Keynote Speaker: "Reprogramming the Tumor Microenvironment to Enhance Cancer Treatment: Bench to Bedside", Gordon Research Conference on Angiogenesis, Salve Regina, Newport, RI (August 4-9, 2019).

Keynote Speaker: "Reprogramming the Tumor Microenvironment to Improve Immunotherapy: Bench to Bedside", 21st International Vascular Biology Meeting, Seoul, S. Korea, VIRTUAL (Sept 9 -1 2, 2020).
Keynote Speaker: "Normalizing the Tumor Microenvironment to Improve Immunotherapy: Bench to Bedside", 2nd Annual Congress of Immuno-Oncology Society of India, VIRTUAL (October 30- Nov 1, 2020).

PUBLICATIONS (Key publications in bold; citations >116,200; h-factor = 163; Nov 1, 2020)
(https://www.ncbi.nlm.nih.gov/myncbi/rakesh.jain.2/bibliography/public/)

1. E. Ruckenstein and R.K. Jain, "Spontaneous rupture of thin liquid films, " *J. Chemical Society, Faraday Transactions II,* **70:**132-147 (1974).
2. R.K. Jain and E. Ruckenstein, "Stability of stagnant viscous films on a solid surface," *J. Colloid and Interface Science,* **54:**108-116 (1976).
3. R.K. Jain and M.M. Denn, "Short term regulation of BOD upsets in an estuary," *Trans. ASME J. Dynamic Systems, Measurement and Control,* **98**, Series G, 30-31 (1976).
4. R.K. Jain and J. Wei, "Dynamics of drug transport in solid tumors: distributed parameter model," *J. Bioengineering*, **1**:313-329 (1977).
5. R.N. Pierson, D.C. Price, J. Wang and R.K. Jain, "Extracellular water measurements: organ tracer kinetics of bromide and sucrose in rats and man," *Am. J. Physiology*, **235**:254-264 (1978).
6. R.K. Jain, "Effect of inhomogeneities and finite boundaries on temperature distribution in a perfused medium with application to tumors," *Trans. ASME J. Biomechanical Engineering*, **100**:235-241 (1978).
7. R.K. Jain, C. Maldarelli and E. Ruckenstein, "Onset of microvilli in normal and neoplastic cells," *A.I.Ch.E. Symposium Series, Biorheology*, **74**:120-124 (1978).
8. J.M. Weissbrod, R.K. Jain and F.M. Sirotnak, "Pharmacokinetics of methotrexate in leukemia cells: effect of dose and mode of injection," *J. Pharmacokinetics and Biopharmaceutics*, **6**:487-503 (1978).
9. R.K. Jain, "Transient temperature distributions in an infinite perfused medium due to a time-dependent, spherical heat source," *Trans. ASME J. Biomechanical Engineering*, **101:**82-86 (1979).
10. R.K. Jain, J. Wei and P.M. Gullino, "Pharmacokinetics of methotrexate in solid tumors," *J. Pharmacokinetics and Biopharmaceutics*, **7**:181-194 (1979).
11. R.K. Jain, F.H. Grantham and P.M. Gullino, "Blood flow and heat transfer in Walker 256 mammary carcinoma," *J. National Cancer Institute*, **62**:927-933 (1979).
12. H.P. Sien and R.K. Jain, "Temperature distributions in normal and neoplastic tissues during hyperthermia: a lumped parameter model," *J. Thermal Biology,* **4**:157-164 (1979).
13. G. Tzeghai and R.K. Jain, "A semi-empirical model for cell kill kinetics during hyperthermia," *J. Thermal Biology*, **4**:257-258 (1979).
14. I.B. Ivanov and R.K. Jain, "Formation and thinning of thin liquid films," *Dynamics and Instability of Fluid Interfaces,* edited by T.S. Sorensen, Springer-Verlag, New York, pp 120-139 (1979).
15. R.K. Jain, I.B. Ivanov, C. Maldarelli and E. Ruckenstein, "Instability and rupture of thin liquid films," *Dynamics and Instability of Fluid Interfaces*, edited by T.S. Sorensen, Springer-Verlag, New York, pp 140-167 (1979).
16. I.B. Ivanov, R.K. Jain, P. Somasundaran and T.T. Traykov, "The role of surfactants on the coalescences of emulsion droplets," *Solution Chemistry of Surfactants*, edited by K.A. Mittal, Plenum Press, New York, Volume 2, pp 817-840 (1979).
17. H.P. Sien, and R.K. Jain, "Intratumour temperature distributions during hyperthermia," *J. Thermal Biology*, **5**:127-130 (1980).
18. J. Weissbrod and R.K. Jain, "Preliminary model of streptozotocin metabolism in mice," *J. Pharmaceutical Science*, **69**:691-694 (1980).
19. R. K. Jain, "Temperature distributions in normal and neoplastic tissues during normothermia and hyperthermia," *Annals of New York Academy of Sciences,* **335**:48-64 (1980).
20. C. Maldarelli, R.K. Jain, I.B. Ivanov and E. Ruckenstein, "Stability of symmetric and unsymmetric, thin liquid films to short and long wavelength perturbations," *J. Colloid and Interface Science*, **78**:118-143 (1980).
21. R.K. Jain and I.B. Ivanov, "Thinning and rupture of ring-shaped films," *J. Chemical Society, Faraday Transactions II*, **76**:250-266 (1980).

22. R.K. Jain and P.M. Gullino, "Analysis of transient temperature distribution in a perfused medium Due to a spherical heat source with application to heat transfer in tumors: homogeneous and infinite medium," *Chemical Engineering Communications*, **4**:95-118 (1980).
23. G. Chrysanthopoulos and R.K. Jain, "Thermal interactions between normal and neoplastic tissues in the rat, rabbit, swine and dog during hyperthermia," *Medical Physics*, **7**:529-536 (1980).
24. R.K. Jain, "Heat transfer in tumors: characterization and applications to thermography and hyperthermia," *Advances in Biomedical Engineering*, edited by D.O. Cooney, Marcel Dekker, Inc., New York, Part I, Chapter 2, pp 59-91 (1980).
25. R.K. Jain, J. Weissbrod and J. Wei, "Mass transfer in tumors: characterization and applications in chemotherapy," *Advances in Cancer Research,* **33**:251-310 (1980).
26. D.F. Zawicki, R.K. Jain, G.W. Schmid-Schoenbein and S. Chien, "Dynamics of neovascularization in normal tissue," *Microvascular Research,* **21**:27-47 (1981).
27. R.K. Jain, L. Gerlowski, J. Weissbrod, J. Wang and R.N. Pierson, Jr., "Kinetics of uptake, distribution and excretion of zinc in rats," *Annals of Biomedical Engineering,* **9**:347-361 (1981).
28. P.M. Gullino, R.K. Jain and F.H. Grantham, "Temperature gradients and local perfusion in a mammary carcinoma," *J. National Cancer Institute,* **68**:519-533 (1982).
29. B.T. Volpe and R.K. Jain, "Temperature distributions and thermal responses in humans. I. Simulations of various modes of whole-body hyperthermia in normal subjects," *Medical Physics*, **9**:506-513 (1982).
30. L.J. Nugent and R.K. Jain, "Monitoring transport in the rabbit ear chamber," *Microvascular Research*, **24**:204-209 (1982).
31. J.G. Townsend, R.K. Jain and A.R. Cashmore, "*In vivo* pharmacokinetics of triazinate in LI210 and W256 cells," *J. Pharmaceutical Sciences*, **71**:1102-1105 (1982).
32. C. Maldarelli and R.K. Jain, "The linear, hydrodynamic stability of an interfacially perturbed, transversely isotropic, thin, planar viscoelastic film. I. General formulation and a derivation of the dispersion equation," *J. Colloid and Interface Science,* **90**:233-262 (1982).
33. C. Maldarelli and R.K. Jain, "The linear, hydrodynamic stability of an interfacially perturbed, transversely isotropic, thin, planar viscoelastic film II. Extension of the theory to the study of the onset of small-scale cell membrane motions," *J. Colloid and Interface Science,* **90**:263-276 (1982).
34. I.E. Grossmann, R.D. Drabbant and R.K. Jain, "Incorporating toxicology in the synthesis of industrial chemical complexes," *Chemical Engineering Communications,* **17**:151-170 (1982).
35. S.A. Shah, R.K. Jain and P.L. Finney, "Effects of hyperthermia and hyperglycemia on the metastases formation and on survival of rats bearing W256 carcinosarcoma," *Hyperthermia*, H.I. Bicher and D.F. Bruley, eds., Plenum Publishing Corporation, New York, pp 23-42 (1982).
36. B.T. Volpe and R.K. Jain, "Temperature distributions and thermal response in humans. II. Simulation of whole-body, regional and localized hyperthermia in cancer patients," *AIChE Symposium Series 227,* **79**:116-123 (1983).
37. R.K. Jain and C. Maldarelli, "Stability of thin viscoelastic films with applications to biological membrane deformation," *Annals of New York Academy of Sciences,* **404**:89-102, (1983).
38. T.E. Dudar and R.K. Jain, "Microcirculatory flow changes during tissue growth," *Microvascular Research*, **25**:1-21 (1983).
39. L.J. Nugent and R.K. Jain, "Interstitial diffusion of macromolecules in normal and tumor capillary beds," *AIChE Symposium Series 227*, **79**:1-10 (1983).
40. T.E. Dudar and R.K. Jain, "Mathematical models for microcirculatory changes during hyperthermia in normal and neoplastic tissues," *AIChE Symposium Series 227*, **79**:153-162 (1983).
41. S.A. Shah, R.K. Jain and P.L. Finney, "Enhanced metastasis formation by combined hyperthermia and hyperglycemia in rats bearing Walker 256 carcinosarcoma," *Cancer Letters,* **19**:317-323 (1983).
42. R.K. Jain, "Bioheat transfer: mathematical models of thermal systems," *Hyperthermia in Cancer Therapy*, F.K. Storm, Ed., G.K. Hall and Co., Boston, Chapter 2, pp 9-46 (1983).
43. L.E. Gerlowski and R.K. Jain, "Physiologically based pharmacokinetic modeling: principles and applications." *Journal of Pharmaceutical Sciences*, **72**:1103-1127 (1983).

44. L.J. Nugent and R.K. Jain, "Plasma pharmacokinetics and interstitial diffusion of macromolecules in a normal capillary bed," *American Journal of Physiology,* **246**:H129-H137 (1984).

45. L.J. Nugent and R.K. Jain, "Extravascular diffusion in normal and neoplastic tissues," *Cancer Research*, **44**:238-244 (1984).

46. T.E. Dudar and R.K. Jain, "Differential responses of normal and tumor microcirculation to hyperthermia," *Cancer Research*, **44**:605-612 (1984).

47. R.K. Jain, S.A. Shah and P.L. Finney, "Continuous noninvasive monitoring of pH and temperature in rat Walker 256 carcinoma during normoglycemia and hyperglycemia," *Journal of the National Cancer Institute*, **73**:429-436 (1984).

48. L.J. Nugent and R.K. Jain, "Pore and fiber-matrix models for diffusive transport in normal and neoplastic tissues," *Microvascular Research*, **28**:270-274 (1984).

49. L.J. Nugent and R.K. Jain, "Two-compartment model for plasma pharmacokinetics in individual blood vessels," *Journal of Pharmacokinetics and Biopharmaceutics,* **12**:451-461 (1984).

50. R. Peloso, D.T. Tuma and R.K. Jain, "Dielectric Properties of Solid Tumors during Normothermia and Hyperthermia," *IEEE Trans., Biomedical Engineering,* **BME-31**:725-728 (1984).

51. D.S. Dimitrov and R.K. Jain, "Stability of thin viscoelastic films between permeable membranes," *Journal of Colloid and Interface Science,* **101**:489-499 (1984).

52. D.S. Dimitrov, J. Li, M. Angelova and R.K. Jain, "Surface effects in preparation of cell-size liposomes", *FEBS Letters*, **176**:398-400 (1984).

53. R.K. Jain, "Mass and heat transfer in tumors: applications in detection and treatment," *Advances in Transport Processes,* **3**:205-339 (1984).

54. R.K. Jain and K. A. Ward-Hartley, "Tumor blood flow: characterization, modifications and role in hyperthermia," *IEEE Transactions in Sonics and Ultrasonics; Special Issue on Hyperthermia*, **SU-31**:504-526 (1984).

55. D.S. Dimitrov and R.K. Jain, "Membrane stability," *Biochim. Biophys. Acta.*- Reviews on Biomembranes, **779**:437-468 (1984).

56. I. B. Ivanov, D.S. Dimitrov, P. Somasundaran, and R.K. Jain, "Thinning of films with deformable surfaces: diffusion-controlled surfactant transfer," *Chemical Engineering Science*, **40**:137-150 (1985).

57. D.S. Dimitrov, D.V. Zhelev and R.K. Jain, "Stability of membrane systems modeled as multilayered viscoelastic thin films," *J. Theor. Biol.,* **133**:353-377 (1985).

58. L. E. Gerlowski and R.K. Jain, "Effect of hyperthermia on microvascular permeability of normal and neoplastic tissues," *International Journal of Microcirculation: Clinical and Experimental,* **4**:336-372 (1985).

59. R.K. Jain, "Analysis of heat transfer and temperature distributions in tissues during local and whole body hyperthermia," *Heat Transfer in Medicine and Biology*, A. Shitzer and R. Eberhart, Eds, Plenum Press, New York, Volume 2, Chapter 16, pp 3-54 (1985).

60. R.K. Jain, "Transport of macromolecules in tumor microcirculation," *Biotechnology Progress*, **1**:81-94 (1985).

61. L.E. Gerlowski and R.K. Jain, "Microvascular permeability of normal and neoplastic tissues," *Microvascular Research,* **31**:288-305 (1986).

62. T.T. Traykov and R.K. Jain, "Effect of transmembrane potential on the deformability of RBC's suspended in carbohydrate-saline solutions," *J. Colloid and Interface Science*, **114**:273-276 (1986).

63. D. DiPette, K. Ward-Hartley and R.K. Jain, "Effect of hyperglycemia on systemic hemodynamics and blood flow rate in normal and neoplastic tissues in rats," *Cancer Research,* **46:**6299-6304 (1986).

64. R.K. Jain and L.E. Gerlowski, "Extravascular transport in normal and tumor tissues," *CRC Critical Reviews in Hematology and Oncology*, **5**:115-170 (1986).

65. T.T. Traykov and R.K. Jain, "Effect of glucose, galactose, and transmembrane potential on shear elastic modulus of erythrocyte membrane," *A.I.Ch.E. Symposium Series,* **82**:190-194 (1986).

66. T.T. Traykov and R.K. Jain, "Effect of glucose and galactose on red blood cell membrane deformability," *International Journal of Microcirculation: Clinical and Experimental,* **6**:35-44 (1987).

67. K. Ward-Hartley and R.K. Jain, "Effect of glucose and galactose on microcirculatory flow in normal and neoplastic tissues in rabbits," *Cancer Research*, **47**:371-377 (1987).

68. R.K. Jain and K. Ward-Hartley, "Dynamics of cancer cell interactions with microvasculature and interstitium," *Biorheology*, **24**:117-125 (1987).

69. R.K. Jain, "Transport of molecules in the tumor interstitium: a review," *Cancer Research*, 47:3038-3050 (1987).

70. S.C. Chary and R.K. Jain, "Analysis of diffusive and convective recovery after photobleaching-uniform flow field," *Chemical Engineering Communications,* **55**:235-249 (1987).

71. L.T. Baxter, R.K. Jain and E. Svensjo, "Vascular permeability and interstitial diffusion of macromolecules in the hamster cheek pouch: effects of vasoactive drugs," *Microvascular Research,* **34**:336-348 (1987).

72. R.K. Jain, "Interstitial transport in tumors," *Advances in Microcirculation,* **13**:266-284 (1987).

73. R.K. Jain, "Transport of molecules across tumor vasculature," *Cancer and Metastasis Reviews,* 6:559-594 (1987).

74. R.K. Jain, "Tumor blood flow response to hyperthermia and pharmacological agents," *Radiation Research*, E.M. Fieldman *et al* (eds.), Volume 2, pp 813-818, Taylor and Francis, London (1987).

75. E.M. Sevick and R.K. Jain, "Blood flow and efferent blood pH of "tissue-isolated" Walker 256 carcinoma during hyperglycemia," *Cancer Research*, **48**:1201-1207 (1988).

76. D. DiPette, K.A. Ward and R.K. Jain, "Effect of galactose on systemic hemodynamics and blood flow rate in normal and neoplastic tissues in rats," *Cancer Research,* **48**:1476-1480 (1988).

77. R.K. Jain, "Determinants of tumor blood flow: a review," *Cancer Research,* 48:2641-2658 (1988). [Chosen as one of 9 high impact reviews by AACR on the 75th Anniversary of Cancer Research: http://digitaleditions.sheridan.com/publication/index.php?i=291813&m=&l=&p=3&pre=&ver=html5#{"page":2,"issue_id":291813}].

78. K.A. Ward and R.K. Jain, "Physiological response of tumors to hyperglycemia: characterization, significance, and role in hyperthermia," *International Journal of Hyperthermia,* **4**:223-250 (1988).

79. L.T. Baxter and R.K. Jain, "Vascular permeability and interstitial diffusion in superfused tissues: a two-dimensional model," *Microvascular Research,* **36**:108-115 (1988).

80. R.K. Jain, "Transvascular and interstitial transport in tumors," *Vascular Endothelium in Health and Disease*, S. Chien (Ed.), pp 215-220, Elsevier, Amsterdam (1988).

81. C. Maldarelli and R.K. Jain, "Stability of thin films: characterization and applications in industrial and biological systems," *Thin Liquid Films*, I.B. Ivanov, Ed., pp 497-568, M. Dekker, New York (1988).

82. R.K. Jain and L.T. Baxter, "Mechanisms of heterogeneous distribution of monoclonal antibodies and other macromolecules in tumors: significance of elevated interstitial pressure," *Cancer Research*, 48:7022-7032 (1988). Pub Med link

83. L.T. Baxter and R.K. Jain, "Transport of fluid and macromolecules in tumors. I. Role of interstitial pressure and convection," *Microvascular Research,* **37**:77-104 (1989).

84. R.K. Jain, "Delivery of novel therapeutic agents in tumors: physiological barriers and strategies," *Journal of the National Cancer Institute*, 81:570-576 (1989). PubMed link

85. E.M. Sevick and R.K. Jain, "Geometric resistance to blood flow in solid tumors perfused ex *vivo*: effects of tumor size and perfusion pressure," *Cancer Research,* **49**:3506-3512 (1989).

86. E.M. Sevick and R.K. Jain, "Viscous resistance to blood flow in solid tumors: effect of hematocrit on intratumor blood viscosity," *Cancer Research*, **49**:3513-3519 (1989).

87. A. Sasaki, R.K. Jain, A.A. Maghazachi, R.H. Goldfarb, and R.B. Herberman, "Low deformability of LAK cells: a possible determinant of *in vivo* distribution," *Cancer Research*, **49**:3742-3746 (1989).

88. S.R. Chary and R.K. Jain, "Direct measurement of interstitial diffusion and convection of albumin in normal and neoplastic tissues using fluorescence photobleaching," *PNAS*, 86:5385-5389 (1989). PubMed link

89. R.K. Jain, "Tumor physiology and antibody delivery," *Frontiers in Radiation Therapy and Oncology*, **24**:32-46 (1990).

90. R.K. Jain, "Physiological barriers to delivery of monoclonal antibodies and other macromolecules in tumors," *Cancer Research,* **50**:814s-819s (1990).

91. R.K. Jain, R.J. Stock, S.R. Chary and M. Rueter, "Convection and diffusion measurements using fluorescence recovery after photobleaching and video image analysis: *in vitro* calibration and assessment," *Microvascular Research,* **39**:77-93 (1990).

92. M.A. Clauss and R.K. Jain, "Interstitial transport of rabbit and sheep antibodies in normal and neoplastic tissues," *Cancer Research*, **50**:3487-3492 (1990).

93. R.B. Herberman, P. Basse, R.K. Jain, R.J. Melder, R.H. Goldfarb, M.S. Ernstoff, J.M. Kirkwood, and T.L. Whiteside, "Approaches to immunotherapy with defined populations of IL-2 cultured NK cells, immune T Cells or tumor infiltrating lymphocytes," In: *Biology and Clinical Applications of IL-2*, R.C. Rees, Ed., Oxford University Press, London, Chapter 12, pp. 111-119 (1990).

94. Y. Boucher, L.T. Baxter and R.K. Jain, "Interstitial pressure gradients in tissue-isolated and subcutaneous tumors: implications for therapy," *Cancer Research,* 50:4478-4484 (1990). PubMed link

95. E. Kaufman and R.K. Jain, "Quantification of transport and binding parameters using fluorescence recovery after photobleaching: potential for in vivo applications," *Biophysical Journal,* **58**:873-885 (1990).

96. R.K. Jain, "Vascular and interstitial barriers to delivery of therapeutic agents in tumors," *Cancer and Metastasis Reviews,* **9**:253-266 (1990).

97. L.T. Baxter and R.K. Jain, "Transport of fluid and macromolecules in tumors. II. Role of heterogeneous perfusion and lymphatics," *Microvascular Research*, **40**:246-263 (1990).

98. J. Less, T. Skalak, E.M. Sevick, and R.K. Jain, "Microvascular architecture in a mammary carcinoma: branching patterns and dimensions," *Cancer Research,* **51**:265-273 (1991).

99. E. M. Sevick and R.K. Jain, "Measurement of capillary filtration coefficient in a solid tumor," *Cancer Research*, **51**:1352-1355 (1991).

100. C. Ohkubo, D. Bigos and R.K. Jain, "IL-2 induced leukocyte adhesion to the normal and tumor microvascular endothelium i*n vivo* and its inhibition by dextran sulfate: implications for vascular-leak-syndrome," *Cancer Research*, **51**:1561-1563 (1991).

101. E. M. Sevick and R.K. Jain, "Effect of RBC Rigidity on Tumor Blood Flow: Increase in Viscous Resistance During Hyperglycemia," *Cancer Research*, **51**:2727-2730 (1991).

102. F. Yuan, L.T. Baxter and R.K. Jain, "Pharmacokinetic Analysis of Two-step Approaches Using Bifunctional and Enzyme-conjugated Antibodies," *Cancer Research,* **51**:3119-3130 (1991).

103. K.A. Ward, D.J. DiPette, T.N. Held and R.K. Jain, "Effect of I.V. Versus I.P. Glucose Injection on Systemic Hemodynamics and Blood Flow Rate in Normal and Tumor Tissues in Rats," *Cancer Research*, **51**:3612-3616 (1991).

104. Y. Boucher, J. Kirkwood, D. Opacic, M. Desantis and R.K. Jain, "Interstitial Hypertension in Superficial Metastatic Melanomas in Humans," *Cancer Research*, **51**:6691-6694 (1991).

105. H.D. Roh, Y. Boucher, S. Kalnicki, R. Buchsbaum, W.D. Bloomer and R.K. Jain, "Interstitial Hypertension in Carcinoma of Uterine Cervix in Patients: Possible Correlation with Tumor Oxygenation and Radiation Response," *Cancer Research*, **51**:6695-6698 (1991).

106. A. Sasaki, R.J. Melder, T.L. Whiteside, R.B. Herberman, and R.K. Jain, "Preferential Localization of Human A-LAK Cells in Tumor Microcirculation: A Novel Mechanism of Adoptive Immunotherapy," *Journal of National Cancer Institute*, **83**:433-437 (1991).

107. L.T. Baxter and R.K. Jain, "Transport of Fluid and Macromolecules in Tumors. III. Role of Binding and Metabolism," *Microvascular Research*, **41**:5-23 (1991).

108. L.T. Baxter and R.K. Jain, "Transport of Fluid and Macromolecules in Tumors. IV. A Microscopic Model of the Perivascular Distribution," *Microvascular Research*, **41**:252-272 (1991).

109. E.N. Kaufman and R.K. Jain, "Measurement of Mass Transport and Reaction Parameters in Bulk Solution Using Photobleaching: Reaction Limited Binding Regime," *Biophysical Journal*, **60**:596-610 (1991).

110. R.K. Jain, "Parameters Governing Tumor Blood Flow," *In: Tumor Blood Supply and Metabolic Microenvironment: Characterization and Therapeutic Implications*, P. Vaupel and R.K. Jain, Eds., Fischer Publications, Stuttgart (1991).

111. L.T. Baxter and R.K. Jain, "Vascular and Interstitial Transport in Tumors," *In: Tumor Blood Supply and Metabolic Microenvironment: Characterization and Therapeutic Implications*, P. Vaupel and R.K. Jain, Eds., Fischer Publications, Stuttgart (1991).

112. E.M. Sevick and R.K. Jain, "Viscous Resistance to Blood Flow in the Tumor Microcirculation: Clinical Implications," *In: Tumor Blood Supply and Metabolic Microenvironment: Characterization and Therapeutic Implications*, P. Vaupel and R.K. Jain, Eds., Fischer Publications, Stuttgart (1991).
113. K.A. Ward and R.K. Jain, "Blood Flow Response to Hyperglycemia," *In: Tumor Blood Supply and Metabolic Microenvironment: Characterization and Therapeutic Implications*, P. Vaupel and R.K. Jain, Eds., Fischer Publications, Stuttgart (1991).
114. R.K. Jain, "Hemodynamic and Transport Barriers to the Treatment of Solid Tumors," *International Journal of Radiation Biology*, **60**:85-100 (1991).
115. R.K. Jain, "Therapeutic Implications of Tumor Physiology," *Current Opinion in Oncology,* **3**:1105-1108 (1991).
116. M. Leunig, A.E. Goetz, M. Dellian, G. Zetterer, F. Gamarra, R.K. Jain and K. Messmer, "Interstitial Fluid Pressure in Solid Tumors Following Hyperthermia: Possible Correlation with Therapeutic Response," *Cancer Research,* **52**:487-490 (1992).
117. R. Gutmann, M. Leunig, J. Feyh, A.E. Goetz, K. Messmer, E. Kastenbauer and R.K. Jain, "Interstitial Hypertension in Head and Neck Tumors in Patients: Correlation with Tumor Size," *Cancer Research*, **52**:1993-1995 (1992).
118. I. Lee, Y. Boucher, and R.K. Jain, "Nicotinamide Can Lower Tumor Interstitial Fluid Pressure: Mechanistic and Therapeutic Implications," *Cancer Research*, **52**:3237-3240 (1992).
119. E.N. Kaufman and R.K. Jain, "Effect of Bivalent Interaction Upon Apparent Antibody Affinity: Experimental Confirmation of Theory Using Fluorescence Photobleaching and Implications for Antibody Binding Assays," *Cancer Research*, **52**:4157-4167 (1992).
120. Y. Boucher and R.K. Jain, "Microvascular Pressure Is the Principal Driving Force for Interstitial Hypertension in Solid Tumors: Implications for Vascular Collapse," *Cancer Research*, **52**:5110-5114 (1992).
121. L.T. Baxter, F. Yuan, and R.K. Jain, "Pharmacokinetic Analysis of the Perivascular Distribution of Bifunctional Antibodies and Haptens," *Cancer Research,* **52**:5838-5844 (1992).
122. C.J. Eskey, A.P. Koretsky, M.M. Domach and R.K. Jain, "^{2}H NMR Imaging of Tumor Blood Flow: Spatial and Temporal Heterogeneity in a Tissue-isolated Mammary Adenocarcinoma," *Cancer Research,* **52**:6010-6019 (1992).
123. J.R. Less, M.C. Posner, Y. Boucher, D. Borochovitz, N. Wolmark and R.K. Jain, "Interstitial Hypertension in Human Breast and Colorectal Tumors," *Cancer Research,* **52**:6371-6374 (1992).
124. R. J. Melder and R.K Jain, "Kinetics of Interleukin - 2 Induced Changes in Rigidity of Human Natural Killer Cells," *Cell Biophysics,* **20**:161-176 (1992).
125. M. Leunig, F. Yuan, M. Menger, Y. Boucher, A. Goetz, K. Messmer and R.K. Jain, "Angiogenesis, Microvascular Architecture, Microhemodynamics and Interstitial Fluid Pressure During Early Growth of Human Adenocarcinoma LS174T in SCID Mice," *Cancer Research*, **52**:6553-6560 (1992).
126. E. N. Kaufman and R.K. Jain, "*In Vitro* Measurement and Screening of Monoclonal Antibody Affinity Using Fluorescence Photobleaching," *J. Immunol. Methods*, **155**:1-17 (1992).
127. C.J. Eskey, A.P. Koretsky, M.M. Domach and R.K. Jain, "Role of Oxygen versus Glucose in Energy Metabolism in a Mammary Carcinoma Perfused *Ex Vivo*: Direct Measurement by ^{31}P NMR," *PNAS*, 90:2646-2650 (1993).
128. F. Yuan, M. Leunig, D. Berk and R.K. Jain, "Microvascular Permeability of Albumin, Vascular Surface Area and Vascular Volume Measured in Human Adenocarcinoma LS174T Using Dorsal Chamber in SCID Mice," *Microvascular Research*, **45**:269-289 (1993).
129. R. Zlotecki, Y. Boucher, I. Lee, L.T. Baxter and R.K.Jain, "Effect of Angiotensin II Induced Hypertension on Tumor Blood Flow and Interstitial Fluid Pressure," *Cancer Research,* **53**:2466-2468 (1993).
130. G.R. Martin and R.K. Jain, "Fluorescence Ratio Imaging of pH Gradients: Calibration and Application in Normal and Tumor Tissues," *Microvascular Research,* **46**, 216-230 (1993).
131. D. Berk, F. Yuan, M. Leunig and R.K.Jain, "Fluorescence Photobleaching with Spatial Fourier Analysis: Measurement of Diffusion in Light-Scattering Media," *Biophysical Journal*, **65**:2428-2436 (1993).

132. P.E.G. Kristjansen, Y. Boucher and R.K. Jain, "Dexamethasone Reduces the Interstitial Fluid Pressure in a Human Colon Adenocarcinoma Xenograft," *Cancer Research,* **53**:4764-4766 (1993).

133. R.J. Melder, A.L. Brownell, T.M. Shoup, G.L. Brownell and R.K. Jain, "Imaging of Activated Natural Killer Cells in Mice by Positron Emission Tomography: Preferential Uptake in Tumors," *Cancer Research*, **53**:5867-5871 (1993).

134. R.K. Jain and L.T. Baxter, "Extravasation and Interstitial Transport in Tumors," In: *Biological Barriers to Protein Delivery*, K.L. Audus and T.J. Raub, Eds., Chapter 15, pp 441-465, Plenum Press, New York (1993).

135. R.K. Jain, "Physiological Resistance to the Treatment of Solid Tumors," In: *Drug Resistance in Oncology,* B. Teicher, Ed., Chapter 4, pp 87-105, M. Dekker, New York (1993).

136. R.J. Melder and R.K. Jain, "Delivery of Effector Cells to Tumors," In: *'93 Recent Advances in Cancer Research*, J.G. Park, Ed., pp. 202-217, Seoul National University, Seoul, (1993).

137. I.P. Torres-Filho, M. Leunig, F. Yuan, M. Intaglietta, and R.K. Jain "Non-invasive Measurement of Microvascular and Interstitial $p0_2$ Profiles in a Human Tumor in SCID Mice," *PNAS,* 91:2081-2085 (1994). PubMed link

138. M. Leunig, A.E. Goetz, F. Gamarra, G. Zetterer, K. Messmer and R.K Jain, "Photodynamic Therapy-induced Alterations in Interstitial Fluid Pressure, Volume and Water Content of an Amelanotic Melanoma in the Hamster," *British Journal of Cancer*, **69**:101-103 (1994).

139. L.T. Baxter, H. Zhu, D. Mackensen and R.K. Jain, "Physiologically Based Pharmacokinetic Model for Specific and Nonspecific Monoclonal Antibodies and Fragments in Human Tumor Xenograft in Nude Mice," *Cancer Research*, **54**:1517-1528 (1994).

140. C.J. Eskey, N. Wolmark, C.L. McDowell, M.M. Domach and R.K. Jain, "Residence Time Distributions of Various Tracers in Tumors: Implications for Drug Delivery and Blood Flow Measurement," *Journal of the National Cancer Institute,* **86**:293-299 (1994).

141. I. Lee, Y. Boucher, T. J. Demhartner and R.K. Jain, "Changes in tumour blood flow, oxygenation and interstitial fluid pressure induced by pentoxifylline," *British Journal of Cancer*, **69**:492-496 (1994).

142. F. Yuan, M. Leunig, S.K. Huang, D.A. Berk, D. Papahadjopoulos and R.K. Jain, "Microvascular Permeability and Interstitial Penetration of Sterically Stabilized (Stealth) Liposomes in a Human Tumor Xenograft," *Cancer Research*, **54**:3352-3356 (1994).

143. M. Leunig, F. Yuan, D. Berk, L.E. Gerweck and R.K. Jain, "Angiogenesis and Growth of Isografted Bone: Quantitative In Vivo Assay in Nude Mice," *Laboratory Investigations,* **71**:300-307 (1994).

144. I. Lee, T.J. Demhartner, Y. Boucher, R.K. Jain and M. Intaglietta, "Effect of Hemodilution and Resuscitation on Tumor Interstitial Fluid Pressure, Blood Flow and Oxygenation," *Microvascular Research,* **48**:1-12 (1994).

145. P.E.G. Kristjansen, S. Roberge, I. Lee and R.K. Jain, "Tissue-Isolated Human Tumor Xenografts in Athymic Nude Mice," *Microvascular Research,* **48**:389-402 (1994).

146. F. Yuan, H.A. Salehi, Y. Boucher, U.S. Vasthare, R.F. Tuma and R.K. Jain, "Vascular Permeability and Microcirculation of Gliomas and Mammary Carcinomas Transplanted in Rat and Mouse Cranial Windows," *Cancer Research*, **54**:4564-4568 (1994).

147. A.J. Leu, D.A. Berk, F. Yuan and R.K. Jain, "Flow Velocity in the Superficial Lymphatic Network of the Mouse Tail," *American Journal of Physiology*, **267**:H1507-H1513 (1994).

148. G.R. Martin and R.K. Jain, "Noninvasive Measurement of Interstitial pH Profiles in Normal and Neoplastic Tissue Using Fluorescence Ratio Imaging Microscopy," *Cancer Research,* **54**:5670-5674 (1994).

149. L. Hamberg, P.E.G. Kristjansen, G.J. Hunter, G.L. Wolf and R.K. Jain, "Spatial Heterogeneity in Tumor Perfusion Measured with Functional Computed Tomography at 0.05ml Resolution," *Cancer Research,* **54**:6032-6036 (1994).

150. L.L. Munn, R.J. Melder and R.K. Jain, "Analysis of Cell Flux in the Parallel Plate Flow Chamber: Implications for Cell Capture Studies," *Biophysical Journal,* **67**:889-895 (1994).

151. R.J. Melder and R.K. Jain, "Reduction of Rigidity in Human Activated Natural Killer Cells by Thioglycollate Treatment," *Journal of Immunological Methods,* **175**:69-77 (1994).

152. R.J. Melder, D. Elmaleh, A. L. Brownell, G. L. Brownell and R.K. Jain, "A Method for Labeling Cells for Positron Emission Tomography (PET) Studies," *Journal of Immunological Methods,* **175**:79-87 (1994).

153. R.K. Jain, "Transport Phenomena in Tumors," *Advances in Chemical Engineering,* **20**:129-200 (1994).

154. R.K Jain, "Tumor Microcirculation: Role in Cancer Diagnosis and Treatment," In: *Progress in Microcirculation Research*, H. Niimi, et al, Eds., pp 29-36, Pergamon Press, Tarrytown (1994).

155. R.K. Jain, "Barriers to Drug Delivery in Solid Tumors," *Scientific American*, 271:58-65 (1994). PubMed link

156. E.M. Johnson, D.A. Berk, R.K. Jain and W.M. Deen, "Diffusion and Partitioning of Proteins in Charged Agarose Gels," *Biophysical Journal*, **68**:1561-1568 (1995).

157. R.J. Melder, H.A. Salehi, and R.K. Jain, "Interaction of Activated Natural Killer Cells with Normal and Tumor Vessels in Cranial Windows in Mice," *Microvascular Research*, **50**, 35-44 (1995).

158. F. Yuan, M. Dellian, D. Fukumura, M. Leunig, D.A. Berk V.P. Torchilin and R.K. Jain, "Vascular Permeability in a Human Tumor Xenograft: Molecular Size-dependence and Cut-off Size," *Cancer Research*, **55**:3752-3756 (1995).

159. Y. Boucher, I. Lee and R.K. Jain, "Lack of General Correlation between Interstitial Fluid Pressure and Oxygen Partial Pressure in Solid Tumors," *Microvascular Research,* **50:**175-182 (1995).

160. L.L. Munn, G.C. Koenig, R.K. Jain and R.J. Melder, "Kinetics of Adhesion Molecule Expression and Spatial Organization Using Targeted Sampling Fluoremetry," *BioTechniques*, **19**:622-631 (1995).

161. Y. Gazit, D.A. Berk, M. Leunig, L.T. Baxter and R.K. Jain, "Scale-Invariant Behavior and Vascular Network Formation in Normal and Tumor Tissue," *Physical Review Letters*, 75:2428-2431 (1995). PubMed link

162. L.T. Baxter, H. Zhu, D.G. Mackensen, W.F. Butler and R.K. Jain, "Biodistribution of Monoclonal Antibodies: Scale-up from Mouse to Human Using a Physiologically Based Pharmacokinetic Model," *Cancer Research*, **55**:4611-4622 (1995).

163. D. Fukumura, H. Salehi, B. Witwer, R.F. Tuma, R.J. Melder and R.K. Jain, "TNFa-Induced Leukocyte-Adhesion in Normal and Tumor Vessels: Effect of Tumor Type, Transplantation Site and Host," *Cancer Research*, **55**:4824-4829 (1995).

164. S. Yamada, T. Mayadas, F. Yuan, D. Wagner, R. Hynes, R. Melder and R.K. Jain, "Rolling in P-Selectin Deficient Mice is Reduced but Not Eliminated in the Dorsal Skin," *Blood*, **86**:3487-3492 (1995).

165. R.J. Melder, L.L. Munn, S. Yamada, C. Ohkubo and R.K. Jain, "Selectin and Integrin Mediated T Lymphocyte Rolling and Arrest on TNFα-activated Endothelium is Augmented by Erythrocytes," *Biophysical Journal,* **69**:2131-2138 (1995).

166. R.A. Zlotecki, L.T. Baxter, Y. Boucher and R.K. Jain, "Pharmacologic Modification of Tumor Blood Flow and Interstitial Fluid Pressure in a Human Tumor Xenograft: Network Analysis and Mechanistic Interpretation," *Microvascular Research*, **50**:429-443 (1995).

167. M. Leunig, F. Yuan, L. E. Gerweck, D.A. Berk and R.K. Jain, "Quantitative Analysis of Angiogenesis and Growth of Bone: Consequences of Indomethacin Exposure in a Combined *In Vitro - In Vivo* Approach," *Res. Exp. Medicine,* **195**:275-288 (1995).

168. P.A. Netti, L.T. Baxter, Y. Boucher, R. Skalak and R.K. Jain, "Time Dependent Behavior of Interstitial Pressure in Solid Tumors: Implications for Drug Delivery," *Cancer Research,* **55**:5451-5458 (1995).

169. S. Yamada, R. J. Melder, M. Leunig, C. Ohkubo and R.K. Jain, "Leukocyte-rolling Increases with Age," *Blood*, **86**:4707-4708 (1995).

170. M.A. Swartz, D.A. Berk and R.K. Jain, "Transport in Lymphatic Capillaries: I. Macroscopic Measurements Using Residence Time Distribution Theory," *American Journal of Physiology*, **270**:H324-H329 (1996).

171. D.A. Berk, M.A. Swartz, A.J. Leu and R.K. Jain, "Transport in Lymphatic Capillaries: II. Microscopic Velocity Measurement with Fluorescence Recovery After Photobleaching," *American Journal of Physiology*, **270**:H330-H337 (1996).

172. P.E.G. Kristjansen, T.J. Brown, L.A. Shipley and R.K. Jain, "Intratumor Pharmacokinetics, Flow Resistance, and Metabolism During Gemcitabine Infusion in *Ex Vivo* Perfused Human Small Cell Lung Cancer," *Clinical Cancer Research*, **2**:359-367 (1996).

173. **R.K. Jain, "Delivery of Molecular Medicine to Solid Tumors," *Science*, 271:1079-1080 (1996). PubMed link**

174. C.A. Znati, M. Rosenstein, Y. Boucher, M.W. Epperly, W.D. Bloomer and R.K. Jain, "Effect of Radiation on Interstitial Fluid Pressure and Oxygenation in a Human Colon Carcinoma Xenograft," *Cancer Research*, **56**:964-968 (1996).

175. L.T. Baxter and R.K. Jain, "Pharmacokinetic Analysis of the Microscopic Distribution of Enzyme-conjugated Antibodies and Prodrugs: Comparison with Experimental Data," *British Journal of Cancer*, **73**:447-456 (1996).

176. S. Patan, L. Munn and R.K. Jain, "Intussusceptive Microvascular Growth in Solid Tumors: A Novel Mechanism of Tumor Angiogenesis," *Microvascular Research*, **51**:260-272 (1996).

177. E.M. Johnson, D.A. Berk, R.K. Jain and W.M. Deen, "Hindered Diffusion in Agarose Gels: Test of Effective Medium Model," *Biophysical Journal*, **70**:1017-1026 (1996).

178. M. Leunig, F. Yuan, D.A. Berk, L. Gerweck and R.K. Jain, "Heating or Freezing Bone: Effects on Angiogenesis Induction and Growth Potential in Mice," *Acta Orthop Scand.*, **67**:383-388 (1996).

179. W. M. Saltzman and R.K. Jain, "Drug Delivery: Barriers to Drug Transport and the Design of Novel Therapeutic Agents," *Molecular Medicine Today*, **1**:4 (1996).

180. J.W. Baish, Y. Gazit, D.A. Berk, M. Nozue, L.T. Baxter and R.K. Jain, "Role of Tumor Vascular Architecture in Nutrient and Drug Delivery: An Invasion Percolation Model," *Microvascular Research*, **51**:327-346 (1996).

181. R.K. Jain, "1995 Whitaker Lecture: Delivery of Molecules, Particles and Cells to Solid Tumors," *Annals of Biomedical Engineering*, 24:457-473 (1996). PubMed link

182. R.K. Jain, G. Koenig, M. Dellian, D. Fukumura, L.L. Munn and R.J. Melder, "Leukocyte-Endothelial Adhesion and Angiogenesis in Tumors," *Cancer and Metastasis Reviews*, **15**:195-204 (1996).

183. M. Dellian, B.P. Witwer, H.A. Salehi, F. Yuan and R.K. Jain, "Quantitation and Physiological Characterization of bFGF and VEGF/VPF Induced Vessels in Mice: Effect of Microenvironment on Angiogenesis," *American Journal of Pathology*, **149**:59-71 (1996).

184. R.K. Jain, "Solid Tumor Barriers to Anticancer Drugs," *Cope*, **12**:22-23 (1996).

185. L.L. Munn, R.J. Melder and R.K.Jain, "Role of Erythrocytes in Leukocyte-endothelial Interactions: Mathematical Model and Experimental Validation," *Biophysical Journal*, **71**:466-478 (1996).

186. M. Nozue, I. Lee, J.M. Manning, L. R. Manning and R.K. Jain, "Oxygenation in Tumors by Modified Hemoglobins," *Journal of Surgical Oncology,* **62**:109-114 (1996).

187. P.A. Netti, S. Roberge, Y. Boucher, L.T. Baxter, and R.K. Jain, "Effect of Transvascular Fluid Exchange on Arterio-Venous Pressure Relationship: Implication for Temporal and Spatial Heterogeneities in Tumor Blood Flow," *Microvascular Research*, **52**:27-46 (1996).

188. C.A. Kristensen, M. Nozue, Y. Boucher and R.K. Jain, "Reduction of Interstitial Fluid Pressure After TNF-α Treatment of Human Melanoma Xenografts," *British Journal of Cancer*, **74**:533-536 (1996).

189. H. Zhu, R. Melder, L. Baxter and R.K. Jain, "Physiologically Based Kinetic Model of Effector Cell Biodistribution in Mammals: Implications for Adoptive Immunotherapy," *Cancer Research*, **56**:3771-3781 (1996).

190. Y. Boucher, M. Leunig and R.K. Jain, "Tumor Angiogenesis and Interstitial Hypertension," *Cancer Research*, **56**:4264-4266 (1996).

191. R.J. Melder, G. Koenig, B.P. Witwer, N. Safabakhsh, L.L. Munn and R.K. Jain, "During Angiogenesis, Vascular Endothelial Growth Factor and Basic Fibroblast Growth Factor Regulate Natural Killer Cell Adhesion to Tumor Endothelium," *Nature Medicine*, 2:992-997 (1996). PubMed link

192. R. Skalak, S. Zargaryan, P. Netti, R.K. Jain and A. Hoger, "Compatibility and the Genesis of Residual Stress by Volumetric Growth," *Journal of Mathematical Biology*, **34**:889-914 (1996).

193. M. Dellian, G. Helmlinger, F. Yuan and R.K. Jain, "Fluorescence Ratio Imaging and Optical Sectioning: Effect of Glucose on Spatial and Temporal Gradients," *British Journal of Cancer,* **74**:1206-1215 (1996).

194. M.E. Johnson, D.A. Berk, D. Blankschtein, D.E. Golan, R.K. Jain and R. Langer, "Lateral Diffusion of Small Compounds in Human Stratum Corneum and Model Lipid Bilayer Systems," *Biophysical Journal,* **71**:2656-2668 (1996).

195. F. Yuan, Y. Chen, M. Dellian, N. Safabakhsh, N. Ferrara and R.K. Jain, "Time-dependent Vascular Regression and Permeability Changes in Established Human Tumor Xenografts Induced by an Anti-VEGF/VPF Antibody," *PNAS,* 93:14765-14770 (1996). PubMed link

196. H.C. Lichtenbeld, F. Yuan, C.C. Michel and R.K. Jain, "Perfusion of Single Tumor Microvessels: Application to Vascular Permeability Measurement," *Microcirculation*, **3**:349-357 (1996).

197. G. Helmlinger, F. Yuan, M. Dellian and R.K. Jain, "Interstitial pH and pO_2 Gradients in Solid Tumors *In Vivo:* High-Resolution Measurements Reveal a Lack of Correlation," *Nature Medicine*, 3:177-182 (1997). PubMed link

198. C. A. Kristensen, S. Roberge and R.K. Jain, "Effect of Tumor Necrosis Factor-α on Vascular Resistance, Nitric Oxide Production, Glucose and Oxygen Consumption in Perfused, Tissue-Isolated Human Melanoma Xenografts," *Clinical Cancer Research*, **3**:319-324 (1997).

199. D. Fukumura, F. Yuan, M. Endo and R. K. Jain, "Role of Nitric Oxide in Tumor Microcirculation: Blood Flow, Vascular Permeability, and Leukocyte-endothelial Interactions," *American Journal of Pathology*, **150**:713-725 (1997).

200. R.K. Jain, "1996 Landis Award Lecture: Delivery of Molecular and Cellular Medicine to Solid Tumors," *Microcirculation*, 4:1-23 (1997).

201. J.R. Less, M.C. Posner, T.C. Skalak, N. Wolmark and R.K. Jain, "Geometric Resistance and Microvascular Network Architecture of Human Colorectal Carcinoma," *Microcirculation,* **4**:25-33 (1997).

202. Y. Boucher, H. Salehi, B. Witwer, G.R. Harsh, IV and R.K, Jain, "Interstitial Fluid Pressure in Intracranial Tumors in Patients and in Rodents," *British Journal of Cancer*, **75**:829-836 (1997).

203. D.M. Briscoe, P. Ganz, S.I. Alexander, R.J. Melder, R.K. Jain, R.S. Cotran and A.H. Lichtman, "The Problem of Chronic Rejection: Influence of Leukocyte-Endothelial Interactions," *Kidney International*, **51:**S-22-S-27 (1997).

204. P.A. Netti, L.T. Baxter, Y. Boucher, R. Skalak and R.K. Jain, "Macro- and Microscopic Fluid Transport in Living Tissues: Application to Solid Tumors," *AIChE Journal*, **43**:818-834 (1997).

205. R.J. Melder, G. Koenig, L.L. Munn and R.K. Jain, "Adhesion of Activated Natural Killer Cells to TNF-α Treated Endothelium Under Physiological Flow Conditions," *Natural Immunity,* **15**:154-163 (1997).

206. H. Zhu, L. Baxter, and R.K. Jain, "Potential and Limitations of Radioimmunodetection and Radioimmunotherapy with Monoclonal Antibodies: Evaluation Using a Physiologically-Based Pharmacokinetic Model," *Journal of Nuclear Medicine*, **38**:731-741 (1997).

207. D.A. Berk, F. Yuan, M. Leunig and R.K. Jain, "Direct *in vivo* Measurement of Targeted Binding in a Human Tumor Xenograft," *PNAS,* 94:1785-1790 (1997). PubMed Link

208. J.W. Baish, P.A. Netti and R.K. Jain, "Transmural Coupling of Fluid Flow in Microcirculatory Network and Interstitium in Tumors," *Microvascular Research,* **53**:128-141 (1997).

209. M. Jeltsch, A. Kaipainen, V. Joukov, X. Meng, M. Lakso, H. Rauvala, M. Swartz, D. Fukumura, R.K. Jain, and K. Alitalo, "Hyperplasia of Lymphatic Vessels in VEGF-C Transgenic Mice," *Science*, 276:1423-1425 (1997). PubMed link

210. M. Leunig, F. Yuan, L. Gerweck and R.K. Jain, "Effect of bFGF on Angiogenesis and Growth of Isografted Bone: Quantitative *in vitro -in vivo* Analysis in Mice," *International Journal of Microcirculation*, **17**:1-9 (1997).

211. T. Shioda, L.L Munn, R.K. Jain and K.J. Isselbacher, "Early Events of Metastasis in the Microcirculation Involve Changes in Gene Expression of Cancer Cells," *American Journal of Pathology*, **150**:2099-2112 (1997).

212. G. Helmlinger, P.A. Netti, H.C. Lichtenbeld, R.J. Melder and R.K. Jain, "Solid Stress Inhibits the Growth of Multicellular Tumor Spheroids," *Nature Biotechnology*, 15:778-783 (1997). PubMed link

213. D. Fukumura, F. Yuan, W. L. Monsky, Y. Chen and R. K. Jain, "Effect of Host Microenvironment on the Microcirculation of Human Colon Adenocarcinoma," *American Journal of Pathology*, **150**:679-688 (1997).

214. R.K. Jain, "Vascular and Interstitial Physiology of Tumours: Role in Cancer Detection and Treatment," In: *Tumor Angiogenesis,* R. Bicknell, C. Lewis and N. Ferrara, Eds, Oxford University Press, Oxford, pp 45-59 (1997).

215. R.K. Jain, "Delivery of Molecular and Cellular Medicine to Solid Tumors," *Advanced Drug Delivery Reviews,* **26**:71-90 (1997).

216. R.K. Jain, K. Schlenger, M. Höckel and F. Yuan, "Quantitative Angiogenesis Assays: Progress and Problems," *Nature Medicine,* 3:1203-1208 (1997). PubMed link

217. G. Griffon-Etienne, Y. Boucher, R.K. Jain and H.D. Suit, "Effects of Needle Insertion in Tumors on Interstitial Fluid Pressure," *Microvascular Research*, **54**:174-177 (1997).

218. M. Nozue, I. Lee, F. Yuan, B. Teicher, D. M. Brizel, M.W. Dewhirst, C. G. Milross, L. Milas, C.W. Song, C.D.Thomas, M. Guichard, S.M. Evans, C.J. Koch, E.M. Lord, R.K. Jain and H.D. Suit, "Interlaboratory Variation in Oxygen Tension Measurement by Eppendorf "Histograph" and Comparison With Hypoxic Marker," *Journal of Surgical Oncology*, **66**:30-38 (1997).

219. Y. Gazit, J.W. Baish, N. Safabakhsh, M. Leunig, L.T. Baxter and R.K. Jain, "Fractal Characteristics of Tumor Vascular Architecture During Tumor Growth and Regression," *Microcirculation*, **4**:395-402 (1997).

220. M. Nozue, I. Lee, A. Hartford, S. Tanda, H.D. Suit and R.K. Jain, "p02 Measurements in Murine Tumors Using Eppendorf "Histograph": Calibration, Reproducibility and Comparison with Diamond-General Device," *International Journal of Oncology*, **9**:955-962 (1997).

221. R.K. Jain, "Delivery of Molecular Medicine to Solid Tumors," In: *Microcirculation Annual 1997,* M. Tsuchiya, M. Asano and N. Sato, Eds, Nihon-Igakukan, Tokyo, **13**:1-5 (1997).

222. R.K. Jain, "Tumor Microcirculation: Role in Drug and Nutrient Delivery," In: *Advances in Blood Substitutes*, Eds, R.M. Winslow, K. D. Vandegriff, and M. Intaglietta, Birkhäuser, Boston, pp 46-70 (1997).

223. R.K. Jain, "Microcirculation and Transport Phenomena in Tumours," In: *Connective Tissue Biology: Integration and Reductionism*. Eds. R.K. Reed and K. Rubin, Portland Press Ltd, London, **71**:269-293 (1998).

224. H. Zhu, R.K. Jain and L.T. Baxter, "Tumor Pretargeting for Radioimmunodetection and Radioimmunotherapy: Evaluation Using a Physiologically-Based Pharmacokinetic Model," *Journal of Nuclear Medicine*, **39**:65-76 (1998).

225. S. Hobbs, W. Monsky, F. Yuan, G. Roberts, L. Griffiths, V.P. Torchilin and R.K. Jain, "Regulation of Transport Pathways in Tumor Vessels: Role of Tumor Type and Microenvironment," *PNAS*, 95:4607-4612 (1998). PubMed link

226. G.J. Hunter, L.M. Hamberg, N. Choi, R.K. Jain, T. McCloud and A.J. Fischman, "Dynamic T1-weighted Magnetic Resonance Imaging and Positron Emission Tomography in Patients with Lung Cancer: Correlating Vascular Physiology with Glucose Metabolism," *Clinical Cancer Research,* **4:**949-955 (1998).

227. M. Rosenzweig, M. DeMaria, D. Harper, S. Friedrich, R.K. Jain and R. P. Johnson, "Increased Rates of CD4+ and CD8+ T Lymphocyte Turnover in Simian Immunodeficiency Virus-infected Macaques," *PNAS,* 95:6388-6393 (1998). PubMed link

228. U. Schoeph, E.M. Marecos, R.J. Melder, R.K. Jain and R. Weissleder, "Intracellular Magnetic Labeling of Lymphocytes for *in vivo* Trafficking Studies," *Biotechniques*, **24**:642-651 (1998).

229. M. Detmar, L.F. Brown, M.P. Schön, B.M. Elicker, L. Richard, P. Velasco, D. Fukumura, W. Monsky, K.P. Claffey and R.K. Jain, "Increased Microvascular Density and Enhanced Leukocyte Rolling and Adhesion in the Skin of VEGF Transgenic Mice," *Journal of Investigative Dermatology,* **3**:1-6 (1998).

230. P. Carmeliet, Y. Dor, J.M. Herbert, D. Fukumura, K. Brusselmans, M. Dewerchin, M. Neeman, F. Bono, R. Abramovitch, P. Maxwell, C.J. Koch, P. Ratcliffe, L. Moons, R.K. Jain, D. Collen and Eli Keshet, "Role of HIF-1α in Hypoxia-mediated Apoptosis, Cell Proliferation and Tumor Angiogenesis," *Nature*, 394:485-490 (1998). PubMed link

231. D. Fukumura, R. Xavier, T. Sugiura, Y. Chen, E.C. Parks, N. Lu, M. Selig, G. Nielsen, T. Taksir, R.K. Jain and B. Seed, "Tumor Induction of VEGF Promoter Activity in Stromal Cells," *Cell,* 94:715-725 (1998). PubMed link

232. R.K. Jain, N. Safabakhsh, A. Sckell, Y. Chen, L.A. Benjamin, F. Yuan and E. Keshet, "Endothelial Cell Death, Angiogenesis, and Microvascular Function Following Castration in an Androgen-dependent Tumor: Role of VEGF," *PNAS,* 95:10820-10825 (1998). PubMed link

233. D.S. Milstone, D. Fukumura, R.C. Padget, P.E. O'Donnell, V.M. Davis, O.J. Benavidez, R.J. Melder, R.K. Jain and M.A. Gimbrone, "Mice Lacking E-selectin Show Normal Rolling But Reduced Arrest of Leukocytes on Cytokine-Activated Microvascular Endothelium," *Microcirculation*, **5**:153-171 (1998).

234. Y. Boucher, C. Brekken, P.A. Netti, L.T. Baxter and R.K. Jain, "Intratumoral Infusion of Fluid: Estimation of Hydraulic Conductivity and Implications for the Delivery of Therapeutic Agents," *British Journal of Cancer*, **78**:1442-1448 (1998).

235. A. Sckell, N. Safabakhsh, M. Dellian and R.K. Jain, "Primary Tumor Size-Dependent Inhibition of Angiogenesis at a Secondary Site: An Intravital Microscopic Study in Mice," *Cancer Research*, **58**:5866-5869 (1998).

236. R.K. Jain, "The Next Frontier of Molecular Medicine: Delivery of Therapeutics," *Nature Medicine*, 4:655-657 (1998). PubMed link

237. R.K.Jain, "Integrative Pathophysiology of Solid Tumors: Role in Detection and Treatment," *The Cancer Journal from Scientific American*, **4**:48-57 (1998).

238. R.K. Jain, "Delivery of Molecular and Cellular Medicine to Solid Tumors," *Journal of Controlled Release*, **53**:49-67 (1998).

239. D. Fukumura and R.K. Jain, "Role of Nitric Oxide in Angiogenesis and Microcirculation in Tumors," *Cancer and Metastasis Reviews*, **17**:77-89 (1998).

240. J.W. Baish and R.K. Jain, "Cancer, Angiogenesis and Fractals," *Nature Medicine*, **4**:984 (1998).

241. R.K. Jain, "Tumor Microcirculation: Role in Delivery of Molecular and Cellular Medicine," In: *The Biology of Tumors*, Proceedings of the Ninth Annual Pezcoller Symposium on the Biology of Tumors, Rovereto, Italy, June 4-7, 1997, 319-345 (1998).

242. R.K. Jain, L.L. Munn, D. Fukumura and R.J. Melder, "*In Vitro* and *In Vivo* Quantification of Adhesion Between Leukocytes and Vascular Endothelium," In: Methods in Molecular Medicine - Methods in Tissue Engineering, J.R. Morgan and M.L. Yarmush, Eds., Humana Press, Totowa, pp 553-575 (1998).

243. R.K. Jain, "Delivery of Monoclonal Antibodies to the Tumor Cell", In: *Monoclonal Antibody-Based Therapy of Cancer*, M.L. Grossbard, Ed., Marcel Dekker, Inc., New York, pp 23-52 (1998).

244. P.A. Netti, L.M. Hamberg, J.W. Babich, S. Roberge, D. Kierstead, W. Graham, G.J. Hunter, G.L. Wolf, A. Fischman, Y. Boucher and R.K. Jain, "Enhancement of Fluid Filtration Across Tumor Vessels: Implication for Delivery of Macromolecules," *PNAS*, 96:3137-3142 (1999). PubMed link

245. C.A. Kristensen, N. Askenasy, R.K. Jain and A.P. Koretsky, "Creatine and Cyclocreatine Treatment of Human Colon Adenocarcinoma Xenografts: ^{31}P and ^{1}H Magnetic Resonance Spectroscopic Studies," *British Journal of Cancer*, **79**:278-285 (1999).

246. S.A. Slavin, A.D. van den Abbeele, A. Losken, M. Swartz and R.K.Jain, "Return of Lymphatic Function Following Flap Transfer for Acute Lymphedema," *Annals of Surgery,* **229**:421-427 (1999).

247. H.C. Lichtenbeld, N. Ferrara, R.K. Jain and L. L. Munn, "Effect of Anti-VEGF Antibody on Tumor Microvessel Permeability," *Microvascular Research,* **57**:357-362 (1999).

248. A. Pluen, P.A. Netti, R.K. Jain and D.A. Berk, "Diffusion of Macromolecules in Agarose Gels: Comparison of Linear and Globular Configurations," *Biophysical Journal*, **77**:542-552 (1999).

249. G. Griffon-Etienne, Y. Boucher, C. Brekken, H.D. Suit and R.K. Jain, "Taxane-Induced Apoptosis Decompresses Blood Vessels and Lowers Interstitial Fluid Pressure in Solid Tumors: Clinical Implications," *Cancer Research*, **59**:3776-3782 (1999).

250. R.K. Jain, "Understanding Barriers to Drug Delivery: High Resolution In Vivo Imaging is Key," *Clinical Cancer Research*, **5**:1605-1606 (1999).

251. W.L. Monsky, D. Fukumura, T. Gohongi, M. Ancukiewcz, H.A. Weich, V.P, Torchilin, F. Yuan and R.K. Jain, "Augmentation of Transvascular Transport of Macromolecules and Nanoparticles in Tumors Using Vascular Endothelial Growth Factor," *Cancer Research,* **59**:4129-4135 (1999).

252. M. Heijn, S. Roberge and R.K Jain, "Cellular Membrane Permeability of Anthracyclines Does Not Effect Their Delivery in a Tissue Isolated Tumor," *Cancer Research*, **59**:4458-4463 (1999).

253. M. Endo, R.K. Jain, B. Witwer and D. Brown, "Water Channel (Aquaporin 1) Expression and Distribution in Mammary Carcinomas and Glioblastomas," *Microvascular Research*, **58**: 89-98 (1999).

254. P. Somasundaran, S. Simpson, I. Ivanov, R.K. Jain, and D. Sarkar, "Thinning and Rupture of Aqueous Surfactant Films on Silica," *Langmuir*, **15**: 7658-7661 (1999).

255. K.S. Moulton, R.J. Melder, V. Dharnidharka, J. Hardin-Young, R.K. Jain, and D.M. Briscoe, "Angiogenesis in the huPBL-SCID Model of Human Transplant Rejection," *Transplantation*, **67**:1626-1631 (1999).

256. T. Gohongi, D. Fukumura, Y. Boucher, C. Yun, G.A. Soff, C. Compton, T. Todoroki and R.K. Jain, "Tumor-host Interactions in the Gallbladder Suppress Distal Angiogenesis and Tumor Growth: Role of TGFβ," *Nature Medicine*, 5:1203-1208 (1999). PubMed link

257. R.K. Jain, "Transport of Molecules, Particles, and Cells in Solid Tumors," *Annual Reviews of Biomedical Engineering,* **1**:241-263 (1999).

258. M.A. Swartz, A. Kaipainen, P. Netti, C. Brekken, Y. Boucher, A.J.Grodzinsky and R.K.Jain, "Mechanics of Interstitial-Lymphatic Fluid Transport: Theoretical Foundation and Experimental Validation," *Journal of Biomechanics,* **32**: 1297-1303 (1999)

259. C. A. Kristensen, L. M. Hamberg, G. J. Hunter, S. Roberge, D. Kierstead, G. L. Wolf and R. K. Jain, "Changes in Vascularization of Human Breast Cancer Xenografts Responding to Estrogen Withdrawal and Tamoxifen Therapy," *Neoplasia*, **1**:518-525 (1999).

260. M.A. Swartz, C.A. Kristensen, R.J. Melder, S. Roberge, E. Calautti, D. Fukumura, and R.K. Jain, "Cells Shed from Tumors Show Reduced Clonogenicity, Resistance to Apoptosis, and *in vivo* Tumorigenicity," *British Journal of Cancer*, **81**:756-759 (1999).

261. S. Ramanujan, G.C. Koenig, T.P. Padera, B.R. Stoll and R.K. Jain, "Local Imbalance of Angiogenic and Anti-Angiogenic Regulators: A Potential Mechanism of Focal Necrosis and Dormancy in Primary Tumors," *Cancer Researc*h, **60**: 1442-1448 (2000).

262. R.K. Jain, "Delivery of Biologic Molecules and Cells to Tumors," In: Biologic Therapy of Cancer: Principles and Practice, S. Rosenberg, Ed., Lippincott, Williams and Watkins, Philadelphia, pp. 865-874 (2000).

263. R.J. Melder, J. Yuan, L.L. Munn, R.K. Jain, "Erythrocytes Enhance Lymphocyte Rolling and Arrest in Vivo," *Microvascular Research*, **59**: 316-322 (2000).

264. Y.S. Chang, L.L. Munn, M. V. Hillsley, R. O. Dull, T.W. Gardner, R.K. Jain and J.M. Tarbell, "Effect of Vascular Endothelial Growth Factor on Cultured Endothelial Cell Monolayer Transport Properties," *Microvascular Research*, **59**: 265-277 (2000).

265. R.K. Jain and L.L. Munn "Leaky Vessels? Call Ang1!"*Nature Medicine*, 6:131-32 (2000).

266. M. Dellian, F. Yuan, V. S. Trubetskoy, V.P. Torchilin and R.K. Jain, "Vascular Permeability in a Human Tumor Xenograft: Molecular Charge Dependence", *British Journal of Cancer*, **82**: 1513-1518 (2000).

267. H. Hashizume, P. Baluk, S. Morikawa, J.W. McLean, G. Thurston, S. Roberge, R.K. Jain and D.M. McDonald, "Openings Between Defective Endothelial Cells Contribute to Tumor Vessel Leakiness", *American Journal of Pathology*, **156**: 1363-1380 (2000).

268. A.C. Hartford, T. Gohongi, D. Fukumura and R.K. Jain, "Irradiation of a Primary Tumor, Unlike Surgical Removal, Enhances Angiogenesis Suppression at a Distal Site: Potential Role of Host-Tumor Interaction," *Cancer Research*, **60**: 2128-2131 (2000).

269. P.A. Netti, D.A. Berk, M.A. Swartz, A.J. Grodzinsky and R.K. Jain, "Role of Extracellular Matrix Assembly in Interstitial Transport in Solid Tumors," *Cancer Research*, 60: 2497-2503 (2000).

270. D.M. McDonald, L. Munn and R.K. Jain, "Vasculogenic Mimicry: How Convincing, How Novel, and How Significant?" *American Journal of Pathology*, **156**: 383-388 (2000).

271. G. Helmlinger, M. Endo, N. Ferrara, L. Hlatky and R.K. Jain, "Formation of Endothelial Cell Networks," *Nature,* 405: 139-141 (2000). PubMed link

272. J.W. Baish and R.K. Jain, "Fractals and Cancer," *Cancer Research*, **60**: 3683-88 (2000).

273. A. Kaur, C.L. Hale, S. Ramanujan, R.K. Jain and R. P. Johnson. "Differential Dynamics of CD4+ and CD8+ T Lymphocyte Proliferation and Activation in acute Simian Immunodeficiency Virus Infection," *Journal of Virology*, **74**: 8413-8424 (2000).

274. M. Stohrer, Y. Boucher, M. Stangassinger and R.K. Jain, "Oncotic Pressure in Solid Tumors is Elevated," *Cancer Research*, **60**: 4251-4255 (2000).

275. A.J. Leu, D.A. Berk, A. Lymboussaki, K. Alitalo and R.K. Jain, "Absence of Functional Lymphatics within a Murine Sarcoma: a Molecular and Functional Evaluation," *Cancer Research*, **60**: 4324-4327 (2000).

276. N. Hansen-Algenstaedt, B.R. Stoll, T.P. Padera, D.E.J.G.J. Dolmans, D.J. Hicklin, D. Fukumura and R.K. Jain, "Tumor Oxygenation during Vascular Endothelial Growth Factor 2 Blockade, Hormone Ablation, and Chemotherapy," *Cancer Research* , **60**: 4556-4560 (2000).

277. P. Somasundaran, S. Simpson, R.K. Jain, I. Ivanov, V. Raghuraman, "Investigation of Thin Aqueous Films on Silica Using a Modified Interferometric Technique," *Journal of Colloid and Interface Science*, **225**: 243-246 (2000).

278. P. Carmeliet and R.K. Jain, "Angiogenesis in Cancer and Other Diseases," *Nature*, 407: 249-257 (2000). PubMed link

279. C.G. Lee, M. Heijn, E. diTomaso, G. Griffon-Etienne, M. Ancukiewicz, C. Koike, K.R. Park, N. Ferrara, R.K. Jain, H.D. Suit and Y. Boucher, "Anti-Vascular Endothelial Growth Factor Treatment Augments Tumor Radiation Response Under Normoxic or Hypoxic Conditions," *Cancer Research*, **60**: 5565-5570 (2000).

280. Y. Tsuzuki, D. Fukumura, B. Oosthuyse, C. Koike, P. Carmeliet and R.K. Jain. "Vascular Endothelial Growth Factor Modulation by Targeting HIF-1α→HRE→ VEGF Cascade Differentially Regulates Vascular Response and Growth Rate in Tumors," *Cancer Research*, **60**: 6248-6252 (2000).

281. Y.S. Chang, E. di Tomaso, D.M. McDonald. R. Jones, R.K. Jain and L.L. Munn. "Mosaic Blood Vessels in Tumors: Frequency of Cancer Cells in Contact with Flowing Blood, " *PNAS*, 97: 14608-14613 (2000). PubMed link

282. D. Fukumura, T. Gohongi, A Kadambi, J. Ang, C. Yun, D.G. Buerk, P.L. Huang and R.K. Jain, "Predominant Role of Endothelial Nitric Oxide Synthase in VEGF-induced Angiogenesis and Vascular Permeability," *PNAS,* 98: 2604-2609 (2001). PubMed link

283. A. Pluen, Y. Boucher, S. Ramanujan, T.D. McKee, T. Gohongi, E. di Tomaso, E.B. Brown, Y. Izumi, R.B. Campbell, D.A. Berk, and R.K. Jain, "Role of Tumor-Host Interactions in Interstitial Diffusion of Macromolecules: Cranial vs. subcutaneous tumors," *PNAS,* 98: 4628-4633 (2001). PubMed link

284. J. Yuan, R.J. Melder, R.K. Jain and L.L. Munn, "A Lateral View Flow System for Studies of Cell Adhesion and Deformation under Flow Conditions," *Biotechniques*, **30**:388-394 (2001).

285. S.V. Kozin, Y. Boucher, D.J. Hicklin, P. Bohlen, R.K. Jain and H.D. Suit, "VEGF Receptor-2 Blocking Antibody Potentiates Radiation-Induced Long Term Control of Human Tumor Xenografts," *Cancer Research*, **61**: 39-44 (2001).

286. A. Kadambi, CM Carreira, C.-O. Yun, T.P. Padera, D.E.J.G.J. Dolmans, P. Carmeliet, D. Fukumura and R.K. Jain. "Vascular endothelial Growth Factor (VEGF)-C Differentially Affects Tumor Vascular Function and Leukocyte Recruitment: Role of VEGF-Receptor 2 and Host VEGF-A," *Cancer Research*, **61**: 2404-2408 (2001).

287. R.O. Dull, J. Yuan, Y.S. Chang, J. Tarbell, R.K. Jain, and L.L. Munn, "Kinetics of Placenta Growth Factor/Vascular Endothelial Growth Factor Synergy in Endothelial Hydraulic Conductivity and Proliferation," *Microvascular Research*, **61:** 203-210 (2001).

288. R.J. Melder, C.A. Kristensen, L.L. Munn, and R.K. Jain, "Modulation of A-NK Cell Rigidity: In Vitro Characterization and In Vivo Implications for Cell Delivery," *Biorheology*, **38**:151-159 (2001).

289. **E.B. Brown, R.B. Campbell, Y. Tsuzuki, L. Xu, P. Carmeliet, D. Fukumura, and R.K. Jain, "In vivo Measurement of Gene Expression, Angiogenesis and Physiological Function in Tumors Using Multiphoton Laser Scanning Microscopy," *Nature Medicine*, 7:864-868 (2001). PubMed link**

290. R.K. Jain, "Clearing the Smoke on Nicotine and Angiogenesis," *Nature Medicine*, 7:775-777 (2001).

291. C. de Lange Davies, R.J. Melder, L.L. Munn, C. Mouta-Carreira, R.K. Jain, and Y. Boucher, "Decorin Inhibits Endothelial Migration and Tube-Like Structure Formation: Role of Thrombospondin-1," *Microvascular Research,* **62**: 26-42 (2001).

292. R.K. Jain. "Delivery of Molecular and Cellular Medicine to Solid Tumors," *Adv Drug Deliv Rev*, **46**: 149-168 (2001).

293. A. Losken, M.A. Swartz, A.D. Van Den Abbeele, R.K. Jain, and S.A. Slavin, "A Potential Murine Model for Flap-Related Investigations," *Plastic and Reconstructive Surgery*, **107**:1504-1508 (2001).

294. R.K. Jain, L.L. Munn, and D. Fukumura, "Transparent Window Models and Intravital Microscopy: Imaging Gene Expression, Physiological Function and Drug Delivery in Tumors," In: *Tumor Models in Cancer Research*, B. Teicher, Ed., Humana Press, Inc., Totowa, NJ, Chapter **34**: 647-671 (2001).

295. R.K. Jain, "Delivery of Molecular Medicine to Solid Tumors: Lessons from In Vivo Imaging of Gene Expression and Function," *J Controlled Release*, **74:** 7-25 (2001).

296. D. Fukumura, L. Xu, Y. Chen, T. Gohongi, B. Seed, and R.K. Jain, "Hypoxia and Acidosis Independently Up-Regulate Vascular Endothelial Growth Factor Transcription in Brain Tumors In Vivo," *Cancer Research*, **61**:6020-6024 (2001).

297. R.K. Jain, "Normalizing Tumor Vasculature with Anti-Angiogenic Therapy: A New Paradigm for Combination Therapy," *Nature Medicine,* 7: 987-989 (2001). PubMed link

298. S. Patan, L.L. Munn, S. Tanda, S. Roberge, R.K. Jain, and R.C. Jones, "Vascular Morphogenesis and Remodeling in a Model of Tissue Repair: Blood Vessel Formation and Growth in the Ovarian Pedicle after Ovariectomy," *Circulation Research* **89:** 723-731 (2001).

299. S. Patan, S. Tanda, S. Roberge, R.C. Jones, R.K. Jain and L.L. Munn, "Vascular Morphogenesis and Remodeling in a Model of Tissue Repair: Blood Vessel Formation and Growth after Ovariectomy and Tumor Implantation," *Circulation Research* **89:** 732-739 (2001).

300. Y. Tsuzuki, C. Mouta-Carreira, M. Bockhorn, L. Xu, R.K. Jain, D. Fukumura, "Pancreas Microenvironment Promotes VEFG Expression and Tumor Growth: Novel Window Models for Pancreatic Tumor Angiogenesis and Microcirculation," *Lab Investigations* **81:** 1439-1451 (2001).
301. C. Mouta-Carreira, S.M. Nasser, E. diTomaso, T.P. Padera, Y. Boucher, S.I. Tomarev, and R.K. Jain, "LYVE-1 is not Restricted to the Lymph Vessels: Expression in Normal Liver Blood Sinusoids and Down-Regulation in Human Liver Cancer and Cirrhosis," *Cancer Research*, **61:** 8079-8084 (2001).
302. J. W. Baish and R. K. Jain, "Correspondence Regarding Fractals and Cancer," *Cancer Research* **61:** 8347-8351, (2001).
303. R.K. Jain, "In Memoriam: Pietro M. Gullino (1919-2001)," *Cancer Research,* **61:** 8930-8931 (2001).
304. R.K. Jain and N.S. Forbes, "Can Engineered Bacteria Help Control Cancer?," *PNAS*, 98: 14748-14750 (2001).
305. R.K. Jain and P.F. Carmeliet, "Vessels of Death or Life," *Scientific American*, 285: 38-45 (2001). PubMed link
306. T.P. Padera, B.R. Stoll, P.T.C. So, and R.K. Jain, "Conventional and High-Speed Intravital Multiphoton Laser Scanning Microscopy of Microvasculature, Lymphatics, and Leukocyte-Endothelial Interactions," *Molecular Imaging* **1:** 9-15 (2002).
307. L. Xu, D. Fukumura, R.K. Jain, "Acidic extracellular pH induces vascular endothelial growth factor (VEGF) in human glioblastoma cells via ERK1/2 MAPK signaling pathway. Mechanism of low pH induced VEGF. *J Biol Chem.*, **277:** 11368-11374 (2002).
308. Y. Izumi, L. Xu, E. di Tomaso, D. Fukumura, and R.K. Jain, "Herceptin Acts as an Anti-angiogenic Cocktail," *Nature* 416: 279-280 (2002). PubMed link
309. **R.K. Jain, L.L. Munn, and D. Fukumura, "Dissecting Tumor Pathophysiology using Intravital Microscopy," *Nature Reviews Cancer* 2: 266-276 (2002). PubMed link**
310. R.K. Jain and B.T. Fenton, "Intratumoral Lymphatic Vessels: A Case of Mistaken Identity or Malfunction?" *JNCI* **94:** 417-421 (2002).
311. D.E.J.G.J. Dolmans, A. Kadambi, J.S. Hill, C.A. Waters, B.C. Robinson, J.P. Walker, D. Fukumura, and R.K. Jain, "Vascular Accumulation of a Novel Photosensitizer, MV6401, Causes Selective Thrombosis in Tumor Vessels following Photodynamic Therapy," *Cancer Research* **62:** 2151-2156 (2002).
312. W.L. Monsky, C. Mouta Carreira, Y. Tsuzuki, T. Gohongi, D. Fukumura, and R.K. Jain, "Role of Host Microenvironment in Angiogenesis and Microvascular Functions in Human Breast Cancer Xenografts: Mammary Fat Pad vs. Cranial Tumors," *Clinical Cancer Research* **8:** 1008-1013 (2002).
313. G. Helmlinger, A. Sckell, M. Dellian, N.S. Forbes, and R.K. Jain, "Acid Production in Glycolysis-Impaired Tumors Provides New Insights into Tumor Metabolism," *Clinical Cancer Research* **8**: 1284-1291 (2002).
314. S. Morikawa, Peter Baluk, T. Kaidoh, A. Haskell, R.K. Jain, and D.M. McDonald, "Abnormalities In Pericytes on Blood Vessels and Endothelial Sprouts In Tumors," *American Journal of Pathology* **160:** 985-1000 (2002).
315. R.J. Melder, L.L. Munn, B.R. Stoll, E.M. Marecos, L.T. Baxter, R. Weissleder, and R.K. Jain, "Systemic Distribution and Tumor Localization of Adoptively Transferred Lymphocytes in Mice: Comparison With Physiologically Based Pharmacokinetic Model," *Neoplasia*, **4:** 3-8 (2002).
316. T.P. Padera, A. Kadambi, E. di Tomaso, C. Mouta Carreira, E.B. Brown, Y. Boucher, N.C. Choi, D. Mathisen, J. Wain, E.J. Mark, L.L. Munn, R.K. Jain, "Lymphatic Metastasis in the Absence of Functional Intratumor Lymphatics," *Science*, 296:1883-1886 (2002). PubMed link
317. C. Koike, T.D. McKee, A. Pluen, S. Ramanujan, K. Burton, L.L. Munn, Y. Boucher, and R.K. Jain, "Solid Stress Facilitates Spheroid Formation: Potential Involvement of Hyaluronan," *BJC* **86:** 947-953 (2002).
318. C. de L. Davies, D.A. Berk, A. Pluen, and R.K. Jain, "Comparison of IgG Diffusion and Extracellular Matrix Composition in Rhabdomyosarcomas Grown in Mice Versus In Vitro as Spheroids Reveals the Role of Host Stromal Cells," *British J Cancer*, **86:** 1639-1644 (2002).
319. R.K. Jain and T.P. Padera "Prevention of Lymphatic Metastasis by Anti-Lymphangiogenic Therapy," *JNCI* **94**: 785-787 (2002).
320. D.E.J.G.J. Dolmans, A. Kadambi, J.S. Hill, K. Flores, J. Gerber, J.P. Walker, I.H.M. Borel Rinkes, R.K. Jain, D. Fukumura, "Targeting Tumor Vasculature and Cancer Cells in Orthotopic Breast Tumor by Fractionated Photosensitizer Dosing Photodynamic Therapy," *Cancer Research* **62:** 4289-4294, (2002).
321. S. Ramanujan, A. Pluen, T.D. McKee, E.B. Brown, Y. Boucher, R.K. Jain, "Diffusion and Convection in Collagen Gels: Implications for Transport in the Tumor Interstitium," *Biophysical Journal* **83:** 1650-1660 (2002).

322. C. Migliorini, Y.H. Qian, H. Chen, E.B. Brown, R.K. Jain and L.L. Munn, "Red Blood Cells Augment Leukocyte Rolling in a Virtual Blood Vessel," *Biophysical Journal* **83:** 1834-1841 (2002)

323. R.B. Campbell, D. Fukumura, E.B. Brown, L.M. Mazzola, Y. Izumi, R.K. Jain, V.P. Torchilin and L.L. Munn, "Cationic Charge Determines the Distribution of Liposomes between the Vascular and Extravascular Compartments of Tumors," *Cancer Research*, **62**: 6831-6836 (2002).

324. S.W. Friedrich, S.C. Lin, B.R. Stoll, L.T. Baxter, L.L. Munn and R.K. Jain, "Antibody Directed Effector Cell Therapy of Tumors: Analysis and Optimization Using a Physiologically Based Pharmacokinetic Model," *Neoplasia* **4:** 449-463 (2002).

325. R.K. Jain, "Tumor Angiogenesis and Accessibility: Role of Vascular Endothelial Growth Factor," *Seminars in Oncology* **29s:** 3-9 (2002).

326. R.K. Jain, "Angiogenesis and Lymphangiogenesis in Tumors: Insights from Intravital Microscopy," *Cold Spring Harbor Symposia on Quantitative Biology (The Cardiovascular System)* **67:** 239-248 (2002).

327. R.K. Jain and T. P. Padera, " Lymphatics Make the Break," *Science*, 299: 209-210 (2003).

328. Y. Izumi, E. di Tomaso, A. Hooper, P. Huang, J. Huber, DJ Hicklin, D Fukumura, R.K. Jain and H.D. Suit, " Responses to Anti-Angiogenesis Treatment of Spontaneous Autochthonous Tumors and Their Isografts," *Cancer Research*, **63:** 747-751 (2003).

329. F. Mollica, R.K. Jain and P.A. Netti, "A Model for Temporal Heterogeneities of Tumor Blood Flow," *Microvascular Research*, **65:** 56-60 (2003).

330. P.A. Netti and R.K. Jain, "Interstitial Transport in Solid Tumors," *In*: Cancer Modeling and Simulation (Editor: L Preziosi), Chapman & Hall, Boca Raton, FL, Chapter 3, pp. 51-74 (2003)

331. P.A. Netti, F. Travascio, R.K. Jain, "Coupled Macromolecular Transport and Gel Mechanics: Poroviscoelastic Approach", *AIChE Journal,* **49:** 1580-1596 (2003)

332. R. K. Jain, D. Duda, "Role of Bone Marrow-Derived Cells in Tumor Angiogenesis and Treatment", *Cancer Cell*, 3: 515-516 (2003).

333. D.E.J.G.J. Dolmans, D. Fukumura, R.K. Jain, "Photodynamic Therapy for Cancer" *Nature Rev. Cancer* 3: 380-387 (2003). PubMed link

334. R.K. Jain, "Molecular Regulation of Vessel Maturation," *Nature Medicine,* 9: 685-693 (2003). PubMed link

335. E. Brown, T. McKee, E. di Tomaso, B. Seed, Y. Boucher, R.K. Jain, "Dynamic Imaging of Collagen and its Modulation in Tumors in vivo using Second Harmonic Generation," *Nature Medicine* 9: 796-801 (2003). PubMed link

336. M. Abdul-Karim, K. Al-Kofahi, E. Brown, R.K. Jain, K. Roysam, "Automated Tracing and Change analysis of Angiogenic Vasculature from in vivo Multiphoton Confocal Image Time series," *Microvascular Research* **66**: 113-125 (2003).

337. B.R. Stoll, C. Migliorini, A. Kadambi, L.L. Munn, R.K. Jain, "A Mathematical Model of the Contribution of Endothelial Progenitor Cells to Angiogenesis in Solid Tumors: Implications for Anti-Angiogenic Therapy," Blood, **103**: 2555-2561 (2003).

338. N.S. Forbes, L.L. Munn, D. Fukumura and R.K. Jain, "Sparse initial entrapment of systemically injected salmonella typhimurium leads to heterogeneous accumulation within tumor necrosis." *Cancer Research* **63**: 5188-5193 (2003).

339. D. Fukumura, A. Ushiyama, D. G. Duda, L. Xu, J. Tam, V. K. K. Chatterjee, I. Garkavtsev, and R. K. Jain. "Paracrine Regulation of Angiogenesis and Adipocyte Differentiation during In Vivo Adipogenesis." *Circulation Research* **93**: E88-E97 (2003). (Published on line on Oct 2, 2003).

340. T. Roose, P.A. Netti, L. Munn, Y. Boucher, R.K. Jain, "Solid Stress generated by spheroid growth estimated using a linear poroelasticity model," *Microvascular Research* **66**: 204-212 (2003).

341. C. A. Znati, M. Rosenstein, T. D. McKee, E. B. Brown, D. Turner, W.D. Bloomer, S. Watkins, R. K. Jain, and Y. Boucher, "Irradiation Reduces Interstitial Fluid Transport and Increases the Collagen Content in Tumors". *Clinical Cancer Research* **9**: 5508-5513 (2003).

342. R. K. Jain and M. F. Booth, "What brings pericytes to tumor vessels?" *Journal of Clinical Investigation* **112**: 1134-1136 (2003).

343. R.K. Jain, "Molecular Pathophysiology of Tumors," In: *Principles and Practice of Radiation Oncology, 4th Edition* (Editors: C. A. Parez, L. W. Brady, E. C. Halperin, and R. Schmidt-Ullrich), Lippincott, Williams & Wilkins, New York, Chapter 4, pp 163-179 (2003).

344. C. Willett, Y. Boucher, E. di Tomaso, D. Duda, L. L. Munn, R. Tong, D. Chung, D. Sahani, S. Kalva, S. Kozin, M. Mino, K. Cohen, D. Scadden, A. Hartford, A. Fischman, J. Clark, D. Ryan, A. Zhu, L. Blaszkowsky, H. Chen, P. Shellito, G. Lauwers, and R. K. Jain. "Direct evidence that the VEGF-specific antibody bevacizumab has antivascular effects in human rectal cancer," *Nature Medicine*, 10: 145-147 (2004). PubMed link

345. G. Alexandrakis, E. B. Brown, R. T. Tong, T. D. McKee, R. B. Campbell, Y. Boucher and R. K. Jain, "Two-photon fluorescence correlation microscopy reveals the two-phase nature of transport in tumors," *Nature Medicine*, 10: 203-207 (2004).

346. T. Padera, B. Stoll, J. Tooredman, D. Capen, E. di Tomaso, and R. K. Jain, "Cancer cells compress intratumor vessels," *Nature*, 427: 695 (2004). PubMed link

347. N. Koike, D. Fukumura, O. Gralla, J. Schechner, and R. K. Jain, "Tissue Engineering: Creation of long-lasting blood vessels," *Nature*, 428: 138-139 (2004). PubMed link

348. I. Garkavtsev, S. Kozin, O. Chernova, L. Xu, F. Winkler, E. B. Brown, G. Barnett, and R. K. Jain, "The candidate tumour suppressor protein ING4 regulates brain tumour growth and angiogenesis," *Nature*, 428: 328-332 (2004). PubMed link

349. R. K. Jain, "Correspondence: Recognition of tumor blood vessel normalization as a new antiangiogenic concept," *Nature Medicine*, **10**: 329-330 (2004).

350. D.G. Duda, D. Fukumura and R.K. Jain, "Role of eNOS in neovascularization: NO for endothelial progenitor cells," *TRENDS in Molecular Medicine*, 10: 143-199 (2004).

351. T. Gohongi, T. Todoroki, D. Fukumura and R.K. Jain, "Influence of the site of human gallbladder xenograft (Mz-ChA-1) on angiogenesis at the distant site," *Oncology Reports*, **11**: 803-807 (2004).

352. M. Bockhorn, S. Roberge, C. Sousa, R. K. Jain and L. L. Munn, "Differential Gene Expression in Metastasizing Cells Shed from Kidney Tumors," *Cancer Research*, **64**: 2469-2473 (2004).

353. E. B. Brown, Y. Boucher, S. Nasser, and R. K. Jain," Measurement of Macromolecular Diffusion Coefficients in Human Tumors", *Microvascular Research*, **67**: 231-236 (2004).

354. C.G. Willett, D.G. Duda, A. Fischman and R.K. Jain, "Correspondence: PET concerns in bevacizumab treatment," *Nature Medicine*, **10**: 561 (2004).

355. R. T. Tong, Y. Boucher, S. V. Kozin, F. Winkler, D. J. Hicklin, and R. K. Jain, "Vascular normalization by VEGFR2 blockade induces a pressure gradient across the vasculature and improves drug penetration in tumors," *Cancer Research*, 64: 3731-3736 (2004). PubMed link

356. N. Isaka, T. P. Padera, J. Hagendoorn, D. Fukumura, and R. K. Jain, "Peritumor lymphatics induced by vascular endothelial growth factor-C exhibit abnormal function," *Cancer Research*, **64**: 4400-4404 (2004).

357. J. Hagendoorn, T.P. Padera, S. Kashiwagi, N. Isaka, F. Noda, M.I. Lin, P.L. Huang, W.C. Sessa, D. Fukumura, and R.K. Jain. "Endothelial nitric oxide synthase regulates microlymphatic flow via collecting lymphatics," *Circulation Research*, **95**: 204-9 (2004).

358. D.G. Duda, D. Fukumura, L.L. Munn, M.F. Booth, E.B. Brown, P. Huang, B. Seed and R.K. Jain, "Differential transplantibility of tumor-associated stromal cells," *Cancer Research*, **64**:5920-5924 (2004).

359. R.K. Jain, E.B. Brown, L.L. Munn, and D. Fukumura, "Intravital microscopy of normal and diseased tissues in the mouse." In: *Live Cell Imaging: A Laboratory Manual* (Editors: R. D. Goldman and D. L. Spector). Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, Chapter 24, pp. 435-466 (2004).

360. R.K. Jain "Vascular and Interstitial Biology of Tumors," In: *Clinical Oncology, 3rd Edition* (Editors: M. Abeleff, J. Armitage, J. Niederhuber, M. Kastan and G. McKenna), Elsevier, Philadelphia, PA, Chapter 9, pp. 153-172 (2004).

361. R.K. Jain, & M. Stroh, "Zooming in and out with quantum dots." *Nature Biotechnology*, **22**, 959-960 (2004).

362. Y.T. Chan, J.P. Zimmer, M. Stroh, J.S. Steckel, R.K. Jain, & M.G. Bawendi, "Incorporation of luminescent nanocrystals into monodisperse core-shell silica microspheres," *Advanced Materials*, **16**: 23-24, 2004.

363. F. Winkler, S. Kozin, R. Tong, S. Chae, M. Booth, I. Garkavstev, L. Xu, D. J. Hicklin, D. Fukumura, E. di Tomaso, L.L. Munn, R.K. Jain. "Kinetics of vascular normalization by VEGFR2 blockade governs brain tumor response to radiation: Role of oxygenation, Angiopoietin-1, and matrix metallproteinases," *Cancer Cell* 6: 553-562, 2004. PubMed link

364. R.K. Jain, Normalization of the tumor vasculature: An emerging concept in anti-angiogenic therapy of cancer, *Science* 307: 58-62 (2005). PubMed link

365. E. B. Brown, A. Majewska, and R. K. Jain, "FRAP and Multiphoton FRAP," In: *Imaging in Neuroscience and Development: A Laboratory Manual* (Editors: R. Yuste and A. Konnerth), Cold Spring Harbor Press, Cold Spring Harbor, New York, Chapter 56, pages 429-438 (2005).

366. E. B. Brown, L. L. Munn, D. Fukumura & R. K. Jain, "A Practical Guide to in vivo Imaging of Tumors," In: *Imaging in Neuroscience and Development: A Laboratory Manual* (Editors: R. Yuste and A. Konnerth), Cold Spring Harbor Press, Cold Spring Harbor, New York, Chapter 92, pages 695-700 (2005).

367. D. Duda and R. K. Jain, "Pleiotropy of tissue-specific growth factors: from neurons to vessels via the bone marrow", *Journal of Clinical Investigation*, **115**: 596-598 (2005).

368. M. Stroh, J. P. Zimmer, V. Torchilin, M. G. Bawendi, D. Fukumura, & R.K. Jain. "Quantum dots spectrally distinguish multiple species within the tumor milieu in vivo," *Nature Medicine* 11, 678 - 682 (2005). PubMed link

369. R. K. Jain, "Antiangiogenic therapy of cancer: Current and emerging concepts," *Oncology (Supplement)*, **19**: 7-16 (2005).

370. Z. N. Demou, M. Awad, T. McKee, J. Y. Perentes, X. Wang, L. L. Munn, R. K. Jain and Y. Boucher. Lack of Telopeptides in Fibrillar Collagen I Promotes the Invasion of a Metastatic Breast Tumor Cell Line. *Cancer Research*, **65**: 5674-5682 (2005).

371. L. Xu, R. Tong, D. M. Cochran and R. K. Jain, "Blocking PDGF-D/PDGFRb Signaling Inhibits Human Renal Cell Carcinoma Progression in an Orthotopic Mouse Model," *Cancer Research*, **65**: 5711-5719 (2005).

372. E. di Tomaso, D. Capen, A. Haskell, J. Hart, J. Logie, R.K. Jain, D.M. McDonald, R.C. Jones and L.L. Munn, "Mosaic tumor vessels: cellular basis and ultrastructure of focal regions lacking endothelial markers," *Cancer Research*, **65**: 5740-5749 (2005).

373. R. K. Jain, P. Au, J. Tam, D. G. Duda and D. Fukumura, "Engineering vascularized tissue," *Nature Biotechnology*, **23**:821-823 (2005).

374. P. Huang, T. D. McKee, R. K. Jain and D. Fukumura, "Green fluorescence protein (GFP)-expressing model derived from a spontaneous osteosarcoma in a VEGF-GFP expressing mouse," *Comparative Medicine*, **55**: 236-243 (2005).

375. S. Kashiwagi, Y. T. Gohongi, Z. N. Demou, L. Xu, P. L. Huang, D. G. Buerk, L. L. Munn, R. K. Jain, and D. Fukumura," NO mediates mural cell recruitment and vessel morphogenesis in murine melanomas and tissue-engineered blood vessels," *Journal of Clinical Investigation*, 115:1816-1827 (2005).

376. T. Acker, T. Diez, J. Aragones, M. Tjwa, K. Brusselmans, D. Fukumura, J. M. Herbert, A. Burger, J. Riedel, G. Elvert, I. Flamme, P. Maxwell, D. Collen, R. K. Jain, K. H. Plate and P. Carmeliet, "Genetic evidence for a tumor suppressor role of HIF-2α", *Cancer Cell*, **8**:131-141 (2005).

377. A. Ny, M. Koch, M. Schneider, E. Neven, R. T. Tong, S. Maity, C. Fischer, S. Plaisance, D. Lambrechts, C. Héligon, S. Terclavers, M. Ciesiolka, R. Kälin, W. Y. Man, I. Senn, S. Wyns, L. Marconcini, K. Vleminckx, S. Oliviero, F. Lupu, J. Wood, A. Brändli, D. Collen, E. M. Conway, M. Dewerchin, L. Moons, R. K. Jain and P. Carmeliet, "A genetic Xenopus laevis tadpole model to study lymphangiogenesis," *Nature Medicine*, **11**: 998-1004 (2005).

378. J. Hagendoorn, T. P. Padera, D. Fukumura and R. K. Jain, "Molecular regulation of microlymphatic formation and function: Role of nitric oxide," *Trends in Cardiovascular Medicine*, **15**: 169-173 (2005).

379. J. A. Tyrrell, V. Mahadevan, R. T. Tong, E. B. Brown, R. K. Jain and B. Roysam, "A 2-D/3-D model-based method to quantify the complexity of microvasculature imaged by in vivo multiphoton microscopy," *Microvascular Research*, **70**: 165-178 (2005).

380. C. Willett, Y. Boucher, E. di Tomaso, D. Duda, L. L. Munn, R. Tong, D. Chung, D. Sahani, S. Kalva, S. Kozin, M. Mino, K. Cohen, D. Scadden, A. Hartford, A. Fischman, J. Clark, D. Ryan, A. Zhu, L. Blaszkowsky, P. Shellito, G. Lauwers, and R. K. Jain. "Surrogate markers for antiangiogenic therapy and dose limiting toxicities for bevacizumab with radio-chemotherapy: Continued experience of a Phase I trial in rectal cancer patients," *Journal of Clinical Oncology*, 23: 8136-8139 (2005). PubMed link

381. J. Kisucka, C. E. Butterfield, D. G. Duda, S. C. Eichenberger, S. Saffaripour, J. Ware, Z. M. Ruggeri, R. K. Jain, J. Folkman and D. D. Wagner, "Platelets and platelet adhesion support angiogenesis while preventing excessive hemorrhage," *PNAS*, **103**: 855-860 (2006).

382. **R. K. Jain, D. G. Duda, J. W. Clark and J. S. Loeffler, "Lessons from phase III trials on anti-VEGF therapy for cancer," *Nature Clinical Practice Oncology*, 3: 24-40 (2006). PubMed link**

383. D. G. Duda, K. S. Cohen, S. V. Kozin, J. Y. Perentes, D. Fukumura, D. T. Scadden and R. K. Jain, "Evidence for bone marrow-derived endothelial cells incorporation into perfused blood vessels in tumors," *Blood*, **107**: 2774-2776 (2006).

384. Duda DG, Cohen KS, di Tomaso E, Au P, Klein RJ, Scadden DT, Willett CG & Jain RK. "Differential CD146 expression on circulating versus tissue endothelial cells in cancer patients: Implications for circulating endothelial cells as biomarker for antiangiogenic therapy," *Journal of Clinical Oncology*, **24**: 1449-1453 (2006).

385. T McKee, P Grandi, W Mok, G Alexandrakis, N Insin, J P. Zimmer, M G Bawendi, Y Boucher, X O Breakefield and R K Jain, "Degradation of fibrillar collagen in a human melanoma xenograft improves the efficacy of an oncolytic HSV vector," *Cancer Research*, **66**: 2509-2513 (2006).

386. J Hagendoorn, Tong R, Fukumura D, Lin Q, Lobo J, Padera TP, Xu L, Kucherlapati R, Jain RK, " Onset of abnormal blood and lymphatic vessel function and interstitial hypertension in early stages of carcinogenesis," *Cancer Research*, **66**: 3360-3364 (2006).

387. L. Xu, D. M. Cochran, R. T. Tong, F. Winkler, S. Kashiwagi, R. K. Jain and D. Fukumura, "PlGF Overexpression Inhibits Tumor Growth, Angiogenesis and Metastasis by Depleting VEGF Homodimers in Orthotopic Mouse Models," *Cancer Research*, **66**: 3971-3977 (2006).

388. T. Hoshida, N. Isaka, J. Hagendoorn, E. di Tomaso, Y-L Chen, B. Pytowski, D. Fukumura, T. P. Padera, and R. K. Jain, "Imaging steps of lymphatic metastasis reveals that VEGF-C increases metastasis by increasing delivery of cancer cells to lymph nodes: Therapeutic implications," *Cancer Research*, **66**: 8065-8075 (2006).

389. D. M. Cochran, D. Fukumura, M. Ancukiewicz, P. Carmeliet and R. K. Jain, "Evolution of Oxygen and Glucose Concentration Profiles in a Tissue-Mimetic Culture System of Embryonic Stem Cells," *Annals of Biomedical Engineering*, **34**: 1247-1258 (2006).

390. J. Hagendoorn, T. P. Padera, T. I. Yock, G. P. Nielsen, E. di Tomaso, T. F. Delaney, H. A. Gaissert, A. E. Rosenberg, R. K. Jain and D. H. Ebb, "Platelet-derived growth factor receptor-β in Gorham's disease," *Nature Clinical Practice Oncology* **3**: 693-697 (2006).

391. S. T. Reddy, D. A. Berk, R. K. Jain and M. A. Swartz, "A sensitive in vivo model for quantifying interstitial convective transport of injected macromolecules and nanoparticles," *Journal of Applied Physiology* **101**:1162-1169 (2006).

392. D. Fukumura, S. Kashiwagi and R. K. Jain, "Role of nitric oxide in tumor progression," *Nature Review Cancer*, 6: 521-534 (2006).

393. R. K. Jain, "Seminal findings and an allergy to black flies." In: *Reflections from the Frontiers, Explorations for the Future: Gordon Research Conferences, 1931-2006* (Editors: Arthur A. Daemmrich, Nancy Ryan Gray and Leah Shaper), Gordon Research Conferences and Chemical Heritage Foundation, Philadelphia, pp 70-71 (2006).

394. C. G. Willett, S.V. Kozin, D. G. Duda, E. di Tomaso, K. R. Kozak, Y. Boucher and R. K. Jain, "Combined Vascular Endothelial Growth Factor–Targeted Therapy and Radiotherapy for Colorectal Cancer: Theory and Clinical Practice," *Seminars in Oncology* **33**: S35-S40 (2006).

395. T. T. Batchelor, A. G. Sorensen, E. di Tomaso, W. T. Zhang, D. G. Duda, K. S. Cohen, K. R. Kozak, D. P. Cahill, P-J. Chen, M. Zhu, M. Ancukiewicz, M. Mrugala, D. N. Louis, P. Ivy, D. T. Scadden, T. Benner, J. S. Loeffler, P. Y. Wen, and R. K. Jain, " AZD2171, a pan-VEGF receptor tyrosine kinase inhibitor, normalizes tumor vasculature and alleviates edema in glioblastoma patients," *Cancer Cell*, 11: 83-95 (2007). PubMed link (Chosen as a New Hot Paper in May 2008 by ScienceWatch for top 1% citation in the comparable field.)

396. J. A. Tyrrell, E. di Tomaso, D. Fuja, R. Tong, K. Kozak, R. K. Jain and B. Roysam, "Robust 3-D modeling of vasculature imagery using superellipsoid," *IEEE Transactions on Medical Imaging*, **26**: 223-237 (2007).

397. Z.Z. Wang, P. Au, T. Chen, Y. Shao, L. M. Daheron, H. Bai, M. Arzigian, D. Fukumura, R. K. Jain and D. Scadden, "Human ES cell-derived endothelial cells form durable functional blood vessels in vivo," *Nature Biotechnology* 25, 317 - 318 (2007). PubMed link

398. R. K. Jain, R. Tong and L. L. Munn, "Effects of vascular normalization on interstitial hypertension, peri-tumor edema and lymphatic metastasis: Insights from a mathematical model," *Cancer Research* **67**: 2729-2735 (2007).

399. Duda DG, Cohen KS, Au P, Scadden DT, Willett CG, Jain RK. "Detection of circulating endothelial cells: CD146- based magnetic separation enrichment or flow cytometric assay?" *J Clin Oncol*. **25**: e3-e5 (2007).

400. Lawenda BD, Smith DE, Xu L, Niemierko A, Silverstein JR, Boucher Y, Kashiwagi S, Held KD, Jain RK, Loeffler JS, Eisenberg DM, Blumberg JB. Do the dietary supplements epigallocatechin gallate or vitamin E cause a radiomodifying response on tumors in vivo? A pilot study with murine breast carcinoma. *J Soc Integr Oncol*. **5**:11-7 (2007).

401. Willett CG, Duda DG, di Tomaso E, Boucher Y, Czito BG, Bendell J, Hurwitz HI, Bentley R, Wong TZ, Paulson E, Jain, RK. "Complete pathological response in T4 locally advanced rectal cancer after treatment with bevacizumab and standard radio-chemotherapy". *Nature Clinical Practice Oncology* 4: 316-321 (2007). PubMed link

402. D. G. Duda, K. S. Cohen, D. Scadden and R. K. Jain, "A protocol for detection and enumeration of blood circulating endothelial cells and progenitor cells in human blood," *Nature Protocols* 4: 805-810 (2007). PubMed link

403. C. G. Willett, D. G. Duda, R. K. Jain, "Surrogate biomarkers for anti-angiogenic therapy for advanced colorectal cancer," *Current Colorectal Cancer Reports* **3**:94-98 (2007).

404. D. G. Duda, T. Batchelor, C. G. Willett and R. K. Jain, "The current progress, hurdles and future prospects in anti-VEGF targeted cancer therapy strategies." *Trends in Molecular Medicine* **13**: 222-230 (2007).

405. T. P. Padera, M. Ancukiewicz, T. Hoshida, D. Fukumura and R. K. Jain, "Data do not support benefits of anti-VEGFR3 therapy," *Cancer Research* **67**:5055 (2007).

406. M. Bockhorn, R. K. Jain and L. L. Munn, "Active versus passive mechanisms in metastasis: do cancer cells crawl into vessels, or are they pushed?" *Lancet Oncology* **8**:444-8 (2007).

407. R. K. Jain, E. diTomaso, D. G. Duda, J. S. Loeffler, A. G. Sorensen and T. T. Batchelor, "Angiogenesis in brain tumors," *Nature Reviews Neuroscience*, 8:610-622 (2007). PubMed link

408. R. K. Jain, A. V. Finn, F. D. Kolodie, H. K. Gold and R. Virmani, "Antiangiogenic therapy for normalization of atherosclerotic plaque vasculature: A potential strategy for plaque stabilization," *Nature Clinical Practice Cardiovascular Medicine*, 4: 491-502 (2007). PubMed link

409. L. Xu and R. K. Jain, "Downregulation of Placenta Grwoth Factor by Promoter Hypermethylation in Human Lung and Colon Carcinoma," *Molecular Cancer Research* **5**:873-880 (2007).

410. D. Fukumura and R. K. Jain, "Tumor microenvironment abnormalities: causes, consequences, and strategies to normalize". *Journal of Cellular Biochemistry*, **101**:937-949 (2007).

411. R. K. Jain & D. G. Duda, "Angiogenesis in Solid Tumors". In: *Antiangiogenic Cancer Therapy* (Editors: James L. Abbruzzese, Darren W. Davis and Roy S. Herbst), CRC Press, Boca Raton, pp. 43-90 (2007).

412. R. K. Jain and D. G. Duda, "Normalization of tumor vasculature and microenvironment by antiangiogenic therapy." In: *Angiogenesis: Mechanisms and Cancer Therapy* (Editors: Dieter Marmé and Norbert E. Fusenig), Springer-Verlag, Berlin, pp. 577-92 (2007).

413. R. K. Jain, T. T. Batchelor, D. G. Duda, C. G. Willett, "Normalization of tumor vasculature and microenvironment," In: *Antiangiogenic Agents in Cancer Therapy.* (Editors: Beverly Teicher and Lee Ellis), Humana Press, pp. 261-76 (2007).

414. C. G. Willett, D. G. Duda, B. G. Czito, J. C. Bendell, J. W. Clark, R. K. Jain, "Targeted therapy in rectal cancer," *Oncology*, **21**:1055-65 (2007).

415. D. G. Duda, R. K. Jain, C. G. Willett, "Antiangiogenics: The potential role of integrating this novel treatment modality with chemoradiation for solid cancers," *J. Clinical Oncology*, 225:4033-42 (2007).

416. P. Au, J. Tam, D. Fukumura, R. K. Jain, "Small blood vessel engineering," *Methods in Molecular Medicine*, **140**:183-195 (2007).

417. R. K. Jain and L. L. Munn, "Vascular normalization as rationale for combining chemotherapy with antiangiogenic agents," *PPO Updates*, **21**:1-7 (2007).

418. C. Sun, R. K. Jain and L. L. Munn, "Non-uniform plasma leakage affects local hematocrit and blood flow: Implications for inflammation and tumor perfusion," *Annals of Biomedical Engineering*, **35**:2121-29 (2007).

419. D. Fukumura and R. K. Jain, "Tumor microvasculature and microenvironment: Targets for anti-angiogenesis and normalization," *Microvascular Research*, **74**: 72-84 (2007).

420. G. M. Nelson, T. P. Padera, I. Garkavtsev, T. Shioda and R. K. Jain, "Differential gene expression of primary cultured lymphatic and blood vascular endothelial cells," *Neoplasia*, 9: 1038-1045 (2007).

421. W. Mok, Y. Boucher and R. K. Jain, "MMP-1 and -8 improve the distribution and efficacy of an oncolytic virus," *Cancer Research*, 67: 10664-10668 (2007).

422. R. K. Jain and L. Xu, "aPlGF: A new kid on the antiangiogenic block," *Cell* **131**: 443-445 (2007).

423. Gerstner ER, Duda DG, di Tomaso E, Sorensen G, Jain RK, Batchelor TT. "Antiangiogenic agents for the treatment of glioblastoma," *Expert Opin Investig Drugs*. **16**:1895-1908 (2007).

424. R. K. Jain, D. Fukumura, L. Munn and E. Brown, "Optical Microscopy in Small Animal Research". In: *Imaging of Vertebrates* (Editors: Tavitian B, Leroy-Willig A & Ntziachristos V). Wiley, London, pp 183-187 (2007).

425. R. K. Jain, D. Fukumura, L. Munn and E. Brown, "Tumor Angiogenesis and Blood Flow". In: *Imaging of Vertebrates* (Editors: Tavitian B, Leroy-Willig A & Ntziachristos V). Wiley, London, pp 199-201 (2007).

426. R. K. Jain, "Taming vessels to treat cancer," *Scientific American*, 298: 56-63 (2008). PubMed link

427. P. Au, L. M. Daheron, D. G. Duda, K. S. Cohen, J. A. Tyrrell, R. M. Lanning, D. Fukumura, D. T. Scadden, and R. K. Jain, "Differential in vivo potential of endothelial progenitor cells from human umbilical cord blood and adult peripheral blood to form functional long-lasting vessels," *Blood*, 111: 1302-1305 (2008).

428. P. Au, J. Tam, D. Fukumura and R. K. Jain, "Bone marrow-derived mesenchymal stem cells facilitate engineering of long-lasting functional vasculature," *Blood* 111: 4551-4558 (2008).

429. R. Jones, D. Capen, K. S. Cohen, L. L. Munn, R. K. Jain, D. G. Duda. "A protocol for phenotypic detection and characterization of vascular cells in a lung neovascularization model in rodents," *Nature Protocols,* **3**:378-87 (2008).

430. R. Jones, D. Capen, B. Petersen, R. K. Jain, D.G. Duda, "A protocol for a lung neovascularization model in rodents," *Nature Protocols,* **3**:388-97 (2008).

431. R. K. Jain, J. Lahdenranta and D. Fukumura, "Targeting Platelet-Derived Growth Factor Signaling in Carcinoma-Associated Fibroblasts Controls Cervical Cancer in Mouse Model," *PLoS Medicine* 5(1): e24 (2008); doi:10.1371/journal.pmed.0050024.

432. S. Kashiwagi, K. Tsukada, L. Xu, J. Miyazaki, S. V. Kozin, J. A. Tyrrell, W. C. Sessa, L. E. Gerweck, R. K. Jain and D. Fukumura, "Perivascular nitric oxide gradients normalize tumor vasculature," *Nature Medicine* 14: 255-257 (2008). PubMed link

433. R. K. Jain, "Lessons from multidisciplinary translational trials on antiangiogenic therapy of cancer," *Nature Reviews Cancer* 8:309-316 (2008). PubMed link

434. P. Huang, D. G. Duda, R. K. Jain and D. Fukumura, "Histopathological findings and establishment of novel tumor lines from spontaneous tumors in FVB/N mice," *Comparative Medicine* 58: 253-263 (2008).

435. S. Nagano, J. Y. Perentes, R. K. Jain and Y. Boucher, "Cancer cell death enhances the penetration and efficacy of oncolytic herpes simplex virus in tumors," *Cancer Research* 68: 3795-802 (2008).

436. R. K. Jain, "Judah Folkman," *Journal of Clinical Investigation* 118: 823 (2008).

437. E. Brown, A. Majewska and R. K. Jain, "Photobleaching and recovery with nonlinear microscopy." In: *Handbook of Biomedical Nonlinear Optical Microscopy* (Editors: B. R. Masters and P. T. C. So). Oxford University Press, New York, Chapter 26, pp. 673-688 (2008).

438. R. K. Jain, M. F. Booth, T. P. Padera, L. L. Munn, D. Fukumura and E. Brown, "Applications of nonlinear intravital microscopy in tumor biology." In: *Handbook of Biomedical Nonlinear Optical Microscopy* (Editors: B. R. Masters and P. T. C. So). Oxford University Press, New York, Chapter 29, pp. 735-756 (2008

439. R.K. Jain and K. Kozak, "Molecular Pathophysiology of Tumors," In: *Principles and Practice of Radiation Oncology, 5th Edition* (Editors: E. C. Halperin, C. A. Parez, L. W. Brady), Lippincott, Williams & Wilkins, New York, Chapter 4, pp. 126-141 (2008).

440. R. K. Jain and D. G. Duda, "Vascular and interstitial biology of tumors," In: *Clinical Oncology*. *4th Edition*, (Editors: Abeloff M, Armitage J, Niederhuber J, Kastan M, McKenna WG), Elsevier, Philadelphia. pp. 105-24 (2008).

441. R. K. Jain, D. G. Duda, T. T. Batchelor, A. G. Sorensen and C. G. Willett, "Normalization of tumor vasculature and microenvironment," In: *Angiogenesis: An Integrative Approach from Science to Medicine* (Editors: W. D. Figg and J. Folkman), Springer, pp. 273-282 (2008).

442. D. Fukumura and R. K. Jain," Imaging angiogenesis and the microenvironment," *APMIS* 116: 695-715 (2008).

443. **T. P. Padera, A. H. Kuo, T. Hoshida, S. Liao, J. Lobo, K. R. Kozak, D. Fukumura and R. K. Jain, "Differential response of primary tumor versus lymphatic metastasis to VEGFR-2 and -3 kinase inhibitors cediranib and vandetanib," *Molecular Cancer Therapeutics* 7: 2272-2279 (2008). PubMed link**

444. T. P. Padera and R. K. Jain, "VEGFR3: A new target for anti-angiogenesis therapy?" *Developmental Cell* 15:178-179 (2008).

445. E. R. Gerstner, A. G. Sorensen, R. K. Jain and T. T. Batchelor, "Advances in neuroimaging techniques for the evaluation of tumor growth, vascular permeability, and angiogenesis in gliomas," *Current Opinion in Neurology* 21:728-35 (2008).

446. A. G. Sorensen, T. T. Batchelor, P. Y. Wen, W. T. Zhang and R. K. Jain, "Response criteria for glioma," *Nature Clinical Practice Oncology* 5:634-44 (2008).

447. J. Tam, D. Fukumura and R. K. Jain, "A mathematical model of murine metabolic regulation by leptin: energy balance and defense of a stable body weight," *Cell Metabolism* 9: 52-63 (2009). PubMed link

448. J. Y. Perentes, T. D McKee, C. D. Ley, H. Mathiew, M. Dawson, T. P. Padera, L. L Munn, R. K. Jain and Y. Boucher, "In Vivo Imaging of Extracellular Matrix Remodeling by Tumor-Associated Fibroblasts," *Nature Methods* 6:143-145 (2009). PubMed link

449. P. Y. Wen, W.K. A. Yung, K. R. Lamborn, A. D. Norden, T. F. Cloughesy, L. M. DeAngelis, H. A. Fine, S. M. Chang, H. I. Robins, K. Fink, L. E. Abrey, A. B. Lassman, M. Mehta, J. Drappatz, E. Di Tomaso, K. Ligon, K. Aldape, Rakesh K. Jain, R. Capdeville, C. Stiles, R. Kaplan, M. J. Egorin, A. J. Murgo, M. D. Prados, "Phase II Study of Imatinib Mesylate (Gleevec®) For Recurrent Meningiomas (North American Brain Tumor Consortium Study 01-08)," *Neuro-Oncology* 11:853-60 (2009).

450. G. Cheng, J. Tse, R. K. Jain and L. L. Munn, "Micro-environmental Mechanical Stress Controls Tumor Spheroid Size and Morphology by Suppressing Proliferation and Inducing Apoptosis in Cancer Cells," *PLoS ONE* 4:e4632 PMID: 19247489 (2009).

451. M. X. Luong, J. T. Q. Lin, J. Hagendoorn, K. J. Moore, T. P. Padera, B. Seed, D. Fukumura, R. Kucherlapati, and R. K. Jain "Lack of lymphatic vessel phenotype in LYVE-1/CD44 double knock out mice," *Journal of Cellular Physiology* 219: 430-437 (2009).

452. J. Y. Perentes, D. G. Duda and R. K. Jain, "Visualizing anti-tumor immune responses in vivo," *Disease Model and Mechanisms* 2:107-10 (2009).

453. W. Mok, T. Stylianopoulos, Y. Boucher, and R. K. Jain, "Mathematical Modeling of Herpes Simplex Virus Distribution in Solid Tumors: Implications for Cancer Gene Therapy," *Clinical Cancer Research* 15: 2352-2360 (2009).

454. J. Lahdenranta, J. Hagendoorn, T. P. Padera, T. Hoshida, G. Nelson, S. Kashiwagi, R. K. Jain, D. Fukumura, "Endothelial nitric oxide synthase mediates lymphangiogenesis and lymphatic metastasis," *Cancer Research* 69:2801-8 (2009).

455. Gerstner ER, Duda DG, di Tomaso E, Ryg PA, Loeffler JS, Sorensen AG, Ivy P, Jain RK, Batchelor TT. "The potential utility of anti-VEGF agents to normalize tumor vasculature and alleviate edema in brain and spinal cord tumor patients," *Nat Clin Pract Oncol*. 6: 229-36 (2009).

456. Gerstner ER, Sorensen AG, Jain RK, Batchelor TT. "Anti-vascular endothelial growth factor therapy for malignant glioma," *Current Neurol Neurosci Report* 9:254-62 (2009).

457. R. K. Jain, J. Tam, P. Au, D. Fukumura, "Angiogenesis in Development, Disease and Regeneration," In: Santin M, editor. Strategies in Regenerative Medicine: Integrating Biology with Materials Design. Chapter 6. Springer, New York (2009).

458. J. Tam, D. G. Duda, J. Y. Perentes, R. S. Quadri, D. Fukumura and R. K. Jain, "Blockade of VEGFR2 and not VEGFR1 can limit diet-induced fat tissue expansion: Role of local versus bone-marrow derived endothelial cells," *PLoS ONE* 4: e4974 (2009).

459. E. di Tomaso, N. London, D. Fuja, J. Logie, J. A. Tyrrell, W. Kamoun, L. L. Munn and R. K. Jain, "PDGF-C induces maturation of blood vessels in a model of glioblastoma and attenuates the response to anti-VEGF treatment," *PLoS ONE* 4(4): e5123 (2009).

460. P. Au, J. Tam, D. G. Duda, D. Fukumura, R. K. Jain, "Paradoxical effects of PDGF-BB overexpression in endothelial cells on engineered blood vessels in vivo," *American J Pathology. 175:* 294-302 (2009).

461. A. S. Chi, A. G. Sorensen, R. K. Jain and T. T. Batchelor, "Angiogenesis as a therapeutic target in malignant gliomas," *Oncologist* 14:621-36 (2009).

462. A. T. N. Kumar, E. Chung, S. B. Raymond, J. A. J. M. van de Water, K. Shah, D. Fukumura, R. K. Jain, B. J. Bacskai, and D. A. Boas, "Feasibility of in vivo imaging of fluorescent proteins using lifetime contrast," *Optical Letters 34*:2066-8 (2009).

463. W. S. Kamoun, C. D. Ley, C. T. Farrar, A. M. Duyverman, J. Lahdenranta, D. A. Lacorre, T. T. Batchelor, E. di Tomaso, D. G. Duda, L. L. Munn, D. Fukumura, A. G. Sorensen and R. K. Jain, "Edema control by cediranib, a VEGF targeted kinase inhibitor, prolongs survival despite persistent brain tumor growth in mice," *Journal of Clinical Oncology* 27: 2542-52 (2009). PubMed link

464. C. G. Willett, Duda DG, di Tomaso E, Boucher Y, Ancukiewicz M, Sahani DV, Lahdenranta J, Chung DC, Fischman AJ, Lauwers GY, Shellito PC, Czito BG, Wong TZ, Paulson E, Poleski M, Vujaskovic Z, Bentley R, Chen HX, Clark JW, Jain RK, "Efficacy, safety and biomarkers of neoadjuvant bevacizumab, radiation therapy and 5-Fluorouracil in rectal cancer: A multidisciplinary phase II study," *Journal of Clinical Oncology* 27: 3020-6 (2009). PubMed link

465. A. X. Zhu, Sahani DV, Duda DG, di Tomaso E, Ancukiewicz M, Catalano O, Sindhwani V, Blaszkowsky LS, Yoon SS, Meyerhardt J, Clark JW, Kwak EL, Hezel AF, Miksad R, Abrams TA, Enzinger PC, Fuchs CS, Ryan DP, Jain RK, "Efficacy, safety and potential biomarkers of sunitinib monotherapy in advanced hepatocellular carcinoma: A phase II study," *Journal of Clinical Oncology* 27: 3027-35 (2009). PubMed link

466. R. K. Jain, D. G. Duda, C. G. Willett, A. X. Zhu, J. S. Loeffler, T. B. Batchelor, and A. G. Sorensen, "Biomarkers of benefit and resistance to antiangiogenic therapy," *Nature Reviews Clinical Oncology* 6: 327-338 (2009). PubMed link

467. R. K. Jain, "A new target for tumor therapy," *New England Journal of Medicine* 360: 2669-71 (2009). PubMed link

468. A. G. Sorensen, T. T. Batchelor, W.-T. Zhang, P.-J. Chen, P. Yeo, M. Wang, D. Jennings, P. Y. Wen, J. Lahdenranta, M. Ancukiewicz, E. di Tomaso, D. G. Duda, and R. K. Jain, "A "Vascular Normalization Index" as potential mechanistic biomarker to predict survival after a single dose of cediranib in recurrent glioblastoma patients," *Cancer Research* 69: 5296-5300 (2009). PubMed link

469. S. R. Plotkin, A. O. Stemmer-Rachamimov, F. G. Barker II, C. Halpin, T. P. Padera, A. Tyrell, A. G. Sorensen, R. K. Jain and E. di Tomaso, "Hearing improvement after bevacizumab in patients with neurofibromatosis 2," *New England Journal of Medicine* 361: 358-369 (2009). PubMed link

470. B. J. Vakoc, R. M. Lanning, J. A. Tyrrell, T. P. Padera, L. A. Bartlett, T. Stylianopoulos, L. L. Munn, G. J. Tearney, D. Fukumura, R. K. Jain and B. E. Bouma, "Three-dimensional microscopy of the tumor microenvironment in vivo using optical frequency domain imaging," *Nature Medicine* 15: 1219-23 (2009) PubMed link

471. A. Zhu, D. G. Duda, D. Sahani and R. K. Jain, "Development of Sunitinib in hepatocellular carcinoma: Rationale, early clinical experience and correlative studies, " *The Cancer Journal*, 15: 263-8 (2009).

472. V. P. Chauhan, R. M. Lanning, B. Diop-Frimpong, W. Mok, E. B. Brown, T. P. Padera, Y. Boucher, and R. K. Jain, "Multiscale measurements distinguish cellular and interstitial hindrances to diffusion in vivo," *Biophysical Journal* 97: 330-6 (2009).

473. M. R. Dawson, D. G. Duda, S. S. Chae, D. Fukumura and R. K. Jain, "VEGFR1 activity modulates myeloid cell infiltration in growing lung metastases but is not required for spontaneous metastasis formation," *PLoS-One* 4(9): e6525 (Published online on September 18, 2009).

474. M. R. Dawson, D. G. Duda, D. Fukumura and R. K. Jain, "VEGFR1 activity-independent metastasis formation," *Nature* 461(7262): E4 (Published online on September 17, 2009). PubMed link

475. L. Xu, D. G. Duda, E. di Tomaso, M. Ancukiewicz, D. C. Chung, G. Y. Lauwers, P. Shellito, B. G. Czito, P.-C. Lin, M. Poleski, R. Bentley, J. W. Clark, C. G. Willett, and R. K. Jain, "Direct evidence that bevacizumab, an anti-VEGF antibody, SDF1a, CXCR4, CXCL6 and neuropilin 1 in rectal cancer patients," *Cancer Research* 69:7905-10 (2009).

476. Chung E, Yamashita H, Au P, Tannous BA, Fukumura D, et al. Secreted Gaussia Luciferase as a Biomarker for Monitoring Tumor Progression and Treatment Response of Systemic Metastases. *PLoS ONE* 4(12): e8316 (2009).

477. **Kirsch DG, Santiago PM, di Tomasso E, Sullivan JM, Hou W-S, Dayton T, Jeffords LB, Sodha P, Mercer K, Cohen R, Tekeyushi O, Korsmeyer S, Bronson R, Kim CF, Haigis KM, Jain RK, Jacks T. p53 Controls Radiation-induced Gastrointestinal Syndrome in Mice Independent of Apoptosis. *Science* 327:593-6 (2010).**

478. Liu W, Greytak AB, Lee J, Wong CR, Park J, Marshall LF, Jiang W, Curtin PN, Ting AY, Nocera DG, Fukumura D, Jain RK, Bawendi MG. Compact Biocompatible Quantum Dots via RAFT-Mediated Synthesis of Imidazole-Based Random Copolymer Ligand. *J Am Chem Soc.* 132:472-83 (2010).

479. Allen PM, Liu W, Chauhan VP, Lee J, Ting AY, Fukumura D, Jain RK, Bawendi MG. InAs(ZnCdS) Quantum Dots Optimized for Biological Imaging in the Near-Infrared. *J Am Chem Soc.* 132: 470-1 (2010).

480. D. G. Duda, M. Ancukiewicz, and R. K. Jain, "Biomarkers of antiangiogenic therapy: How do we move from candidate biomarkers to valid biomarkers?" *Journal of Clinical Oncology* 28:183-5 (2010).

481. R. K. Jain, L. L. Munn and D. Fukumura, "Intravital microsopy of normal and diseased tissues in the mouse. In: Live Cell Imaging: A Laboratory Manual, 2nd Edition, Chpater 26, pp 475-521 (R. D. Goldman, J. R. Swedlow and D. L. Specter, Eds.), CSH Press, Cold Spring Harbor, NY (2010).

482. A. K. Finn, R. K. Jain, "Coronary plaque neovascularization and hemorrhage: a potential target for plaque stabilization?," *JACC Cardiovasc Imaging*. 3:41-4 (2010).

483. C. T. Farrar, W. S. Kamoun, C. D. Ley, Y. R. Kim, S. J. Kwon; G. Dai, B. R. Rosen, E. di Tomaso; R. K. Jain, A. G. Sorensen, "In vivo validation of MRI vessel caliber index measurement methods with intravital optical microscopy in a U87 mouse brain tumor model," *Neuro-Oncology* 12:341-50 (2010).

484. E. R. Gerstner, P. J. Chen, P. Y. Wen, R. K. Jain, T. T. Batchelor, and G. Sorensen, " Infiltrative patterns of glioblastoma spread detected via diffusion MRI after treatment with cediranib," *Neuro-Oncology*, 12:466-72 (2010).

485. D. Fukumura, D. G. Duda, L. L. Munn and R. K. Jain, "Tumor microvasculature and microenvironment: Novel insights through intravital imaging in pre-clinical models," *Microcirculation* 17:206-25 (2010).

486. H. K. Wong, J. Lahdenranta, W. S. Kamoun, A. W. Chan, A. I. McClatchey, S. R. Plotkin, R. K. Jain and E. di Tomaso, "Anti-vascular endothelial growth factor therapies as a novel therapeutic approach to treating neurofibromatosis-related tumors," *Cancer Research* 70:3483-93 (2010).

487. P. Kim, E. Chung, H. Yamashita, K. E. Hung, A. Mizoguchi, R. Kucherlapati, D. Fukumura, R. K. Jain and S. H. Yun, "In vivo wide-area cellular imaging by side-view endomicroscopy", *Nature Methods* 7:303-5 (2010).

488. T. T. Batchelor, D. G. Duda, E. di Tomaso, M. Ancukiewicz, S. R. Plotkin, E. Gerstner, A. F. Eichler, J. Drappatz, F. H. Hochberg, D. N. Louis, K. S. Cohen, H. Chea, A. Exarhopoulos, M. A. Moses, P. Ivy, A. G. Sorensen, P. Y. Wen and R. K. Jain, "Phase II study of cediranib, an oral pan-VEGF receptor tyrosine kinase inhibitor, in patients with recurrent glioblastoma," *J. Clinical Oncology,* 28: 2817-23 (2010).

489. Kamoun, W., Chae, S.-S., Lacorre, D., Tyrell, J., Mitre, M., Gillissen, M., Fukumura, D., Jain, R., and Munn, LL. Simultaneous measurement of RBC velocity, flux, hematocrit and shear rate in vascular networks in vivo. *Nature Methods*, 15:845–851 (2010).

490. Duda DG, Willett CG, Ancukiewicz M, di Tomaso E, Shah M, Czito BG, Bentley R, Poleski M, Lauwers GY, Carroll M, Tyler D, Mantyh C, Shellito PC, Clark JW, Jain RK. Plasma Soluble VEGFR1 is a Potential Dual Biomarker of Response and Toxicity for Bevacizumab with Chemoradiation in Locally Advanced Rectal Cancer. *The Oncologist*, 15: 577-83 (2010).

491. Willett CG, Duda DG, Ancukiewicz M, di Tomaso E, Shah M, Czito BG, Bentley R, Poleski M, Lauwers GY, Carroll M, Tyler D, Mantyh C, Shellito PC, Clark JW, Jain RK. A Safety and Survival Analysis of Neoadjuvant Bevacizumab with Standard Chemoradiation in a Phase I/II Study Compared to Standard Chemoradiation in Locally Advanced Rectal Cancer. *The Oncologist,* 15:845–851 (2010).

492. D. G. Duda and R. K. Jain, "Premetastatic Lung "Niche": Is Vascular Endothelial Growth Factor Receptor 1 Activation Required?" *Cancer Research* 70: 5670-3 (2010).

493. Sergey V. Kozin, Walid S. Kamoun, Yuhui Huang, Michelle R. Dawson, Rakesh K. Jain, and Dan G. Duda, "Recruitment of Myeloid but not Endothelial Precursor Cells Facilitates Tumor Regrowth after Local Irradiation," *Cancer Research* 70:5679-85 (2010).

494. Chae SS, Kamoun WS, Farrar CT, Kirkpatrick ND, Niemeyer E, de Graaf AM, Sorensen AG, Munn LL, Jain RK, Fukumura D, "Angiopoietin-2 Interferes with Anti-VEGFR-2- Induced Vessel Normalization and Survival Benefit in Mice Bearing Gliomas," *Clinical Cancer Research* 16:3618-27 (2010).

495. Brown E, Munn LL, Fukumura D, Jain RK. In vivo imaging of tumors. *Cold Spring Harb Protoc*. 2010 Jul 1; 2010:pdb.prot5452. doi: 10.1101/pdb.prot5452.

496. R. Mounzer, O. Svendsen, P. Baluk, C. Bergman, T. Padera, H. Wiig, R. K. Jain, D. McDonald, N. Ruddle, "Lymphotoxin α contributes to lymphangiogenesis," *Blood* 116:2173-82 (2010).

497. Z. Popović, W. Liu, V. P. Chauhan, J. Lee, C. Wong, A. B. Greytak, N. Insin, D. G. Nocera, D. Fukumura, R. K. Jain and M. G. Bawendi, "A nanoparticle size series for in vivo fluorescence imaging, " *Angewandte Chemie* Intl Ed Engl, 49:8649-52 (2010).

498. S. Liao, T. P. Padera and R. K. Jain, "Notch leads lymphatics and connects to blood vessels," *Arteriosclerosis, Thrombosis and Vascular Biology* 30:1682-3 (2010).

499. Stylianopoulos T, Poh M-Z, Insin N, Bawendi MG, Fukumura D, Munn LL, Jain RK," Diffusion of Particles in the Extracellular Matrix: the Effect of Repulsive Electrostatic Interactions," *Biophysical Journal* 99:1342-9 (2010).

500. T. Stylianopoulos, B. Diop-Frimpong, L. L. Munn and R. K. Jain, "Diffusion anisotropy in collagen gels and tumors: the effect of fiber network orientation," *Biophysical Journal* 99:3119-3128 (2010).

501. R. K. Jain and T. Stylianopoulos, "Delivering nanomedicine to solid tumors," *Nature Reviews Clinical Oncology* 7:653-64 (2010).

502. D. G. Duda, A. M. M. J. Duyvermana, M. Kohno, M. Snuderl, E. J. A. Steller, D. Fukumura and R. K. Jain, "Malignant cells facilitate lung metastasis by bringing their own soil," *PNAS*, 107: 21677-21682 (2010).

503. Y. Huang, M. Snuderl, and R. K. Jain, "Polarization of tumor-associated macrophages: A novel strategy for vascular normalization and anti-tumor immunity," *Cancer Cell* 19: 1-2 (2011).

504. E. Van Cutsem, D. Lambrechts, H. Prenen, R. K. Jain and P. Carmeliet, "Lessons From the Adjuvant Bevacizumab Trial on Colon Cancer: What Next?," *J Clin Oncol*, 29:1-4 (2011).

505. Tse JM, Cheng G, Tyrrell JA, Wilcox-Adelman SA, Boucher Y, Jain RK, Munn LL, "Mechanical compression drives cancer cells toward invasive phenotype," *PNAS* 109: 911-6 (2011).

506. E. diTomaso, M. Snuderl, W. Kamoun, D. G. Duda, P. Auluck, L. Fazlollahi, O. C. Andronesi, M. Frosch, P. Y. Wen, S. R. Plotkin, T. Hedley-Whyte, A. G. Sorensen, T. T. Batchelor and R. K. Jain, "Glioblastoma Recurrence after Cediranib Therapy in Patients: Lack of "Rebound" Revascularization as Mode of Escape," *Cancer Research* 71:19-28 (2011).

507. P Gerstner ER, Eichler AF, Plotkin SR, Drappatz J, Doyle CL, Xu L, Duda DG, Wen PY, Jain RK, Batchelor TT, "Phase I trial with biomarker studies of vatalanib (PTK787) in patients with newly diagnosed glioblastoma treated with enzyme inducing anti-epileptic drugs and standard radiation and temozolomide.," *J Neurooncology* 103: 325-32 (2011).

508. S. Hiratsuka, D. G. Duda, Y. Huang, S. Goel, T. Sugiyama, T. Nagasawa, D. Fukumura and R. K. Jain, "C-X-C receptor type 4 promotes metastasis by activating p38 mitogen-activated protein kinase in myeloid differentiation antigen (Gr-1)-positive cells," *PNAS*, 108:302-7 (2011).

509. A. X. Zhu, Duda DG, Ancukiewicz M, di Tomaso E, Clark JW, Miksad R, Fuchs CS, Ryan DP, Jain RK, "Exploratory analysis of early toxicity of sunitinib in advanced hepatocellular carcinoma patients: Kinetics and potential biomarker value." *Clin Cancer Research* 17: 918-27 (2011).

510. J. Baish, T. Stylianopoulos, R. M. Lanning, W. S. Kamoun, D. Fukumura, L. L. Munn, and R. K. Jain, "Scaling rules for diffusive drug delivery in tumor and normal tissues," *PNAS*, 108: 1799-1803 (2011).

511. C. Wong, T. Stylianopoulos, J. Cuia, J. Martin, V. P. Chauhan, W. Jiang, Z. Popovic, R. K. Jain, M. G. Bawendi and D. Fukumura, "Multistage nanoparticle delivery system for deeppenetration into tumor tissue," *PNAS*, 108: 2426-2431 (2011).

512. B. Diop-Frimpong, V. P. Chauhan, S. Krane, Y Boucher, and R. K. Jain, "Losartan inhibits collagen I synthesis and improves the distribution and efficacy of nanotherapeutics in tumors," *PNAS*, 108:2909-14 (2011).

513. S. Hiratsuka, S. Goel, W. Kamoun, Y. Maru, D. Fukumura, D. G. Duda, and R. K. Jain, "Endothelial focal adhesion kinase mediates cancer cell homing to discrete regions of the lungs via E-selectin upregulation," *PNAS* 108: 3725-30 (2011).

514. S. Liao, J. Liu, P. Lin, T. Shi, R. K. Jain and Lei Xu, "TGF-beta blockade controls ascites by preventing abnormalization of lymphatic vessels in orthotopic human ovarian carcinoma model," *Clinical Cancer Research*, 17:1415-24 (2011).

515. D. G. Duda, S. V. Kozin, N. D. Kirkpatrick, L. Xu, D. Fukumura, and R. K. Jain, "CXCL12 (SDF1a) – CXCR4/CXCR7 Pathway Inhibition: An Emerging Sensitizer for Anti-Cancer Therapies?" *Clinical Cancer Research* 17:2074-2080 (2011).

516. J. Liu, S. Liao, Y. Huang, R. Samuel, T. Shi, K. Naxerova, P. Huang, W. Kamoun, R. K. Jain, D. Fukumura and L. Xu, "PDGF-D improves drug delivery and efficacy via vascular normalization, but promotes lymphatic metastasis by activating CXCR4 in breast cancer," *Clinical Cancer Research* 17: 3638-48 (2011).

517. C. T. Farrar, W. S. Kamoun, C. D. Ley, Y. R. Kim, C. Catana, S. J. Kwon, B. R. Rosen, R. K. Jain, A. G. Sorensen, "Sensitivity of MRI Tumor Biomarkers to VEGFR Inhibitor Therapy in an Orthotopic Mouse Glioma Model." *PLoS One* 6(3): e17228 (2011).

518. H. Kim, C. Catana, E. M. Ratai, O. C. Andronesi, D. Jennings, T. T. Batchelor, R. K. Jain, A. G. Sorensen, "Serial Magnetic Resonance Spectroscopy Reveals a Direct Metabolic Effect of Cediranib in Glioblastoma," *Cancer Research* 71:3745-52 (2011).
519. K. E. Emblem, A. Bjornerud, K. Mouridsen, R. J. Borra, T. T. Batchelor, R. K. Jain, A. G. Sorensen, "T(1)- and T(2)(*)-dominant extravasation correction in DSC-MRI: Part II-predicting patient outcome after a single dose of cediranib in recurrent glioblastoma patients," *J Cereb Blood Flow Metab.* (2011).
520. A. X. Zhu, D. G. Duda, D. V. Sahani and R. K. Jain, "HCC and angiogenesis: possible targets and future directions," *Nature Reviews Clinical Oncology* 8: 292-301 (2011).
521. P. Carmeliet and R. K. Jain, "Molecular mechanisms and clinical applications of angiogenesis," *Nature* 473: 298-307 (2011).
522. P. Carmeliet and R. K. Jain, "Principles and mechanisms of vessel normalization for cancer and other angiogenic diseases," *Nature Reviews Drug Discovery* 10:417-27 (2011).
523. **S. Goel, D. G. Duda, L. Xu, L.L. Munn, Y. Boucher, D. Fukumura and R. K. Jain, "Normalization of the vasculature for treatment of cancer and other diseases," *Physiological Reviews* 91: 1071–1121 (2011).**
524. A. F. Eichler, E. Chung, D. P. Kodack, J. S. Loeffler, D. Fukumura and R. K. Jain,"The biology of brain metastases—translation to new therapies," *Nature Reviews Clinical Oncology* 8: 344-56 (2011).
525. V. P. Chauhan, T. Stylianopoulos, Y. Boucher and R. K. Jain, "Delivery of molecular and nanoscale medicine to tumors: Transport barriers and strategies," *Annual Review of Chemical and Biomolecular Engineering* 2: 281–98 (2011).
526. N. S. Horowitz, R. T. Penson, D. G. Duda, E. di Tomaso, Y. Boucher, M. Ancukiewicz, K. S. Cohen, S. Berlin, C. N. Krasner, M. A. Moses and R. K. Jain, "Safety, Efficacy, and Biomarker Exploration in a Phase II Study of Bevacizumab, Oxaliplatin, and Gemcitabine in Recurrent Müllerian Carcinoma," *Clinical Ovarian Cancer* 4: 26-33 (2011).
527. P. Huang, S. V. Westmoreland, R. K. Jain and D. Fukumura, "Spontaneous Nonthymic Tumors in SCID Mice." *Comp Medicine* 61:227-34 (2011).
528. M. R. Dawson, S. S. Chae, R. K. Jain and D. G. Duda, "Direct evidence for lineage-dependent effects of bone marrow stromal cells on tumor progression.," *Am J Cancer Research* 1:144-154 (2011).
529. J.Y. Perentes, N. Kirkpatrick, S. Nagano, E. Y. Smith, C. M. Shaver, D. Sgroi, I. Garkavstev, L. L. Munn, R. K. Jain and Y. Boucher, "Cancer cell-associated MT1-MMP promotes blood vessel invasion and distant metastasis in triple-negative mammary tumors," *Cancer Research* 71: 4527-38 (2011).
530. I. Garkavtsev, V. Chauhan, H. K.Wong, A. Mukhopadhyay, M. Glicksman, R. Peterson and R. K. Jain, "Dehydro-α-lapachone, a plant product with antivascular activity," *PNAS* 108: 11596-601 (2011).
531. S. V. Kozin, D. G. Duda, L. L. Munn, R, K. Jain, "Is vasculogenesis crucial for the regrowth of irradiated tumours?" *Nature Reviews Cancer* 11: 532 (2011).
532. Zhao W, Schafer S, Choi J, Yamanaka YJ, Lombardi ML, Bose S, Carlson AL, Phillips JA, Teo W, Droujinine IA, Cui CH, Jain RK, Lammerding J, Love JC, Lin CP, Sarkar D, Karnik R, Karp JM, "Cell-surface sensors for real-time probing of cellular environments," *Nat Nanotechnol.* 6:524-31 (2011).
533. G. Cheng, S. Liao, H. K. Wong, D. A. Lacorre, E. di Tomaso, P. Au, D. Fukumura, R. K. Jain and L. L. Munn, "Engineered blood vessel networks connect to host vasculature via wrapping-and-tapping anastomosis." *Blood* 118:4740-9 (2011).
534. Liao S, Cheng G, Conner DA, Huang Y, Kucherlapati RS, Munn LL, Ruddle NH, Jain RK, Fukumura D and Padera TP, "Impaired lymphatic contraction associated with immunosuppression." *PNAS* 108:18784-9 (2011).
535. Chauhan VP, Popović Z, Chen O, Cui J, Fukumura D, Bawendi MG and Jain RK, "Fluorescent Nanorods and Nanospheres for Real-Time In Vivo Probing of Nanoparticle Shape-Dependent Tumor Penetration," *Angew Chem* Int Ed Engl. 50:11417-11420 (2011).
536. S. S. Yoon, D. G. Duda, D. L. Karl, T-M. Kim, A. R. Kambadakone, Y-L. Chen, C. Rothrock, A. E. Rosenberg, G. Petu.rNielsen, D. P. Kirsch, E. Choy, D. C. Harmon, F. J. Hornicek, J. Dreyfuss, M. Ancukiewica, D. V Sahani, P. J Park, R. K. Jain and T. F. DeLaney, "Phase II Study of Neoadjuvant Bevacizumab and Radiation Therapy for Resectable Soft Tissue Sarcomas," *International Journal of Radiation Oncology, Biology and Physics* 81: 1081-90 (2011).
537. Faber A, Corcoran RB, Ebi H, Sequist LV, Waltman BA, Chung E, Incio J, Digumarthy SR, Pollack SF, Song Y, Muzikansky A, Lifshits E, Roberge S, Coffman EJ, Benes C, Gómez H, Baselga J, Arteaga CL,

Rivera MN, Dias-Santagata D, Jain RK and Engelman JA. BIM expression in treatment naïve cancers predicts responsiveness to kinase inhibitors. *Cancer Discovery* 1:352-365 (2011).

538. A. G. Sorensen, K. E. Emblem, P. Polaskova, D. Jennings, H. Kim, M. Ancukiewicz, M. Wang, P. Y. Wen, P. Ivy, T. T. Batchelor and R. K. Jain, "Increased Survival of Glioblastoma Patients who Respond to Anti-angiogenic Therapy with Elevated Blood Perfusion." *Cancer Research* 72: 402-7 (2012).

539. Saylor PJ, Kozak RK, Smith MR, Ancukiewicz M, Efstathiou JA, Zietman AL, Jain RK and Duda DG, "Changes in biomarkers of inflammation and angiogenesis during androgen deprivation therapy for prostate cancer." *Oncologist* 17: 212-9 (2012).

540. Raut CP, Boucher Y, Duda DG, Morgan JA, Quek R, Ancukiewicz M, Lahdenranta J, Eder JP, Demetri GD and Jain RK, "Effects of sorafenib on intra-tumoral interstitial fluid pressure and circulating biomarkers in patients with refractory sarcomas (NCI Protocol 6948)." *PLoS One* 7: e26331 (2012).

541. Meyerhardt J, Ancukiewicz M, Abrams TA, Schrag D, Enzinger PC, Chan JA, Kulke MH, Wolpin BM, Goldstein M, Blaszkowsky L, Zhu AX, Elliott M, Regan E, Jain RK, Duda DG. Phase I study of cetuximab, irinotecan, and vandetanib (ZD6474) as therapy for patients with previously treated metastastic colorectal cancer. *PLoS One* 7:e38231 (2012).

542. Wong AH, Shimizu A, Kikpatrick N, Garkavstev G, Chen AW, diTomso E, Klagsbrun M and Jain RK. Merlin/NF2 regulates angiogenesis in schwannomas via a Rac1/semaphorin 3F-dependent mechanism. *Neoplasia* 14: 84–94 (2012).

543. Goel S, Wong AH and Jain RK. Vascular normalization as a therapeutic strategy for malignant and nonmalignant disease. Cold Spring Harb Perspect Med. 2(3): a006486 (2012).

544. Jain R.K. and Duda DG. Molecular Pathophysiology of Tumors. In: Principles and Practice of Radiation Oncology, 6th Edition (Editors: E. C. Halperin, C. A. Parez, L. W. Brady), Lippincott, Williams & Wilkins, New York, Chapter 4 (in press).

545. Duyverman AMMJ, Kohno M, Roberge S, Fukumura D, Duda DG, Jain RK. Studying stromal cell involvement in cancer metastasis using an isolated tumor perfusion model in mice. *Nature Protocols* 7:749-55 (2012).

546. Duyverman AMMJ, Steller JA, Fukumura D, Jain RK, Duda DG. Studying carcinoma-associated fibroblast involvement in cancer metastasis in mice. *Nature Protocols* 7:756-62 (2012).

547. Duyverman AMMJ, Kohno M, Duda DG, Jain RK, Fukumura D. Studying stromal cell involvement in cancer metastasis in mice using skin transplantation by transient parabiosis. *Nature Protocols* 7:763-70 (2012).

548. Chauhan VP, Stylianopoulos T, Martin JD, Popović Z, Chen O, Kamoun WS, Bawendi MG, Fukumura D, and Jain RK. Normalization of tumour blood vessels improves the delivery of nanomedicines in a size dependent manner. *Nature Nanotechnology 7: 383-8 (2012).*

549. Vacok B, Fukumura D, Jain RK and Bouma B. Cancer imaging by optical coherence tomography: preclinical progress and clinical potential. *Nature Reviews Cancer* 12:363-8 (2012).

550. Stylianopoulos T, Wong C, Bawendi MG, Jain RK, Fukumura D. Multistage nanoparticles for improved delivery into tumor tissue. *Methods Enzymol*. 508:109-30 (2012).

551. Goel S, Fukumura D, Jain RK. Normalization of the tumor vasculature through oncogenic inhibition: An emerging paradigm in tumor biology**.** *PNAS*, 2012 May 1. Doi: 10.1073/pnas.1203794109.

552. Kozin SV, Duda DG, Munn LL and Jain RK. Neovascularization after irradiation: What is the source of newly formed vessels in recurring tumors? *JNCI*, 104: 899-905 (2012).

553. Somers RC, Lanning RM, Snee PT, Greytak AB, Jain RK, Bawendi MG and Nocera DG. A Nanocrystal-based Ratiometric pH Sensor for Natural pH Ranges. *Chemical Science* (2012).

554. Stylianopoulos T, Soteriou K, Fukumura D, and Jain RK. Cationic nanoparticles have superior transvascular flux into solid tumors: Insights from a mathematical model. *Annals of Biomedical Engineering* 41:68-77 (2012).

555. ND. Kirkpatrick, E Chung, DC.Cook, XHan, G Gruionu, S Liao, LL Munn, TP Padera, D Fukumura and RK Jain, Video-rate resonant scanning multiphoton microscopy: An emerging technique for intravital imaging of the tumor microenvironment. IntraVital, 1: 60-68 (2012).

556. Jain RK, Carmeliet P. SnapShot: Tumor Angiogenesis. *Cell,* 149:1408-1408.e1 (2012).

557. Stylianopoulos T, Martin JD, Chauhan VP, Jain SR, Diop-Frimpong B, Bardeesy N, Smith BL, Ferrone CR, Hornicek FJ, Boucher Y, Munn LL and Jain RK. Causes, consequences and remedies for growth-induced solid stress in murine and human tumors. *PNAS* 109:15101-8 (2012).

558. **Liu J, et al. TGF-β blockade improves the distribution and efficacy of therapeutics in breast carcinoma by normalizing the tumor stroma. *PNAS* 109:16618-23 (2012).**
559. Huang Y, et al. Vascular normalizing doses of antiangiogenic treatment reprogram the immunosuppressive tumor microenvironment and enhance immunetherapy. *PNAS*, 109:17561-6 (2012).
560. Kodack DP, et al. Combined targeting of HER2 and VEGFR2 for effective treatment of HER2-amplified breast cancer brain metastases. *PNAS*, 109: E3119–E3127 (2012).
561. Jain RK, Munn LL, Fukumura D. Rabbit ear chambers. Cold Spring Harb Protoc. 2012(7).
562. Jain RK, Munn LL, Fukumura D Corneal pocket assay in rabbits. Cold Spring Harb Protoc. 2012(9): 1017-8
563. Jain RK, Munn LL, Fukumura D. Mammary fat pad chamber preparation in mice. Cold Spring Harb Protoc. 2012(10): 1113-4.
564. Jain RK, Munn LL, Fukumura D. Mammary fat pad tumor preparation in mice. Cold Spring Harb Protoc. 2012(10): 1115-6.
565. Jain RK, Munn LL, Fukumura D. Lymphangiography of the mouse tail. Cold Spring Harb Protoc. 2012(11): 1177-8
566. Jain RK, Munn LL, Fukumura D. Lymphangiography of the mouse ear. Cold Spring Harb Protoc. 2012(11): 1179-80
567. Jain RK, Munn LL, Fukumura D. Pancreatic tumor preparation in mice. Cold Spring Harb Protoc. 2012(12)
568. Jain RK, Munn LL, Fukumura D. Liver tumor preparation in mice. Cold Spring Harb Protoc. 2012(12)
569. Jain RK, Munn LL, Fukumura D. Lung window preparation in mice. Cold Spring Harb Protoc. 2013(1)
570. Jain RK, Munn LL, Fukumura D. Measuring angiogenesis and hemodynamics in mice. Cold Spring Harb Protoc. 2013(4): 354-8
571. Jain RK, Munn LL, Fukumura D. Measuring vascular permeability in mice. Cold Spring Harb Protoc. 2013(5): 444-6
572. Jain RK, Munn LL, Fukumura D. Measuring leukocyte-endothelial interactions in mice. Cold Spring Harb Protoc. 2013(6): 561-3
573. Jain RK, Munn LL, Fukumura D. Measuring interstitial diffusion, convection, and binding parameters in mouse tumors. Cold Spring Harb Protoc. 2013(7): 678-80
574. Jain RK, Munn LL, Fukumura D. Measuring Interstitial pH and pO2 in Mouse Tumors. Cold Spring Harb Protoc. 2013(7): 675-7
575. H-S Han, JD Martin, J Lee, DK. Harris, D Fukumura, RK. Jain, and M Bawendi, Spatial Charge Configuration Regulates Nanoparticle Transport and Binding Behavior In Vivo. *Angew Chem* Int Ed Engl. 52:1414-9 (2013).
576. **M Snuderl, A Batista, ND Kirkpatrick, CR de Almodovar, L Riedemann, EC Walsh, R Anolik, Y Huang, JD Martin, W Kamoun, E Knevels, T Schmidt, CT Farrar, BJ Vakoc, N Mohan, E Chung, S Roberge, T Peterson, C Bais, BH Zhelyazkova, S Yip, M Hasselblatt, C Rossig, E Niemeyer; N Ferrara, M Klagsburn, DG Duda, D Fukumura, L Xu, P Carmeliet and RK Jain. Targeting placental growth factor/neuropilin 1 pathway inhibits growth and spread of medulloblastoma. *Cell*, 152: 1065–1076 (2013). [Highlighted in Nature Reviews Cancer, Cancer Discovery, The New England Journal of Medicine].**
577. Zhu AX, Ancukiewicz M, Supko JG, Sahani DV, Blaszkowsky LS, Meyerhardt JA, Abrams TA, Jackson McCleary N, Bhargava P, Muzikansky A, Sheehan S, Regan E, Vasudev E, Knowles M, Fuchs CS, Ryan DP, Jain RK, Duda DG. Efficacy, safety, pharmacokinetics and biomarkers of cediranib monotherapy in advanced hepatocellular carcinoma: A phase II study. *Clin Cancer Res.* 19: 1557-66 (2013).
578. O Chen, J Zhao, VP Chauhan, J Cui, C Wong, DK Harris, H Wei, H-S Han, D Fukumura, RK Jain & MG Bawendi. Compact high-quality "CdS core" shell nanocrystals with narrow emission linewidths and suppressed blinking. *Nature Materials*. 12: 445-51 (2013).
579. U Prabhakar, H Maeda, RK Jain, EM Sevick-Muraca, W Zamboni, OC Farokhzad, ST Barry, A Gabizon, P Grodzinski and DC Blakey. Challenges and key considerations of the enhanced permeability and retention (EPR) effect for nanomedicine drug delivery in oncology. *Cancer Research* 73: 2412-2417 (2013).
580. Y Huang, S Goel, DG Duda, D Fukumura and RK Jain. Vascular normalization as an emerging strategy to enhance cancer immunotherapy. *Cancer Research* 73: 2943-2948 (2013).

581. **RK Jain. Normalizing tumor microenvironment to treat cancer: Bench to bedside to biomarkers. *J Clinical Oncology* 31:2205-18 (2013). (http://meetinglibrary.asco.org/content/68595?media=vm)**
582. DG Duda, LL Munn and RK Jain. Can we identify predictive biomarkers for anti-angiogenic therapy of cancer using mathematical modeling? *JNCI* 105:762-5 (2013).
583. T Stylianopoulos, JD Martin, M Snuderl, F Mpekris, SR Jain and RK Jain. Coevolution of solid stress and interstitial fluid pressure in tumors during progression: Implications for vascular collapse. *Cancer Research* 73: 3833-3841 (2013).
584. C Lu-Emerson, M Snuderl, ND Kirkpatrick, J Goveia, C Davidson, Y Huang, L Riedemann, J Taylor, P Ivy, DG Duda, M Ancukiewicz, SR Plotkin, AS Chi, ER Gerstner, AF Eichler, J Dietrich, AO Stemmer-Rachamimov, TT Batchelor and RK Jain. Increase in tumor-associated macrophages after antiangiogenic therapy is associated with poor survival in recurrent glioblastoma patients. *Neuro*-Oncology 15:1079-87, 2013.
585. **R Samuel, L Daheron, S Liao, T Vardam, WS Kamoun, A Batista, C Buecker, R Schäfer, X Han, P Au, DT Scadden, DG Duda, D Fukumura and RK Jain. Generation of functionally competent and durable engineered blood vessels from human induced pluripotent stem cells. *PNAS* 110:12774-9, 2013**. **[Highlighted** by the NIH Director: http://directorsblog.nih.gov/2013/08/15/reprograming-adult-cells-to-produce-blood-vessels/; The New England Journal of Medicine: http://www.jwatch.org/na32147/2013/09/05/making-human-liver-and-blood-vessels-stem-cells.]
586. T Batchelor, P Mulholland, B Neyns, L Nabors, M Campone, A Wick, W Mason, T Mikkelsen, S Phuphanich, L Ashby, J DeGroot, R Gattamaneni, L Cher, M Rosenthal, F Payer, J Jurgensmeier, RK Jain, GA Sorensen, J Xu, Q Liu and M van den Bent. Phase III randomized trial comparing the efficacy of cediranib as monotherapy, and in combination with lomustine, versus lomustine alone in patients with recurrent glioblastoma. *Journal of Clinical Oncology* 31:3212-8 (2013).
587. DV Sahani, T Jiang, K Hayano, DG Duda, OA Catalano, M Ancukiewicz, RK Jain and AX Zhu. Magnetic resonance imaging biomarkers in hepatocellular carcinoma: Association with response and circulating biomarkers after sunitinib therapy. *J of Hematology & Oncology* 6:51 (2013).
588. S Goel, N Gupta, BP Walcott, M Snuderl, CT Kesler, ND Kirkpatrick, T Heishi, Y Huang, JD Martin, E Ager, R Samuel, S Wang, J Yazbek, BJ Vakoc, RT Peterson, TP Padera, DG Duda, D Fukumura, and RK Jain. Effects of Vascular-Endothelial Protein Tyrosine Phosphatase Inhibition on Breast Cancer Vasculature and Metastatic Progression. *JNCI* 105 (16): 1188-1201 (2013). [Accompanying editorial: doi: 10.1093/jnci/djt199].
589. M Thunemann, L Wen, M Hillenbrand, IA Vachaviolos, S Feil, T Ott, X Han, D Fukumura, RK Jain, M Russwurm, C de Wit and R Feil. Transgenic Mice for cGMP Imaging. *Circulation Research* 113:365-71 (2013).
590. KE Emblem, K Mouridsen, A Bjornerud, CT Farrar, D Jennings, RJ H. Borra, PY Wen, P Ivy, TT Batchelor, BR Rosen, RK Jain and AG Sorensen. Vascular architecture imaging identifies patient responders to anti-angiogenic therapy. *Nature Medicine* 19:1178-1183 (2013).
591. V Chauhan, JD Martin, H Liu, DA Lacorre, SR Jain, SV Kozin, T Stylianopoulos, AS Mousa, X Han, P Adstamongkonkul, Z Popović, P Huang, MG Bawendi, Y Boucher and RK Jain. Angiotensin inhibition enhances drug delivery and potentiates chemotherapy by decompressing tumor blood vessels. *Nature Communications* 4: 2516 doi: 10.1038/ncomms.3516 (2013).
592. V Chauhan and RK Jain. Strategies for advancing cancer nanomedicine. *Nature Materials* 12: 958-962 (2013).
593. T Stylianopoulos and RK Jain. Combining two strategies to improve perfusion and drug delivery in solid tumors. *PNAS* 110: 18632-7 (2013).
594. TT Batchelor, ER Gerstner, KE Emblem, DG Duda, J Kalpathy-Cramer, M Snuderl, M Ancukiewicz, P Polaskova, MC. Pinho, D Jennings, SR Plotkin, AS Chi, AF Eichler, J Dietrich, FH Hochberg, C Lu-Emerson, AJ Iafrate, B Rosen, JS Loeffler, PY Wen, AG Sorensen and RK Jain. Improved tumor oxygenation and survival in glioblastoma patients who show increased blood perfusion after cediranib and chemoradiation. *PNAS* 110: 19059-64 (2013).
595. A Zhu, Finn RS, Mulcahy M, Gurtler J, Sun W, Schwartz JD, Dalal RP, Joshi A, Hozak RR, Xu Y, Ancukiewicz M, Jain RK, Nugent F, Duda DG, Stuart K. A Phase II and Biomarker Study of Ramucirumab, a Human Monoclonal Antibody Targeting the VEGF Receptor-2 in Patients with Advanced Hepatocellular Cancer. *Clinical Cancer Research* 19: 6614-23 (2013).
596. Huang Y, Stylianopoulos T, Duda DG, Fukumura D, Jain RK Benefits of Vascular Normalization Are

Dose and Time Dependent--Letter. *Cancer Res*. 73:7144-6 (2013).

597. Y Chen, et al. Differential effects of sorafenib on liver versus tumor fibrosis mediated by SDF1α/CXCR4 axis and Gr-1+ myeloid cell infiltration in mice. *Hepatology* 59:1435-47 (2013).
598. Faber AC, Coffee EM, Costa C, Dastur A, Ebi H, Hata AN, Yeo AT, Edelman EJ, Song Y, Tam AT, Boisvert JL, Milano RJ, Roper J, Kodack DP, Jain RK, Corcoran RB, Rivera MN, Ramaswamy S, Hung KE, Benes CH, Engelman JA. mTOR Inhibition Specifically Sensitizes Colorectal Cancers with KRAS or BRAF Mutations to BCL-2/BCL-XL inhibition by Suppressing MCL-1. *Cancer Discovery* 4:42-52 (2014).
599. MC Pinho, P Polaskova, J Kalpathy-Kramer, D Jennings, K Emblem, RK Jain, BR Rosen, PY Wen, AG Sorensen, TT Batchelor and ER Gerstner. Anti-VEGF therapy suppresses GBM pseudoprogression. *Oncologist* 19:75-81 (2014).
600. CM Lemon, PN Curtin, RC Somers, AB Greytak, RM Lanning, RK Jain, MG Bawendi and DG Nocera. Metabolic Tumor Profiling with pH, Oxygen, and Glucose Chemosensors on a Quantum Dot Scaffold. *Inorg Chem.* 53:1900-15 (2014).
601. **RK Jain. An indirect way to tame cancer. *Scientific American* 310: 46-53 (2014).** [Link to the podcast about this article, posted on January 27, 2014: http://www.scientificamerican.com/podcast/episode/rakesh-jain-fight-cancer-with-physics/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+sciam%2Fbiology+(Topic%3A+Biology)].
602. Naxerova K, Brachtel E, Salk JJ, Seese AM, Power K, Abbasi B, Snuderl M, Chiang S, Kasif S, and Jain RK. Hypermutable DNA chronicles the evolution of human colon cancer. *PNAS* 111(18): E1889-98 (2014).
603. VP Chauhan, Y Boucher, CR Ferrone, S Roberge, JD Martin, T Stylianopoulos, N Bardeesy, RA DePinho, TP Padera, LL Munn, and RK Jain. Compression of pancreatic tumor blood vessels by hyaluronan is caused by solid stress and not interstitial fluid pressure. *Cancer Cell* 26:14-15 (2014).
604. DG Duda, M Ancukiewicz, SJ Isakoff, IE Krop, RK Jain. Seeds and soil: How does local tumor stroma mediate distant metastasis? *JNCI* 106(8) pii: dju187 (2014).
605. Hong TS, Ryan DP, Borger DR, Blaszkowsky LS, Yeap BY, Ancukiewicz M, Deshpande V, Shinagare S, Wo JY, Boucher Y, Wadlow RC, Kwak EL, Allen JN, Clark JW, Zhu AX, Ferrone CR, Mamon HJ, Adams J, Winrich B, Grillo T, Jain RK, DeLaney TF, Fernandez-Del Castillo C, Duda DG. A Phase 1/2 and Biomarker Study of Preoperative Short Course Chemoradiation With Proton Beam Therapy and Capecitabine Followed by Early Surgery for Resectable Pancreatic Ductal Adenocarcinoma. *Int J Radiat Oncol Biol Phys*. 89:830-8 (2014).
606. **RK Jain, JD Martin and T Stylianopoulos. The role of physical forces in tumor growth and therapy. *Annual Reviews of Biomedical Engineering* 16: 321-46 (2014).**
607. G Seano, G Chiaverina, PA Gagliardi, L di Blasio, A Puliafito, C Bouvard, R Sessa, G Tarone, L Sorokin, D Helley, RK Jain, G Serini, F Bussolino and L Primo. Endothelial podosome rosettes regulate vascular branching in tumor angiogenesis. *Nature Cell Biology* 16:931-941 (2014).
608. K Emblem, C Farrar, E Gerstner, T Batchelor, R Borra, B Rosen, AG Sorensen, and RK Jain. Vessel caliber - a potential MRI biomarker of tumour response in clinical trials. *Nature Reviews Clinical Oncology.* 11:566-584 (2014).
609. O Chen, L Riedemann, F Etoc, H Herrmann, M Coppey, M Barch, C Farrar, J Zhao, O Bruns, H Wei, P Guo, J Cui, R Jensen, Y Chen, D Harris, J Cordero, Z Wang, A Jasanoff, D Fukumura, R Reimer, M Dahan, RK Jain, and M Bawendi. Magneto-fluorescent core-shell supernanoparticles. *Nature Communications* 5:5093 (2014). doi: 10.1038/ncomms6093
610. E Chung, C Yeon, RK Jain and D Fukumura. Uncovering tumor biology by intravital microscopy. In: Comprehensive Biomedical Physics, Volume: IV "Optical molecular imaging" (Editor: Kiessling Alves & Anders Brahme). Elsevier Press (In press).
611. Jain RK, Netti PA. Letter to the editor regarding recent article by Wu et Al. [journal of Theoretical Biology, 355, 194-207 (2014)].
612. Thunemann M, Schmidt K, de Wit C, Han X, Jain RK, Fukumura D, Feil R. Correlative intravital imaging of cGMP signals and vasodilation in mice. Front Physiol. 2014; 5:394.

613. RK Jain, D Fukumura and DG Duda. Modes of neovascularization in tumors and clinical translation of antiangiogenic therapy. In: Pathobiology of Human Disease: A Dynamic Encyclopedia of Disease Mechanisms (Editor: LM McManus & RN Mitchell). Elsevier Press, San Diego, p. 2926-2957 (2014).

614. Jain RK. Antiangiogenesis strategies revisited: From starving tumors to alleviating hypoxia. *Cancer Cell* 26: 605–622 (2014).

615. Naxerova K, Jain RK Using tumour phylogenetics to identify the roots of metastasis in humans. *Nat Rev Clin Oncol.* 12: 258-272 (2015).

616. Han HS, Niemeyer E, Huang Y, Kamoun WS, Martin JD, Bhaumik J, Chen Y, Roberge S, Cui J, Martin MR, Fukumura D, Jain RK, Bawendi MG, Duda DG. Quantum dot/antibody conjugates for in vivo cytometric imaging in mice. *PNAS* 112(5): 1350-5 (2015).

617. Heist RS, Duda DG, Sahani DV, Ancukiewicz M, Fidias P, Sequist LV, Temel JS, Shaw AT, Pennell NA, Neal JW, Gandhi L, Lynch TJ, Engelman JA, Jain RK. Improved tumor vascularization after anti-VEGF therapy with carboplatin and nab-paclitaxel associates with survival in lung cancer. *PNAS* 112(5): 1547-52 (2015).

618. Datta M, Via LE, Kamoun WS, Liu C, Chen W, Seano G, Weiner DM, Schimel D, England K, Martin JD, Gao X, Xu L, Barry CE III, and Jain RK. Anti-vascular endothelial growth factor treatment normalizes tuberculosis granuloma vasculature and improves small molecule delivery. *PNAS* 112(6): 1827-32 (2015).

619. Kodack DP, Askoxylakis V, Ferraro GB, Fukumura D and Jain RK. Emerging strategies for treating brain metastases from breast cancer. *Cancer Cell* 27: 163–175 (2015).

620. C Lu-Emerson, DG Duda, KE Emblem, JW Taylor, ER Gerstner, JS Loeffler, TT Batchelor, and RK Jain. Lessons from Anti-VEGF/VEGFR Trials in Glioblastoma Patients. *Journal of Clinical Oncology* 33:1197-1213 (2015).

621. Ager EI, Kozin S, Kirkpatrick ND, Seano G, Kodack DP, Askoxylakis V, Huang Y, Goel S, Snuderl M, Muzikansky A, Finkelstein D, Dransfield DT, Devy L, Boucher Y, Fukumura D, Jain RK. Blockade of MMP14 activity in murine breast carcinomas: implications for macrophages, vessels, and radiotherapy. *JNCI* 107(4). pii: djv017. doi: 10.1093/jnci/djv017 (2015).

622. Stylianopoulos T, Economides E-A, Baish JW, Fukumura D and Jain RK. Towards optimal design of cancer nanomedicines: Multi-stage nanoparticles for the treatment of solid tumors. *Annals of Biomedical Engineering* 43: 2291-2300 (2015).

623. Chen Y, Ramjiawan RR, Reiberger T, Ng MR, Hato T, Huang Y, Ochiai H, Kitahara S, Unan EC, Reddy TP, Fan C, Huang P, Bardeesy N, Zhu AX, Jain RK, Duda DG. CXCR4 inhibition in tumor microenvironment facilitates anti-programmed death receptor-1 immunotherapy in sorafenib-treated hepatocellular carcinoma in mice. *Hepatology* 61(5): 1591-602 (2015).

624. Jain RK, Fukumura D, Duda DG. Lessons From 30 Years of Teaching About the Microenvironment of Tumors. *Cancer J.* 21:137 (2015)

625. Duda DG, Heist RS, Sahani DV, Stylianopoulos T, Engelman JA, Jain RK. Reply to Ciccolini et al.: Using mathematical modeling to predict response to antiangiogenic therapy in cancer patients. P*NAS* 112(27): E3454 (2015).

626. H-S Jeong, D Jones, S Liao, DA Wattson, C Cui, DG Duda, CG Willett, RK Jain and TP Padera. Investigation of the lack of angiogenesis in the formation of lymph node metastases. *JNCI* 2015;107(9) pii: djv155. doi: 10.1093/jnci/djv155.

627. Lee EQ, Kaley TJ, Duda DG, Schiff D, Lassman AB, Wong ET, Mikkelsen T, Purow B, Muzikansky A, Ancukiewicz M, Huse JT, Ramkissoon SH, Drappatz J, Norden AD, Beroukhim R, Weiss SE, Alexander BM, McCluskey CS, Gerard M, Smith KH, Jain RK, Batchelor T, Ligon KL, Wen PY. A multicenter, phase II, randomized, non-comparative clinical trial of radiation and temozolomide with or without vandetanib in newly-diagnosed glioblastoma patients. *Clin Cancer Res*. 21(16): 3610-8 (2015).

628. Gerstner ER, Ye X, Duda DG, Levine MA, Mikkelsen T, Kaley TJ, Olson JJ, Nabors BL, Ahluwalia MS, Wen PY, Jain RK, Batchelor TT, Grossman S. A phase I study of cediranib in combination with cilengitide in patients with recurrent glioblastoma. *Neuro Oncol*. 17:1386-92 (2015).

629. Reiberger T, Chen Y, Ramjiawan RK, Hat T, Fan C, Samuel R, Roberge S, Huang P, Lauwers GY, Zhu AX, Bardeesy N, Jain RK, Duda DG. An orthotopic mouse model of hepatocellular carcinoma with underlying liver cirrhosis. *Nature Protocols* 10:1264-1274 (2015).

630. Jain, RK, Duda DG and Fukumura, D. Role of Tumor Microenvironment in Tumor Progression and Treatment Response: A 30 Years Journey. *Cancer J.* 21: 235-236 (2015).

(http://journals.lww.com/journalppo/Fulltext/2015/07000/From_the_Guest_Editors__Role_of_Tumor.1.aspx)

631. Batista A, Riedemann L, Vardam T, and Jain, RK. Targeting the Tumor Microenvironment to Enhance Pediatric Brain Cancer Treatment. *Cancer Journal* 21: 307-313 (2015). (http://journals.lww.com/journalppo/Fulltext/2015/07000/Targeting_the_Tumor_Microenvironment_to_Enhance.12.aspx)
632. Lemon CM, Karnas E, Han X, Bruns OT, Kempa TJ, Fukumura D, Bawendi MG, Jain RK, Duda DG, Nocera DG. Micelle-Encapsulated Quantum Dot-Porphyrin Assemblies as in Vivo Two-Photon Oxygen Sensors. *J Am Chem Soc.* 137:9832-42 (2015).
633. Zou HY, Friboulet L, Kodack DP, Engstrom LD, Li Q, West M, Tang RW, Wang H, Tsaparikos K, Wang J, Timofeevski S, Katayama R, Dinh DM, Lam H, Lam JL, Yamazaki S, Hu W, Patel B, Bezwada D, Frias RL, Lifshits E, Mahmood S, Gainor JF, Affolter T, Lappin PB, Gukasyan H, Lee N, Deng S, Jain RK, Johnson TW, Shaw AT, Fantin VR, Smeal T. PF-06463922, an ALK/ROS1 Inhibitor, Overcomes Resistance to First and Second Generation ALK Inhibitors in Preclinical Models. *Cancer Cell* 28:70-81 (2015).
634. R Samuel, DG Duda, D Fukumura and RK Jain. Vascular diseases await translation of blood vessels engineered from stem cells. *Science Translational* Medicine 7, 309rv6 (2015). doi: 10.1126/scitranslmed.aaa1805
635. Stylianopoulos T and Jain RK. Design considerations for nanotherapeutics in oncology. *Nanomedicine: Nanotechnology, Biology and Medicine* 11: 1893-1907 (2015).
636. Sara M. Tolaney Yves Boucher, Dan G. Duda, John D. Martin, Giorgio Seano, Marek Ancukiewicz, William T. Barry, Shom Goel, Johanna Lahdenrata, Steven J. Isakoff, Eren Yeh, Saloni R. Jain, Mehra Golshan, Jane Brock, Matija Snuderl, Eric P. Winer, Ian E. Krop, Rakesh K. Jain. Potential Role of Vascular Density and Vascular Normalization in Response to Neoadjuvant Bevacizumab and Chemotherapy in Breast Cancer Patients. *PNAS*, 112: 14325-14330 (2015).
637. X Gao, Y Zhao, AO Stemmer-Rachamimov, H Liu, Peigen Huang, SM China, M Selig, S Plotkin, RK Jain and L Xu. Anti-VEGF treatment improves neurological function and augments radiation response in NF2 schwannoma model. *PNAS*, 112: 14676-81 (2015).
638. Askoxylakis V, Ferraro GB, Kodack DP, Badeaux M, Shankaraiah RC, Seano G, Kloepper J, Vardam T, Martin JD, Naxerova K, Bezwada D, Qi X, Selig M, Brachtel E, Duda DG, Huang P, Fukumura D, Engelman JA and Jain RK. Preclinical efficacy of ado-trastuzumab emtansine in the brain microenvironment. *JNCI* Nov 7; 108(2). pii: djv313. Print 2016 Feb.
639. J Incio, P Suboj, SM Chin, T Vardam-Kaur, H Liu, T Hato, S Babykutty, I Chen, V Deshpande, RK Jain, and D Fukumura. Metformin reduces desmoplasia in pancreatic cancer by reprogramming stellate cells and tumor-associated macrophages. *PLoS One* 10(12): e0141392 (2015). doi: 10.1371/journal.pone.0141392.
640. PK Singhal, S Sassia, L Lana, P Au, SC Halvorsena, D Fukumura, RK Jain, and B Seed. Mouse Embryonic Fibroblasts Exhibit Extensive Developmental and Phenotypic Diversity. *PNAS,* 113:122-7 (2016). doi/10.1073/pnas.1522401112.
641. Whitley MJ, Cardona DM, Lazarides AL, Spasojevic I, Ferrer JM, Cahill J, Lee CL, Snuderl M, Blazer III DG, Hwang SE, Greenup RA, Mosca PJ, Mito JK, Cuneo KC, Larrier NA, O'Reilly EK, Riedel RF, Eward WC, Strasfeld DB, Fukumara D, Jain RK, Lee WD, Griffith LG, Bawendi MG, Kirsch DG, and Brigman BE. A Mouse-human Phase I co-clinical trial of a protease-activated fluorescent probe for imaging cancer. *Science Translational Medicine,* 8(320):320ra4 (2016).
642. Park KR, Monsky WL, Lee CG, Song CH, Kim DH, Jain RK, Fukumura D. Mast Cells Contribute to Radiation-Induced Vascular Hyperpermeability. *Radiat Res*. 185:182-9 (2016).
643. D Fukumura, J Incio, R Shankaraiah, RK Jain, Obesity and cancer: an angiogenic and inflammatory link. *Microcirculation* 23:191-206 (2016).
644. Datta M, Via LE, Chen W, Baish JW, Xu L, Barry CE, and Jain RK. Mathematical Model of Oxygen Transport in Tuberculosis Granulomas. *Annals of Biomedical Engineering* 44: 863-872 (2016).
645. Peterson TE, Kirkpatrick ND, Huang Y, Farrar CT, Marijt KA, Kloepper J, Datta M, Amoozgar Z, Seano G, Jung K, Kamoun WS, Vardam T, Snuderl M, Goveia J, Chatterjee S, Batista A, Muzikansky A, Leow CC, Xu L, Batchelor TT, Duda DG, Fukumura D, Jain RK. Dual inhibition of Ang-2 and VEGF receptors normalizes tumor vasculature and prolongs survival in glioblastoma by altering macrophages. *PNAS* 113:4470-5 (2016).

646. Kloepper J, Riedemann L, Amoozgar Z, Seano G, Susek K, Yu V, Dalvie N, Amelung RL, Datta M, Song JW, Askoxylakis V, Taylor JW, Lu-Emerson C, Batista A, Kirkpatrick ND, Jung K, Snuderl M, Muzikansky A, Stubenrauch KG, Krieter O, Wakimoto H, Xu L, Munn LL, Duda DG, Fukumura D, Batchelor TT, Jain RK. Ang-2/VEGF bispecific antibody reprograms macrophages and resident microglia to anti-tumor phenotype and prolongs glioblastoma survival. *PNAS* 113:4476-81 (2016).

647. Incio J, Tam J, Rahbari NN, Suboj P, McManus DT, Chin SM, Vardam TD, Batista A, Babykutty S, Jung K, Khachatryan A, Hato T, Ligibel J, Krop IE, Puchner SB, Schlett CL, Hoffmman U, Ancukiewicz M, Shibuya M, Carmeliet P, Soares R, Duda DG, Jain RK, Fukumura D. PlGF/VEGFR-1 signaling promotes macrophage polarization and accelerated tumor progression in obesity. *Clinical Cancer Research* 22: 2993-3004 (2016).

648. Blakeley JO, Ye X, Duda DG, Halpin CF, Bergner AL, Muzikansky A, Merker VL, Gerstner ER, Fayad LM, Ahlawat S, Jacobs MA, Jain RK, Zalewski C, Dombi E, Widemann BC, Plotkin SR. Efficacy and Biomarker Study of Bevacizumab for Hearing Loss Resulting From Neurofibromatosis Type 2-Associated Vestibular Schwannomas. *J Clin Oncol.* 34:1669-75 (2016).

649. Munn LL and Jain, RK. The forces of cancer. *The Scientist* 30: 52-57 (2016).

650. Incio J, Liu H, Suboj P, Chin SM, Chen IX, Pinter M, Ng MR, Nia HT, Grahovac J, Kao S, Babykutty S, Huang Y, Jung K, Rahbari NN, Han X, Chauhan VP, Martin JD, Kahn J, Huang P, Desphande V, Michaelson J, Michelakos TP, Ferrone CR, Soares R, Boucher Y, Fukumura D & Jain RK. Obesity-induced inflammation and desmoplasia promote pancreatic cancer progression and resistance to chemotherapy. *Cancer Discovery* 6: 852–869 (2016). [Commentaries by V Bronte and G Tortora, *Cancer Discovery* 6: 821-3 (2016); MC Arkan, *Nature* 536:157-8 (2016).]

651. Ferraro GB, Kodack DP, Askoxylakis V and Jain RK. Closing the gap between astrocytes and brain metastases. *Cell Research* 26: 973-4 (2016).

652. Martin JD, Fukumura D, Duda DG, Boucher Y, Jain RK Reengineering the tumor microenvironment to alleviate hypoxia and overcome cancer heterogeneity. *Cold Spring Harbor Perspectives in Medicine* 6:a027094 (2016). doi: 10.1101/cshperspect.a027094

653. Kumar V, Boucher Y, Liu H, Ferreira D, Hooker J, Catana C, Jain RK and Guimaraes AR. Noninvasive assessment of losartan-induced increase in functional microvasculature and drug delivery in pancreatic ductal adenocarcinoma. *Tranlational Oncology* 9:431-437 (2016).

654. Rahbari N, Kedrin D, Incio J, Liu H, Nia HT, Edrich C, Dubroix J, Chen I, Heishi T, Martin JD, Huang Y, Grodzinsky AJ, Duda DG, Jain RK & Fukumura D. Extracellular matrix remodeling after anti-VEGF therapy contributes to therapeutic resistance in colorectal cancer liver metastases. *Science Translational Medicine* 8: 360ra135 (2016). doi:10.1126/scitranslmed.aaf5219. [Featured on the journal cover. Highlighted in *Cancer Discovery, Nature Reviews Cancer, Nature Reviews Gasrtoenterology*].

655. Emblem KE and Jain RK. Improving Treatment of Liver Metastases by Targeting Non-angiogenic Mechanisms. *Nature Medicine* 22: 1209-1210 (2016).

656. **Nia HT, Liu H, Seano G, Datta M, Jones D, Rahbari N, Incio J, Chauhan VP, Jung K, Martin JD, Askoxylakis V, Padera TP, Fukumura D, Boucher Y, Hornicek FJ, Grodzinsky AJ, Baish JW, Munn LL and Jain RK. Solid stress and elastic energy as measures of tumour mechanopathology. *Nature Biomedical Engineering* 1: 4 (2016). doi:10.1038/s41551-016-0004. [Accomanying News & Views by Daniele M. Gilkes and Denis Wirtz - 'Tumour mechanopathology: Cutting the stress out' doi: 10.1038/s41551-016-0012; Peter Sidaway, Solid stress indicates tumour pathology, Nature Reviews Clinical Oncology (2016) doi:10.1038/nrclinonc.2016.209].**

657. Hajjarian Z, Nia HT, Ahn S, Grodzinsky AL, Jain RK, and Nadkarni S. Laser Speckle Rheology for evaluating the viscoelastic properties of hydrogel scaffolds. *Scientific Reports* 6: 37949 (2016). doi: 10.1038/srep37949.

658. Tolaney SM, Ziehr DR, Guo H, Ng MR, Barry WR, Higgins MJ, Isakoff SJ, Brock JE, Ivanova EV, Paweletz CP, Demeo MK, Ramaiya NH, Overmoyer BA, Jain RK, Winer EP and Duda DG. Clinical and translational outcomes from a phase 2 study of cabozantinib for metastatic triple-negative breast cancer. *Oncologist* 22(1): 25-32 (2017).

659. Kalpathy-Cramer J, Chandra V, Da X, Ou Y, Emblem KE, Muzikansky A, Cai X, Douw L, Evans JG, Dietrich J, Chi AS, Wen PY, Stufflebeam S, Rosen B, Duda DG, Jain RK, Batchelor TT, Gerstner ER Phase II study of tivozanib, an oral VEGFR inhibitor, in patients with recurrent glioblastoma. *J*

Neurooncol 131: 603-610 (2017).

660. Menter AR, Carroll NM, Sakoda LC, Delate T, Hornbrook MC, Jain RK, Kushi LH, Quinn VP and Ritzwoller DP. Effect of Angiotensin System Inhibitors on Survival in Patients Receiving Chemotherapy for Advanced Non-Small Cell Lung Cancer. *Clinical Lung Cancer* 18:189-197 (2017).
661. Ng RM and Jain RK. Hypoxia–induced DNA hypermethylation: Another reason to normalize tumor vessels. *Translational Cancer Research* 5: S1358-S1362 (2016). doi: 10.21037/tcr.2016.12.72.
662. Wang N, Jain RK, Batchelor TT. New Directions in Anti-Angiogenic Therapy for Glioblastoma. *Neurotherapeutics* 14:321-332 (2017).
663. N Gupta, M Badeaux, Y Liu, K Naxerova, D Sgroi, LL Munn, RK Jain, and I Garkavtsev. Stress granule-associated protein G3BP2 regulates breast tumor initiation. *PNAS* 114:1033-1038 (2017).
664. F Mpekris, JW Baish, T Stylianopoulos and RK Jain. Role of vascular normalization in benefit from metronomic chemotherapy. *PNAS* 114: 1994–1999 (2017).
665. Y Chen, Y-C Liu, T-T Lin, R Ramjiawan, Y-C Sung, C-C Chang, K-S Jeng, C-F Chang, C-H Liu, D-Y Gao, F-F Hsu, A Duyvermann, S Kitahara, P Huang, S Dima, I Popescu, K Flaherty, A Zhu, N Bardeesy, RK Jain, C Benes, and GD Duda. Overcoming sorafenib evasion in hepatocellular carcinoma using CXCR4-targeted nanoparticles to co-deliver MEK-inhibitors. *Scientific Reports* 7: 44123; doi: 10.1038/srep44123 (2017).
666. Goyal L, Zheng H, Yurgelun MB, Abrams TA, Allen JN, Cleary JM, Knowles M, Regan E, Reardon A, Khachatryan A, Jain RK, Nardi V, Borger DR, Duda DG, Zhu AX. A phase 2 and biomarker study of cabozantinib in patients with advanced cholangiocarcinoma. *Cancer* 23:1979-1988 (2017).
667. **OT Bruns, TS Bischof, DK Harris, D Franke, Y Shi, L Riedemann, A Bartelt, F Jaworski, JA Carr, CJ Rowlands, MWB Wilson, O Chen, H Wei, GW Hwang, D Montana, I Coropceanu, OB Achorn, J Kloepper, J Heeren, PTC So, D Fukumura, K Jensen, RK Jain and MG Bawendi. Next-generation in vivo optical imaging with short-wave infrared quantum dots. Nature Biomedical Engineering 1: 56 (2017). [Accompanying News & Views by E. Sevick-Muraca. Optical imaging: Resolutely deep and fast. 1: 0064].**
668. C Rowlands, D Park, O Bruns, K Piatkevich, D Fukumura, R K Jain, M Bawendi, E Boyden, and P So. Wide-field Three-Photon Excitation in Biological Specimens. *Light: Science & Applications* 6, e16255; (2017). doi:10.1038/lsa.2016.255 Published online 5 May 2017
669. DP Kodack, V Askoxylakis, GB Ferraro, Q Sheng, M Badeaux, S. Goel, X. Qi, R. Shankaraiah, AZ Cao, RR Ramjiawan, D Bezwada, B. Patel, Y. Song, C. Costa, K Naxerova, C Wong, J Kloepper, R Das, A Tam, J Tanboon, DG Duda, RC Miller, MB Siegel, C K Anders, M Sanders, VM Estrada, R Schlegel, C L Arteaga, E Brachtel, A Huang, D Fukumura, JA Engelman, and RK Jain. The brain microenvironment mediates resistance in luminal breast cancer to PI3K inhibition through HER3 activation. *Science Translational Medicine* 9: eaal4682 (2017). [Featured on the journal cover; Highlighted in Nature - https://www.nature.com/articles/n-12311114].
670. De Palma M, Jain RK. CD4 T cell activation and vascular normalization: Two sides of the same coin? *Immunity* 46: 773-5 (2017).
671. Andronesi O, Esmaeili M, Borra R, Emblem K, Gerstner E, Pinho M, Plotkin S, Chi A, Eichler A, Dietrich J, Ivy P, Wen PY, Duda DG, Jain RK, Rosen B, Sorensen AG, Batchelor TT. Early changes in glioblastoma metabolism measured by MR Spectroscopic Imaging during combination of antiangiogenic cediranib and chemoradiation therapy are associated with survival. *Nature Precision Oncology* 2017; 1: 20; doi:10.1038/s41698-017-0020-3.
672. H Liu, K Naxerova, M Pinter, J Incio, H Lee, K Shigata, W Ho, J Crain, A Jacobson, T Michelakos, D Dias-Santos, A Zanconato, TS Hong, JW Clark, JE Murphy, DP Ryan, V Deshpande, KD Lillemoe, C Fernandez-del Castillo, M Downes, RM Evans, J Michaelson, CR Ferrone, Y Boucher and RK Jain. Use of Angiotensin System Inhibitors is Associated with Immune Activation and Longer Survival in Non-Metastatic Pancreatic Ductal Adenocarcinoma. *Clinical Cancer Research*. 23(19):5959-5969 (2017).
673. VA Levin, J Chan, M Datta, J Yee and RK Jain. Effect of angiotensin system inhibitors on survival in newly diagnosed glioma patients and recurrent glioblastoma patients receiving chemotherapy and/or bevacizumab. *Journal of Neuro-Oncology*. Published online on June 19, 2017. doi:10.1007/s11060-017-2528-3.
674. V Askoxylakis, DP Kodack, GB Ferraro and RK Jain. Antibody-based therapies for the treatment of brain metastases from HER2-positive breast cancer: time to rethink the importance of the BBB? *Breast Cancer Research and Treat*ment. Published online on June 22, 2017. doi: 10.1007/s10549-017-4351-0.

675. V Askoxylakis, C Arvanitis, CSF Wong, GB Ferraro and RK Jain. Emerging Strategies for Delivering Antiangiogenic Therapies to Primary and Metastatic Brain Tumors. *Advanced Drug Delivery Reviews*. Published online on June 22, 2017. https://doi.org/10.1016/j.addr.2017.06.011.
676. **K Naxerova, JG Reiter, E Brachtel, J Lennerz, M Van de Wetering, A Rowan, T Cai, H Clevers, C Swanton, MA Nowak, SJ Elledge, and RK Jain. Origins of lymphatic and distant metastases in human colorectal cancer. *Science* 357: 55-60 (2017). [Accompanying commentary by S. D. Markowitz. Cancer bypasses the lymph nodes. *Science* 357: 35-36 (2017). Also, highlighted in *Nature Reviews Cancer*, *Nature Reviews Clinical Oncology*, *Nature Reviews Gastro & Hepatology*.]**
677. K Jung, T Heishi, O F Khan, PS Kowalski, J Incio, NN Rahbari, E Chung, JW Clark, CG Willett, AD Luster, SH Yun, R Langer, DG Anderson, TP Padera, RK Jain and D Fukumura. Ly6C-low monocytes drive immunosuppression and confer resistance to anti-VEGFR2 cancer therapy. *Journal of Clinical Investigation*. 127:3039-3051 (2017). https://doi.org/10.1172/JCI93182 [Featured as a "Scientific Show Stoppers" - https://www.jci.org/posts/545].
678. Wang X, Freire Valls A, Schermann G, Shen Y, Moya IM, Castro L, Urban S, Solecki GM, Winkler F, Riedemann L, Jain RK, Mazzone M, Schmidt T, Fischer T, Halder G, Ruiz de Almodóvar C. YAP/TAZ Orchestrate VEGF Signaling during Developmental Angiogenesis. *Developmental Cell* 42:462-478 (2017).
679. K Jung, T Heishi, J Incio, Y Huang, EY Beech, M Pinter, WW Ho, NN Rahbari, E Chung, JK Kim, JW Clark, CG Willett, SH Yun, AD Luster, TP Padera, RK Jain and D Fukumura. Targeting CXCR4-dependent immunosuppressive Ly6Clow monocytes improves anti-VEGFR2 therapy in colorectal cancer *PNAS* 114:10455-10460 (2017).
680. Zhang N, Chen J, Ferraro G, Wu L, Datta M, Jain RK, Plotkin SR, Stemmer-Rachamimov A, Xu L.Anti-VEGF treatment improves neurological function in tumors of the nervous system. *Exp Neurol*. 2017 doi: 10.1016/j.expneurol.2017.09.008.
681. V Askoxylakis, M Badeaux, S Roberge, A Batista, N Kirkpatrick, M Snuderl, Z Amoozgar, G Seano, GB Ferraro, S Chatterjee, L Xu, D Fukumura, DG Duda and RK Jain. A cerebellar window for intravital imaging of medulloblastoma in mice. *Nature Protocols* 12: 2251–2262 (2017).
682. **M Pinter and RK Jain. Targeting the renin-angiotensin system to improve cancer treatment: Implications for immunotherapy. *Science Translational Medicine* 9: eaan5616 (2017).**
683. **MJ Mitchell, RK Jain and R Langer. Engineering and Physical Sciences in Oncology: Challenges and Opportunities. *Nature Reviews Cancer* 17: 659-675 (2017). [Featured on the cover.]**
684. Pinter M, Weinmann A, Wörns MA, Hucke F, Bota S, Marquardt JU, Duda DG, Jain RK, Galle PR, Trauner M, Peck-Radosavljevic M, Sieghart W. Use of inhibitors of the renin-angiotensin system is associated with longer survival in patients with hepatocellular carcinoma. *United European Gastroenterol Journal*: 5(7): 987-996 (2017).
685. S Kozin, N Maimon, R Wang, N Gupta, LL Munn, RK Jain and I Garkavstev. Secretory leukocyte protease inhibitor (SLPI) as a potential target for inhibiting metastasis of triple-negative breast cancers. *Oncotarget* 8: 108292-302 (2017).
686. S Li, P Kumar T, S Joshee, T Kirschstein, S Subburaju, J Khalili, J Kloepper, C Du, A Elkhal, G Szabo, RK Jain, R Koehling and A Vasudevan. Endothelial Cell Derived GABA Signaling Modulates Neuronal Migration and Postnatal Behavior. *Cell Research*, 28:221-248 (2018).
687. MJ Khandekar and RK Jain. Smooth sailing for immunotherapy for unresectable stage III Non-small cell lung cancer: The PACIFIC study. *Translational Cancer Research* 7: S16-S20 (2018).
688. DA Reardon, A Lassman, D Schiff, Shakeeb Yunus; Elizabeth Gerstner; Timothy Cloughesy; Eudocia Quant Lee; Sarah C. Gaffey; Jennifer Barrs; Jennifer Bruno; Alona Muzikansky, Dan G. Duda; Rakesh K. Jain; Patrick Y. Wen. Phase II and biomarker study of trebananib, an angiopoietin blocking peptibody, with and without bevacizumab for recurrent glioblastoma patients. *Cancer* (Online on December 19, 2017). doi: 10.1002/cncr.31172. 124:1438-1448 (2018).
689. W Li, Y Liu, W Yang, X Han, S Li, H Liu, LE Gerweck, D Fukumura, JS Loeffler, BB Yang, RK Jain and P Huang. MicroRNA-378 enhances radiation response in ectopic and orthotopic implantation models of glioblastoma. *Journal of Neuro-Oncology* 136: 63-71 (2018).
690. Y Zhao, P Liu, N Zhang, J Chen, LD Landegger, L Wu, F Zhao, Y Zhang, J Zhang, T Fujita, A Stemmer-Rachamimov, GB Ferraro, H Liu, A Muzikansky, SR Plotkin, KM Stankovic, RK Jain and L Xu. Targeting the cMET pathway augments radiation response without adverse effect on hearing in NF2 schwannoma models. ***PNAS*** (online on Feb 9, 2018) 115: E2077-E2084 (2018).

691. K Dixon, M Schorer, J Nevin, Y Etminan, Z Amoozgar, T Kondo, S Kurtulus, N Kassam, RA Sobel, D Fukumura, RK Jain, AC Anderson, VK Kuchroo, N Joller. Functional anti-TIGIT antibodies regulate development of autoimmunity and anti-tumor immunity. *Journal of Immunology*. 200: 3000-3007 (2018).
692. **D Fukumura, J Kloepper, Z Amoozgar, DG Duda and RK Jain. Enhancing Cancer Immunotherapy Using Antiangiogenics: Opportunities and Challenges. *Nature Reviews Clinical Oncology*. 15: 325-340 (2018).**
693. **J Incio, JA Ligibel, DT McManus, P Suboj, K Jung, K Kawaguchi, M Pinter, S Babykutty, SM Chin, TD Vardam, Y Huang, NN Rahbari, S Roberge, D Wang, IL Gomes-Santos, SB Puchner, CL Schlett, U Hoffmman, M Ancukiewicz, SM Tolaney, IE Krop, DG Duda, Y Boucher, D Fukumura and RK Jain. Obesity promotes resistance to anti-VEGF therapy in breast cancer by upregulating IL-6 and potentially FGF-2. *Science Translation Medicine*, 10: eaag0945. Published online on March 14, 2018.**
694. RK Jain and A. Batista. A physical view of cancer. *Trends in Cancer* 4: 257 (2018).
695. T Stylianopoulos, LL Munn and RK Jain. Reengineering the tumor vasculature: Improving drug delivery and efficacy. *Trends in Cancer* 4: 258-259 (2018).
696. T Stylianopoulos, LL Munn and RK Jain. Reengineering the physical microenvironment of tumors to improve drug delivery and efficacy: From math modeling to bench to bedside. *Trends in Cancer* 4: 292-319 (2018).
697. M Pinter, WJ Kwanten and RK Jain. Renin-angiotensin system inhibitors to mitigate cancer treatment-related adverse events. *Clinical Cancer Research* 24: 3803-12 (2018).
698. JA Carr, D Frankea, JR Carama, CF Perkinsona, V Askoxylakis, M Datta, D Fukumura, RK Jain, MG Bawendi and OT Bruns. Shortwave Infrared Fluorescence Imaging with the Clinically Accessible Near-Infrared Dye Indocyanine Green. ***PNAS*** 115:4465-4470 (2018).
699. HT Nia, M Datta, G Seano, P Huang, LL Munn, and RK Jain. Quantifying solid stress and elastic energy from excised or in situ tumors. *Nature Protocols* 13(5):1091-1105 (2018). https://rdcu.be/LZEV
700. **A Griveau, G Seano, SJ Shelton R Kupp, A Jahangiri, K Obernier, S Krishnan, OR Lindberg, TJ Yuen, A-C Tien, JK Sabo, N Wang, I Chen, J Kloepper, L Larrouquere, M Ghosh, It Tirosh, E Huillard, A Alvarez-Buylla, MC Oldham, AI Persson, WA Weiss, TT Batchelor, A Stemmer-Rachamimov, ML Suva, JJ Phillips, M Aghi, S Mehta, RK Jain and DH Rowitch. A glial signature and Wnt7 signaling regulate glioma-vascular interactions and tumor microenvironment. *Cancer Cell* 33 (5): 874-889 (2018).**
701. M Binnewies, E Roberts, V Chan, K Kersten, DF Fearon, M Merad, LM Coussens, D Gabrilovich, S Ostrand-Rosenberg, CC Hedrick, RH Vonderheide, M Pittet, RK Jain, W Zou, K Howcroft, E Woodhouse, The TiME Working Group, R Weinberg, M Krummel. The Tumor Immune Microenvironment (TIME): The Future of Understanding Tumor-Tissue Biology for Key Insights and Cures. ***Nature Medicine*** 24(5): 541-550 (2018).
702. Nowak-Sliwinska P, Alitalo K, Allen E, Anisimov A, Aplin AC, Auerbach R, Augustin HG, Bates DO, van Beijnum JR, Bender RHF, Bergers G, Bikfalvi A, Bischoff J, Böck BC, Brooks PC, Bussolino F, Cakir B, Carmeliet P, Castranova D, Cimpean AM, Cleaver O, Coukos G, Davis GE, De Palma M, Dimberg A, Dings RPM, Djonov V, Dudley AC, Dufton NP, Fendt SM, Ferrara N, Fruttiger M, Fukumura D, Ghesquière B, Gong Y, Griffin RJ, Harris AL, Hughes CCW, Hultgren NW, Iruela-Arispe ML, Irving M, Jain RK, Kalluri R, Kalucka J, Kerbel RS, Kitajewski J, Klaassen I, Kleinmann HK, Koolwijk P, Kuczynski E, Kwak BR, Marien K, Melero-Martin JM, Munn LL, Nicosia RF, Noel A, Nurro J, Olsson AK, Petrova TV, Pietras K, Pili R, Pollard JW, Post MJ, Quax PHA, Rabinovich GA, Raica M, Randi AM, Ribatti D, Ruegg C, Schlingemann RO, Schulte-Merker S, Smith LEH, Song JW, Stacker SA, Stalin J, Stratman AN, Van de Velde M, van Hinsbergh VWM, Vermeulen PB, Waltenberger J, Weinstein BM, Xin H, Yetkin-Arik B, Yla-Herttuala S, Yoder MC, Griffioen AW. Consensus guidelines for the use and interpretation of angiogenesis assays. *Angiogenesis*. 2018; ePub - PMID: 29766399 - DOI: 10.1007/s10456-018-9613-x
703. Grassberger C, Hong TS, Hato T, Yeap BY, Wo JY, Tracy M, Bortfeld T, Wolfgang JA, Eyler CE, Goyal L, Clark JW, Crane CH, Koay EJ, Cobbold M, DeLaney TF, Jain RK, Zhu AX and Duda DG. Differential Association Between Circulating Lymphocyte Populations with Outcome after Radiation Therapy in Subtypes of Liver Cancer. *Int J Radiat Oncol Biol* Phys. 101(5):1222-1225 (2018).
704. EQ Lee, DG Duda, A Muzikansky, ER Gerstner, JG Kuhn, DA Reardon, L Nayak, AD Norden, L Doherty, J Stefanik, D LaFrankie, J Armitage, T Vardam, D Stokes, KH Smith, C McCluskey, S Gaffey,

TT Batchelor, RK Jain and, PY Wen. Phase I and biomarker study of plerixafor and bevacizumab in recurrent high-grade glioma. *Clinical Cancer Research* 24(19):4643-4649 (2018).

705. CD Arvanitis, V Askoxylakis, Y Guo, M Datta, J Kloepper, GK Ferraro, MO Bernabeu, D Fukumura, N McDannold and RK Jain. Mechanisms of enhanced drug delivery in brain metastases with focused ultrasound-induced transient blood-tumor barrier disruption. *PNAS* 115(37): E8717-E8726 (2018).

706. Ina Ly K, Vakulenko-Lagun B, Emblem KE, Ou Y, Da X, Betensky RA, Kalpathy-Cramer J, Duda DG, Jain RK, Chi AS, Plotkin SR, Batchelor TT, Sorensen G, Rosen BR, Gerstner ER. Probing tumor microenvironment in patients with newly diagnosed glioblastoma during chemoradiation and adjuvant temozolomide with functional MRI. *Science Reports* 8(1):17062 (2018).

707. S Li, W Li, C-H Leung, S Kitahara, Y Liu, S Klein, D Fukumura, JS Loeffler, RK Jain, DG Duda, and P Huang. Combining Angiotensin Receptor Blocker Losartan and the CXCR4 Inhibitor AMD3100 Increases the Efficacy of Radiotherapy in a Metastatic Osteosarcoma Mouse Model. *J Cancer Sci Ther* 10: 351-365 (2018). doi: 10.4172/1948-5956.1000570.

708. L Goyal, H Zheng, T Abrams, R Miksad, A Bullock, J Allen, M Yurgelun, J Clark, A Muzikansky, M Knowles, A Galway, A Afflitto, C Dinicola, E Regan, T Hato, E Mamessier, K Shigeta, RK Jain, DG Duda, and A Zhu. **A** Phase II and Biomarker Study of Sorafenib Combined with FOLFOX in Patients with Advanced Hepatocellular Carcinoma. *Clinical Cancer Research* 25: 80-89 (2019).

709. I Keklikoglou, C Cianciaruso, E Güç, M L Squadrito, S Tazzyman, L Lambein, A Poissonnier, GB Ferraro, C Baer, A Cassará, A Guichard, ML Iruela-Arispe, CE Lewis, LM Coussens, A Bardia, LM Spring, RK Jain, JW Pollard and M DePalma. Chemotherapy elicits pro-metastatic extracellular vesicles in breast cancer models. *Nature Cell Biology* 21(2):190-202 (2019). https://rdcu.be/be4fa

710. S Liao, EM Bouta, LM Morris, D Jones, RK Jain and TP Padera. Inducible nitric oxide synthase and CD11b+Gr1+ cells impair lymphatic contraction of tumor draining lymphatic vessels. *Lymphatic Research and Biology* 17: 294-300 (2019).

711. G Seano, HT Nia, KE Emblem, M Datta, J Ren, J Kloepper, S Krishnan, M Ghosh, MC Pinho, V Askoxylakis, GB Ferraro, L Riedemann, ER Gerstner, TT Batchelor, PY Wen, NU Lin, AJ Grodzinsky, D Fukumura, P Huang, JW Baish, TP Padera, LL Munn and RK Jain. Solid stress in brain tumours causes neuronal loss and neurological dysfunction and can be reversed by lithium. ***Nature Biomedical Engineering*** 3: 230-245 (2019). https://rdcu.be/bfJBl

712. J Chen, L Landegger, Y Sun, J Ren, N Maimon, L Wu, M Ng, J Chen, N Zhang, Y Zhao, X Gao, T Fujita, S Roberge, P Huang, RK Jain, S Plotkin, K Stankovic and L Xu. A cerebellopontine angle mouse model for the investigation of tumour biology, hearing and neurological function in NF2-related vestibular schwannoma. *Nature Protocols* 14(2):541-555 (2019).

713. V Askoxylakis, GB Ferraro, M Badeaux, DP Kodack, I Kirst, RC Shankaraiah, CSF Wong, DG Duda, D Fukumura and RK Jain. Dual endothelin receptor inhibition enhances T-DM1 efficacy in brain metastases from HER2-positive breast cancer. *NPJ Breast Cancer* 5: 4 (2019). https://rdcu.be/bgVG5

714. Y Zhao, J Cao , A Melamed , M Worley , A Gockley , D Jones , HT Nia , Y Zhang , T Stylianopoulos , AS Kumar , F Mpekris , M Datta , Y Sun , L Wu , X Gao , O Yeku , MG del Carmen , DR Spriggs , RK Jain and L Xu. Losartan treatment enhances chemotherapy efficacy and reduces ascites in ovarian cancer models by normalizing the tumor stroma. *PNAS* 116: 2210-2219 (2019) https://doi.org/10.1073/pnas.1818357116

715. C Voutouri, ND Kirkpatrick, E Chung, F Mpekris, JW Baish, LL Munn, D Fukumura, T Stylianopoulos and RK Jain. Experimental and computational analyses reveal dynamics of tumor vessel cooption and optimal treatment strategies. ***PNAS*** 116: 2662-2671 (2019) doi:10.1073/pnas.1818322116

716. **JD Martin, G Seano and RK Jain. Normalizing Function of Tumor Vessels: Progress, Prospects and Challenges. *Annual Reviews of Physiology* 81: 505-534 (2019).** https://doi.org/10.1146/annurev-physiol-020518-114700

717. **IX Chen, VP Cauhan, J Posada, MR Ng, MW Wu, P Adstamongkonkul, P Huang, N Lindeman, R Langer and RK Jain. Blocking CXCR4 alleviates desmoplasia, increases T-lymphocyte infiltration, and improves immunotherapy in metastatic breast cancer. *PNAS* 116 (10) 4558-4566 (2019) www.pnas.org/cgi/doi/10.1073/pnas.1815515116 [Accompanying Commentary by George Sledge 116 (11) 4769-4771 (2019) https://doi.org/10.1073/pnas.1900368116] [NCI Blog:** https://www.cancer.gov/news-events/cancer-currents-blog/2019/transplant-drug-immunotherapy-metastatic-breast-cancer]

718. H Nia, LL Munn and RK Jain. Mapping physical tumor microenvironment and drug delivery. *Clinical Cancer Research* 25: 2024-6 (2019). http://clincancerres.aacrjournals.org/content/25/7/2024.full
719. Z Amoozgar, RK Jain and D Duda. Role of apelin in glioblastoma vascularization and invasion after anti-VEGF therapy: What is the impact on the immune system? *Cancer Research* 79: 2104-2106 (2019).
720. **VP Chauhan, IX Chen, R Tong, MR Ng, JD Martin, K Naxerova, MW Wu, Y Boucher, DS Kohane, R Langer and RK Jain. Reprogramming the microenvironment with tumor-selective angiotensin blockers enhances cancer immunotherapy. *PNAS* 116: 10674-10680 (2019).**
721. M Datta, LM Coussens, H Nishikawa, FS Hodi and RK Jain. Reprogramming the Tumor Microenvironment to Improve Immunotherapy: Emerging Strategies and Combination Therapies. *Am Soc Clin Oncol Educ Book*. 39:165-174 (2019). doi: 10.1200/EDBK_237987.
722. **JE Murphy, JY Wo, DP Ryan, JW Clark, W Jiang, BY Yeap, LC Drapek, LS Blaszkowsky, CR Ferrone, M Qadan, D Berger, A Parikh, CD Weekes, R Nipp, EL Kwak, JN Allen, RB Corcoran, DT Ting, JE Faris, AX. Zhu, L Goyal, KD Lillemoe, RK Jain, TF DeLaney, DG Duda, Y Boucher, C Fernandez-del Castillo and TS Hong. Total Neoadjuvant Therapy with Folfirinox in Combination with Losartan Followed by Chemoradiotherapy for Locally Advanced Pancreatic Cancer: A Phase II Clinical Trial. *JAMA Oncology* 5(7):1020-1027 (2019).** Doi: 10.1001./jamaoncol.2019.0892.
723. JM Cleary, NK Horick, NJ McCleary, TA Abrams, MB Yurgelun, CG Azzoli, DA Rubinson, G Brooks, JA Chan, LS Blaszkowsky, JW Clark, L Goyal, JA Meyerhardt, K Ng, D Schrag, DMF Savarese, C Graham, KA Gibb, Y Boucher, DG Duda, RK Jain, CS Fuchs, and PC Enzinger. FOLFOX plus ziv-aflibercept or placebo in first-line metastatic esophagogastric adenocarcinoma (ZAMEGA): a double blind randomized multi-center phase 2 trial. *Cancer* 125: 2213-2221 (2019). **https://doi.org/10.1002/cncr.32029**
724. CJ Rowland, OT Bruns, D Franke, D Fukumura, RK Jain, MG Bawendi and PTC So. Increasing the penetration depth of temporal focusing multiphoton microscopy for neurobiological applications. *Journal of Physics D: Applied Physics* (in press, 2019).
725. C Fernandez-Martos, C Pericay, F Losa, R García-Carbonero, L Layos, N Rodríguez-Salas, M Martin-Richard, V Alonso, R Vera, J Gallego, J Capdevila, A Salud, M Nogué, J Maurel, I Guash, C Montagut, C Lopez, I Macias RK Jain, and X Garcia-Albeniz. Effect of Adding Aflibercept to Induction Chemotherapy Followed by Chemoradiotherapy and Surgery in High-Risk Rectal Cancer. GEMCAD 1402 Study. A Randomized Clinical Trial. *JAMA Oncology*. 5(11):1566-1573 (2019).
726. **LL Munn and RK Jain. Vascular regulation of anti-tumor immunity. *Science* 365: 544-545 (2019).**
727. **CD Arvanitis, GB Ferraro and RK Jain. The blood–brain barrier and blood–tumor barrier in brain tumors and metastases. *Nature Reviews Cancer* 20: 26-41 (2020).**
728. E Gerstner, K Emblemn, K Chang, B Vakulenko-Lagun, Y-F Yen, A Beers, J Dietrich, S Plotkin, C Catana, J Hooker, D Duda, B Rosen, J Kalpathy-Cramer, RK Jain, and TB Batchelor. Bevacizumab reduces permeability and concurrent temozolomide delivery in a subset of patients with recurrent glioblastoma. *Clinical Cancer Research* 26 :206-212 (2020).
729. **JA Flores-Toro, D Luo, A Gopinath, MR Sarkisian, JJ. Campbell, IF Charo, R Singh, TJ Schall, M Datta, RK Jain, DA Mitchell and JK Harrison. CCR2 inhibition reduces tumor myeloid cells and unmasks a checkpoint inhibitor effect to slow progression of resistant murine gliomas. *PNAS* 117(2):1129-1138 (2020).**
730. JP Leone, DG Duda, J Hu, WT Barry, L Trippa, ER Gerstner, RK Jain, STan, E Lawler, EP Winer, NU Lin, and SM Tolaney. A phase II study of cabozantinib alone or in combination with trastuzumab in breast cancer patients with brain metastases. *Breast Cancer Research and Treatment* 179(1):113-123 (2020).
731. G. Seano and RK Jain. Vessel co-option in glioblastoma: emerging insights and opportunities. *Angiogenesis* 23: 9–16 (2020). https://doi.org/10.1007/s10456-019-09691-z
732. F Mpekris, C Voutouri, JW Baish, DG Duda, LL Munn, T Stylianopoulosa and RK Jain. Combining microenvironment normalization strategies to improve cancer immunotherapy. *PNAS* 117: 3728-37 (2020). [Accompanying Commentary by AS Popel, Immuno-activating the tumor microenvironment enhances immunotherapy as predicted by integrative computational model. PNAS 117 (9) 4447-4449 (2020), https://www.pnas.org/content/early/2020/02/25/2001050117].
733. **Sahai E, Astsaturov I, Cukierman E, DeNardo DG, Egeblad M, Evans RM, Fearon D, Greten FR, Hingorani SR, Hunter T, Hynes RO, Jain RK, Janowitz T, Jorgensen C, Kimmelman AC, Kolonin MG, Maki RG, Powers RS, Puré E, Ramirez DC, Scherz-Shouval R, Sherman MH, Stewart S, Tlsty**

TD, Tuveson DA, Watt FM, Weaver V, Weeraratna AT, Werb Z. A framework for advancing our understanding of cancer-associated fibroblasts. ***Nature Reviews Cancer*** **20(3):174-186 (2020).**

734. **JD Martin, H Cabral, T Stylianopoulos and RK Jain. Improving cancer immunotherapy using nanomedicine: Progress, opportunities and challenges.** ***Nature Reviews Clinical Oncology*****. 17(4):251-266 (2020). DOI:** https://www.nature.com/articles/s41571-019-0308-z
735. **DG Millar, N Gupta, RR Ramjiawan, LT Morton, S Zhang, F Shi, JM Heather, K Shigeta, S Sepulveda, L Wan, R Joseph, E Minogue, A Khatri, A Bardia, LW Ellisen, RB Corcoran, A Hata, SI Pai, RK Jain, D Fukumura, DG Duda and M Cobbold. Reprogramming antigenicity through selective delivery of peptide payload corrects antigen-repertoire mismatch in cancer.** ***Nature Biotechnology*****. 38(4):420-425 (2020)** https://doi.org/10.1038/s41587-019-0404-8.
736. K Shigeta, M Datta, Tai Hato, S Kitahara, I Chen, A Matsui, H Kikuchi, E Mamessier, S Aoki, P Huang, M Cobbold, AX Zhu, RK Jain and DG Duda. Dual PD-1 and VEGFR-2 blockade promotes vascular normalization and enhances anti-tumor immune responses in HCC. *Hepatology* 71(4):1247-126 (2020).
737. **M Saif, WJ Kwanten, JA Carr, IX Chen, JM Posada, A Srivastava, J Zhang, Y Zheng, M Pinter, S. Chatterjee, S Softic, CR Kahn, KV Leyen, OT Bruns, RK Jain and MG Bawendi. NIR/SWIR Imaging Establishes Endogenous Lipofuscin as a Biomarker for Monitoring Chronic Liver Disease Noninvasively.** ***Nature Biomedical Engineering*** **4(8):801-813 (2020).** https://doi.org/10.1038/s41551-020-0569-y
738. B Ngo, E Kim, V Osorio-Vasquez, S Doll, S Bustraan, RJ Liang, A Luengo, SM Davidson, A Ali, GB Ferraro, GM Fischer, R Eskandari, DS Kang, J Ni, A Plasger, VK.Rajasekhar, ER Kastenhuber, S Bacha, RK Sriram, BD Stein, SF Bakhoum, M Snuderl, P Cotzia, JH Healey, N Mainolfi, V Suri, A Friedman, M Manfredi, DM Sabatini, DR Jones, M Yu, JJ Zhao, RK Jain, KR Keshari, MA Davies, MG Vander Heiden, E Hernando, M Mann, LC Cantley and ME Pacold. Limited Environmental Serine and Glycine Confer Brain Metastasis Sensitivity to PHGDH Inhibition. *Cancer Discovery*. 10:1352–73 (2020) **DOI:** 10.1158/2159-8290.CD-19-1228
739. HT Nia, M Datta, G Seano, S Zhang, WW Ho, S Roberge, P Huang, LL Munn and RK Jain. In vivo compression and imaging in the brain to measure the effects of solid stress. *Nature Protocols* 15(8):2321-2340 (2020). DOI: 10.1038/s41596-020-0328-2
740. JD Martin, DG Duda and RK Jain. Going beyond VEGF pathway inhibition for antiangiogenic cancer therapy: Is inhibition of the PP2A/B55a complex the answer? *Circulation Research* 127(6):724-726 (2020).
741. JD Martin and RK Jain. Normalizing the tumor microenvironment for radiosensitization. In "Molecular Targeted Radiosensitizers: Opportunities and Challenges." Editors: Henning Willers & Iris Eke. *Cancer Drug Discovery and Development*. Chapter 12 pp 301-338 (2020). DOI: 10.1007/978-3-030-49701-9
742. M Valiente, A Van Swearingen, C Anders, A Bairoch, A Boire, P Bos, D Cittelly, N Erez, G Ferraro, D Fukumura, B Gril, M Herlyn, S Holmen, RK Jain, J Joyce, M Lorger, J Massague, J Neman, N Sibson, P Steeg, F Thorsen, L Young, D Varešlija, A Vultur, F Weiss-Garcia, and F Winkler. Brain Metastasis Cell Lines Panel: a public resource of organotropic cell lines. *Cancer Research*. Published online on July 8, 2020. DOI: 10.1158/0008-5472.CAN-20-0291.
743. **IX Chen, K Newcomer, K Pauken, VR Juneja, K Naxerova, MW Wu, M Pinter, M Singer, AH Sharpe and RK Jain. A bilateral tumor model identifies transcriptional programs that associated with patient response.** ***PNAS*****. 117: 23684-94 (2020).**
744. C Voutouri, MR Nikmaneshi, CC Hardin, AB Patel, A Verma, MJ Khandekar, S Dutta, T Stylianopoulos, LL Munn and RK Jain. In silico dynamics of COVID-19 phenotypes for optimizing clinical management. Posted on September 3, 2020. DOI: 10.21203/rs.3.rs-71086/v1
745. S Subburaju, S Kaye, YK Choi, J Baruah, D Datta, J Ren, A S Kumar, G Szabo, D Fukumura, RK Jain, A Elkha and A Vasudevan. NAD+ Mediated Rescue of Prenatal Forebrain Angiogenesis Restores Postnatal Behavior. *Science Advances* 6(41): eabb9766 (2020).PMID: 33036972 - DOI: 10.1126/sciadv.abb9766
746. M Pinter, RK Jain, DG Duda. The current landscape of immune checkpoint blockade in hepatocellular carcinoma. *JAMA Oncology*. Published online October 22, 2020. doi:10.1001/jamaoncol.2020.338
747. **H Nia, LL Munn and RK Jain. Physical Traits of Cancer.** ***Science*** **370: eaaz0868 (2020). doi: 10.1126/science.aaz0868. https://science.sciencemag.org/content/370/6516/eaaz0868**
748. K Shigeta, A Matsui, H Kikuchi, S Klein, E Mamessier, I Chen, S Aoki, S Kitahara, K Inoue, A Shigeta, T Hato, RR Ramjiawan, D Staiculescu, D Zopf, L Fiebig, GS. Hobbs, A Quaas, S Dima, I Popescu, P Huang, LL Munn, M Cobbold, L Goyal, AX Zhu, RK.Jain and DG Duda. Regorafenib combined with

PD1 blockade increases CD8 T-cell infiltration by inducing CXCL10 expression in hepatocellular carcinoma. *Journal for ImmunoTherapy of Cancer* (in press).

749. L Nayak, AM Molinaro, KB Peters, JL Clarke, JT Jordan, JF de Groot, PL Nghiemphu, TJ Kaley, H Colman, C McCluskey, S Gaffey, T Smith, DJ Cote, M Severgnini, JH Yearley, Q Zhao, WM Blumenschein, DG Duda, A Muzikansky, RK Jain, PY Wen and DA Reardon. Phase II and biomarker study of pembrolizumab or pembrolizumab plus bevacizumab for recurrent glioblastoma patients. *Clinical Cancer Research* (in press).
750. X Jin, Z Demere, K Nair, A Ali, GB Ferraro, T Natoli, A Deik, L Petronio, A Tang, C Zhu, L Wang, D Rosenberg, V Mangena, J Roth, K Chung, RK Jain, C Clish, M Vander Heiden and TR Golub.MetMap: a map of metastatic potential of human cancer cell lines. *Nature* (in press).
751. Gerstner ER, Emblem KE, Yen Y-F, Dietrich J, Jordan JT, Catana C, Wenchin KL, Hooker J, Duda DG, Rosen BR, Kalpathy-Cramer J, Jain RK, Batchelor TT. Vascular Dysfunction Promotes Regional Hypoxia after Bevacizumab Therapy in Recurrent Glioblastoma Patients. *Neuro-Oncology Advances*.

SUBMITTED

752. G Ferraro et al. Fatty acid synthesis is required for breast cancer brain metastasis. (submitted).
753. S Aoki, DH Schanne, S Klein, E Nakagawa, A Koch, A Matsui, HT Nia, K Inoue, M Yamanaka, H Kikuchi, E Mamessier, G Geidel, NP Talele, P Huang, S Dima, Vlad Herlea, I Popescu, JW Clark, RK Jain, LL Munn, N Bardeesy, AX Zhu, R Büttner, A Liss, C Fernandez-del Castillo, TS. Hong and, DG Duda. Role of MET/CTGF axis in growth and chemotherapy resistance of metastatic pancreatic ductal adenocarcinoma. (submitted).
754. S Aoki, S Kitahara, T Hato, H Nia, I Chen, S Halvorsen, S Sassi, D Schanne, Ay Matsui, E Mamessier, K Shigeta, R Ramjiawan, K Inoue, H Kikuchi, S Dima, I Popescu, N Bardeesy, LL Munn, RK Jain, A Zhu, and DG Duda. Placental growth factor increases desmoplasia and tissue stiffness and promotes tumor progression via Akt activation in intrahepatic cholangiocarcinoma. (submitted).

BOOKS/MONOGRAPHS

R.K. Jain and P.M. Gullino (editors), "Thermal Characteristics of Tumors: Applications in Detection and Treatment." Proceedings of an International Conference held in New York, March 14-16, 1979, *Annals of the New York Academy of Sciences,* **335** (1980)

P. Stroeve, R.K. Jain, and K. Himmelstein (editors), "Transport Phenomena in Biomedical Systems." Proceedings of Biomedical Engineering Sessions at the 75th Annual Meeting of AIChE, Los Angeles, November 1982. *A.I.Ch.E. Symposium Series 227*, **79** (1983)

J.C. Chato and R.K. Jain (editors), "Macro- and Microscopic Modeling of Heat and Mass Transfer in Biological Systems." *Proceedings of NSF Workshop,* Urbana-Champaign, April (1983)

W.B. Krantz, D.T. Wasan and R.K. Jain (editors), "Thin Liquid Film Phenomena." Proceedings of Symposia held at the ACS Meeting, Chicago, September 8-11, 1985. *A.I.Ch.E. Symposium Series 252,* **82** (1986)

P. Vaupel and R.K. Jain (editors), "Tumor Blood Supply and Metabolic Microenvironment: Characterization and Therapeutic Implications," Gustav Fischer Publications, Stuttgart (1991).

R.K. Jain (editor), "Blocking Tumor Angiogenesis: The Role of Bevacizumab (Avastin)," Supplement to *Seminars in Oncology,* **29** (2002).

D. Shepro, P. A. D'Amore, C. M. Black, J. G. N. Garcia, D. N. Granger, C. Haudenschild, H. B. Hechtman, R. K. Jain and J. A. Madri (editors), "Microvascular Research: Biology and Pathology," Academic Press (2005).

Choi B, Bouma B, Fukumura D, Jain RK (editors), "Optical methods in vascular biology and medicine." *J Biomed Opt*. 15:011001 (2010).

Jain RK, Duda DG, Fukumura D (Guest Editors), "Special Issue on Critical Issues in Tumor Microenvironment." *The Cancer Journal*. Volume 24: 235-356 (2015). http://journals.lww.com/journalppo/pages/currenttoc.aspx

Jain RK and Batista A (Editors), "Special Issue: Physical Sciences in Oncology." *Trends in Cancer* vol 4 (2018). https://www.cell.com/trends/cancer/issue?pii=S2405-8033(17)X0005-8

PATENTS (Granted)

R.K. Jain, Y. Boucher, A. Stacey-Clear, R. Moore and D. Kopans, "Method for Locating Tumors Prior to Needle Biopsy," U.S. Patent Number 5, 396, 897, March 14, 1995.

P. Netti and R.K. Jain, "Method of Enhancing Delivery of a Pharmaceutical Formulation," U.S. Patent Number 5, 888, 530, March 30, 1999.

R.K. Jain, R.J. Melder, G.C. Koenig, and L.L. Munn. "Therapeutic Use of bFGF to Treat Conditions Involving Adhesion of Cytotoxic White Cells to Endothelium," U.S. Patent Number 6, 101, 712, January 4, 2000.

G. Helmlinger, P. Netti, R.J. Melder, H. Lichtenbeld-Dubois, and R.K. Jain. "Modulation of Multicellular Aggregates by Pressure from Growth in a Matrix," U.S. Patent Number 6,368,858, April 9, 2002.

R. B. Campbell and R. K. Jain, "Drug Delivery Formulations and Targeting," U.S. Patent Number 6,860,068, January 20, 2004.

B. Seed and R. K. Jain. "Methods to Potentiate Cancer Therapies," U.S. Patent number 6,719,977, April 13, 2004.

Jain RK, Duda DG, Kozin SV, Fukumura D. "Anti-CXCR4 as a sensitizer to cancer therapeutics," U.S. Patent No. 9,155,723, Oct 13, 2015.

R. K. Jain, V. Chauhan, B. Diop-Frimpong, Y. Boucher, S. M. Krane and A. L. Crane. "Novel Composition and Uses of Anti-hypertension agents for Cancer Therapy." Foreign Patent No. 030258-069094-AU, April 13, 2017.

C. R. Wong, M. G. Bawendi, D. Fukumura, and R. K. Jain. "Multistage nanoparticle drug delivery system for the treatment of solid tumors," U.S. Patent No. 9,919,059, March 20, 2018.

Weblinks related to Dr. Jain's work:

http://steele.mgh.harvard.edu
https://scholar.google.com/citations?hl=en&view_op=list_works&gmla=AJsN-F6VH0cp60-zRChr4702P2i1DqGD8iPwaPQK8n0LLqol0SSIkGimHni7dI-89yMSfyUpH6DOJMeOGCikApvMxnTF9-FrN8OqdhfepL9rNEO-A8hp2G9W8C5Zjs1sN3jSKvhe6CRN&user=8Zwiu-oAAAAJ
http://dms.hms.harvard.edu/BBS/fac/Jain.php
http://www.onclive.com/publications/Oncology-live/2013/July-2013/Exploring-Tumors-in-Context-Jains-Work-Blazes-Trail-on-Microenvironment
https://giving.massgeneral.org/pursuing-new-cancer-treatments-basics-breakthroughs/
http://www.kuleuven.be/english/news/2015/psd2015-interview-rakesh-jain;
https://www.nationalmedals.org/laureates/rakesh-k-jain
https://www.youtube.com/watch?v=wLmZDdEu5pA&list=PLGILsjR-1Ms1uGmfjagfOMa2ftPlO1LE&index=34
https://vimeo.com/344117059