

Date Prepared: August 17, 2026  
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## Education

|      |                       |                                       |                          |
|------|-----------------------|---------------------------------------|--------------------------|
| 1987 | B.S., summa cum laude | Chemical Engineering                  | University of Cincinnati |
| 1993 | Ph.D.                 | Chemical Engineering & Bioengineering | Rice University          |

## Industry Experience

|           |                |                  |                   |
|-----------|----------------|------------------|-------------------|
| 1984-1986 | Co-op Engineer | Photolithography | Kodak, Dayton, OH |
|-----------|----------------|------------------|-------------------|

## Postdoctoral Training

|             |                     |                                        |                                |
|-------------|---------------------|----------------------------------------|--------------------------------|
| 06/93-03/96 | Postdoctoral Fellow | Blood Rheology & Leukocyte Trafficking | Massachusetts General Hospital |
|-------------|---------------------|----------------------------------------|--------------------------------|

## Faculty Academic Appointments

|              |                     |                                          |                                        |
|--------------|---------------------|------------------------------------------|----------------------------------------|
| 1996-1998    | Instructor          | Radiation Oncology                       | Harvard Medical School                 |
| 1999-2004    | Assistant Professor | Radiation Oncology                       | Harvard Medical School                 |
| 2004-present | Associate Professor | Radiation Oncology                       | Harvard Medical School                 |
| 2021-present | Visiting Professor  | Biomechanical and Biomedical Engineering | Université de Technologie de Compiègne |

## Appointments at Hospitals/Affiliated Institutions

|              |                     |                        |                                |
|--------------|---------------------|------------------------|--------------------------------|
| 1988-1993    | Fellow, Immunology  | Immunology             | M.D. Anderson Cancer Center    |
| 1993-1996    | Research Fellow     | Radiation Oncology     | Massachusetts General Hospital |
| 2004-2016    | Associate Biologist | Radiation Oncology     | Massachusetts General Hospital |
| 2016-present | Investigator        | MGH Research Institute | Massachusetts General Hospital |

## Major Administrative Leadership Positions

### Local

|              |                                                                            |                                                          |
|--------------|----------------------------------------------------------------------------|----------------------------------------------------------|
| 1995-present | Director, Bioengineering, Imaging, and Computing Core, Steele Laboratories | Massachusetts General Hospital                           |
| 2010-present | Deputy Director                                                            | Steele Laboratories, MGH                                 |
| 2017         | Co-chair and organizer                                                     | 2017 Boston Angiogenesis Meeting<br>Starr Center, Boston |

### Regional

|              |                                   |                                                                                |
|--------------|-----------------------------------|--------------------------------------------------------------------------------|
| 2006-2023    | Program Steering Committee Member | City College New York / Memorial Sloan Kettering                               |
| 2023-present | Chair, Program Steering Committee | Cancer Center Partnership for Cancer Research, Training and Community Outreach |

**National and International**

|               |                                           |                                                                                                                                                          |
|---------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2012 -2014    | Expert Panelist                           | Assessment of Physical Sciences and Engineering Advances in Life Sciences and Oncology (APHELION) in Europe<br>NCI, Office of Physical Sciences Oncology |
| 2012          | Co-Chair and Organizer                    | US National Committee on Biomechanics 4 <sup>th</sup> Symposium on Frontiers in Biomechanics: "Mechanics in Oncology"                                    |
| 2014          | Co-Chair and Organizer                    | Mathematical Biosciences Institute Workshop on Metastasis and Angiogenesis, Ohio State University                                                        |
| 2018          | Co-Chair                                  | 8th World Congress of Biomechanics, Dublin, Ireland                                                                                                      |
| 2019 -present | SAB member                                | SimBioSys, Inc.                                                                                                                                          |
| 2020-present  | Chair, External Scientific Advisory Board | Center for Cancer Engineering,<br>The Ohio State University                                                                                              |
| 2021          | Chair, Lymphatic Modeling                 | Lymphatic Forum 2021                                                                                                                                     |
| 2022          | Participant                               | NCI/IBM Ideas Lab on Biologically Informed Models of Combination Therapies                                                                               |

**Committee Service****Local**

|              |                                       |                                                        |
|--------------|---------------------------------------|--------------------------------------------------------|
| 1993-present | Candidate Search Committee<br>1993-96 | Steele Laboratories, MGH<br>Chair                      |
| 2016-2020    | Co-Organizer, MGH site                | Harvard Medical School Vascular Biology Seminar Series |

**National and International**

|      |                                  |                                                                      |
|------|----------------------------------|----------------------------------------------------------------------|
| 2013 | External thesis committee member | Univ. Waterloo, Madjid Soltani dissertation                          |
| 2013 | President, thesis committee      | Institut Curie, Kevin Alessandri dissertation                        |
| 2016 | External thesis committee member | McGill University, S. Ghaffari dissertation                          |
| 2023 | External thesis committee member | Univ. Waterloo, Cameron Meaney dissertation                          |
| 2023 | External thesis committee member | Boston University, Sue Zhang dissertation                            |
| 2023 | External thesis committee member | Texas A&M Univ., Mutaz Mohammad dissertation                         |
| 2025 | External thesis committee member | Université de Technologie de Compiègne,<br>Alaa Bou Orm dissertation |

**Professional Societies**

|              |                                                       |               |
|--------------|-------------------------------------------------------|---------------|
| 1993-present | American Institute of Chemical Engineers<br>1999–2008 | session chair |
| 2001-present | Biomedical Engineering Society<br>2000-2005           | session chair |
| 2002-present | American Association for Cancer Research              |               |
| 2002-present | Radiation Research Society                            |               |
| 2010-present | Microcirculatory Society                              |               |
| 2009-present | North American Vascular Biology Association           |               |
| 2017-present | American Association for the Advancement of Science   |               |

2019-present American Physiology Society

### Grant Review Activities

|                  |                                                                          |                                            |
|------------------|--------------------------------------------------------------------------|--------------------------------------------|
| 6/7/00           | Transfusion Medicine                                                     | NIH (NHLBI), Ad hoc Member                 |
| 3/23/01          | Oncological Sciences Rev. Committee                                      | NIH (NCI), Ad hoc Member                   |
| 6/2/04 - 6/10/04 | FastLane review system                                                   | National Science Foundation, Ad hoc Member |
| 3/9/05           | Microscopic Imaging Study Section                                        | NIH, Ad hoc Member                         |
| 10/12 – 10/13/06 | Tumor Microenvironment                                                   | NIH (NCI), Ad hoc Member                   |
| 6/4-6/6/07       | Modeling & Analysis of Biological Systems                                | NIH, Ad hoc Member                         |
| 2010 -present    | Systems Biology, ZRG1 VH-D (55)                                          | NIH (NHLBI), Member                        |
| 1/11-3/12        | Vascular Hematology SEP                                                  | NIH, Ad hoc Member                         |
| 3/18/14          | SEP/ Scientific Review Group ZEB1 OSR-C (M3) Review panel                | NIH (NIBIB), Ad hoc Member                 |
| 11/19/2015       | SEP/Scientific Review Group 2016/01 ZCA1 TCRB-T (J2) Review panel        | NIH (NCI), Ad hoc Member                   |
| 4/14/2016        | Physical Sciences Oncology Centers (U54) Review panel                    | NIH (NCI), Ad hoc Member                   |
| 2014-present     | Research Council KU Leuven                                               | University of Leuven, Belgium, Reviewer    |
| 2016-present     | Research Grants Council (RGC) of Hong Kong                               | University Grants Committee, Reviewer      |
| 2/19-2/20 2019   | Drug Discovery and Molecular Pharmacology Study Section                  | NIH (NCI), Ad hoc Member                   |
| 2019-present     | ITMO Cancer of the French National Alliance for Life and Health Sciences | Inserm, Reviewer                           |
| 2/19-2/20/2020   | Hypertension and Microvasculature                                        | NIH (NHLBI), Ad hoc Member                 |
| 7/26/2021        | IVPP SEP                                                                 | NIH (NHLBI), Ad hoc Member                 |
| 2/17-18/2021     | Integrative Vascular Physiology and Pathology                            | NIH (NHLBI), Ad hoc Member                 |
| 4/4/2025         | Physical Sciences- Oncology Projects (U01)                               | NIH (NCI), Ad hoc Member                   |

### Editorial Activities (reviewer)

|                                  |                            |
|----------------------------------|----------------------------|
| American Journal of Physiology   | Lab on a Chip              |
| Analytical Chemistry             | Lancet Oncology            |
| Annals of Biomedical Engineering | Microcirculation           |
| Biorheology                      | Microvascular Research     |
| Biotechniques                    | Nature Cell Biology        |
| Cancer Cell                      | Nature Methods             |
| Cancer Research                  | Physical Review Letters    |
| Integrative Biology              | PLoS Computational Biology |
| Nature Biomedical Engineering    | PNAS                       |
| Journal of Theoretical Biology   | PNAS Nexus                 |

### Other Editorial Roles

|              |              |                  |
|--------------|--------------|------------------|
| 2015-present | Guest Editor | PNAS             |
| 2017-2022    | Editor       | Microcirculation |

### Honors and Prizes

|              |                                                        |                                                                            |                                           |
|--------------|--------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------|
| 1987         | Eng. Honor Society, Tau Beta Pi                        | University of Cincinnati                                                   |                                           |
| 1989         | Cox Fellowship                                         | Rice University                                                            |                                           |
| 1991         | Phillips Award for Pre-doctoral Research               | Rice University                                                            |                                           |
| 1995         | Postdoctoral training grant                            | NIH                                                                        |                                           |
| 2000         | LJIS Travel Award                                      | Whitaker Foundation                                                        |                                           |
| 2006         | Outstanding cover design                               | Taylor & Francis Group, Computational and Mathematical Methods in Medicine | Scientific illustration for journal cover |
| 2013         | Gerritsen Award                                        | Microcirculatory Society                                                   | Most cited journal article                |
| 2014         | Gerritsen Award                                        | Microcirculatory Society                                                   | Most cited journal article                |
| 2015         | Distinguished Alumnus Award                            | Rice University                                                            |                                           |
| 2016-present | Member of the College of Fellows                       | American Institute for Medical and Biological Engineering                  |                                           |
| 2018         | University Delegate, Inauguration of Harvard President | Rice University                                                            |                                           |
| 2019         | Top cited article                                      | Wires Systems Biology and Medicine                                         |                                           |
| 2020-present | Top 0.05% composite citation index                     | Elsevier Data Repository<br>DOI: 10.17632/btchxktzyw.6                     |                                           |
| 2024-present | Highly Ranked Scholar                                  | ScholarGPS                                                                 | Top 0.05% of all scholars                 |

### Report of Funded and Pending Projects

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7/12/95-7/11/97    | <p><b>Molecular Biophysics of Leukocyte Adhesion (Munn)</b><br/>NIH F32</p> <p>In this training grant project, I used quantitative in vitro and in vivo approaches to analyze the biophysics of leukocyte trafficking. A major finding, which formed the basis of my first R01, was that mechanical interactions with leukocytes greatly affect leukocyte interactions with the endothelium.</p>                                                                                                                                                                |
| 12/1/96 - 11/30/99 | <p><b>Microvascular Permeability Measurements in Individual Tumor Vessels (Munn)</b><br/>The Whitaker Foundation Bioengineering Young Investigator Grant<br/>PI (Total Direct Costs: \$209,153)</p> <p>In this project, we used innovative approaches, including cannulation of individual microvessels, to determine the roles of growth factors such as VEGF in vascular permeability control. The conclusion was that tumor vessel heterogeneity is caused by local growth factor secretion and synergistic cooperation between distinct growth factors.</p> |

- 6/1/00 – 5/31/04      **Cell-Surface Adhesion: Influence of Blood Rheology (Munn)**  
NIH R01 HL64240  
PI (Total Direct Costs: \$991,431)  
These studies focused on the physical forces and rheological characteristics that influence adhering leukocytes in the bloodstream. Results showed that the forces exchanged between the blood cells and the vasculature can have important implications for 1) the extrapolation of in vitro studies to physiological adhesion, 2) the development of more physiologic blood substitutes, 3) explaining and overcoming immune surveillance by solid tumors and 4) formulation of novel strategies for prevention of atherosclerosis.
- 8/1/03-4/1/06      **Blood Rheology and Leukocyte Mechanics (Munn)**  
NIH K02 HL73237  
PI (Total Direct Costs: \$514,755)  
In this career development award, I developed mathematical models to study the dynamics of leukocyte rolling and adhesion in representative vascular geometries. The model provided new insight into the essential physics of RBC-leukocyte interactions, and established the mathematical model as an essential tool in my lab for analyzing blood flow.
- 6/1/04 – 4/30/08      **Blood Rheology, Cell Adhesion and Endothelial Activation (Munn)**  
NIH R01 HL64240  
PI (Total Direct Costs: \$725,000)  
This work determined the role of blood vessel geometry and RBC aggregation in the initiation of leukocyte rolling. Mathematical modeling and novel microfabricated networks were used to determine the critical fluid dynamics and vessel parameters required for leukocyte adhesion.
- 9/1/07 – 8/31/09      **Microfluidic Device for Isolating Rare Blood Cells (Munn)**  
NIH R21 CA126761  
PI (Total Direct Costs: \$225,000)  
Taking advantage of the natural tendency for blood cells to segregate under certain conditions, we developed microfluidic devices for collecting nucleated cells from whole blood samples.
- 7/20/00 - 5/31/10      **Integrative Biology of Tumor Metastasis Bioengineering Research Partnership (Jain)**  
NIH R01CA085140  
Role: Project 3 Leader, "Role of solid stress in micrometastasis progression"  
The goal of this partnership grant was to determine the role of the microenvironment in metastasis. My project discovered that growth-induced compressive stresses can initiate cancer cell invasion.
- 10/01/09–09/30/11      **Microfluidic collection of circulating tumor cells (Munn)**  
Federal Share/NCI Proton Beam Program Income  
PI (Total Direct Costs: \$158,103)  
We developed a small device that enriches rare cells directly from whole blood. The goal was to detect circulating cells in blood samples from patients during cancer treatment, integrating a downstream processing unit that specifically quantifies and captures defined cell populations.

- 8/01/06–04/30/11      **Integrative Pathophysiology of Solid Tumors (Jain)**  
 NIH PO1-CA80124 (2<sup>nd</sup> competitive renewal)  
 Project 2 Leader (Project 2 Total Direct Costs: \$856,96)  
 The overall goal of this P01 (PPG) Grant was to develop a quantitative understanding of the physiological resistance to solid tumor treatment using intravital microscopy, mathematical modeling and molecular techniques.
- 09/15/09–08/31/12      **Blood rheology: analytical approaches to sickle cell disease (Munn)**  
 NIH R56HL064240  
 PI (Total Direct Costs: \$442,500)  
 In this project, we used mathematical simulations and microfluidic devices to improve treatment of sickle cell disease.
- 06/01/10–05/31/14      **Flow-based remodeling and function of tumor vasculature (Munn)**  
 National Institutes of Health R01CA149285  
 PI (Total Direct Costs: \$747,000)  
 The goal of this project is to determine how changes in vessel permeability and network structure independently influence oxygen and drug delivery throughout tumor tissue.
- 12/1/11 – 11/30/16      **Encouraging Anastomosis of engrafted vascular networks (Munn)**  
 NHLBI/National Institutes of Health R01HL106584  
 PI (Total Direct Costs: \$1,378,098)  
 This study tests novel strategies for accelerating perfusion of engrafted vascular networks by facilitating vascular connections.
- 5/1/12–4/30/17      **Integrative Pathophysiology of Solid Tumors (Jain)**  
 NCI/National Institutes of Health PO1CA80124 (3<sup>rd</sup> competitive renewal)  
 Core A Director (Core A Total Direct Costs: \$645,612; PI: R.K. Jain)  
 The overall goal of this P01 (PPG) Grant was to develop a quantitative understanding of the physiological resistance to solid tumor treatment using intravital microscopy, mathematical modeling and molecular techniques.
- 8/1/15-5/31/20      **Systems biology of lymphatic transport (Munn, Padera)**  
 NHLBI/National Institutes of Health R01HL128168  
 Contact PI (Total Direct Costs: \$1,818,464)  
 This project will characterize the mechanobiological control mechanisms that drive lymphatic transport, and use the resulting information to develop therapies for lymphedema.
- 12/01/16-11/30/21      **Targeting glycocalyx-mediated mechanisms of tumor metastasis (Munn, Tarbell)**  
 NCI/National Institutes of Health R01CA204949  
 Contact PI (Total Direct Costs: \$2,182,865)  
 We propose to identify the mechanical structures and signals that initiate metastasis and then target these in a preclinical model of renal carcinoma. When complete, this project will reveal basic information about cancer mechanobiology and lead to novel strategies for treating metastatic disease.

- 07/2021- 06/2023      **Multiplexed device for rapid coagulopathy testing**  
 NIBIB National Institutes of Health R21 EB031982  
 PI (Total Direct Costs \$462,000)  
 Abnormal blood clotting is a major contributor to patient mortality in COVID-19 and trauma cases, causing pulmonary embolism, heart attack or stroke. Intravascular clotting can also reduce blood oxygenation, contributing to the need for ventilation. Unfortunately, clinical tests for abnormal blood clotting are limited, and not optimized for COVID-19 testing. Here, we will develop new technology for measuring blood clotting status so coagulation problems can be diagnosed more easily and accurately.
- 07/2021 - 06/2026      **Vascularized tumor explants for drug testing**  
 NCI/ NIH-National Institutes of Health R01CA247441  
 Contact PI (Total Direct Costs \$1,856,363)  
 Oncologists need better tools for assessing patient tumors on a case-by-case basis during treatment planning. We propose to develop robust technology that will allow scientists to study cancer biology or perform drug testing on clinically relevant samples. The technology will provide the urgently needed tools for cancer research and for personalized assessment of treatment response so that the most effective treatment can be applied.
- Current**  
 07/2023 - 06/2028      **Systems Biology of Antigen and T-Cell Transport in Cancer Immunotherapy**  
 NCI/ NIH-National Institutes of Health R01 CA284603  
 Co-PI (Total Direct Costs: \$2,433,478)  
 Cancer immunotherapy is curing patients who previously had extremely poor prognosis, but many patients do not respond. A critical step for immune activation is for the correct T-cells to encounter antigen in the tumor-draining lymph node. We propose to analyze this process using mathematical modeling and animal experiments to determine how these encounters between antigen and T-cells in lymph nodes can be impaired by metastasis and identify strategies for enhancing immune activation in non-responding patients.
- 09/2021 - 08/2026      **Targeting physical stress-driven mechanisms to overcome glioblastoma treatment resistance**  
 NCI/ NIH-National Institutes of Health U01CA261842  
 Contact PI (Total Direct Costs \$3,062,772)  
 Immune checkpoint blockade therapy has shown great promise, creating durable responses in a number of cancers, but the current drugs are expensive and have no survival benefit in brain cancer. We propose to find new targets for immunotherapy that will be effective for treating patients with glioblastoma, the most aggressive brain cancer. Specifically, we will determine how physical stresses in the tumor allow them to escape immunity, and then inhibit these pathways with strategies to improve outcomes and decrease toxicity in GBM patients.
- 07/2025 - 06/2028      **Modeling fluid homeostasis and vessel function in single ventricle heart disease**  
 Additional Ventures Foundation 1452100  
 PI (Total Direct Costs \$647,229)  
 In congenital heart diseases such as SVD, fluid balance is disrupted, leading to swelling (edema) and potential complications like liver disease or organ failure. While previous studies have explored fluid balance, none have fully addressed the complexities of SVD. Our project aims to create a comprehensive computer model simulating fluid flow in blood and lymphatic vessels, considering factors like pressure, flow rates, and vessel shear stresses.

**Training Grants and Mentored Trainee Grants**

6/01/08-5/31/13

**Training Program in Integrative Pathophysiology of Solid Tumors (Jain)** NCI/National Institutes of Health T32CA073479 (3<sup>rd</sup> competitive renewal)

Role: Faculty

The goal was to train postdoctoral fellows from diverse backgrounds in the area of tumor pathophysiology and the physical oncology.

**REPORT OF LOCAL TEACHING AND TRAINING****Teaching of Students in Courses**

|              |                                                                   |                                     |
|--------------|-------------------------------------------------------------------|-------------------------------------|
| 1998-present | Tumor Pathophysiology, HST-52520-40 graduate students/year        | MIT/HST<br>Two hour lecture         |
| 1999-2005    | Biology of the Vascular Endothelium40 undergraduate students/year | Boston University; One hour lecture |
| 2024-present | Co-Director, Tumor Pathophysiology, HST-525                       | MIT/Harvard                         |

**Formal Teaching of Residents, Clinical Fellows and Research Fellows**

|              |                                                                              |                                                            |
|--------------|------------------------------------------------------------------------------|------------------------------------------------------------|
| 1998-present | "Preparing manuscripts and grant proposals" postgraduate & graduate students | Methods in Bioengineering, Rad. Onc, MGH, Two hour lecture |
| 1998-present | "In vitro methods" postgraduate & graduate students                          | Methods in Bioengineering, Rad. Onc, MGH Two hour lecture  |
| 1998-present | "Mathematical modeling of Tumor Physiology" postgraduate & graduate students | Methods in Bioengineering, Rad. Onc, MGH Two hour lecture  |
| 1998-present | "Scientific Illustration" postgraduate & graduate students                   | Methods in Bioengineering, Rad. Onc, MGH, Two hour lecture |
| 2017-present | "Microfluidics in cancer research" postgraduate & graduate students          | Methods in Bioengineering, Rad. Onc, MGH One hour lecture  |
| 2017-present | "Introduction to AI and machine learning" postgraduate & graduate students   | Methods in Bioengineering, Rad. Onc, MGH One hour lecture  |

**Laboratory and Other Research Supervisory and Training Responsibilities**

|              |                                                                               |                    |
|--------------|-------------------------------------------------------------------------------|--------------------|
| 1995-present | Director, Bioengineering, Imaging and Computational Core, Steele Laboratories | 120 hours per year |
|--------------|-------------------------------------------------------------------------------|--------------------|

**Formally Supervised Trainees**

|           |                                                                                                                                                                                                                                                  |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1996—1998 | <b>Hera Lichtenbeld, PhD/</b> Currently: Assistant Director, UF Innovate Tech Licensing Postdoctoral, Project title: "Vascular Permeability of Individual Microvessels" Published one paper.                                                     |
| 1997—2000 | <b>Jin Yuan, PhD/</b> Currently: Principal Investigator at Guardian Therapeutics Inc Postdoctoral, Project title: "Fluid Dynamics and Leukocyte Adhesion" Published three papers.                                                                |
| 2001-2002 | <b>Cristina Sousa/</b> Doctoral, Project title: "Trafficking of Lymphocytes and Metastatic Cancer Cells"                                                                                                                                         |
| 1998–1999 | <b>Gerald Koenig, MD, PhD/</b> Currently: Cardiologist, Henry Ford West Bloomfield Hospital, MI Postdoctoral, Project title: "Biophysics of Lymphocyte Adhesion in Tumors" Published one manuscript, granted F32 Fellowship, co-authored patent. |

- 1998—2000 **Yong Chang, PhD/** Currently: Vice President at Intellia Therapeutics, Inc.  
Postdoctoral, Project title: “Hydraulic Conductivity and Permeability of Endothelial Monolayers”  
Published three papers, one in *PNAS*.
- 1998—2000 **Randall Dull, MD, PhD/** Currently: Presidential Endowed Chair in Anesthesiology, Director, Lung Vascular Biology Laboratory, Associate Professor, Bioengineering, University of Utah  
Postdoctoral, Project title: “PIGF-VEGF Synergy in Endothelial Responses”  
Published two papers.
- 1998—2001 **Emmanuelle di Tomaso, PhD/** Currently: Global Head - Translational Sciences, Bayer OncologyPharmaceuticals, Cambridge MA  
Postdoctoral, Project title: “Permeability of Brain Tumor Vasculature”  
Published four papers, one in *Cancer Research* and one in *PNAS*; received Claflin Distinguished Scholar Award, and Martin Prize
- 2000—2001 **Cristiano Migliorini, PhD/** Currently: Head of Research, Vontobel Asset Management, Zurich, Switzerland  
Postdoctoral, Project title: “Modeling Fluid Dynamics and Leukocyte Adhesion”  
Published three papers.
- 2000-2002 **Robert Campbell, PhD/** Currently: Associate Professor, Massachusetts College of Pharmacy and Health Sciences  
Postdoctoral, Project title: “Delivery of Liposomes to Tumor Vessels”  
Published one paper, *Cancer Research*.
- 2000-2003 **Maximilian Bockhorn, MD, PhD/** Currently: Surgeon, Department of General & Transplant Surgery; University Hospital, Essen, Germany  
Postdoctoral, Project title: “Analysis of Cancer Cells Shed from a Solid Tumor”  
Published two papers, *Lancet Oncology* and *Cancer Research*.
- 2000-2003 **Neil Forbes, PhD/** Currently: Professor, U. Massachusetts Amherst  
Postdoctoral, Project title: “Treating Tumors with Penetrating Bacteria”  
Published one paper, *Cancer Research*.
- 2002-2006 **Chenghai Sun, PhD/** Currently: Consulting Physicist at Exa Corporation, Burlington, MA  
Postdoctoral, Project title: “Lattice-Boltzmann Modeling of Hemodynamics”  
Published five papers, two in *Biophysical Journal*.
- 2003-2007 **Aaron Mulivor, PhD/** Currently: Clinical Research Services Management, The Hospital for Sick Children, Toronto  
Postdoctoral, Project title: “Blood Dynamics and Atherosclerosis”
- 2004-2008 **Michael Dupin, PhD/** Currently: Director of AI, Wolters Kluwer  
Project title: “3D Simulation of Blood Rheology”  
Published three papers.
- 2004-2010 **Janet Tse/** Currently: Senior Patent Counsel at Sanofi, Boston  
Doctoral, Project title: “Tumor Solid Stress”  
Published 1 paper, *PNAS*.
- 2005-2009 **Gang Cheng, PhD/** Currently: Head of Scientific Liaison at Roche China  
Postdoctoral, Project title: “Cellular mechanisms of Angiogenesis”  
Published 2 papers, one in *Blood*.
- 2006-2009 **James Alex Tyrrell, PhD/** Currently: SVP & CTO Health at Wolters Kluwer  
Postdoctoral, Project title: “Quantitative Image Analysis of Vascular Networks”  
Published three papers. Co-authored successful R01 application (R01CA149285).
- 2006-2011 **Delphine Lacorre, PhD/** Currently: Research Engineer in Light Microscopy, Histology, Preclinical Studies, Limoges  
Postdoctoral, Project title: “Effects of Vascular Normalization on Drug Delivery”  
Published two papers; received Komen Fellowship.
- 2006-2011 **Walid Kamoun, PhD/** Currently: Vice President, Global Head of R&D Oncology at Servier  
Postdoctoral, Project title: “Blood Flow Distribution in Tumors”  
Published five papers, one in *Nature Methods*; received Komen Fellowship.

- 2008-2011 **Temitope Sodunke, PhD**/ Currently: Head, Strategy and Operations, Bristol Myers Squibb  
Postdoctoral, Project title: "Stromal Determinants of Cancer Cell Invasion"  
Received Merck Postdoctoral Fellowship.
- 2008-2011 **Abhishek Jain, PhD**/ Currently: Associate Professor, Texas A&M  
Doctoral, Project title: "Blood Microfluidics"  
Published three papers, one in *Lab Chip*
- 2008-2014 **Jonathan Song, PhD** / Currently: Associate Professor, Ohio State University  
Postdoctoral, Project title: "Fluid forces control endothelial morphogenesis"  
Published three papers, PNAS, Lab Chip, Integrative Biology
- 2010-2015 **Christian Kunert, PhD**/ Currently: Senior Digital and Data Science Engineer at Takeda  
Postdoctoral, Project title: "Mechanobiology of lymphatic transport"  
Received DFG Fellowship; publication in *PNAS*
- 2011-2015 **Gabriel Gruionu, PhD**/ Currently: Lecturer, Indiana University  
Postdoctoral, Project title: "Determinants of vascular remodeling in tumors"  
Published 2 patents and one paper
- 2011-2016 **Despina Bazou, PhD** / Currently: Assistant Professor, Maynooth University, Ireland  
Postdoctoral, Project title: "Endothelial dynamics and tumor tissue engineering"  
Published 5 papers
- 2012-2019 **Nir Maimon, PhD**  
Postdoctoral, Project title: "Communication between blood vessel cells in tumors"
- 2014-2019 **Hadi Tavakoli Nia, PhD**/ Currently: Assistant Professor, Boston University  
Postdoctoral, Project title: Quantifying tumor mechanopathologies
- 2017-2019 **Huabing Li, PhD**/ Currently: Professor, Guilin University, China  
Postdoctoral, Project title: "Lymphatic valve mechanics"
- 2018-2020 **Mohammad Reza Nikmaneshi**/ Currently: Postdoctora Fellow, Harvard Medical School  
Doctoral, Project title: "Tumor tissue engineering and computational modeling"
- 2020-2021 **Tuoye Xu**  
Postdoctoral, Project title: "Stress-induced tumor immune suppression"
- 2020-2024 **Mohammad Razavi**/ Currently: Assistant Professor, U. Nebraska, Lincoln, NE  
Postdoctoral, Project title: "Systems biology of anti-cancer immunity"
- 2022-2023 **Stacie (Si) Chen Fellow**/ Currently: Flagship Pioneering, Boston, MA  
Postdoctoral, Project title: "Mechanobiology of glioma immune suppression"
- 2022-2024 **Kohji Uzawa**  
Postdoctoral, Project title: "Role of the glycocalyx in anti-cancer immunity"
- 2024-2025 **Rieke Schleinhage**  
Postdoctoral, Project title: "Vascularized tumor explants for drug testing"
- 2020-present **Meghan O'Melia**  
Postdoctoral, Project title: "Lymphatic regulation of anti-tumor immunity"
- 2023-present **Mohammad Reza Nikmaneshi**  
Postdoctoral, Project title: "Tumor Immunotherapy and Personalized Medicine"
- 2024-present **Xingjian Zhang**  
Postdoctoral, Project title: "Glycocalyx immune mechanobiology"

|              |                                                                                                             |
|--------------|-------------------------------------------------------------------------------------------------------------|
| 2024-present | <b>Marc Charabati</b><br>Postdoctoral, Project title: "Causes and consequences of brain tumor solid stress" |
| 2025-present | <b>Nemo Noeh</b><br>Doctoral, Project title: "Vascularized tumor engineering"                               |
| 2026-present | <b>Nene Zhvania</b><br>Undergraduate, Project title: "Low-cost, accessible vascularized tissue engineering" |

### Local Invited Presentations

No presentations below were sponsored by outside entities

|                   |                                                                                                                                                                                                                                                  |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| November 3, 2008  | "Multiscale analyses of blood dynamics." Martinos Center for Biomedical Imaging, Neurovascular Seminar Series, MGH, Charlestown, MA                                                                                                              |
| October 14, 2009  | "Blood dynamics and tumor micro-anatomy." Harvard Catalyst, Center for Nanoscale Systems Special Seminar: Applying Nanoscale Technologies in Biomedical Research, Cambridge MA.                                                                  |
| November 5, 2010  | "Connection of vascular networks via wrapping-and-tapping anastomosis." Boston Angiogenesis Meeting, MEEI, 2010, Boston MA                                                                                                                       |
| March 8, 2011     | "Microanatomy and mechanobiology: how the cell microenvironment influences coordinated migration and vascular morphogenesis." Topics in Bioengineering Seminar Series, Harvard School of Engineering and Applied Sciences (SEAS), Cambridge, MA. |
| April 21, 2013    | "Mechanobiology of Vascular Dynamics." Mechanical Forces in Development meeting, Tufts Medical School, Boston                                                                                                                                    |
| November 7, 2013  | "Biomechanical control of vessel morphogenesis, adaptation and function." Boston Angiogenesis Meeting, MEEI, 2013, Boston MA                                                                                                                     |
| March 8, 2013     | "Vascular Biology and Mechanobiology." MGH T32 Lecture Series                                                                                                                                                                                    |
| November 4, 2015  | "Untangling tumor vasculature." Boston Angiogenesis Meeting, MEEI, 2015, Boston MA                                                                                                                                                               |
| March 9, 2020     | "Physical Traits of Cancer," Physics Seminar Series, Department of Radiation Oncology, Massachusetts General Hospital, Boston                                                                                                                    |
| November 9, 2020  | "Physical Traits of Cancer." Ludwig Center, Harvard Medical School                                                                                                                                                                               |
| January 26, 2021  | "Systems Biology Modeling of COVID-19." Nanomedicine Academy at Northeastern University Lecture Series                                                                                                                                           |
| December 13, 2021 | "Identifying COVID-19 Patient Phenotypes and Biomarkers using Mathematical Modeling." Ludwig Center, Harvard Medical School                                                                                                                      |

### REPORT OF REGIONAL, NATIONAL AND INTERNATIONAL INVITED TEACHING AND PRESENTATIONS

Those presentations below sponsored by outside entities are so noted and the sponsor is identified.

### Invited Presentations and Courses

#### Regional

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| March 31, 2009 | "Multi-scale Analyses of tumor physiology and blood vessel dynamics." 2009 Seminar Series, Center for Fluid Dynamics, Brown University, Providence, RI. |
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#### National

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| July 23-28, 1995  | "The Role of Erythrocytes in Leukocyte-Endothelial Interactions." Annual Conference on Biorheology and Clinical Hemorheology, Big Sky, MT.                |
| October 4-6, 1996 | "Quantification of Metastatic Cell Arrest, Extravasation, and Colonization." Annual Meeting of the Biomedical Engineering Society, Penn State University. |

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| June 4, 1999         | "Molecular Determinants of Tumor Pathophysiology." American Association of Clinical Chemistry Meeting, Boston, MA                                                                                                                           |
| June 25-26, 1999     | "Transvascular Transport in Tumors." 8th Annual Workshop on Advanced Methods of Pharmacokinetic and Pharmacodynamic Systems Analysis, Los Angeles, CA.                                                                                      |
| Jan 11-15, 2000      | "Visualization and Quantification of Gene Function in Vivo." Quantitative Challenges in the Post-genomic Sequence Era: A Workshop and Symposium, San Diego, CA                                                                              |
| January 19, 2001     | "Tumor Angiogenesis at the Cellular Level." (Mayo Clinic) Mayo Clinic Goldman Symposium on Innovative Research in Multiple Myeloma, Amelia Island, FL                                                                                       |
| April 29, 2001       | "Vascular Development and Anti-angiogenic Strategies." Pediatric Academic Societies' 2001 Annual Meeting, Baltimore, MD                                                                                                                     |
| November 8, 2001     | "Modeling leukocyte adhesion in small vessels: a Lattice Boltzmann approach." Plenary Talk (selected abstract), American Institute of Chemical Engineering Annual Meeting, Reno, NV                                                         |
| September 6-8, 2002  | "Tumor Physics and Biology: Impact of Aberrant Vascular Architecture on Therapy." Third Annual BioMEMs & Biomedical Nanotechnology World 2002 Columbus, OH                                                                                  |
| October 25, 2002     | "Influence of Vessel Geometry on Leukocyte Adhesion: a Lattice-Boltzmann Model." Annual Meeting of the Biomedical Engineering Society, Houston, TX.                                                                                         |
| February 27, 2003    | "Tumor Vessel Abnormalities and Leukocyte-Erythrocyte Dynamics." Penn State University, State College, PA                                                                                                                                   |
| November 11, 2004    | "Microfluidic device for auto-separation of white blood cells from whole blood." Plenary Talk (selected abstract), American Institute of Chemical Engineering Annual Meeting, Austin, TX                                                    |
| December 1, 2004     | "Reverse engineering of blood cell dynamics." City College of New York, Fall 2004 Seminar Series, Department of Biomedical Engineering                                                                                                      |
| February 17-21, 2005 | "The Tumor Microenvironment: Modeling and Experimental Validation." Mathematical Oncology: Bridging the Scientific Divide, AAAS Annual Meeting, Washington DC                                                                               |
| May 10, 2005         | "Biomimetic Design of a Microfluidic Device for Auto-separation of Leukocytes from Whole Blood." NSTI Nanotechnology Conference, Anaheim CA                                                                                                 |
| December 18-19, 2006 | "Microfluidics and particle transport in tumors." Fine Particle Society Nanotechnology in Life Sciences Symposium, San Diego, CA                                                                                                            |
| December 18-21, 2006 | "Biomimetic Design of a Microfluidic Device for Auto-separation of Leukocytes from Whole Blood." Symposium on Nanotechnology in Life Sciences 20th International Conference on Bio and Pharmaceutical Science and Technology, San Diego, CA |
| October 2-4, 2008    | "Isolation of Rare Cells from Whole Blood Using Microfluidics." Plenary Talk (selected abstract), Annual Meeting of the Biomedical Engineering Society, St Louis, MA                                                                        |
| October 26-28, 2008  | "Isolation of Rare Cells from Whole Blood Using Microfluidics." NCI Innovative Molecular Analysis Technologies (IMAT) program, Cambridge, MA                                                                                                |
| November 30, 2008    | "Isolation of Rare Cells from Whole Blood Using Microfluidics." Materials Research Society: Cancer Nanotechnology Med School- Real World Challenges and Nano's Strengths in Cancer Prevention, Diagnosis, and Treatment, Boston, MA         |
| January 26-30, 2009  | "Multi-scale tumor physiology and blood vessel dynamics." Mathematical Biosciences Institute Workshop on Cancer Development, Angiogenesis, Progression and Invasion, Columbus, OH                                                           |
| October 8, 2009      | "Tumor blood vessel dynamics." Quantitative Pharmacology Technical Summit (Eli Lilly), Indianapolis, IN                                                                                                                                     |
| October 7-10, 2009   | "Tumor blood vessel dynamics." Plenary Talk (selected abstract), Annual Meeting of the Biomedical Engineering Society, Pittsburgh, PA                                                                                                       |
| November 23, 2009    | "Tumor blood vessel dynamics." 62nd Annual Meeting of the APS Division of Fluid Dynamics, Minneapolis, Minnesota                                                                                                                            |
| April 24-28, 2010    | "Wrapping-and-tapping anastomosis between engrafted endothelial networks and host vasculature." Plenary Talk (selected abstract), Experimental Biology Meeting, Anaheim, CA                                                                 |
| October 6-8, 2010    | "Wrapping-and-tapping anastomosis between engrafted endothelial networks and host vasculature." Plenary Talk (selected abstract), Annual Meeting of the Biomedical Engineering Society, Austin, TX                                          |
| November 1-2, 2010   | "Compression-induced cancer cell invasion: don't push me 'cause I'm close to the edge." UCSD/NSF Physics of Cancer Metastasis Meeting Arlington, VA                                                                                         |
| April 3-6, 2011      | "Tumor vessel dynamics during anti-angiogenic therapy." American Conference on Pharmacometrics, San Diego, CA                                                                                                                               |

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| Aug 30-Sept 3, 2011 | "Cell-Matrix Interactions within Tumors and Normal Tissue." 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society Boston, MA                                                      |
| March 7, 2011       | "Tumor blood vessel dynamics." Physical Sciences – Oncology Center Steering Committee meeting                                                                                                                            |
| October 28, 2011    | "Imaging vascular dynamics" Multiscale Systems Biology working group of the Multiscale Modeling (MSM) Consortium                                                                                                         |
| October 24, 2012    | "Solid and Fluid Biomechanics in the Tumor Environment". US National Committee on Biomechanics 4th Symposium on Frontiers in Biomechanics: Mechanics in Oncology                                                         |
| April 2, 2013       | "Mechanobiology and Vascular Dynamics," IME Seminar Series, University of Pennsylvania                                                                                                                                   |
| September 27, 2013  | "Biomechanical determinants of cell invasion, angiogenesis and lymphatic function." Custer Workplace Lecture Series, University of Western Michigan                                                                      |
| October 15, 2014    | "Biomechanics of cancer invasion and vessel function." Mathematical Biosciences Institute Workshop on Metastasis and Angiogenesis, Columbus, OH.                                                                         |
| April 3, 2015       | "Deconvolving tumor dynamics." Department of Mechanical and Aerospace Engineering Seminar Series, Ohio State University                                                                                                  |
| March 29, 2016      | "Deconvolving tumor dynamics." Rice University's Bioengineering Colloquium                                                                                                                                               |
| October 27, 2016    | "Systems Biology of Lymph Transport." NHLBI Systems Biology meeting, Bethesda, MD.                                                                                                                                       |
| April 10, 2018      | "Tumor Engineering and Mechanobiology." Department of Chemical and Biomolecular Engineering Seminar Series, Ohio State University                                                                                        |
| September 7, 2018   | "Engineered tumors for personalized medicine." Duke University Lecture Series, Durham, NC                                                                                                                                |
| March 5, 2019       | "Reverse engineering tumors and vasculature." (Keynote) University of North Carolina Integrative Vascular Biology research symposium. Chapel Hill, NC                                                                    |
| September 12, 2019  | "Mechanobiological control of vascular function." American Physiological Society meeting, Interface of mathematical models and experimental biology: Role of microvasculature. Scottsdale, AZ                            |
| January 20, 2020    | "Reengineering the Physical Microenvironment of Tumors to Improve Treatment Response" Cambridge Healthtech Institute; Engineering Next Generation Cancer Immunotherapies; Part of the 19th Annual PepTalk, San Diego, CA |
| July 20, 2020       | "Optimizing treatment for COVID-19 using computational modelling: Implications for cancer patients." AACR Virtual Meeting: COVID-19 and Cancer                                                                           |
| October 6-9, 2021   | "In Silico Dynamics of COVID-19 Phenotypes for Optimizing Clinical Management," Annual Meeting of the Biomedical Engineering Society, Orlando, FL                                                                        |
| November 18, 2021   | "Deconstructing and Reconstructing the Tumor Environment," Distinguished Lecture Series, Simbiosys, Chicago                                                                                                              |
| December 1, 2021    | "Systems Biology of Inflammation and The Tumor Environment," Mechanical and Industrial Engineering Department Seminar Series, New Jersey Institute of Technology                                                         |
| October 24, 2022    | "Systems Biology Modeling of Tumor Immunotherapy," American Association for Cancer Research Meeting, Tumor Immunology and Immunotherapy. Boston, MA                                                                      |
| November 10, 2022   | "A chemical Engineer's Journey into Cancer Research," Howard University Chemical Engineering                                                                                                                             |
| November 9, 2023    | "The Impact of Mechanical Stress on Glioblastoma Biology," NCI CSBC / PS-ON Investigators Meeting. Bethesda, MD                                                                                                          |
| April 13, 2026      | "Mathematical Modeling of Tumors and Blood Vessels," Biomedical Engineering Dept., University of Nebraska-Lincoln                                                                                                        |

## International

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| August 25-30, 1996 | "Interaction of Activated Leukocytes with Tumor Vessels." Sixth World Congress for Microcirculation, Munich, Germany           |
| October 3-7, 1998  | "Tumor Angiogenesis and Microcirculation." 10th Annual Conference of the International Society of Differentiation, Houston, TX |
| Oct 22-25, 1999    | "Tumor Angiogenesis." Conference on Angiogenesis and Tumors, Paris, France                                                     |
| Oct 12-15, 2002    | "Tumor Vessel Abnormalities." Second Interdisciplinary Euroconference on Angiogenesis, Cascals, Portugal                       |

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| April 23-24, 2004  | "The interaction of circulating cells with tumors: pharmacokinetic and fluid dynamic models." Workshop on Mathematical Oncology, The Fields Institute, Toronto, ON                                                       |
| August 1, 2006     | "Tumor vessel abnormalities affect blood cell dynamics and flow distribution." Cancer and Bioengineering; World Congress of Biomechanics, Munich Germany                                                                 |
| July 2-4, 2008     | "Multi-scale analyses of tumor physiology and blood vessel dynamics." Fields Institute Workshop on Growth and Control of Tumors: Theory and Experiment Toronto, CA                                                       |
| July 9-13, 2008    | "Blood dynamics in normal and abnormal vessel networks." International Congress of Biorheology, Penn State University, State College, PA                                                                                 |
| January 4-7, 2010  | "Modeling Tumor blood vessel dynamics." Workshop on Mathematical Methods in Systems Biology, Tel Aviv, Israel                                                                                                            |
| March 18-20, 2010  | "Modeling Tumor blood vessel dynamics." Fields Institute Workshop on Mathematical Oncology Toronto, CA                                                                                                                   |
| May 10-12, 2010    | "Modeling Tumor blood vessel dynamics." Centre European de Calcul Atomique et Moléculaire (CECAM) Workshop on Trends in Computational Hemodynamics, Lausanne, Switzerland                                                |
| Sept. 17-20, 2011  | "Vascular dynamics and anti-angiogenic therapy." Tumor -Vessel Interface meeting, Kloster Seeon Germany                                                                                                                  |
| March 28-30, 2011  | "Targeting vascular dynamics." VIth Academician Nicolae Cajal Symposium, Bucharest, Romania                                                                                                                              |
| December 3, 2013   | "Biomechanical determinants of morphogenesis and vascular function" Institut Curie, Paris France                                                                                                                         |
| May 29-30, 2014    | "Microsystems for probing blood, vessel and tumor dynamics." (Keynote) Ontario-on-a-Chip Conference, University of Toronto, Toronto, CA                                                                                  |
| July 6-11, 2014    | "Biomechanical Control of Vessel Morphogenesis, Adaptation and Function." Seventh World Congress of Biomechanics, Boston, MA                                                                                             |
| July 6-11, 2014    | "Biomechanical autoregulation of lymphatic transport." Seventh World Congress of Biomechanics, Boston, MA                                                                                                                |
| October 2-8, 2014  | "Biomechanical processes and topological dynamics in tumors" Annual Symposium of Physics of Cancer, University of Leipzig                                                                                                |
| June 25-28, 2016   | "Visualizing cell and matrix dynamics in tumors" AACR Special Conference on Engineering and Physical Sciences in Oncology, Westin Boston Waterfront, Boston, MA                                                          |
| February 5-9, 2017 | "Tumor solid stress and mechanobiology" Physical Science of Cancer Gordon Research Conference, Galveston, TX                                                                                                             |
| Dec. 7-10, 2017    | "Accelerating revascularization." Innovations in Wound Healing Conference, Bimini, Bahamas.                                                                                                                              |
| July 10, 2018      | "Leaky Blood Vessels, GAGs and Metastasis" World Congress of Biomechanics 2018, Dublin, Ireland                                                                                                                          |
| June 1, 2020       | "Physical Hallmarks of Cancer," Third Workshop on Hallmarks in cancer and the development of diagnostic tools, Porto, Portugal. [Cancelled due to COVID-19 pandemic]<br>In Vitro Systems for Deconvolving Tumor Dynamics |
| August 30, 2021    | "The impact of tumor-generated forces on cell biology and immunotherapy" 12th symposium, Physics of Cancer, University of Leipzig                                                                                        |
| October 27, 2021   | Keynote talk, "In Vitro Systems for Deconvolving Tumor Dynamics," FoReCaST Conference on 2D and 3D In Vitro Tissue Models for Drug Screening, Porto, Portugal.                                                           |
| June 14, 2024      | "Systems Biology of Tumor Immunology" Université de technologie de Compiègne, Compiègne, France                                                                                                                          |
| September 30, 2026 | "Improving treatment of glioblastoma by targeting solid stress" Annual Symposium of Physics of Cancer, University of Leipzig                                                                                             |

## REPORT OF SCHOLARSHIP

### Peer reviewed publications in print or other media

More than 35,000 citations; **H-index= 82** (Google), **75** (Web of Science)

## Research Investigations

1. **Munn LL**, Glacken MW, McIntyre BW, Zygourakis K. Analysis of lymphocyte aggregation using digital image analysis. *J Immunol Methods*. 1993; 166:11-25.
2. Teague TK, **Munn L**, Zygourakis K, McIntyre BW. Analysis of lymphocyte activation and proliferation by video microscopy and digital imaging. *Cytometry*. 1993; 14:772-82.
3. **Munn LL**, Melder RJ, Jain RK. Analysis of cell flux in the parallel plate flow chamber: implications for cell capture studies. *Biophys J*. 1994; 67:889-95.
4. Melder RJ, **Munn LL**, Yamada S, Ohkubo C, Jain RK. Selectin- and integrin-mediated T-lymphocyte rolling and arrest on TNF- $\alpha$ -activated endothelium: augmentation by erythrocytes. *Biophys J*. 1995; 69:2131-8.
5. **Munn LL**, Koenig GC, Jain RK, Melder RJ. Kinetics of adhesion molecule expression and spatial organization using targeted sampling fluorometry. *Biotechniques*. 1995; 19: 622-6, 628-31.
6. Melder RJ, Koenig GC, **Munn LL**, Jain RK. Adhesion of activated natural killer cells to tumor necrosis factor- $\alpha$ -treated endothelium under physiological flow conditions. *Nat Immun*. 1996a; 15:154-63.
7. Melder RJ, Koenig GC, Witwer BP, Safabakhsh N, **Munn LL**, Jain RK. During angiogenesis, vascular endothelial growth factor and basic fibroblast growth factor regulate natural killer cell adhesion to tumor endothelium. *Nat Med*. 1996b; 2:992-7.
8. **Munn LL**, Melder RJ, Jain RK. Role of erythrocytes in leukocyte-endothelial interactions: mathematical model and experimental validation. *Biophys J*. 1996; 71:466-78.
9. Patan S, **Munn LL**, Jain RK. Intussusceptive microvascular growth in a human colon adenocarcinoma xenograft: a novel mechanism of tumor angiogenesis. *Microvasc Res*. 1996; 51:260-72.
10. Neelamegham S, **Munn LL**, Zygourakis K. A model for the kinetics of homotypic cellular aggregation under static conditions. *Biophys J*. 1997; 72:51-64.
11. Shioda T, **Munn LL**, Fenner MH, Jain RK, Isselbacher KJ. Early events of metastasis in the microcirculation involve changes in gene expression of cancer cells. Tracking mRNA levels of metastasizing cancer cells in the chick embryo chorioallantoic membrane. *Am J Pathol*. 1997; 150:2099-112.
12. Lichtenbeld HC, Ferrara N, Jain RK, **Munn LL**. Effect of local anti-VEGF antibody treatment on tumor microvessel permeability. *Microvasc Res* 1999; 57:357-62.
13. Chang YS, di Tomaso E, McDonald DM, Jones R, Jain RK, **Munn LL**. Mosaic blood vessels in tumors: frequency of cancer cells in contact with flowing blood. *Proc Natl Acad Sci U S A*. 2000a; 97:14608-13.
14. Chang YS, **Munn LL**, Hillsley MV, Dull RO, Yuan J, Lakshminarayanan S, Gardner TW, Jain RK, Tarbell JM. Effect of vascular endothelial growth factor on cultured endothelial cell monolayer transport properties. *Microvasc Res*. 2000b; 59:265-77.
15. Melder RJ, Yuan J, **Munn LL**, Jain RK. Erythrocytes enhance lymphocyte rolling and arrest in vivo. *Microvasc Res*. 2000; 59:316-22.
16. Davies Cde L, Melder RJ, **Munn LL**, Mouta-Carreira C, Jain RK, Boucher Y. Decorin inhibits endothelial migration and tube-like structure formation: role of thrombospondin-1. *Microvasc Res*. 2001; 62:26-42.
17. Dull RO, Yuan J, Chang YS, Tarbell J, Jain RK, **Munn LL**. Kinetics of placenta growth factor/vascular endothelial growth factor synergy in endothelial hydraulic conductivity and proliferation. *Microvasc Res*. 2001; 61:203-10.
18. Melder RJ, Kristensen CA, **Munn LL**, Jain RK. Modulation of A-NK cell rigidity: In vitro characterization and in vivo implications for cell delivery. *Biorheology*. 2001; 38:151-9.
19. Patan S, **Munn LL**, Tanda S, Roberge S, Jain RK, Jones RC. Vascular morphogenesis and remodeling in a model of tissue repair: blood vessel formation and growth in the ovarian pedicle after ovariectomy. *Circ Res*. 2001a; 89:723-31.
20. Patan S, Tanda S, Roberge S, Jones RC, Jain RK, **Munn LL**. Vascular morphogenesis and remodeling in a human tumor xenograft: blood vessel formation and growth after ovariectomy and tumor implantation. *Circ Res*. 2001b; 89:732-9.
21. Yuan J, Melder RJ, Jain RK, **Munn LL**. Lateral view flow system for studies of cell adhesion and deformation under flow conditions. *Biotechniques*. 2001; 30:388-94.
22. Campbell RB, Fukumura D, Brown EB, Mazzola LM, Izumi Y, Jain RK, Torchilin VP, **Munn LL**. Cationic charge determines the distribution of liposomes between the vascular and extravascular compartments of tumors. *Cancer Res*. 2002; 62:6831-6.
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25. Melder RJ, **Munn LL**, Stoll BR, Marecos EM, Baxter LT, Weissleder R, Jain RK. Systemic distribution and tumor localization of adoptively transferred lymphocytes in mice: comparison with physiologically based pharmacokinetic model. *Neoplasia*. 2002; 4:3-8.
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32. Sun C, Migliorini C, **Munn LL**. Red blood cells initiate leukocyte rolling in postcapillary expansions: a lattice Boltzmann analysis. *Biophys J*. 2003; 85:208-22.
33. Bockhorn M, Roberge S, Sousa C, Jain RK, **Munn LL**. Differential gene expression in metastasizing cells shed from kidney tumors. *Cancer Res*. 2004; 64:2469-73.
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49. **Munn LL**, Dupin MM. Blood cell interactions and segregation in flow. *Ann Biomed Eng.* 2008; 36:534-44.
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## Thesis

Munn LL The Application of Digital Image Analysis Techniques to Studies of Lymphocyte Function [dissertation] Houston, TX: Rice University; 1993 (advisor: K. Zygorakis)

## Patents

System and method for measuring solid stress in tissues

G Gruionu, L Gruionu, LL Munn, RK Jain  
US Patent 11,259,714

Therapeutic use of bFGF to treat conditions involving adhesion of cytotoxic white cells to endothelium  
Rakesh K. Jain, Robert J. Melder, Gerald C. Koenig, Lance L. Munn  
US6010712A

Modified microorganisms for anti-cancer therapy  
Neil S. Forbes, Lance L. Munn, Dai Fukumura, Rakesh K. Jain, Yves Boucher, Wilson Mok, Trevor D. Mckee, Xandra Breakefield  
WO2005018332A1

Particle separating devices, systems, and methods  
Sergey Shevkoplyas, Lance Munn, Mark Bitensky, Tatsuro Yoshida, Chenghai Sun  
US20060118479A1

Method for mitigating metastasis  
JM Tarbell, LL Munn, Q Ç, SHI Zhongdong  
US20190144867A1