Deepraj Ghosh, Ph.D.

Molecular Biology, Cell Biology & Biochemistry (MCB)
Brown University
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Employment:

Assistant Professor (Research), December 2022-present, December 2020-November 2021, Brown University, Providence, RI

Education:

Ph.D. in Chemical and Biomolecular Engineering, Aug 2009 - July 2014
Georgia Institute of Technology, Atlanta, GA
Ph.D. Thesis: Effects of TGF-β1 and PDGF-BB on the Mechanical Properties and Migratory Behavior of Bone Marrow Isolated Mesenchymal Stem Cell (MSC)

M.Tech. in Chemical Engineering, Aug 2007 – May 2009
Indian Institute of Technology, Kharagpur, India
Master's Thesis: Mathematical modeling of controlled drug release in avascular tumor

B.E. in Chemical Engineering, May 2007
Jadavpur University, Kolkata, India

Post-graduate Training:

Brown University, Providence, RI

Post-doctoral Research Associate, Dec 2016- Nov 2020
Advisor: Dr. Michelle R. Dawson

Georgia Institute of Technology, Atlanta, GA

Post-doctoral Research Fellow, Feb 2015-Feb 2016
Advisor: Dr. Michelle R. Dawson

Publications

Refereed Book Chapters and Review Articles

1. Mejia Pena C, Lee A, Frare M, Ghosh D, Dawson M (2023). Hallmarks of an aging and malignant tumor microenvironment and the rise of resilient subpopulations. Engineering and Physical Approaches to Cancer. Book Series: Current Cancer Research. Springer Publishing.

2. Xuan B, Ghosh D, and Dawson MR (2021). "Contributions of the Distinct Biophysical Phenotype of Polyploidal Giant Cancer Cells to Cancer Progression." Seminars in Cancer Biology. Academic Press, 2021.
3. Dawson MR, Xuan B, Hsu J, and Ghosh D (2021). Force balancing ACT-IN the tumor microenvironment: Cytoskeletal modifications in cancer and stromal cells to promote malignancy. In International review of cell and molecular biology (Vol. 360, pp. 1-31). Academic Press.
4. Ghosh D, Dawson MR (2018). Microenvironment Influences Cancer Cell Mechanics from Tumor Growth to Metastasis. Biomechanics in Oncology, 69-90. Advances in Experimental Medicine and Biology, Volume 1092. Edited by Konstantopoulos, Dong, and Kuhn. Springer Publishing.
5. Dawson MR, Ghosh D (2016). Mucosal Barriers. Drug Delivery Across Physiological Barriers. Edited by Silvia Muro 155-180, Pan Stanford Publishing.

Refereed Journal Articles

1. Howes A, Dea N, Ghosh D, Krishna K, Wang Y, Morrison B, Toussaint C, Dawson M. Temporal Probing of Stress-Induced Premature Senescent Extracellular Matrix Remodeling of the Lung. In Revision, *Advanced Science*, 2023
2. Mejia Pena C, Skipper T, Hsu H, Schechter I, Ghosh D, Dawson M. Paclitaxel Induced Metabolic Reprogramming of HGSOC in a Spatiotemporally Regulated 3D Model. Accepted pending minor revisions to *Scientific Reports*, 2023.
3. Lee A, Ghosh D, Koh I, Dawson M (2023). Senescence-Associated Exosomes Transfer MiRNA-Induced Fibrosis to Neighboring Cells. *Aging*, 2023.
4. Xuan B, Ghosh D, Jiang J, Shao R, Dawson MR. Vimentin filaments drive migratory persistence in polyploidal cancer cells. Proc Natl Acad Sci U S A. 2020.
5. Lee AH, Ghosh D, Quach N, Schroeder D, & Dawson MR. Ovarian Cancer Exosomes Trigger Differential Biophysical Response in Tumor-Derived Fibroblasts. *Scientific Reports*, 2020.
6. Ghosh D, Pena CM, Quach N, Xuan, B, Lee, A, Dawson MR. Senescent Mesenchymal Stem Cells Remodel Extracellular Matrix Driving Breast Cancer Cells to More Invasive Phenotype. *Journal of Cell Science*, 2020.
7. Quach N, Kaur, S, Eggert M, Ingram L, Ghosh D, Sheth S, Nagy T, Dawson MR, Arnold R, Cummings B. Paradoxical Role of Glypican-1 in Prostate Cancer Cell and Tumor Growth. *Scientific Reports,* 2019.
8. Xuan B, Ghosh D, Cheney EM, Clifton EM, & Dawson MR. Dysregulation in Actin Cytoskeletal Organization Drives Increased Stiffness and Migratory Persistence in Polyploidal Giant Cancer Cells. *Scientific reports*, 2018.
9. Ghosh D, McGrail DJ and Dawson MR. TGF-β1 pretreatment improves the function of mesenchymal stem cells in the wound bed. *Frontiers in cell and developmental biology*, 2017, *5*, pp.28.

10. Ali MR, Wu Y, Ghosh D, Do BH, Chen K, Dawson MR, Fang N, Sulchek TA and El-Sayed MA. Nuclear membrane-targeted gold nanoparticles inhibit cancer cell migration and invasion. *ACS nano*, 2017, *11*(4), pp.3716-3726.
11. Ghosh D, Lilli L, McGrail D, Matyunina L, McDonald J, Dawson MR. Integral Role of Platelet Derived Growth Factor in Mediating Transforming Growth Factor-β1 Dependent Mesenchymal Stem Cell Stiffening. *Stem Cells and Development*, 2013. 23(3): pp. 245-61.
12. McGrail D, Ghosh D, Quach N, Dawson MR. Differential Mechanical Response of Mesenchymal Stem Cells and Fibroblasts to Tumor-Secreted Soluble Factors. *PloS one*, 2012. 7(3): pp. e33248.

Abstracts (National/International Meetings)

1. Dawson M, Mejia Pena C, Lee A, Perricone M, Ghosh D (2022). Biomechanics of Therapy Induced Senescence and the Evolving Tumor Microenvironment. Texas A&M's Society of Engineering and Science Meeting. Mechanobiology of Disease Symposium. October 16-19, 2022 (in person).
2. Lee A, Ghosh D, Dawson M (2021). miRNA Content of Senescence-Associated Exosomes Promotes Myofibroblast Differentiation in MSCs via TGF-B Pathway Alterations. American Society for Cell Biology (ASCB) Annual Conference. Dec 2021 (virtual).
3. Lee A, Ghosh D, Dawson M (2021). Heterogenous Exchange of Epithelial Ovarian Cancer Cell Exosomes Plays Unique Role in Metastasis. Biomedical Engineering Society (BMES) Annual Conference. Oct 2021 (virtual).
4. Lee A, Ghosh D, Dawson M (2021). Senescence-Associated Exosome Exchange Activates Myofibroblast Phenotype in Mesenchymal Stem Cells. Experimental Biology (American Society for Biochemistry and Molecular Biology). April 2021 (virtual).
5. Lee A, Ghosh D, Quach N, Dawson M (2020). Heterogeneity in Ovarian Cancer Exosomes Orchestrates Diverse Biophysical Changes in Tissue Fibroblasts to Trigger Malignancy, November 16, 2020, American Society for Extracellular Vesicles (virtual).
6. Lee A, Ghosh D, Quach N, Schroeder D, Dawson M (2020). Single-Cell Derived Exosome Heterogeneity Promotes Invasive Fibroblast Phenotype in Epithelial Ovarian Cancer, Carnegie Mellon Forum on Biomedical Engineering and Annual Symposium of International Academy of Medical and Biological Engineering (AL Poster).
7. Lee A, Ghosh D, Quach N, Dawson M (2020). Heterogeneity in Ovarian Cancer Exosomes Orchestrates Diverse Biophysical Changes in Tissue Fibroblasts to Trigger Malignancy, June 24, 2020, Virtual New England Science Symposium (AL Presentation, 3rd Place Oral Presentation Award).

8. Ghosh D, Quach N, Pena CM, Xuan B, Lee A, Dawson M (2019). Mesenchymal Stem Cell Aging and Senescence Associated Extracellular Matrix Contributions to Breast Cancer Progression. Biomedical Engineering Society Annual Meeting (DG, Poster Presentation).
9. Xuan B, Ghosh D, Jiang J, Dawson M (2019). Targeting Chemoresistant PGCCs through Disruption of Osmotic Stress Response. Biomedical Engineering Society Annual Meeting (BX, Poster Presentation).
10. Lee A, Ghosh D, Quach N, Dawson M (2019). Ovarian Cancer Exosome Heterogeneity Differentially Triggers Biophysical Changes in Ovarian Cancer Stromal Cells. Biomedical Engineering Society Annual Meeting (AL, Poster Presentation).
11. Beland M, Ghosh D, Dawson M (2019). Combining Shear Wave Ultrasound Elastography and Single Cell Biophysical Analysis to Highlight Differences in Tumor Phenotype and Heterogeneity. Radiological Society of North America Annual Meeting (MB, Podium Presentation).
12. Ghosh D, Quach N, Pena CM, Xuan B, Lee A, Dawson M (2019). Mesenchymal Stem Cell Aging and Senescence Associated Extracellular Matrix Contributions to Breast Cancer Progression, Gordon Research Conference: Physics of Cancer Galveston (MD, Podium Presentation).
13. Dawson M, Ghosh D (2018). Cellular Senescence Alters Tumor Microenvironment Interactions Forcing Cancer Progression. Gordon Research Conference: Signal Transduction by Engineered Extracellular Matrices (MD, Poster Presentation).
14. Xuan B, Ghosh D, Dawson M (2018). Biophysics of giant polyploidal cancer cells that form in an aging tumor stroma. Cellular and Molecular Bioengineering (CMBE) Annual Conference (MD, Poster Presentation).
15. Xuan B, Ghosh D, Dawson M (2018). Biophysics of polyploidal cancer cells in an aging stroma. American Association for Cancer Research (AACR) Annual Meeting (MD, Poster Presentation).
16. Bedoya S, Ghosh D, Dawson M (2017). Mechanosensitivity analysis of breast cancer tumor cells from needle biopsy. Annual Biomedical Research Conference for Minority Students – ABRCMS (SA, Poster Presentation).
17. Quach N, Eggert M, Ghosh D, Dawson M, Arnold R, Cummings B (2017). Glypican-1: A tumor suppressor or an oncogene in human bone metastatic prostate cancer cells. Cancer Research (NQ, Podium Presentation).
18. Gupta S, Ghosh D, Schutte S, Dawson M (2016). 3D Spheroid Model of Fibroid Growth: Quantifying the Effect of Mechanical Environment Stiffness on Development. Obstetrics & Gynecology (SG, Poster Presentation).
19. Ghosh D, McGrail D, Dawson M (2014). TGF-β1 pretreatment improves the function of mesenchymal stem cells in the wound bed. Biomedical Engineering Society Annual Meeting (MD, Podium Presentation).

20. Jampol R, Ghosh D, Dawson M (2014). The Effect of Soluble Factors on the Morphological, Adhesive, and Mechanical Properties of Human Bone Marrow Endothelial Cells. American Institute of Chemical Engineers Annual Meeting (MD, Podium Presentation).
21. Ghosh D, McGrail D. and Dawson M. (2013) PDGF and TGF-β1 Crosstalk Is Essential for Mesenchymal Stem Cell Stiffening, American Institute of Chemical Engineers Annual Meeting, (DG, Podium Presentation).
22. Ghosh D, Lilli L, McGrail D, Matyunina L, McDonald J, Dawson M. (2013) TGF-β1 Induced Stiffening of Mesenchymal Stem Cells Depends on PDGF-BB Signaling, Biomedical Engineering Society, (DG, Podium Presentation).
23. Jampol R, Ghosh D, Rodriguez K, Dawson M (2013). Using Luciferase Expression to Quantify the Accumulation of Genetically Engineered Mesenchymal Stem Cells in Murine Tumors. American Institute of Chemical Engineers Annual Meeting (RJ, Podium Presentation).
24. Ghosh D, McGrail D, Dawson M (2012). Soluble growth factor induced mechanical changes regulate the migration of mesenchymal stem cells to tumors. American Chemical Society Annual Meeting (MD, Podium Presentation).
25. Rodriguez K, Ghosh D, McAndrews K, McGrail D, Dawson M (2011). Optimization of Mesenchymal Stem Cell Migration in the Wound Bed. American Institute of Chemical Engineers Annual Meeting (KR, Podium Presentation).
26. Ghosh D, McGrail D, McAndrews K, Dawson M (2011). Toward the Development of New Strategies for the Delivery of MSC-Based Therapeutics. Biomedical Engineering Society Annual Meeting (KM, Poster Presentation)
27. Ghosh D**,** Dawson M. (2011) Soluble Growth Factors Mediate Mesenchymal Stem Cell Migration to Tumors. American Institute of Chemical Engineers Annual Meeting (AIChE), (DG, Podium Presentation).
28. McGrail D, Ghosh D, Dawson M (2011). Mechanical Changes of Senescent Mesenchymal Stem Cells. Controlled Release Society (DM, Podium Presentation).
29. Ghosh D, McGrail D, Dawson M (2011). Mechanically-Optmized Murine Mesenchymal Stem Cells Accumulate in 4T1 Mammary Tumors. Controlled Release Society (DG, Poster Presentation).
30. McGrail D, Zuelke D, Ghosh D, Dawson M (2010). Probing the Microrheology of Mesenchymal Stem Cell Migration to Tumors, Biomedical Engineering Society Annual Meeting (MD, Podium Presentation).
31. McGrail D, Ghosh D, Dawson M (2010). Tumor-Secreted Soluble Proteins Mediate Mesenchymal Stem Cell Migration to Tumors by Rapidly Changing Cytoskeletal Rigidity, American Institute of Chemical Engineers Annual Meeting (DG, Podium Presentation).
32. Ghosh D**,** Chakraborty S. Mathematical modeling of delivery of ionic drugs to proliferating avascular tumors through electro-active polymers (2008),

International Workshop on Biomaterials for Tissue Engineering and Biotechnological Applications, (DG, Podium Presentation).

Abstracts (Local Meetings)

1. 1. Lee A, Ghosh D, Dawson M (2021). Exosomes: Potent Vehicles that Play Impactful Roles in Epithelial Ovarian Cancer. Invited Student Speaker. 2021 Center for Biomedical Engineering (CBME) Retreat. May 2021 (virtual).
2. Lee A, Ghosh D, Dawson M (2020). Exosomes Mediate Biophysical Changes in the Ovarian Cancer Tumor Microenvironment, August, 2020, Stem Cells and Aging Center for Biomedical Research Excellence (COBRE) at Brown University (AL Presentation).
3. Hsu J, Pena CM, Lee A, Quach N, Ghosh D, Dawson M (2018). Characterizing Putative Epithelial-to-Mesenchymal Transition Phenotype of Ovarian Cancer Spheroids in Three-Dimensional Hydrogel Scaffolds. Brown Summer Research Symposium, Brown University.
4. Clifton E, Xuan B, Ghosh D, Dawson M (2017). SASP-induced polyploidy and nuclear enlargement: a potential system of chemotherapeutic resistance. Brown Summer Research Symposium, Brown University.
5. Soriano K, Ghosh D, Dawson M (2017). Effects of Substrate Elasticity on Malignancy and Chemotherapeutic Resistance. Brown Summer Research Symposium, Brown University.
6. Skipper T, Ghosh D, Dawson M (2017). Alginate hydrogels for 3-D cell culture applications. Brown Summer Research Symposium, Brown University.
7. Bedoya S, Ghosh D, Dawson M (2017). Mechanosensitivity analysis of breast cancer tumor cells from needle biopsy. Brown Summer Research Symposium, Brown University.
8. Xuan B, Ghosh D, Dawson M (2017). Investigating the Effect of the Senescence Associated Secretory Phenotype on Tumor Progression. First Year Molecular Pharmacology and Physiology Talks, Brown University.
9. Ghosh D, McGrail D, McAndrews K, Dawson M (2014). Biophysical Approaches for Investigating Stem Cell Behavior in Complex Environments. 17th Annual Hilton Head Workshop on Regenerative Medicine: Technologies Enabling Novel Therapies, Hilton Head, SC (MD, Podium Presentation).

10. Kim M, Lam T, McAndrews K, Ghosh D, McGrail D, Dawson M (2013). Engineering Gelatin Scaffold Mechanics for Tissue Engineering Applications. UROP Spring Symposium, Georgia Institute of Technology.

11. Kuo C, Ghosh D, Dawson M (2012). Gelatin Scaffolds for Tissue Engineering Applications, Air Products Symposium.

Grant Funding

Project Title: Lipid Metabolism Switch Triggers Invasive and Chemoresistant Epithelial Ovarian Cancer Phenotype (1R01CA266415-01A1)
Funding Source: National Institutes of Health
Role: Co-PI
Period of Contract: 08/09/22-08/09/27

Project Title: Role of Senescence Associated Extracellular Vesicles in Radiation-Induced Pulmonary Fibrosis
Funding Source: Research Seed Funds, Office of Vice President for Research, Brown University
Role: Co-Investigator
Period of Contract: 2/21/2021 – 7/01/2022

Awards

- Petit Graduate Mentor Award 2011, Georgia Tech
- ChBE graduate honor for exemplary academic achievement 2009, Georgia Tech

Teaching Role

1. BIOL 0810: Applied Cell and Molecular Biology (Brown University)
   Guest lecture: Spring 2023, Spring 2020, Spring 2019, Spring 2018
2. CHBE 4803: Biomolecular Engineering of the Cell (Georgia Tech)
   Guest lecture: Fall 2015
3. ChBE 3210 Transport II: Heat and Mass Transfer (Georgia Tech)
   Teaching assistant: Spring 2012, Fall 2010, Summer 2010
4. Biochemical Engineering (Indian Institute of Technology)
   Teaching assistant: Spring 2009
5. Transport Processes in Physiological Systems (Indian Institute of Technology)
   Teaching assistant: Fall 2008

Mentoring

Graduate Students, Brown University

1. **Botai Xuan, PhD**
   Department: Molecular Pharmacology, Physiology, and Biotechnology
   Project: Polyploidal Giant Breast Cancer Cells that Drive Paclitaxel Resistance
   Thesis Defense: Graduated and working in industry
2. **Carolina Mejia Pena, PhD**
   Department: Molecular Biology, Cell Biology, and Biochemistry

Project: 3D Model of Chemoresistant Ovarian Cancer Metabolism
Thesis Defense: Graduated and pursuing post-doctoral research

3. **Amy Lee, PhD**
   Department: Biomedical Engineering
   Project: Exosome-Mediated Interactions in Ovarian Cancer Metastasis
   Thesis Defense: Graduated and pursuing post-doctoral research
6. **Andrew Howes, PhD candidate**
   Department: Biotechnology
   Project: Non-Linear Optics of 3D Collagen Matrices in Fibrotic Tissues
   Fourth year PhD candidate (Co-Advisor Kimani Toussaint)
   Expected Graduation: 2023
7. **Braxton Morrison, ScM student**
   Department: Biomedical Engineering
   Project: Epithelial Ovarian Cancer Progression through Exosome Transfer from Polyploidal Giant Cells
   ScM student, (2023 Graduate)
8. **Difei Xu, ScM student**
   Department: Biomedical Engineering
   Project: Metabolic and Treatment Stress Effects on Ovarian Cancer Paclitaxel Resistance
   ScM student, (2023 Graduate)
9. **Crystal Vargas, ScM student**
   Department: Biomedical Engineering
   Project: Senescence Associated Secretory Phenotype and Breast Cancer Polyploidal Cells
   ScM student (Expected Graduation: 2023)
10. **Mateo Frare, ScM student**
    Department: Biomedical Engineering
    Project: Tissue Derived Soluble Factors Direct Metaplastic Breast Cancer
    ScM student (2021 graduate)
11. **Zhan Wu, ScM student**
    Department: Biomedical Engineering
    Project: Using Single Cell Biophysics to Predict Breast Cancer Drug Response
    ScM student (2019 graduate)

<u>Rotation Students, Brown University</u>

1. **Dominique Pablito, PhD rotation student**
   Department: Molecular Biology, Cell Biology, and Biochemistry
   Rotation student (Summer 2021)

Project: Isolation of Polyploidal Giant Cancer Cells in Ovarian Cancer

2. **Sorel Ouonkap Yimga, PhD rotation student**
   Department: Molecular Biology, Cell Biology, and Biochemistry
   Rotation student (Presidential Fellow)
   Project: Biophysics of Polyploidal Giant Cancer Cells in Ovarian Cancer
3. **Jiwon Seo, PhD rotation student**
   Department: Molecular Biology, Cell Biology, and Biochemistry
   Rotation Student
   Project: Using Biophysical Models to Understand Chemoresistant Ovarian Cancer
4. **Blessing Akobundu, PhD rotation student**
   Department: Molecular Pharmacology, Physiology, and Biotechnology
   Rotation student
   Project: Stromal Cell Interactions in Radiation Resistant Prostate Cancer
5. **Chyna Gray, PhD rotation student**
   Department: Molecular Biology, Cell Biology, and Biochemistry
   Rotation student
   Project: Cancer Treatment Resistance and Elements of the Tumor Microenvironment

Undergraduate Students, Brown University

1. **Ivy Koh,** Biochemistry and Molecular Biology, Expected Graduation May 2024.
   Undergraduate thesis: Radiation induced senescence associated secretory phenotype exchange through extracellular vesicles.
2. **Matthew Perricone**, Biochemistry and Molecular Biology, Graduated May 2022.
   Undergraduate thesis: lipid droplet quantification in chemotherapy resistant epithelial ovarian cancer polyploid cells.
3. **Allison Lin**, Biochemistry and Molecular Biology, Graduated May 2021.
   Undergraduate thesis: Lipid droplet metabolism alters chemotherapy response in epithelial ovarian cancer.
4. **Jeffrey Hsu**, Biochemistry, Graduated May 2019.
   Undergraduate thesis: mesenchymal stem cell-secreted TGF-β facilitates EMT in ovarian cancer progression through cytoskeletal and nuclear reorganization.
5. **Thomas Skipper,** Biomedical Engineering, Graduated May 2019.
   Undergraduate thesis: modeling ovarian cancer microenvironments using alginate-gelatin microspheres.
6. **Emily Cheney,** Biology: Physiology and Biotechnology Track, Graduated May 2018.
   Undergraduate thesis: Establishing markers for cellular senescence in irradiated lung fibroblasts.

7. **Kylen Soriano,** Health and Human Biology (Pre-Med), Graduated May 2018. Undergraduate thesis: TGF-b and hypoxia induced epithelial-mesenchymal transition effects on ovarian cancer mechanosensitivity.

Undergraduate Students, Georgia Institute of Technology

1. **Dalton Snyder**, Chemical & Biomolecular Engineering, Graduated 2018.
2. **Andrew Chan,** Chemical & Biomolecular Engineering, Graduated 2018.
3. **Blake Lash**, Biomedical Engineering, Graduated 2017. Petit Scholar (2015).
4. **Christian Burns**, Central Michigan University (2015). NSF Summer Undergraduate Research Experience (SURE).
5. **Vinh Trang**, GT Biochemistry Undergraduate, Graduated 2013. President's Undergraduate Research Award (2013).
6. **Brandon Ling**, GT Chemical & Biomolecular Engineering Undergraduate, Graduated 2012.

Visiting Scholars, Georgia Institute of Technology

1. **Shabnam Gupta**, Emory University Medical Student.

High School Interns, Georgia Institute of Technology

1. **Saachi Datta,** Galloway High School Intern, 2015.