

Melody A. Swartz, PhD

William B. Ogden Professor, Institute for Molecular Engineering and Ben May Department of Cancer Research, University of Chicago

Education

- 1991 B.S. Chemical Engineering, Johns Hopkins University, Baltimore, MD
1998 Ph.D. Chemical Engineering, Massachusetts Institute of Technology, Cambridge, MA;
Thesis: “Interstitial-Lymphatic Transport Phenomena”; Advisor: Prof. Rakesh K. Jain
1998-9: Postdoctoral Fellow, Pulmonary Division, Brigham & Women’s Hospital, Harvard Medical School, Boston, MA; Advisor: Prof. Jeffrey Drazen

Appointments

- 1999-2004: Assistant Professor, Departments of Chemical & Biological Engineering and Biomedical Engineering (joint), Northwestern University, Evanston, IL
2003-2006: Assistant Professor, EPFL, Institute of Bioengineering, School of Life Sciences
2007-2010 Associate Professor (with tenure), Institute of Bioengineering, School of Life Sciences, EPFL (joint appointments in the Institute of Chemistry and Chemical Engineering (ISIC) and Institute for Experimental Cancer Research (ISREC))
2010-2016: Professor, Institutes of Bioengineering and Cancer Research, EPFL (note: between July 2014-Dec 2016, a partial appointment to facilitate transition to Chicago)
2012-2014: Director, Institute of Bioengineering, EPFL
2014- William B. Ogden Professor, Pritzker School of Molecular Engineering, U. Chicago
-*Joint appointment in the Ben May Department for Cancer Research*
-*Committee on Immunology, Committee on Cancer Biology*
-*Member of the University of Chicago Comprehensive Cancer Center*
2020- Deputy Director for Faculty Affairs, Pritzker School of Molecular Engineering, U. Chicago

Honors and Awards

- National Academy of Engineering (2022)
Royal Academy of Medicine of Belgium (2022)
National Academy of Medicine (2020)
American Academy of Arts & Sciences (2018)
MacArthur Foundation Fellow (2012)

Otto Schmidt Distinguished Lecture, Univ. Minnesota (2021)
Plenary Lecture, AACR Annual Meeting, Chicago (2018)
Balloun Lecture, Iowa State Univ., Dept. Chemical and Biological Engineering (2018)
Freshman Convocation Keynote Speaker, University of Alaska, Anchorage (2014)
Plenary Lecture, World Congress of Biomechanics, Boston (2014)
Britton Chance Distinguished Lecture, University of Pennsylvania, Philadelphia (2013)

Wendy Chaite Leadership Award, Lymphatic Research Foundation (2016)
Prix Leenaards for the Promotion of Scientific Research (2011)
Robert Wenner Prize for Cancer Research (*from the Swiss Cancer League*) (2010)
Fellow of the Biomedical Engineering Society (2012)
European Research Council Starting Investigator Grant (2008)
European Research Council Advanced Investigator Grant (2013)
Elected Fellow, American Institute for Medical and Biological Engineering (AIMBE) 2007
Ed Yellin “Integrative Cardiovascular Physiology” Award, CSDS (2006)
Popular Science Magazine’s “Brilliant 10” (2006)
Arnold and Mabel Beckman Young Investigator Award (2002)
NSF CAREER Award (2002)
Rita Schaffer Young Investigator Award, Biomedical Engineering Society (2001)
Watson Foundation Fellow (1991)

Professional Service

Boards and advisory councils:

Scientific Advisory Board, Koch Institute, MIT (2021-present)
Visiting Committee, MIT Department of Biological Engineering (2020-present)
Scientific Advisory Board, Botnar Research Center for Child Health, ETH-Zurich (2020-)
Scientific Advisory Board, Center for Cancer Engineering at The Ohio State University (2020-)

Conference organization:

Chicago Biomedical Consortium “COVID-19 Town Hall” seminar series, co-organizer (2021)
UChicago Immunoengineering Symposium (June 2021), co-organizer
Keystone Conference on Stromal Cells in Immunity (2016), Co-chair
AACR Special Conference on Metastasis (2015), Co-chair
Gordon Research Conference in Molecular Mechanisms in Lymphatic Function and Disease,
Organizing Committee, 2004; Vice Chair (2012); Chair (2014)
AACR Special Conference on Complexity of Tumor Microenvironments (2011), Co-chair
NCI Workshop “Gradients in the Tumor Microenvironment” (2010), Chair
Microcirculatory Society, Programs & Meetings Committee member, 2010-present

Editorial positions:

J. Biomechanics, Associate Editor (2011-present)
Frontiers in Immunology, Associate Editor for Systems Immunology (2021-)
Angiogenesis, Editorial Board (2011-present)
Cancer Immunology Research, Editorial Board (2013-present)
Biomaterials, Editorial Board (2011-present)
J. Royal Soc. Interface, Editorial Board (2014-present)
Scientific Reports, Editorial Board (2014-present)
Biomechanics and Modeling in Mechanobiology, Editorial Board (2015-present)

Selected key manuscripts (out of 165 total; Web of Science h-index=80 with 20,277 total cites)

Briquez PS, Swartz MA (2022). Severe COVID-19 induces autoantibodies against angiotensin II that correlate with blood pressure dysregulation and disease severity. *Sci Adv.* 8(40):eabn3777. doi: 10.1126/sciadv.abn3777.

MacDonald ME, ... Swartz MA (2022). Lymphatic coagulation and neutrophil extracellular traps in lung-draining lymph nodes of COVID-19 decedents. *Blood Adv.* 17:bloodadvances.2022007798.

Yu SS, Hubbell JA, Swartz MA (2021) Overcoming transport barriers to immunotherapy. *Drug Deliv. Transl. Res.* 2021, 11:2273-2275.

Sasso MS, Mitrousis N, Wang Y, Briquez PS, Hauert S, Ishihara J, Hubbell JA, Swartz MA (2021). Lymphangiogenesis-inducing vaccines elicit potent and long-lasting T cell immunity against melanomas. *Sci Adv.* 7(13):eabe4362. doi: 10.1126/sciadv.abe4362.

Focus article (commentary): JT Wilson and AW Lund, “Building new roads to stronger immunity”, *Sci. Adv.* 7(13):eabh3971 (2021). doi: 10.1126/sciadv.abh3971

Maisel K, ... Swartz MA (2020). Pro-lymphangiogenic VEGFR-3 signaling modulates memory T cell responses in allergic airway inflammation. *Mucosal Immunol.* doi: 10.1038/s41385-020-0308-4.

Vokali E,, and MA Swartz (2020). Lymphatic endothelial cells educate naïve CD8+ T cells under steady-state conditions to promote a memory-like phenotype. *Nature Comm.* 11(1):538. doi:10.1038/s41467-019-14127-9.

Kilarski WW, C Martin, M Pisano, O Bain, S Babayan, MA Swartz (2019). Inherent biomechanical traits enable infective filariae to disseminate through collecting lymphatic vessels. *Nature Comm.* 10(1):2895. doi:10.1038/s4167-019-10675-2.

Broggi MAS, Maillat L, Clement CC, Bordry N, Corthésy P, Auger A, Matter M, Hamelin R, Potin L, Demurtas D, Romano E, Harari A, Speiser DE, Santambrogio L, Swartz MA (2019). Tumor-associated factors are enriched in lymphatic exudate compared to plasma in metastatic melanoma patients. *J. Exp. Med.* 216(5):1091-1107. doi: 10.1084/jem.20181618

- M Fankhauser, MA Broggi, L Potin, N Bordry, L Jeanbart, AW Lund, E DaCosta, S Hauert, M Rincon, C Tremblay, DE Speiser, and MA Swartz (2017). Tumor lymphangiogenesis promotes T cell infiltration and potentiates immunotherapy in melanoma. *Sci. Trans. Med.* Sep 13;9(407). pii: eaal4712. doi: 10.1126/scitranslmed.aal4712.
- Commentary: C Moussion & SJ Turley (2017), “Tumor lymph vessels boost immunotherapy”, *Nature* 552:340-342.
- K Maisel, MS Sasso, L Potin, and MA Swartz (2017). Exploiting lymphatic vessels for immunomodulation: Rationale, opportunities, and challenges. *Adv. Drug Deliv. Rev.* 114:43-59.
- Rincon-Restrepo M, Mayer A, Hauert S, Bonner DK, Phelps EA, Hubbell JA, Swartz MA*, Hirose S* (2017). Vaccine nanocarriers: Coupling intracellular pathways and cellular biodistribution to control CD4 vs CD8 T cell responses. *Biomaterials* 132:48-58. doi:10.1016/j.biomaterials.2017.03.047.
- E Guç, PS Briquez, D Foretay, MA Fankhauser, JA Hubbell, WW Kilarski, and MA Swartz (2017). Local control of lymphangiogenesis with engineered fibrin-binding VEGF-C. *Biomaterials* 131:160-75. doi: 10.1016/j.biomaterials.2017.03.033.
- V. Triacca, E Guç, WW Kilarski, M Pisano, MA Swartz (2017). Transcellular pathways in lymphatic endothelial cells regulate changes in solute transport by fluid stress. *Circ Res.* 120(9):1440-52. doi:10.1161/CIRCRESAHA.116.309828.
- AW Lund, ...and MA Swartz (2016). Lymphatic vessels regulate immune microenvironments in human and murine melanoma. *J. Clin. Invest.* 126(9):3389-402.
- L Jeanbart and MA Swartz (2015). Engineering opportunities in cancer immunotherapy. *Proc. Natl. Acad. Sci. U.S.A.* 112(47):14467-72.
- M Pisano, V Triacca, KA Barbee, and MA Swartz (2015). An in vitro model of the tumor-lymphatic microenvironment with simultaneous transendothelial and luminal flows reveals mechanisms of flow-enhanced invasion. *Integr. Biol.* 7(5):525-33.
- MA Swartz (2014). Immunomodulatory roles of lymphatic vessels in cancer progression. *Cancer Immunol. Res.* 2(8):701-7.
- S Hirose, ... MA Swartz (2014). Steady-state antigen scavenging, cross-presentation and CD8⁺ T cell priming: a new role for lymphatic endothelial cells. *J. Immunol.* 192(11):5002-11.
- L Jeanbart, M Ballester, A de Titta, P Corthésy, P Romero, JA Hubbell, MA Swartz (2014). Enhancing efficacy of anticancer vaccines by targeted delivery to tumor-draining lymph nodes. *Cancer Immunol Res.* 2(5):436-47.
- E Güç, M Fankhauser, AW Lund, MA Swartz*, and WW Kilarski* (2014). Long-term intravital immunofluorescence imaging of tissue matrix components with epifluorescence and two-photon microscopy. *J. Vis. Exp.* Apr 22;(86). doi: 10.3791/51388.
- J Dubrot, ..., MA Swartz*, and S Hugues* (2014). Lymph node stromal cells acquire peptide-MHCII complexes from dendritic cells and induce antigen-specific CD4⁺ T cell tolerance. *J Exp.*
- C.M. Card, S.S. Yu, M.A. Swartz (2014). Emerging roles of lymphatic endothelium in regulating adaptive immunity. *J. Clin. Invest.* 124(3):943-52.
- A de Titta, M Ballester, Z Julier, C Nembrini, L Jeanbart, AJ van der Vlies, MA Swartz*, and JA Hubbell* (2013). Nanoparticle conjugation of CpG enhances adjuvancy for cellular immunity and memory recall at low dose. *Proc Natl Acad Sci USA.* 110(49):19902-7
- SN Thomas, E Vokali, AW Lund, JA Hubbell, and MA Swartz (2014). Targeting the tumor-draining lymph node with adjuvanted nanoparticles reshapes the anti-tumor immune response. *Biomaterials*, 35(2):814-24.
- JM Rutkowski, ... MA Swartz (2013). VEGFR-3 neutralization inhibits ovarian lymphangiogenesis, follicle maturation, and murine pregnancy. *Am. J. Pathol.* 183(5):1596-607.
- IC Kourtis, ...and MA Swartz (2013). Peripherally administered nanoparticles target monocytic myeloid cells, secondary lymphoid organs and tumors in mice. *PLoS One* 8(4):e61646.
- WW Kilarski, E Güç, JCM Teo, SR Oliver, AW Lund, MA Swartz (2013). Intravital immunofluorescence for visualizing the microcirculatory and immune microenvironments in the

- mouse ear dermis. *PLoS One* 8(2):e57135.
- JM Munson, RV Bellamkonda, and MA Swartz (2013). Interstitial flow in a 3D microenvironment increases glioma invasion by a CXCR4-dependent mechanism. *Cancer Res.* 73(5):1536-46.
- MA Swartz, S Hirosue, JA Hubbell (2012). Engineering approaches to immunotherapy. *Sci. Transl. Med.* Aug 22;4:148rv9.
- SN Thomas, JM Rutkowski, M Pasquier, EL Kuan, K Alitalo, GJ Randolph, and MA Swartz (2012). Weak humoral immunity and acquired autoimmunity in mice with impaired dermal lymphatic drainage. *J. Immunol.* Sep 1;189(5):2181-90.
- H Wiig and MA Swartz (2012). Interstitial fluid and lymph formation and transport: Physiological regulation and roles in inflammation and cancer. *Physiol Rev* July;92(3):1005-60.
- A.W. Lund, F.V. Duraes, S. Hirosue, S.N. Thomas, C. Nembrini, S. Hugues, and M.A. Swartz (2012). Tumor VEGF-C promotes immune tolerance and tumor antigen cross-presentation by lymphatics. *Cell Reports* 1(3): 191 - 199. Comment: *Cancer Res.* 72:1589-90, 2012; named “*Best of Cell Reports 2012*” (among most downloaded).
- MA Swartz and AW Lund (2012). Lymphatic and interstitial flow in the tumor microenvironment: Linking tumor mechanobiology with lymph node immunity. *Nature Rev. Cancer* 12:210-219.
- U. Haessler, M. Pisano, M. Wu, and M.A. Swartz (2011). Dendritic cell chemotaxis in 3D under defined chemokine gradients reveals differential response to CCL21 and CCL19. *Proc. Natl. Acad. Sci. U.S.A.* 108:5614-18
- JD Shields, I.C. Kourtis, AA Tomei, J. Roberts, and MA Swartz (2010). Induction of lymphoid-like stroma and immune escape by tumors that express the chemokine CCL21. *Science* 328(5979):749-52. (comment: “Perspectives,” *Science* 328:697-7, 2010; “Research Highlights,” *Nature Rev. Cancer*, 10(5):292, 2010).
- DO Miteva, JB Dixon, W Kilarski, JM Rutkowski, JD Shields, MA Swartz (2010). Transmural flow modulates cell and fluid transport functions of lymphatic endothelium: A potential early cue for inflammation. *Circ. Res.* 106(5):920-31.
- JM Rutkowski, CE Markhus, C.C. Gyenge, K. Alitalo, H. Wiig, MA Swartz (2010). Dermal collagen and fat accumulation correlate with tissue swelling and hydraulic conductivity in murine lymphedema. *Am J Pathol.* 176(3):1122-9.
- JA Hubbell, SN Thomas, MA Swartz (2009). Materials engineering for immunomodulation. *Nature* 462(7272):449-460.
- AA Tomei, S Siegert, MR Britschgi, SA Luther, MA Swartz (2009). Fluid flow regulates stromal cell organization and CCL21 expression in a tissue-engineered lymph node model. *J Immunol* 183(7):4273-83 (featured article).
- JB Dixon, S Rangunathan, MA Swartz (2009). A tissue engineered model of the intestinal microenvironment for evaluating lipid uptake into lacteals. *Biotech Bioeng* 103(6):1224-35.
- AA Tomei, F Boschetti, F. Gervaso, MA Swartz (2009). Culturing 3D collagen cultures under well-defined dynamic strain: a novel strain device with a porous elastomeric support. *Biotech Bioeng* 103: 217-225 (featured “Spotlight”).
- A Issa, TX Le, AN Shoushtari, JD Shields, & MA Swartz (2009). VEGF-C and CCL21 in tumor cell – lymphatic crosstalk promote invasive phenotype. *Cancer Res.* 69:349-357.
- MA Swartz, JA Hubbell, and ST Reddy (2008). Lymphatic drainage function and its immunological implications: From dendritic cell homing to vaccine design. *Semin. Immunol.*, 20(2):147-56.
- ST Reddy, AJ van der Vlies, E Simeoni, V Angeli, GJ Randolph, MA Swartz*, and JA Hubbell* (2007). Exploiting lymphatic transport and complement activation in nanoparticle vaccines. *Nature Biotechnol.* 25(10):1159-64.
- JD Shields, ME Fleury, C. Yong, AA Tomei, GJ Randolph, and MA Swartz (2007). Autologous chemotaxis as a mechanism of tumor cell homing to lymphatics via interstitial flow and autocrine

- CCR7 signaling. *Cancer Cell* 11:526-538. (comment *J. Cell Biol.* 178:4; won Servier Award by the Microcirculatory Society in 2008; ranked “must read” by Faculty of 1000).
- JM Rutkowski and MA Swartz (2007). A driving force for change: Interstitial flow as a morphoregulator. *Trends Cell Biol.* 17(1):44-50.
- J Goldman, JM Rutkowski, JD Shields, MC Pasquier, Y Cui, HG Schmoekel, S Wiley, DJ Hicklin, B Pytowksi, MA Swartz (2007). Cooperative and redundant roles of VEGFR-3 and VEGFR-2 signaling in adult lymphangiogenesis. *FASEB J.* 21:1003-12.
- CE Helm, AH Zisch, and MA Swartz (2007). Engineered blood and lymphatic capillaries in 3D VEGF-fibrin-collagen matrices with interstitial flow. *Biotech. Bioeng.* 96(1):167-176.
- JA Pedersen, F. Boschetti, MA Swartz (2007). Effects of extracellular matrix architecture on velocity and shear stress profiles on cells within a 3-D collagen matrix. *J. Biomech.* 40:1484-92.
- ST Reddy, DA Berk, RK Jain, MA Swartz (2006). A sensitive *in vivo* model for quantifying interstitial transport of injected macromolecules and nanoparticles. *J. Appl. Physiol.* 101:1162-9.
- MM Choe, AA Tomei, and MA Swartz (2006). 3D culture model of the human airway mucosa. *Nature Protocols* 1:357-362.
- LG Griffith and MA Swartz (2006). Capturing complex 3D tissue physiology in vitro. *Nature Rev. Mol. Cell Biol.* 7:211-224.
- JM Rutkowski, M. Moya, J. Johannes, J. Goldman, and MA Swartz (2006). Secondary lymphedema in the mouse tail: lymphatic hyperplasia, VEGF-C upregulation, and the protective role of MMP-9. *Microvasc. Res.* 72:161-171.
- JM Rutkowski, KC Boardman, and MA Swartz (2006). Characterization of lymphangiogenesis in a model of adult skin regeneration. *Am. J. Physiol. Heart Circ. Physiol.* 291: H1402–H1410.
- ME Fleury, KC Boardman, and MA Swartz (2006). Autologous morphogen gradients by subtle interstitial flow and matrix interactions. *Biophys. J.* 91(1) 113–121.
- MM Choe, PHS Sporn, and MA Swartz (2006). Extracellular matrix remodeling by dynamic strain in a 3D airway wall model. *Am. J. Resp. Cell Mol. Biol.* 35(3):306-13.
- CP Ng and MA Swartz. (2006). Mechanisms of interstitial flow-induced remodeling of fibroblast-collagen cultures. *Ann Biomed Eng* 34(3):446-54.
- CE Helm, ME Fleury, AH Zisch, F Boschetti, and MA Swartz (2005). Synergy between interstitial flow and VEGF directs capillary morphogenesis in vitro through a gradient amplification mechanism. *Proc Natl Acad Sci USA* 44:15779-15784.
- CP Ng, B Hinz, and MA Swartz (2005). Interstitial fluid flow induces myofibroblast differentiation and collagen alignment in vitro. *J Cell Sci* 118(20):4731-4739.
- GJ Randolph, V Angeli, and MA Swartz (2005). Dendritic cell trafficking to lymph nodes via lymphatic vessels. *Nature Rev. Immunol.* 5: 1-12.
- J Goldman, TX Le, M Skobe, and MA Swartz (2005). Overexpression of VEGF-C causes transient lymphatic hyperplasia but not increased lymphangiogenesis in regenerating skin. *Circ. Res.* 96:1193-1199 (Comment: *Circ Res.* 96:1132-1134, 2005).
- B Pytowski, J Goldman, K Persaud, Y Wu, L Witte, DJ Hicklin, M Skobe, KC Boardman, and MA Swartz (2005). Complete and specific inhibition of adult lymphatic regeneration by a novel VEGFR-3 neutralizing antibody. *J Natl Cancer Inst* 97(1):14-21 (Comments: *J. Natl. Cancer Inst.* 97(1):1-2, 2005; *Lab Invest.* 85 (6): 719, 2005; *Lymphatic Res. Biol.* 3(2):87-88, 2005).
- CP Ng, CE Helm, & MA Swartz (2004). Interstitial flow differentially stimulates blood and lymphatic endothelial cell morphogenesis *in vitro*. *Microvasc Res* 68:258-264.
- KC Boardman and MA Swartz (2003). Interstitial fluid flow as a guide for lymphangiogenesis. *Circ. Res.* 92:801-808, 2003 (Comment: *Circ. Res.* 92:701-3).

Current Sponsored Research Funding

2021-26: NIH R01 CA253248 “Probing cellular, molecular and biomechanical barriers to immunotherapy in the tumor microenvironment with organotypic in vitro models of the tumor-lympho-immune interface” (PI: Swartz; \$1.44M direct)

2021-26: NIH T32AI153020 “Immunoengineering postdoc training program” (PI: Swartz; \$2.14M).

Melody A. Swartz

2022-25: AbbVie “Reversing TGF β -mediated immune suppression in the tumor microenvironment for immunotherapy: Compound screening, mechanistic probing, and novel target identification using an in vitro model of the tumor-lymph-immune circuit” (PI: Swartz, \$927,000).

2022-23: Lipedema Foundation “Neutrophil NETosis and intralymphatic clotting in lipedema” (PI: Swartz).

2018-23: NIH R01 1CA219304 “Paradoxical roles of tumor lymphangiogenesis on tumor immunity and implications for immunotherapy” (PI: Swartz, \$1.25M direct)