# CURRICULUM VITAE

## Gary Frank Mitchell, MD

September 2022

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EDUCATION

| | | |
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| 1980 | B.A. | Vanderbilt University, Nashville, TN<br>Standard Bearer, College of Arts and Science<br>Phi Beta Kappa<br>Summa Cum Laude (Ranked 1 in a class of 846) |
| 1984 | M.D. | Washington University Medical School,<br>St. Louis, MO<br>Alpha Omega Alpha<br>CV Mosby Book Award for Research |

POSTGRADUATE TRAINING

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| 1984-85 | Medical Intern, Brigham and Women's Hospital, Harvard Medical School, Boston, MA |
| 1985-87 | Medical Resident, Brigham and Women's Hospital, Harvard Medical School, Boston, MA |
| 1987-88 | Clinical Fellow in Cardiology, Cardiovascular Division, Brigham and Women's Hospital, Harvard Medical School, Boston, MA |
| 1988-90 | Research Fellow in Cardiology, Cardiovascular Division, Brigham and Women's Hospital, Boston, MA |

## POSTGRADUATE HONORS AND AWARDS

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| 1990-1992 | Physician-Investigator Award, Massachusetts Affiliate of the American Heart Association. Project Title: "Aortic Input Impedance and Hydraulic Power in the Spontaneously Hypertensive Rat: Effects of Aging and Hypertension" |
| 1992-1997 | National Heart, Lung and Blood Institute Clinical Investigator Development Award. Project Title: "Ventricular/Vascular Coupling in the Hypertensive Rat." |

## PROFESSIONAL LICENSES AND BOARD CERTIFICATION

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| 1985 | National Board of Medical Examiners |
| 1986 | Registered Physician, Commonwealth of Massachusetts. |
| 1987 | American Board of Internal Medicine |
| 1989 | Board Certified, Subspecialty of Cardiovascular Diseases |

## ACADEMIC APPOINTMENTS

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| 1984-1990 | Research Fellow in Medicine, Harvard Medical School, Boston, MA |
| 1990-1998 | Instructor in Medicine, Harvard Medical School, Boston, MA |

## HOSPITAL APPOINTMENTS

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| 1990-1998 | Clinical Cardiologist, Brigham and Women's Hospital, Boston, MA |
| 1993-1998 | Director Pacemaker Service, Brigham and Women's Hospital, Boston, MA |

## OTHER APPOINTMENTS

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| 1998-Present | President, Cardiovascular Engineering, Inc. Norwood, MA |
| 1997-Present | Reviewer, *Hypertension.* |
| 1997-Present | Reviewer, *Circulation.* |
| 2006-Present | Reviewer, *American Journal of Physiology.* |
| 2006-Present | Reviewer, *American Journal of Hypertension.* |

2006-Present Reviewer, *Journal of the American Medical Association.*

2006-Present Ad Hoc Grant Reviewer, NIA, NIDDK, NIMH.
2006-Present Ad Hoc Grant Reviewer, Institut national de la santé et de la recherche médicale (INSERM), France.
2008-Present Ad Hoc Grant Reviewer, National Health and Medical Research Council, Australia.
2008-Present Ad Hoc Grant Reviewer, Swiss National Science Foundation (SNSF), Switzerland.

2006-Present Editorial Board, *Hypertension.*

## MEMBERSHIP IN SOCIETIES

1987-Present American Heart Association.
1998-Present American Medical Association.
2002-Present American Society for Hypertension.
2007-Present International Society for Vascular Behavioral and Cognitive Disorders.
2008-Present Association for Research into Arterial Structure and Physiology.
2009-Present The North American Artery Society.

## PUBLICATIONS LIST

### ORIGINAL PUBLICATIONS IN PEER-REVIEWED JOURNALS

1. Burton H, Mitchell GF, Brent D. Second somatic sensory area in the cerebral cortex of cats: somatotopic organization and cytoarchitecture. *J Comparative Neurology* 1982;210:109-135.
2. Mitchell GF, Lamas GA, Vaughan DE, Pfeffer MA. Left ventricular remodeling in the year after first anterior myocardial infarction: a quantitative analysis of contractile segment lengths and ventricular shape. *J Am Coll Cardiol.* 1992;19:1136-1144.
3. Mitchell GF, Lamas GA, Pfeffer MA. Ventricular remodeling after myocardial infarction. *Adv Exp Med Biol.* 1993;346:265-276.
4. Mitchell GF, Pfeffer MA, Westerhof N, Pfeffer JM. Measurement of aortic input impedance in rats. *Am J Physiol.* 1994;267:H1907-H1915.
5. Opitz CF, Mitchell GF, Pfeffer MA, Pfeffer JM. Arrhythmias and death after coronary artery occlusion in the rat. Continuous telemetric ECG monitoring in conscious, untethered rats. *Circulation.* 1995;92:253-261.
6. Ganz LI, Meyerovitz MF, Kandarpa K, Mitchell GF. Removal of the protruding retention wire via a femoral approach while leaving the active-fixation atrial "J" lead in situ: a technique for the management of class III atrial "J" leads. *Pacing Clin Electrophysiol.* 1996;19:1508-1512.

7. Mitchell GF, Pfeffer MA, Finn PV, Pfeffer JM. Equipotent antihypertensive agents variously affect pulsatile hemodynamics and regression of cardiac hypertrophy in spontaneously hypertensive rats. *Circulation.* 1996;94:2923-2929.

8. Mitchell GF, Pfeffer MA, Finn PV, Pfeffer JM. Comparison of techniques for measuring pulse-wave velocity in the rat. *J Appl Physiol (1985 ).* 1997;82:203-210.

9. Mitchell GF, Pfeffer JM, Pfeffer MA. The transition to failure in the spontaneously hypertensive rat. *Am J Hypertens.* 1997;10:120S-126S.

10. Lamas GA, Mitchell GF, Flaker GC, Smith SC, Jr., Gersh BJ, Basta L, Moye L, Braunwald E, Pfeffer MA. Clinical significance of mitral regurgitation after acute myocardial infarction. Survival and Ventricular Enlargement Investigators. *Circulation.* 1997;96:827-833.

11. Mitchell GF, Pfeffer JM, Pfeffer MA. The heart and conduit vessels in hypertension. *Med Clin North Am.* 1997;81:1247-1271.

12. Mitchell GF, Moye LA, Braunwald E, Rouleau JL, Bernstein V, Geltman EM, Flaker GC, Pfeffer MA. Sphygmomanometrically determined pulse pressure is a powerful independent predictor of recurrent events after myocardial infarction in patients with impaired left ventricular function. SAVE investigators. Survival and Ventricular Enlargement. *Circulation.* 1997;96:4254-4260.

13. Mitchell GF, Jeron A, Koren G. Measurement of heart rate and Q-T interval in the conscious mouse. *Am J Physiol.* 1998;274:H747-H751.

14. Lamas GA, Orav EJ, Stambler BS, Ellenbogen KA, Sgarbossa EB, Huang SK, Marinchak RA, Estes NA, III, Mitchell GF, Lieberman EH, Mangione CM, Goldman L. Quality of life and clinical outcomes in elderly patients treated with ventricular pacing as compared with dual-chamber pacing. Pacemaker Selection in the Elderly Investigators. *N Engl J Med.* 1998;338:1097-1104.

15. London B, Jeron A, Zhou J, Buckett P, Han X, Mitchell GF, Koren G. Long QT and ventricular arrhythmias in transgenic mice expressing the N terminus and first transmembrane segment of a voltage-gated potassium channel. *Proc Natl Acad Sci U S A.* 1998;95:2926-2931.

16. Opitz CF, Finn PV, Pfeffer MA, Mitchell GF, Pfeffer JM. Effects of reperfusion on arrhythmias and death after coronary artery occlusion in the rat: increased electrical stability independent of myocardial salvage. *J Am Coll Cardiol.* 1998;32:261-267.

17. Link MS, Estes NA, III, Griffin JJ, Wang PJ, Maloney JD, Kirchhoffer JB, Mitchell GF, Orav J, Goldman L, Lamas GA. Complications of dual chamber pacemaker implantation in the elderly. Pacemaker Selection in the Elderly (PASE) Investigators. *J Interv Card Electrophysiol.* 1998;2:175-179.

18. Chae CU, Pfeffer MA, Glynn RJ, Mitchell GF, Taylor JO, Hennekens CH. Increased pulse pressure and risk of heart failure in the elderly. *JAMA.* 1999;281:634-639.

19. Domanski MJ, Mitchell GF, Norman JE, Exner DV, Pitt B, Pfeffer MA. Independent prognostic information provided by sphygmomanometrically determined pulse pressure

and mean arterial pressure in patients with left ventricular dysfunction. *J Am Coll Cardiol.* 1999;33:951-958.

20. Mitchell GF. Pulse pressure, arterial compliance and cardiovascular morbidity and mortality. *Curr Opin Nephrol Hypertens.* 1999;8:335-342.

21. Domanski MJ, Davis BR, Pfeffer MA, Kastantin M, Mitchell GF. Isolated systolic hypertension : prognostic information provided by pulse pressure. *Hypertension.* 1999;34:375-380.

22. Mitchell GF, Pfeffer MA. Pulsatile hemodynamics in hypertension. *Curr Opin Cardiol.* 1999;14:361-369.

23. Jeron A, Mitchell GF, Zhou J, Murata M, London B, Buckett P, Wiviott SD, Koren G. Inducible polymorphic ventricular tachyarrhythmias in a transgenic mouse model with a long Q-T phenotype. *Am J Physiol Heart Circ Physiol.* 2000;278:H1891-H1898.

24. Domanski MJ, Sutton-Tyrrell K, Mitchell GF, Faxon DP, Pitt B, Sopko G. Determinants and prognostic information provided by pulse pressure in patients with coronary artery disease undergoing revascularization. The Balloon Angioplasty Revascularization Investigation (BARI). *Am J Cardiol.* 2001;87:675-679.

25. Brunner M, Guo W, Mitchell GF, Buckett PD, Nerbonne JM, Koren G. Characterization of mice with a combined suppression of I(to) and I(K,slow). *Am J Physiol Heart Circ Physiol.* 2001;281:H1201-H1209.

26. Mitchell GF, Tardif JC, Arnold JM, Marchiori G, O'Brien TX, Dunlap ME, Pfeffer MA. Pulsatile hemodynamics in congestive heart failure. *Hypertension.* 2001;38:1433-1439.

27. Mitchell GF, Izzo JL, Jr., Lacourciere Y, Ouellet JP, Neutel J, Qian C, Kerwin LJ, Block AJ, Pfeffer MA. Omapatrilat reduces pulse pressure and proximal aortic stiffness in patients with systolic hypertension: results of the conduit hemodynamics of omapatrilat international research study. *Circulation.* 2002;105:2955-2961.

28. Brunner M, Kodirov SA, Mitchell GF, Buckett PD, Shibata K, Folco EJ, Baker L, Salama G, Chan DP, Zhou J, Koren G. In vivo gene transfer of Kv1.5 normalizes action potential duration and shortens QT interval in mice with long QT phenotype. *Am J Physiol Heart Circ Physiol.* 2003;285:H194-H203.

29. Nigam A, Mitchell GF, Lambert J, Tardif JC. Relation between conduit vessel stiffness (assessed by tonometry) and endothelial function (assessed by flow-mediated dilatation) in patients with and without coronary heart disease. *Am J Cardiol.* 2003;92:395-399.

30. Mitchell GF, Lacourciere Y, Ouellet JP, Izzo JL, Jr., Neutel J, Kerwin LJ, Block AJ, Pfeffer MA. Determinants of elevated pulse pressure in middle-aged and older subjects with uncomplicated systolic hypertension: the role of proximal aortic diameter and the aortic pressure-flow relationship. *Circulation.* 2003;108:1592-1598.

31. Vita JA, Mitchell GF. Effects of shear stress and flow pulsatility on endothelial function: insights gleaned from external counterpulsation therapy. *J Am Coll Cardiol.* 2003;42:2096-2098.

32. Kodirov SA, Brunner M, Nerbonne JM, Buckett P, Mitchell GF, Koren G. Attenuation of I(K,slow1) and I(K,slow2) in Kv1/Kv2DN mice prolongs APD and QT intervals but does not suppress spontaneous or inducible arrhythmias. *Am J Physiol Heart Circ Physiol.* 2004;286:H368-H374.

33. Mitchell GF. Increased aortic stiffness: an unfavorable cardiorenal connection. *Hypertension.* 2004;43:151-153.

34. Benjamin EJ, Larson MG, Keyes MJ, Mitchell GF, Vasan RS, Keaney JF, Jr., Lehman BT, Fan S, Osypiuk E, Vita JA. Clinical correlates and heritability of flow-mediated dilation in the community: the Framingham Heart Study. *Circulation.* 2004;109:613-619.

35. Mitchell GF, Parise H, Benjamin EJ, Larson MG, Keyes MJ, Vita JA, Vasan RS, Levy D. Changes in arterial stiffness and wave reflection with advancing age in healthy men and women: the Framingham Heart Study. *Hypertension.* 2004;43:1239-1245.

36. Destefano AL, Larson MG, Mitchell GF, Benjamin EJ, Vasan RS, Li J, Corey D, Levy D. Genome-wide scan for pulse pressure in the National Heart, Lung and Blood Institute's Framingham Heart Study. *Hypertension.* 2004;44:152-155.

37. Mitchell GF, Parise H, Vita JA, Larson MG, Warner E, Keaney JF, Jr., Keyes MJ, Levy D, Vasan RS, Benjamin EJ. Local shear stress and brachial artery flow-mediated dilation: the Framingham Heart Study. *Hypertension.* 2004;44:134-139.

38. Mitchell GF. Arterial stiffness and wave reflection in hypertension: pathophysiologic and therapeutic implications. *Curr Hypertens Rep.* 2004;6:436-441.

39. Mitchell GF, Good MF. Historical review: Sir Gustav Nossal--immunologist and more. *Trends Immunol.* 2004;25:665-669.

40. Vita JA, Keaney JF, Jr., Larson MG, Keyes MJ, Massaro JM, Lipinska I, Lehman BT, Fan S, Osypiuk E, Wilson PW, Vasan RS, Mitchell GF, Benjamin EJ. Brachial artery vasodilator function and systemic inflammation in the Framingham Offspring Study. *Circulation.* 2004;110:3604-3609.

41. Heitritter SM, Solomon CG, Mitchell GF, Skali-Ounis N, Seely EW. Subclinical inflammation and vascular dysfunction in women with previous gestational diabetes mellitus. *J Clin Endocrinol Metab.* 2005;90:3983-3988.

42. Mitchell GF, Pfeffer MA. Evaluation and management of patients with uncontrolled systolic hypertension: is another new paradigm really needed? *Am Heart J.* 2005;149:776-784.

43. Mitchell GF, Destefano AL, Larson MG, Benjamin EJ, Chen MH, Vasan RS, Vita JA, Levy D. Heritability and a genome-wide linkage scan for arterial stiffness, wave reflection, and mean arterial pressure: the Framingham Heart Study. *Circulation.* 2005;112:194-199.

44. Kathiresan S, Larson MG, Vasan RS, Guo CY, Vita JA, Mitchell GF, Keyes MJ, Newton-Cheh C, Musone SL, Lochner AL, Drake JA, Levy D, O'Donnell CJ, Hirschhorn JN, Benjamin EJ. Common genetic variation at the endothelial nitric oxide

synthase locus and relations to brachial artery vasodilator function in the community. *Circulation.* 2005;112:1419-1427.

45. Mitchell GF, Arnold JM, Dunlap ME, O'Brien TX, Marchiori G, Warner E, Granger CB, Desai SS, Pfeffer MA. Pulsatile hemodynamic effects of candesartan in patients with chronic heart failure: the CHARM Program. *Eur J Heart Fail.* 2006;8:191-197.

46. Mitchell GF, Lacourciere Y, Arnold JM, Dunlap ME, Conlin PR, Izzo JL, Jr. Changes in aortic stiffness and augmentation index after acute converting enzyme or vasopeptidase inhibition. *Hypertension.* 2005;46:1111-1117.

47. Mitchell GF, Vita JA, Larson MG, Parise H, Keyes MJ, Warner E, Vasan RS, Levy D, Benjamin EJ. Cross-sectional relations of peripheral microvascular function, cardiovascular disease risk factors, and aortic stiffness: the Framingham Heart Study. *Circulation.* 2005;112:3722-3728.

48. Kathiresan S, Gona P, Larson MG, Vita JA, Mitchell GF, Tofler GH, Levy D, Newton-Cheh C, Wang TJ, Benjamin EJ, Vasan RS. Cross-sectional relations of multiple biomarkers from distinct biological pathways to brachial artery endothelial function. *Circulation.* 2006;113:938-945.

49. Mitchell GF. Triangulating the peaks of arterial pressure. *Hypertension.* 2006;48:543-545.

50. Izzo JLJ, Mitchell GF. Aging and arterial structure-function relations. *Adv Cardiol.* 2007;44:19-34.

51. Ounis-Skali N, Mitchell GF, Solomon CG, Solomon SD, Seely EW. Changes in central arterial pressure waveforms during the normal menstrual cycle. *J Investig Med.* 2006;54:321-326.

52. Mitchell GF, Vasan RS, Keyes MJ, Parise H, Wang TJ, Larson MG, D'Agostino RB, Sr., Kannel WB, Levy D, Benjamin EJ. Pulse pressure and risk of new-onset atrial fibrillation. *JAMA.* 2007;297:709-715.

53. Mitchell GF. Impedance progress: aortic diameter rears its head again? *Hypertension.* 2007;49:1207-1209.

54. Mitchell GF, Guo CY, Kathiresan S, Vasan RS, Larson MG, Vita JA, Keyes MJ, Vyas M, Newton-Cheh C, Musone SL, Camargo AL, Drake JA, Levy D, O'Donnell CJ, Hirschhorn JN, Benjamin EJ. Vascular stiffness and genetic variation at the endothelial nitric oxide synthase locus: the Framingham Heart study. *Hypertension.* 2007;49:1285-1290.

55. Mitchell GF, Dunlap ME, Warnica W, Ducharme A, Arnold JM, Tardif JC, Solomon SD, Domanski MJ, Jablonski KA, Rice MM, Pfeffer MA. Long-term trandolapril treatment is associated with reduced aortic stiffness: the prevention of events with angiotensin-converting enzyme inhibition hemodynamic substudy. *Hypertension.* 2007;49:1271-1277.

56. Mitchell GF, Guo CY, Benjamin EJ, Larson MG, Keyes MJ, Vita JA, Vasan RS, Levy D. Cross-sectional correlates of increased aortic stiffness in the community: the Framingham Heart Study. *Circulation.* 2007;115:2628-2636.

57. Vyas M, Izzo JL, Jr., Lacourciere Y, Arnold JM, Dunlap ME, Amato JL, Pfeffer MA, Mitchell GF. Augmentation index and central aortic stiffness in middle-aged to elderly individuals. *Am J Hypertens.* 2007;20:642-647.

58. Levy D, Hwang SJ, Kayalar A, Benjamin EJ, Vasan RS, Parise H, Larson MG, Wang TJ, Selhub J, Jacques PF, Vita JA, Keyes MJ, Mitchell GF. Associations of plasma natriuretic peptide, adrenomedullin, and homocysteine levels with alterations in arterial stiffness: the Framingham Heart Study. *Circulation.* 2007;115:3079-3085.

59. Widlansky ME, Vita JA, Keyes MJ, Larson MG, Hamburg NM, Levy D, Mitchell GF, Osypiuk EW, Vasan RS, Benjamin EJ. Relation of season and temperature to endothelium-dependent flow-mediated vasodilation in subjects without clinical evidence of cardiovascular disease (from the Framingham Heart Study). *Am J Cardiol.* 2007;100:518-523.

60. Penington DG, Mitchell GF. Human embryonic stem cells leap the barrier. *Med J Aust.* 2007;187:139-140.

61. Sweitzer NK, Shenoy M, Stein JH, Keles S, Palta M, LeCaire T, Mitchell GF. Increases in central aortic impedance precede alterations in arterial stiffness measures in type 1 diabetes. *Diabetes Care.* 2007;30:2886-2891.

62. Ounis-Skali N, Bentley-Lewis R, Mitchell GF, Solomon S, Seely EW. Central aortic pulsatile hemodynamics in obese premenopausal women. *J Am Soc Hypertens.* 2007;1:341-346.

63. Levy D, Larson MG, Benjamin EJ, Newton-Cheh C, Wang TJ, Hwang SJ, Vasan RS, Mitchell GF. Framingham Heart Study 100K Project: genome-wide associations for blood pressure and arterial stiffness. *BMC Med Genet.* 2007;8 Suppl 1:S3

64. Vasan RS, Larson MG, Aragam J, Wang TJ, Mitchell GF, Kathiresan S, Newton-Cheh C, Vita JA, Keyes MJ, O'Donnell CJ, Levy D, Benjamin EJ. Genome-wide association of echocardiographic dimensions, brachial artery endothelial function and treadmill exercise responses in the Framingham Heart Study. *BMC Med Genet.* 2007;8 Suppl 1:S2

65. Mitchell GF. Selection, memory and selective memories: T cells, B cells and Sir Mac 1968. *Immunol Cell Biol.* 2008;86:26-30.

66. Mitchell GF, Conlin PR, Dunlap ME, Lacourciere Y, Arnold JM, Ogilvie RI, Neutel J, Izzo JL, Jr., Pfeffer MA. Aortic diameter, wall stiffness, and wave reflection in systolic hypertension. *Hypertension.* 2008;51:105-111.

67. Hamburg NM, Larson MG, Vita JA, Vasan RS, Keyes MJ, Widlansky ME, Fox CS, Mitchell GF, Levy D, Meigs JB, Benjamin EJ. Metabolic syndrome, insulin resistance, and brachial artery vasodilator function in Framingham Offspring participants without clinical evidence of cardiovascular disease. *Am J Cardiol.* 2008;101:82-88.

68. Mitchell GF, Gudnason V, Launer LJ, Aspelund T, Harris TB. Hemodynamics of increased pulse pressure in older women in the community-based Age, Gene/Environment Susceptibility-Reykjavik Study. *Hypertension.* 2008;51:1123-1128.

69. Schnabel R, Larson MG, Dupuis J, Lunetta KL, Lipinska I, Meigs JB, Yin X, Rong J, Vita JA, Newton-Cheh C, Levy D, Keaney JF, Jr., Vasan RS, Mitchell GF, Benjamin EJ. Relations of inflammatory biomarkers and common genetic variants with arterial stiffness and wave reflection. *Hypertension.* 2008;51:1651-1657.

70. Hamburg NM, Keyes MJ, Larson MG, Vasan RS, Schnabel R, Pryde MM, Mitchell GF, Sheffy J, Vita JA, Benjamin EJ. Cross-sectional relations of digital vascular function to cardiovascular risk factors in the Framingham Heart Study. *Circulation.* 2008;117:2467-2474.

71. Brunner M, Peng X, Liu GX, Ren XQ, Ziv O, Choi BR, Mathur R, Hajjiri M, Odening KE, Steinberg E, Folco EJ, Pringa E, Centracchio J, Macharzina RR, Donahay T, Schofield L, Rana N, Kirk M, Mitchell GF, Poppas A, Zehender M, Koren G. Mechanisms of cardiac arrhythmias and sudden death in transgenic rabbits with long QT syndrome. *J Clin Invest.* 2008;118:2246-2259.

72. Foster MC, Keyes MJ, Larson MG, Vita JA, Mitchell GF, Meigs JB, Vasan RS, Benjamin EJ, Fox CS. Relations of measures of endothelial function and kidney disease: the Framingham Heart Study. *Am J Kidney Dis.* 2008;52:859-867.

73. Ingelsson E, Pencina MJ, Levy D, Aragam J, Mitchell GF, Benjamin EJ, Vasan RS. Aortic root diameter and longitudinal blood pressure tracking. *Hypertension.* 2008;52:473-477.

74. Mitchell GF. Effects of central arterial aging on the structure and function of the peripheral vasculature: implications for end-organ damage. *J Appl Physiol (1985 ).* 2008;105:1652-1660.

75. Mitchell GF. Clinical achievements of impedance analysis. *Med Biol Eng Comput.* 2009;47:153-163.

76. Scherer ML, Aspelund T, Sigurdsson S, Detrano R, Garcia M, Mitchell GF, Launer LJ, Thorgeirsson G, Gudnason V, Harris TB. Abnormal T-wave axis is associated with coronary artery calcification in older adults. *Scand Cardiovasc J.* 2009;43:240-248.

77. Kelley-Hedgepeth A, Peter I, Montefusco MC, Levy D, Benjamin EJ, Vasan RS, Mendelsohn ME, Housman D, Huggins GS, Mitchell GF. The KCNMB1 E65K variant is associated with reduced central pulse pressure in the community-based Framingham Offspring Cohort. *J Hypertens.* 2009;27:55-60.

78. Lieb W, Larson MG, Benjamin EJ, Yin X, Tofler GH, Selhub J, Jacques PF, Wang TJ, Vita JA, Levy D, Vasan RS, Mitchell GF. Multimarker approach to evaluate correlates of vascular stiffness: the Framingham Heart Study. *Circulation.* 2009;119:37-43.

79. Franklin SS, Lopez VA, Wong ND, Mitchell GF, Larson MG, Vasan RS, Levy D. Single versus combined blood pressure components and risk for cardiovascular disease: the Framingham Heart Study. *Circulation.* 2009;119:243-250.

80. Peter I, Kelley-Hedgepeth A, Huggins GS, Housman DE, Mendelsohn ME, Vita JA, Vasan RS, Levy D, Benjamin EJ, Mitchell GF. Association between arterial stiffness and variations in oestrogen-related genes. *J Hum Hypertens.* 2009;23:636-644.

81. Lieb W, Safa R, Benjamin EJ, Xanthakis V, Yin X, Sullivan LM, Larson MG, Smith HM, Vita JA, Mitchell GF, Sawyer DB, Vasan RS. Vascular endothelial growth factor, its soluble receptor, and hepatocyte growth factor: clinical and genetic correlates and association with vascular function. *Eur Heart J.* 2009;30:1121-1127.

82. Parikh NI, Keyes MJ, Larson MG, Pou KM, Hamburg NM, Vita JA, O'Donnell CJ, Vasan RS, Mitchell GF, Hoffmann U, Fox CS, Benjamin EJ. Visceral and subcutaneous adiposity and brachial artery vasodilator function. *Obesity (Silver Spring).* 2009;17:2054-2059.

83. Levy D, Ehret GB, Rice K, Verwoert GC, Launer LJ, Dehghan A, Glazer NL, Morrison AC, Johnson AD, Aspelund T, Aulchenko Y, Lumley T, Kottgen A, Vasan RS, Rivadeneira F, Eiriksdottir G, Guo X, Arking DE, Mitchell GF, Mattace-Raso FU, Smith AV, Taylor K, Scharpf RB, Hwang SJ, Sijbrands EJ, Bis J, Harris TB, Ganesh SK, O'Donnell CJ, Hofman A, Rotter JI, Coresh J, Benjamin EJ, Uitterlinden AG, Heiss G, Fox CS, Witteman JC, Boerwinkle E, Wang TJ, Gudnason V, Larson MG, Chakravarti A, Psaty BM, van Duijn CM. Genome-wide association study of blood pressure and hypertension. *Nat Genet.* 2009;41:677-687.

84. Vasan RS, Glazer NL, Felix JF, Lieb W, Wild PS, Felix SB, Watzinger N, Larson MG, Smith NL, Dehghan A, Grosshennig A, Schillert A, Teumer A, Schmidt R, Kathiresan S, Lumley T, Aulchenko YS, Konig IR, Zeller T, Homuth G, Struchalin M, Aragam J, Bis JC, Rivadeneira F, Erdmann J, Schnabel RB, Dorr M, Zweiker R, Lind L, Rodeheffer RJ, Greiser KH, Levy D, Haritunians T, Deckers JW, Stritzke J, Lackner KJ, Volker U, Ingelsson E, Kullo I, Haerting J, O'Donnell CJ, Heckbert SR, Stricker BH, Ziegler A, Reffelmann T, Redfield MM, Werdan K, Mitchell GF, Rice K, Arnett DK, Hofman A, Gottdiener JS, Uitterlinden AG, Meitinger T, Blettner M, Friedrich N, Wang TJ, Psaty BM, van Duijn CM, Wichmann HE, Munzel TF, Kroemer HK, Benjamin EJ, Rotter JI, Witteman JC, Schunkert H, Schmidt H, Volzke H, Blankenberg S. Genetic variants associated with cardiac structure and function: a meta-analysis and replication of genome-wide association data. *JAMA.* 2009;302:168-178.

85. Upadhyay A, Hwang SJ, Mitchell GF, Vasan RS, Vita JA, Stantchev PI, Meigs JB, Larson MG, Levy D, Benjamin EJ, Fox CS. Arterial stiffness in mild-to-moderate CKD. *J Am Soc Nephrol.* 2009;20:2044-2053.

86. Desai AS, Mitchell GF, Fang JC, Creager MA. Central aortic stiffness is increased in patients with heart failure and preserved ejection fraction. *J Card Fail.* 2009;15:658-664.

87. Chami HA, Keyes MJ, Vita JA, Mitchell GF, Larson MG, Fan S, Vasan RS, O'Connor GT, Benjamin EJ, Gottlieb DJ. Brachial artery diameter, blood flow and flow-mediated dilation in sleep-disordered breathing. *Vasc Med.* 2009;14:351-360.

88. Mitchell GF, Hwang SJ, Vasan RS, Larson MG, Pencina MJ, Hamburg NM, Vita JA, Levy D, Benjamin EJ. Arterial stiffness and cardiovascular events: the Framingham Heart Study. *Circulation.* 2010;121:505-511.

89. Mitchell GF. Arterial Stiffness and Wave Reflection: Biomarkers of Cardiovascular Risk. *Artery Res.* 2009;3:56-64.

90. Lieb W, Zachariah JP, Xanthakis V, Safa R, Chen MH, Sullivan LM, Larson MG, Smith HM, Yang Q, Mitchell GF, Vita JA, Sawyer DB, Vasan RS. Clinical and genetic correlates of circulating angiopoietin-2 and soluble Tie-2 in the community. *Circ Cardiovasc Genet.* 2010;3:300-306.

91. Lam CS, Xanthakis V, Sullivan LM, Lieb W, Aragam J, Redfield MM, Mitchell GF, Benjamin EJ, Vasan RS. Aortic root remodeling over the adult life course: longitudinal data from the Framingham Heart Study. *Circulation.* 2010;122:884-890.

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OTHER PEER-REVIEWED PUBLICATIONS

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5. Mitchell GF. Pulse pressure, arterial compliance and cardiovascular morbidity and mortality. *Curr Opin Nephrol Hypertens.* 1999;8:335-342.
6. Mitchell GF, Pfeffer MA. Pulsatile hemodynamics in hypertension. *Curr Opin Cardiol.* 1999;14:361-369.
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8. Folco EJ, Roder K, Mitchell GF, Koren G. "Cardiac memory": a struggle against forgetting. *Circ Res.* 2003;93:384-386.
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11. Mitchell GF. Arterial stiffness and wave reflection in hypertension: pathophysiologic and therapeutic implications. *Curr Hypertens Rep.* 2004; 6:436-41.
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21. Mitchell GF. Arterial stiffness and hypertension. *Hypertension.* 2014;64:13-18.

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25. Mitchell GF. Does Measurement of Central Blood Pressure have Treatment Consequences in the Clinical Praxis? *Curr Hypertens Rep.* 2015;17:66.

26. Bell V, Mitchell GF. Influence of Vascular Function and Pulsatile Hemodynamics on Cardiac Function. *Curr Hypertens Rep.* 2015;17:580.

27. Wilkinson IB, Maki-Petaja KM, Mitchell GF. Uses of Arterial Stiffness in Clinical Practice. *Arterioscler Thromb Vasc Biol.* 2020;40:1063-1067.

28. Mitchell GF, Powell JT. Arteriosclerosis: A Primer for "In Focus" Reviews on Arterial Stiffness. *Arterioscler Thromb Vasc Biol.* 2020;40:1025-1027.

29. Izzo JL, Jr., Mitchell GF. Pitfalls of Pulse Wave Analysis and Oscillometric Blood Pressure Derivatives. *Hypertension.* 2021;78:372-375.

30. Mitchell GF. Arterial Stiffness in Aging: Does It Have a Place in Clinical Practice?: Recent Advances in Hypertension. *Hypertension.* 2021;77:768-780.

31. Boutouyrie P, Chowienczyk P, Humphrey JD, Mitchell GF. Arterial Stiffness and Cardiovascular Risk in Hypertension. *Circ Res.* 2021;128:864-886.

BOOKS AND BOOK CHAPTERS

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2. Mitchell GM, Izzo Jr JL. Chapter 119. Evaluation of arterial stiffness. In Hypertension Primer, Third Edition. Izzo Jr JL and Black HR, eds. Philadelphia: Lippincott Williams & Wilkins, 2003:351-355.
3. Franklin SS and Mitchell GF. Chapter 45. Aging, arterial function, and systolic hypertension. In Hypertension Primer, Fourth Edition. Izzo Jr JL and Black HR, eds. Philadelphia: Lippincott Williams & Wilkins, 2008:144-148.
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5. Mitchell GF. Chapter 20. Arterial stiffness in chronic heart failure. In Handbook of hypertension. Volume 23. Arterial Stiffness in Hypertension. Safar M and O'Rourke MF, eds. Amsterdam: Elsevier, 2006:309-320.
6. Mitchell GF. Chapter 7. Imaging Tools in Cardiovascular Research. In Clinical And Translational Science: Principles of Human Research. Robertson D and Williams GH, eds. Amsterdam: Elsevier, 2009:105-121.
7. Mitchell GF. Chapter 25. Arterial Function. In Arterial Disorders: Definition, Clinical Manifestations, Mechanisms and Therapeutic Approaches. Adel Berbari, Giuseppe Mancia eds. London: Springer, 2015:373-383.

INVITED PRESENTATIONS

1. European Society of Cardiology. Satellite Symposium on the SAVE Study, Nice, France, 1992, International.
2. National Institutes of Health. Henry Goldberg Workshop, Bethesda, 1992, International.
3. American College of Cardiology. Core Curriculum Lecture on Left Ventricular Remodeling, Anaheim, 1993, International.
4. Brigham and Women's Hospital. Cardiovascular Grand Rounds, Boston, 1993, Regional.
5. University of Wurzburg. The Surviving Myocardium Post-Myocardial Infarction, Wurzburg, 1993, International.
6. American Heart Association. Massachusetts Affiliate, Holyoke, MA, 1994, Regional.

7. Boston Heart Failure Club. Symposium on hypertrophy and remodeling, Boston, 1996, Regional.

8. Third International Workshop on Structure and Function of Large Arteries, Versailles, France, 1998, International.

9. American Heart Association. Council for High Blood Pressure Research Annual Meeting. Chicago, 2004, International.

10. McMaster University. Medical Grand Rounds, Hamilton, Canada, 2000, Regional.

11. University Hospital, Case Western Reserve University. Cardiology Grand Rounds, Cleveland, 2000, Regional.

12. French Society of Hypertension, European Society of Hypertension, American Society of Hypertension, International Society of Hypertension. First International Consensus Conference on the Clinical Applications of Arterial Stiffness, Paris, France, 2000, International.

13. Fourth International Workshop on Structure and Function of Large Arteries, Neuilly, France, 2001, International.

14. Duke Clinical Research Institute, NIH, FDA. Uncontrolled systolic hypertension, Washington, DC, 2002, National.

15. Fifth International Workshop on Structure and Function of Large Arteries, Neuilly, France, 2005, International.

16. UT Southwestern Medical Center. Division of Hypertension Grand Rounds, Dallas, TX, 2005, Regional.

17. Brigham and Women's Hospital. Cardiovascular Grand Rounds, Boston, 2006, Regional.

18. Boston University Medical Center. Cardiology Grand Rounds, Boston, MA, 2006, Regional.

19. NIA/NINDS Working Group. Cell Biology of Vascular Cognitive Impairment, Bethesda, 2006, International.

20. International Society of Vascular Health. Perfusion, Large Arteries, Microcirculation Expert Forum, Paris, France, 2006, International.

21. Sixth International Workshop on Structure and Function of the Vascular System, Neuilly, France, 2007, International.

22. American College of Cardiology. Meet the Experts. New Orleans, LA, 2007, International.

23. American College of Cardiology. Great Debates in Hypertension. New Orleans, LA, 2007, International.

24. International Society for Vascular Behavioral and Cognitive Disorders. The 3rd Congress of the International Society of Vascular Behavioral and Cognitive Disorders, San Antonio, 2007, International.

25. Critical Markers of Disease. Cardiovascular Biomarker and Surrogate Endpoint Symposium, Bethesda, 2007, International.

26. NIA. Fellows' Friday Seminar Series, Baltimore, 2007, Regional.

27. Mayo Clinic. Biomarkers of Cardiovascular Risk: State of the Art, Rochester, MN, 2007, National.

28. Rhode Island Hospital. Medical Grand Rounds, Providence, RI, 2007, Regional.

29. Rhode Island Hospital. Cardiology Grand Rounds, Providence, RI, 2007, Regional.

30. MetroHealth Medical Center, Case Western Reserve University. Visiting Professor, Cardiology Grand Rounds, Medical Grand Rounds, Fellowship Rounds, Cleveland, OH, 2008, Regional.

31. University of Calgary. Cardiovascular Rounds, Calgary, Canada, 2008, Regional.

32. NHLBI Working Group. Target Organ Damage in Hypertension: Research Priorities and Infrastructure Needs, Bethesda, 2008, National.

33. NIA/NINDS Working Group. The Role of the Vascular System in Neurological Diseases of the Aging Brain, Bethesda, 2008, International.

34. Association for Research into Arterial Structure and Function, European Society of Cardiology, European Society of Hypertension. Artery 8, Gent, Belgium, 2008.

35. University of Colorado at Boulder, Department of Integrative Physiology. Research Colloquium Seminar, Boulder, CO, 2008, Regional.

36. Mayo Clinic. Biomarkers of Cardiovascular Risk 2009, Phoenix, AZ, 2009, National.

37. Brigham and Women's Hospital, Cardiovascular Grand Rounds, Boston, 2009, Regional.

38. Seventh International Workshop on Structure and Function of the Vascular System, Neuilly, France, 2009, International.

(Truncated at 2009.)

GRANTS

Prior Awards:

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| 1987-1992 | Bristol-Myers Squibb Pharmaceutical Research Institute ($250,000). Cardiac Catheterization Core Laboratory, Survival and Ventricular Enlargement (SAVE) Study. Assistant Director. |
| 1990-1992 | Physician-Investigator Award, Massachusetts Affiliate of the American Heart Association ($70,000). Project Title: "Aortic Input Impedance and Hydraulic Power in the Spontaneously Hypertensive Rat: Effects of Aging and Hypertension." Principal Investigator. |
| 1992-1997 | NIH/NHLBI (1K08HL02775, $406,400). Clinical Investigator Development Award. Project Title: "Ventricular/Vascular Coupling in the Hypertensive Rat." Principal Investigator. |
| 1997-1999 | Bristol-Myers Squibb Pharmaceutical Research Institute ($95,000). "Conduit vessel pulsatile hemodynamics." A mechanistic substudy of the hemodynamic effects of vasopeptidase (NEP/ACE) inhibition (omapatrilat) in patients with heart failure. In this small pilot study, we demonstrated that omapatrilat had a favorable pressure-independent effect on aortic stiffness. Principal Investigator. |
| 2000-2002 | Bristol-Myers Squibb Pharmaceutical Research Institute (CV137-090, $2,000,000). "Effects Of Omapatrilat Or Enalapril On Conduit Vessel Hemodynamics In Subjects With Systolic Hypertension." This study demonstrated that vasopeptidase inhibition had a more favorable effect on large vessel stiffness than ACE inhibition alone in patients with systolic hypertension. Principal Investigator. |
| 2000-2003 | Bristol-Myers Squibb Pharmaceutical Research Institute (CV137-068, $250,000). "OVERTURE: Omapatrilat versus Enalapril Randomized Trial of Utility in Reducing Events" Amendment #6 Conduit Hemodynamics Substudy. The goal of this study is to further our observations on the favorable effects of vasopeptidase inhibition in patients with heart failure and impaired left ventricular function. Principal Investigator. |
| 1999-2003 | AstraZeneca ($600,000). "Pulsatile hemodynamics in patients with heart failure enrolled in the CHARM Study." A mechanistic substudy |

of the Candesartan in Heart Failure Assessment of Reduction in Mortality and Morbidity (CHARM) study. The goals of this study are 1) to characterize the differences in pulsatile hemodynamics in patients with heart failure and preserved vs. depressed systolic function and 2) to assess the effects of AT1 receptor blockade on conduit vessel stiffness in patients with heart failure with preserved or depressed LV function. Principal Investigator.

2000-2005 Reynolds Foundation (through Stanford University, $955,478). "Genetics of Vascular Stiffness: A Non-Invasive Investigation Using Arterial Tonometry In The Framingham Heart Study." The goals of this study are to evaluate the heritability and genetic determinants of vascular stiffness in the Framingham Heart Study cohorts. Principal investigator: Daniel Levy, MD. Core lab director: Gary F. Mitchell, MD.

2002-2006 NIH/NHLBI (1R01HL70100-01, $577,870 core lab only). "Vascular Function in the Framingham Third Generation." The goal of this study is to evaluate endothelial function, large artery function and ventricular function in a large, well defined, community-based sample. Principal investigator: Emelia Benjamin, MD. Core lab director: Gary F. Mitchell, MD.

2003-2008 NIH/NHLBI (1R01HL075795-01, $225,000 core lab only). "The Clinical Utility of Endothelial Function in PAD." The goals of this study are to determine whether: 1) reversing endothelial dysfunction ameliorates perioperative risk in PAD patients, 2) endothelial dysfunction predicts long-term (2-year) PAD and coronary heart disease risk in PAD patients, and 3) systemic markers of oxidative stress and inflammation relate to endothelial dysfunction and long-term PAD and coronary heart disease risk. Cardiovascular Engineering, Inc. has a subcontract to perform arterial tonometry testing and data analysis and interpretation. Principal investigator: Joseph Vita, MD. Core lab director: Gary F. Mitchell, MD.

2004-2005 NIH/NHLBI (1R43HL073551-01, $100,000). "A central aortic pulse wave velocity measurement device." The goal of this Phase I SBIR-funded research is to develop and validate a noninvasive device that measures central aortic pulse wave velocity. Principal investigator.

2005-2007 NIH/NHLBI (2R44HL073551-02A1, $582,724). "A central aortic pulse wave velocity measurement device." The goal of this Phase II SBIR-funded research is to develop and validate a noninvasive device that measures central aortic pulse wave velocity. Principal investigator.

2004-2009 NIH/NHLBI (1R01HL076784, $10,000 consultant fee). "Framingham: Inflammation, Genes & Cardiovascular Disease." Specific Aims: To examine the environmental determinants of systemic inflammation in the community; To investigate the genetic determinants of systemic inflammation; To identify the inflammatory phenotypic and genetic determinants of subclinical CVD; To determine the contribution of inflammatory phenotype versus genotype to prevalent and incident CVD and to incident hypertension. Principal investigator: Emelia J. Benjamin. Role: Consultant.

2005-2010 NIH/NHLBI (1R01HL080124-01, $3,565,250). Ventricular Vascular Coupling: Correlates & Prognosis. The goals of this proposal are to evaluate cross-sectional correlates of ventricular-vascular coupling, environmental and genetic correlates of diastolic dysfunction, correlates of longitudinal change in arterial stiffness and ventricular function, and prognostic value of measures of ventricular-vascular coupling in the Framingham Offspring Cohort. Cardiovascular Engineering, Inc. will have a subcontract to supervise hemodynamic data acquisition, analysis and interpretation. Principal investigator: Vasan Ramachandran, MD. Core lab director: Gary F. Mitchell, MD.

2005-2010 NIH/NHLBI (1R01HL077234-01, $240,901 core lab only). Cardiovascular and renal hemodynamics and the DASH diet. The goals of this proposal are to evaluate the effects of the DASH diet on pulsatile hemodynamics, ventricular relaxation and renal blood flow. Cardiovascular Engineering, Inc. will have a subcontract to supervise hemodynamic data acquisition, analysis and interpretation. Principal investigator: Paul Conlin, MD. Core lab director: Gary F. Mitchell, MD.

2005-2010 NIH/NHLBI (1R01HL077447-01A1, $2,725,755). Biomarkers of Ventricular-Vascular Coupling. The goal of this project is to identify biomarkers that reflect vascular or ventricular remodeling based on tonometry, echocardiography and biomarker data obtained in the Framingham Study cohorts. Principal investigator: Vasan Ramachandran, MD. Core lab director: Gary F. Mitchell, MD.

2009-2013 NIH/NHLBI (1R01HL094898-01A1, $2,738,347). Aorta, Brain and Kidney Structure and Function in the AGES-Reykjavik Study. The goal of this project is to relate central and peripheral pulse pressure to aorta, kidney and brain structure and function assessed by magnetic resonance imaging in the AGES-Reykjavik Study cohort. Principal investigator, Gary F. Mitchell, MD.

2009-2013 NIH/NIDDK (1 R01 DK082447-01A1, $2,942,659). Kidney Function, Aortic Stiffness and Aging. The goals of this project are to

measure glomerular function in a subset of 800 participants in order to define new estimating equations for kidney function in older people and using these new equations, to relate aortic stiffness to kidney function in the full cohort. Principal Investigator, Andrew Levey, MD. Hemodynamics core lab director, Gary F. Mitchell, MD.

2011-2015 NIH/NHLBI (1 R01 HL107385-01, $2,703,931). Aortic Dysfunction, Pulsatile Stress and Target Organ Damage in Framingham. The goals of this proposal are to evaluate correlates of longitudinal change in arterial stiffness and a comprehensive battery of pulsatile hemodynamic variables in the Framingham Offspring Cohort. Cardiovascular Engineering, Inc. will have a subcontract to supervise hemodynamic data acquisition, analysis and interpretation. Principal Investigators, Gary F. Mitchell, MD and Vasan Ramachandran, MD. Hemodynamics core lab director, Gary F. Mitchell, MD.

2011-2016 NIH/NHLBI (1 R01 HL104184-01, $3,686,631) Clinical and Genetic Correlates of Vascular Function in African Americans: JHS. The goals of this proposal are to evaluate cross-sectional environmental and genetic correlates of vascular function and a comprehensive battery of pulsatile hemodynamic variables in the Jackson Heart Study Cohort. Cardiovascular Engineering, Inc. will have a subcontract to supervise hemodynamic data acquisition, analysis and interpretation. Principal Investigator, Ervin Fox, MD. Hemodynamics core lab director, Gary F. Mitchell, MD.

2015-2019 NIH/NHLBI (1 R01 HL126136-01A1, $2,657,827). Vascular Stiffness as a Precursor of Hypertension in a Middle-aged Cohort. The goals of this proposal are to characterize longitudinal change in arterial stiffness (measured at 3 time points) in middle-aged adults and its contribution to the development of systolic hypertension, end-organ damage to heart, brain and the kidneys, and to new-onset clinical cardiovascular disease. Cardiovascular Engineering, Inc. will have a subcontract to supervise hemodynamic data acquisition, analysis and interpretation. Principal Investigators, Gary F. Mitchell, MD and Vasan Ramachandran, MD. Hemodynamics core lab director, Gary F. Mitchell, MD.

2016-2019 Novartis ($2,606,875). A multicenter, randomized, double-blind, double-dummy, parallel group, active-controlled, forced titration, 12-week comparison of combined angiotensin-neprilysin inhibition with sacubitril and valsartan versus enalapril on changes in central aortic stiffness and ventricular-vascular coupling in patients with heart failure and reduced ejection fraction (HFrEF): EVALUATE-HF Principal Investigator, Akshay Desai, MD. Hemodynamics core lab director, Gary F. Mitchell, MD.

Active:

2019-2023 NIH/NHLBI (1 R01 HL142983-01A1, $3,188,819). Ventricular-vascular coupling in the elderly: life course determinants, trajectories and prognostic significance. The goals of this proposal are to test the hypothesis that aortic stiffness impairs mechanical coupling between the aorta and left ventricle impairs systolic and diastolic function and left atrial function and contributes to the age-related increase in pulmonary artery systolic pressure. We will also assess carotid input impedance and aorta-carotid coupling to test the hypothesis that a disproportionate increase in aortic as compared to common carotid and cerebrovascular input impedances reduces the impedance gradient and increases penetration of pulsatile flow into the cerebral circulation, resulting in microvascular tissue damage, accumulation of amyloid and impaired cognitive function Principal Investigators, Gary F. Mitchell, MD, Ramachandran S. Vasan, MD and Susan Cheng, MD. Hemodynamics core lab director, Gary F. Mitchell, MD.

2020-2024 NIH/NIA (1 R01 AG066910-01, $2,474,352 annual total). The POINTER neurovascular ancillary study. The POINTER neurovascular ancillary study will assess the effects of the POINTER lifestyle intervention on cerebral autoregulation, baroreflex sensitivity, aortic stiffness, carotid stiffness, and cerebral vasomotor reactivity and relate the foregoing to changes in brain structure and cognitive function. Hemodynamics core lab director, Gary F. Mitchell, MD.

2020-2025 NIH/NIA (1 R01 AG065299-01A1, $569,801 annual total). Vascular Mechanisms Underlying Skeletal Fragility in Older Adults. This project will use novel assessments of microvascular and macrovascular function, cortical and trabecular bone microarchitecture, and micro-finite element analysis of bone strength to identify vascular mechanisms contributing to skeletal fragility in women and men. Hemodynamics core lab director, Gary F. Mitchell, MD.

## UNIVERSITY TEACHING ROLES

2007-2008. Visiting Lecturer. Second year class. Brown Medical School. BioMed 3662.

1998-present Investigator, Framingham Heart Study. Vascular and tonometry working groups.

2009-present Offsite trainer, Brown University CardioPulmonary Training Grant (T32).

2015-present Offsite trainer, Boston University Clinical Epidemiology and Statistical Genetics Training Grant (T32).

## HOSPITAL TEACHING ROLES

1990-1998 Cardiac catheterization lab attending, Brigham and Women's Hospital, Boston, MA. Taught Cardiology Fellows to perform cardiac catheterizations.

1993-1998 Director Pacemaker Service, Brigham and Women's Hospital, Boston, MA. Taught Cardiology Fellows to perform pacemaker implantation and follow-up.