Curriculum Vitae

Elizabeth Murphy

Contact Information:

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Education:

1974 BA, Biochemistry, University of Pennsylvania, Philadelphia, PA
1980 Ph.D. Biochemistry/Biophysics, University of Pennsylvania, Philadelphia, PA

Brief Chronology of Employment:

1974–1980	Ph. D. student, University of Pennsylvania, Department of Biochemistry and Biophysics, Philadelphia, PA
1980-1983	Postdoctoral Fellow, Duke University Medical Center, Department of Physiology, Durham, NC
1983-1984	Assistant Research Professor, Department of Physiology, Duke University Medical Center, Durham, NC.
1984-2009	Adjunct Professor Division of Physiology, Department of Cell Biology, Duke University Medical Center, Durham, NC
1984-1990	Senior Staff Fellow, NMR Section, Laboratory of Molecular Biophysics, National Institute of Environmental Health Sciences, Research Triangle Park, NC
1990-2006	Head, Cell Biology Group, Laboratory of Signal Transduction, National Institute of Environmental Health Sciences, Research Triangle Park, NC
2006-2010	Head, Cardiac Physiology Section, Translational Medicine Branch, National Heart, Lung and Blood Institute, NIH, Bethesda, MD
2010-	Head, Cardiac Physiology Section, Systems Biology Center, National Heart, Lung and Blood Institute, NIH, Bethesda, MD

Awards:

Richard Bing Young Investigator Award-International Society Heart Res., London, UK 1983.
Patent No. 5,516,911 for Fluorescent Intracellular Calcium Indicators, 1996
Fellow of American Heart Association, 2001
Fellow of the International Society for Heart Research, 2007
Keith Reimer Award Lecturer of the ISHR, Sapporo, Japan, 2009
NHLBI Award for Outstanding Mentorship, April 2011
Dressler Lecture, Department of Pharmacology, Dalhousie University Halifax April 2012
Orloff Award, NHLBI 2014.
NHLBI Directors Award for Outstanding Translational Science Research, December 2015.
Leducq Foundation Award, North American Coordinator 2016-2021.

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Professional Activities:

Co-chair of 2012 Gordon Research Conference on Cardiac Regulatory Mechanisms.
NIH Study Section Member, ETSA 2005-09; MIM 2013-18 (chair 2016-2018)
American Heart Association, Cell Transport and Metabolism Study Committee, 1996-2000, 2001-2005, Chair 1998-2000; 2001-2005.
American Heart Association, Cardiovascular Pathophysiology Study Committee, 1991-94.
American Heart Association, Leadership Committee for Council on Basic Cardiovascular Sciences, 2000-2004, 2006-8.
American Heart Association National Research Committee 2000 – 2005
American Heart Association Peer Review Steering Committee 2005-11; co-chair/chair 2007-10.
American Heart Association Melvin Marcus Young Investigator Award Committee 2001-2004, 2014-16.
American Heart Association, BCVS Program Committee 2002 - 2007
International Society Heart Research-International Council, 2001-06;Executive Council, 2004-19
International Society Heart Research-International, President-elect 2013-16, President 2016-19.
International Society for Heart Research – American Section Secretary 2003-2009
International Society for Heart Research- American Section, President 2012-15
International Society for Heart Research-American Section Council 1997-2017.
International Society for Heart Research-Young Investigator Selection Committee, 2001, 04, 10
FDA Nonclinical Study Cardiotoxicity Expert Working Group, 2001-2005.
Member ISHR, 1983-present
Member American Heart Association 1984-present
Member American Physiological Society 1994- present

Editorial Boards:

Associate Editor, Journal of Molecular and Cellular Cardiology 2007 –present
Associate Editor, Cardiovascular Research 2016-
Consulting Editor, Circulation Research 2009- present
Senior Guest Editor, Circulation 2009-2016
Editorial Board, Circulation Research, 1994-present
Editorial Board, Circulation, 1996-present
Editorial Board, Cardiovascular Research 2012-present
Editorial Board, Journal of Molecular and Cellular Cardiology, 2001-present
Editorial Board, American Journal of Physiology, Heart & Circulatory 2005-2014
Editorial Review Board, Environmental Health Perspectives, 1993-1997
Editorial Board, American Journal of Physiology, Cell, 1990-1996
Editorial Board, BBA 2012-present

NIH Committees:

NIEHS Technology Evaluation Committee 2001-2006
NIEHS Committee on Promotion 1993-1999, 2001-2002
NIEHS Conference, Symposium and Lecture Committee 1994-1999, Chair 1995-98
NIEHS Executive Committee 1994, 1997, 2004-5
NIEHS Assembly of Scientists - President 1997 and 2005
NIEHS Assembly of Scientists Council 1996-1998 and 2001-2002 and 2004-6
NIEHS Women Scientist Advisor to NIEHS Scientific Director - 1993-94 and 2004-5

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NIEHS Animal Care and Use Committee 1994-97
NIEHS EEO Counselor 1996-2002
NHLBI Women Scientists Advisor 2007-2013
NHLBI Animal Care and Use Committee 2008- present; Chair 2014-
NHLBI Faculty Chair of Proteomics Core 2009-
NHLBI Promotion and Tenure Committee 2014-
NHLBI Women's Health Working Group 2015-present
NIH Women Scientist Advisor, chair-elect 9/2014-6/2016, Chair 6/2016-2018.
NIH Working Group on Women in Biomedical Careers 2015-present

Research Interest:
Cardiac Ischemia-reperfusion injury, calcium homeostasis, mitochondria, male-female differences in cardiovascular disease, apoptosis, membrane transport

Publications (in chronological order)

1. Bikle, DD, Murphy E, Rasmussen H. The ionic control of 1,25-dihydroxyvitamin D3 synthesis in isolated chick renal mitochondria: The role of calcium. J. Clin, Invest. 55: 299-304, 1975.
2. Bikle, DD, Murphy E, Rasmussen H. The ionic control of 1,25-dihydroxyvitamin D3 synthesis in isolated chick renal mitochondria: The role of potassium. Biochem. Biophys. Acta. 437:394-402, 1976.
3. Tischler ME, Viale R, Coll K, Murphy E, Williamson JR. Compartmentation of metabolites between cytosol and mitochondria in rat liver cells. In Thurman, RG, Williamson JR, Drott HR, and Chance B. (eds). *Alcohol and Aldehyde Metabolizing Systems,* Vol III, NY, Academic Press, pp 231-241, 1977.
4. Murphy, E, Coll KE, Viale RO, Williamson JR. Kinetics and regulation of the glutamate-aspartate translocator in rat liver mitochondria. J. Biol. Chem. 254: 8369-8376, 1979.
5. Murphy, E. Coll KE, Rich TL, Williamson JR. Hormonal effects on calcium homeostasis in isolated hepatocytes. J. Biol. Chem. 255:6000-6608, 1980.
6. Williamson JR, Murphy E. Calcium homeostasis and compartmentation in liver. In Thurman RG (ed): *Alcohol and Aldehyde Metabolizing Systems,* NY, Plenum Press, pp 671-688, 1980.
7. Williamson JR, Murphy E, Viale RO, Coll KE. Kinetic mechanisms and energetic of the glutamate-asparate tranlocator in rat liver mitochondria. In Klingenberg, EM, Palmieri F, and Quagliariello, E. *Functional and Molecular Aspects of Biomembrane Transport,* Elsevier North Holland Biomeidcal Press, pp 671-688, 1980.
8. Williamson JR, Hoek JB, Murphy E, Coll KE, Njogu RM. Kinetics and mechanisms of glutamate-aspartate transport across mitochondrial membranes. Ann. N. Y. Acad. Sci 341: 593-608, 1980.

9. Murphy, E. and Mandel LJ. Cytosolic free calcium levels in rabbit proximal kidney tubules. Am. J. Physiol. 242: C124-C128, 1982.

10. Murphy, E. Aiton JF, Horres CR, and Lieberman M. Calcium elevation in cultured chick heart cells: Its role in cell injury. Am. J. Physiol. 245:C316-C321, 1983.

11. LeFurgey, A., Ingram P, Henry SC, Murphy E, Lieberman M. Three-dimensional configuration of the mitochondria in cultured heart cells. Scanning Electron Microsc. 1983/1:293-303, 1983.

12. Lieberman M, Horres CR, Jacob R, Murphy E, Piwnica-Worms, D, Wheeler DM. Physiologic criteria for electrogenic transport in tissue-culture heart cells. In Blaustein, M and Lieberman, M. (ed). *Electrogenic Transport: Fundamental Principles and Physiological Implicatins,* NY, Raven Press, pp 181-191, 1984.

13. Mandel LJ, and Murphy E. Regulation of cytosolic free calcium in rabbit proximal renal tubules. J. Biol. Chem. 259: 11188011196, 1984.

14. Murphy E, Jacob R, Lieberman, M. Cytosolic free calcium in chick heart cells: Its role in cell injury. J. Mol. Cell Cardiol. 17: 221-231, 1985.

15. Lieberman M, LeFurgey A, Murphy E, Liu S. Cultured heart cells as a model for studying myocardial ischemia. In Stone HL, and Weglicki WB (ed) *Pathiobiology of Cardiovascular Injury*, Boston, Marinus Nijhofs, pp 145-155, 1985.

16. Murphy E. Mitochondrial regulation of calcium homeostasis. In Fiskum G. (ed). *Mitochondrial Physiology and Pathology,* N.Y. , Van Nostrand Reinhold Co.Inc., pp. 100-119, 1986.

17. Zeitler P, Murphy E, Handwerger S. Arachidonic acid stimulates 45Ca efflux and HPL release in isolated trophoblast cells. Life Science 38: 99-107, 1986.

18. Murphy E, Wheeler DM, LeFurgey A, Jacob R, Lobaugh LA, Lieberman M. Coupled sodium-calcium transport in cultured chick heart cells. Am. J. Physiol. 250: C442-C452, 1986.

19. Cala P, Murphy E, Mandel LJ. Volume regulation by amphiuma red blood cells: Cytosolic free calcium and alkali metal/H exchange. Am. J. Physiol. 250: C423-C429, 1986.

20. Murphy E, Chamberlin M, Mandel LJ. Effects of calcitonin on cytosolic free calcium in a suspension of rabbit medullary thick ascending limb tubules. Am. J. Physiol. 251:C491-C495, 1986.

21. Murphy E, Levy L, Berkowitz L, Orringer E, Gabel SA, London RE. NMR measurement of cytosolic free calcium in human red blood cells. Am. J. Physiol. 251: C496-C504, 1987.

22. Levy L, Murphy E, London RE. Synthesis and characterization of 19F NMR calcium chelators dor determination of cytosolic free calicum. Am. J. Physiol. 252: C441-C449, 1987.

23. Murphy E, Berkowitz L, Orringer E, Levy LA, Gabel SA, London RE. Cytosolic free calcium levels in sickle red blood cells. Blood 69: 1469-1474, 1987.

24. Jeffreys-Smith L, Murphy E, Gabel SA London RE. In vivo 31P NMR studies of the hepatic response to L-ethionine in anesthetized rats. Toxicology and Applied Pharm. 88: 346-353, 1987.

25. Jacobs R, Lieberman M, Murphy E, Piwnica-Worms D. Sodium-calcium exchange in cultured heart cells: Effects of sodium-potassium pump inhibition and low sodium on membrane potential. J. Physiol. 387: 549-566, 1987.

26. Steenbergen C, Murphy E, Levy LA, London RE. Elevation in cytosolic free calcium concentration early in myocardial ischemia. Circ. Res. 60: 700-707, 1987.

27. Jacob R, Murphy E, Lieberman. Free calcium in isoalted chick embryo heart cells measured using quin2 and fura-2. Am. J. Physiol. 253:C337-C342, 1987.

28. Murphy E, LeFurgey A, Lieberman M. Ionic, metabolic and morphologic changes in cultured chick heart cells induced by metabolic inhibition. Am. J. Physiol. 253: C700-C706, 1987.

29. Murphy E, Gabel SA, Funk A, London RE. NMR invisible ATP: Preferential depletion of cytoplasmic ATP during ischemia in perfused rat liver. Biochemistry 27: 526-528, 1988.

30. Davis DG, Murphy E, London RE. Uptake of cesium ions by human eythrocytes and perfused heart: a Cs-133 NMR study. Biochemistry 27: 3547-3551, 1988.

31. Levy LA, Murphy E. Raju B, London RE. Measurement of cytosolic free magnesium concentration by 19F NMR. Biochemistry 27: 4041-4048, 1988.

32. Murphy E, Yankaskas J, Stutts MJ, Boucher RC. Cytosolic free calcium concentration of normal and cystic fibrosis nasal epithelium. Ped. Res. 24: 79-84, 1988.

33. Murphy E, Steenbergen C, LeFurgey, A, Lieberman M, London, RE. Cytosolic free calcium and myocardial cell injury. In Lemasters, JJ, Hackenbrock CR, Thurman RG, and Westerhoff HV. (ed): *Integration of Mitochondrial Function,* Plenum Press, pp 413-420, 1988.

34. Murphy E, London RE. In vivo spectroscopy and the problem of cell injury. In Hodgson, E. Bend J, and Philpot RM. (eds): *Reviews in Biochemical Toxicology,* Vol. 9, Elsevier/North, pp. 131-184, 1988..

35. LeFurgey A, Murphy E, Wagenknect B, Ingram P, Lieberman M. Structural, biochemical and elemental correlates of injury in cultured cardiac cells. In Fiskum, G (ed): *Cell Calcium Metabolism,* Academic Press, pp 571-580, 1989.

36. Raju, B., E. Murphy, L.A. Levy, R.B. Hall, and R.E. London. A fluorescent indicator for measuring cytosolic free magnesium. Am. J. Physiol. 256: C540-C548, 1989.

37. Murphy, E., C. Steenbergen, L.A. Levy, B. Raju, B., and R.E. London. Cytosolic free magnesium levels in ischemic rat heart. J. Biol. Chem. 264: 5622-5627, 1989.

38. Murphy, E., C. Freudenrich, L.A. Levy, R.E. London, and M. Lieberman. Monitoring cytosolic free magnesium in cultured chick heart cells using a new fluorescent indicator, FURAPTRA. Proc. Nat. Acad. Sci. 86: 2981-2984, 1989.

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44. Murphy, E., M. Perlman, R.E. London, and C. Steenbergen. Amiloride delays the ischemia-induced rise in cytosolic free calcium. Circ. Res. 68: 1250-1258, 1991.

45. Anderson, SE, PM Cala, C Steenbergen, RE London, and E Murphy: Effects of hypoxia and acidification on myocardial Na and Ca. Role of Na-H and Na-Ca exchange. Ann. NY Acad. Sci. 639:453-455, 1991.

46. Murphy, E., C.C. Freudenrich, and M. Lieberman. Cellular magnesium and Na/Mg exchange in heart cells. Annun. Rev. Physiol. 53: 273-287, 1991.

47. Rotevatn, S., H. Sarheim, and E. Murphy. Intracellular free magnesium concentration relevance to cardiovascular medicine. Acta. Physiol. Scan. 5599:125-133, 1991.

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52. Steenbergen, C., M.E. Perlman, R.E. London, and E. Murphy: Mechanisms of preconditioning: Ionic alterations. Circ. Res. 72: 112-125, 1993.

53. Fralix, TA, E. Murphy, R.E. London, and C. Steenbergen: Evaluating the protective effects of adenosine in the isolated perfused rat heart: Changes in metabolism and intracellular ion homeostasis. Am. J. Physiol. 264:C986-994, 1993.

54. Fralix, TA, C. Steenbergen, R.E. London, and E. Murphy. Glybenclamide does not abolish the protective effect of preconditioning on stunning in the isolated, perfused rat heart. Cardiovas. Res. 27: 630-637, 1993.

55. Murphy, E., T.A. Fralix, R.E. London, and C. Steenbergen: Effects of adenosine antagonists on hexose uptake and preconditioning in perfused rat heart. Am. J. Physiol. 265: C1146-C1155, 1993.

56. Steenbergen, C., T.A. Fralix, and E. Murphy: Role of increased cytosolic free calcium concentration in myocardial ischemic injury. Basic. Res. Cardiol. 88: 456-470, 1993.

57. Murphy, E.: Measurement of intracellular ionized magnesium. Mineral & Elec. Metabol. 19: 250-258, 1993.

58. London RE, Rhee CK, Murphy E, Gabel S, Levy LA. NMR-sensitive fluorinated and fluorescent intracellular calcium ion indicators with high dissociation constants. Am. J. Physiol. 266: C1313-C1322, 1994.

59. Murphy E, Steenbergen C, Levy LA, Gabel SA, London RE. Measurement of cytosolic free calicum in perfused rat heart using TF-BAPTA. Am. J. Physiol. 266: C1323-C1329, 1994.

60. Murphy E, Glasgow W, Fralix T, Steenbergen C. Role of lipoxygenase metabolites in ischemic preconditioning. Circ. Res. 76:457-67, 1995

61. Chen W. Gabel S, Steenbergen C, Murphy E. A redox-based mechanism for cardioprotection induced by ischemic preconditioning in perfused rat heart. Circ. Res. 77: 424-429, 1995.

62. Murphy E, and London RE. A practical guide to the use of fluorescent indicators for the measurement of cytosolic free Mg. In Conn PM. (ed) New. York., Academic Press *Measurement of manipulation of Intracelluar Ions.* Methods in Neuroscience, Vol 27, pages 304-318, 1995.

63. Freudenrich CC, Hall SK, Lieberman M, Murphy E. Magnesium homeostasis and cardiac cell function. In: Morad M.. Ebashi, S, Trautwein, W and Kurachi, Y eds. *Molecular Physiology and Pharmacology of Cardiac Ion Channels and Transporter*. Kluwer Academic Publishers, 563-573, 1996.

64. Chen W, Steenbergen C, Levy LA, Vance J, London RE, Murphy E. Measurement of free Ca^{2+} in sarcoplasmic reticulum in perfused rabbit heart loaded with TF-BAPTA by ^{19}F NMR. J. Biol. Chem. 271:7398-7403, 1996.

65. Chen W, Wetsel W, Steenbergen C, Murphy E. Effect of ischemic preconditioning and PKC activation during ischemia in rat hearts. J. Mol. Cell. Cardiol. 28:871-880, 1996.

66. Owens LM, Fralix TA, Murphy E, Cascio WE, Gettes LS. Correlation of extracellular and intracellular ion changes to cell-to-cell electrical uncoupling in isolated blood perfused rabbit hearts. Circulation 94:10-13, 1996.

67. Preston, GA, Barrett JC, Biermann JA, and Murphy E. The Effects of Modulation of Calcium Homeostasis on Apoptosis During Neoplastic Progression. Can. Res. 57: 537-542, 1997.

68. Wu S, Chen W, Murphy E, Gabel S, Tomer KB, Foley J, Steenbergen C, Falck JR, Moomaw CR, and Zeldin DC. Molecular Cloning, Expression, and Functional Significance of a Cytochrome P450 Highly Expressed in Rat Heart Myocytes. J. Biol. Chem. 272:12551-12559, 1997.

69. Gabel SA, O'Connel TM, Murphy E, London RE. Inhibition of glucose transport in human red blood cells by adenosine antagonists. Am. J. Physiol. 272: C1415-1419, 1997.

70. Gabel SA, Cross HR, Steenbergen C, and Murphy E. Decreased intracellular pH is not due to increased H^+ extrusion in preconditionged rat hearts. Am. J. Physiol. 273: H2257-H2262, 1997

71. Chen W, London RE, Murphy E, Steenbergen C. Regulation of the Ca2+ gradient across the sarcoplasmic reticulum in perfused rabbit heart: a 19F NMR study. Circ. Res.83:898-907, 1998.

72. Cross HR, Lu L, Steenbergen C, Philipson KD, Murphy E. Overexpression of the cardiac Na/Ca exhanger increase susceptibility to ischemia/reperfusion injury in male, but not female, transgenic mice. Circ. Res. 83: 1215-1223, 1998.

73. Jayadev S, Petranka J, Cheran SK, Biermann JA, Barrett JC, Murphy E. Reduced capacitative calcium entry correlates with vesicle accumulation and apoptosis. J. Biol. Chem. 274: 8261-8268, 1999.

74. Petranka J, Baldwin W, Biermann J, Jayadev S, Barrett JC, Murphy E. The oncostatic action of melatonin in an ovarian carcinoma cell line. J. Pineal Res. 26: 129-136, 1999.

75. Chen W, Glasgow W, Murphy E, Steenbergen C. Lipoxygenase metabolism of arachidonic acid in ischemic preconditioning and PKC-induced protection in heart. Am. J. Physiol. 276:H2094-H2102, 1999.

76. Murphy E, Cross HR, Steenbergen C. Sodium regulation during ischemia versus reperfusion and its role in injury. Circ. Res. 84:1469-1470, 1999.

77. Murphy E, Cross HR, Steenbergen C. Na/H and Na/Ca exchange: their role in cytosolic free [Ca2+] during ischemia and reperfusion. Eur. Heart J., Suppl. K: K18-K33, 1999.

78. Cross HR, Steenbergen C, Lefkowitz RJ, Koch WJ, Murphy E. Genetic manipulations of the cardiac ß2-adrenergic signaling cascade and effects on myocardial contractility and ischemic injury. Circ. Res. 85: 1077-1084, 1999.

79. Murphy, E. Mysteries of Magnesium Homeostasis. Circ. Res.86:245-248, 2000.

80. Ping P, Murphy E. Role of p38 mitogen-activated protein kinases in preconditioning: A detrimental factor or a protective kinase? Circ Res. 86: 921-922, 2000.

81. Tong H, Chen W, London RE, Murphy E, Steenbergen C. Stress induced glucose uptake is mediated by p38 MAP kinase not by PI3 Kinase. J. Biol. Chem. 275:11981-11986, 2000.

82. Jayadev S., Barrett JC, Murphy E. Elevated ceramide is downstream of altered calcium homeostasis in low serum-induced apoptosis. Am.J. Physiol, 279:C1640-1647, 2000.

83. Tong H, Chen W, Steenbergen C, Murphy E. Ischemic preconditioning activates a PI3-kinase and protein kinase B upstream of protein kinase C. Circ. Res. 87: 309-315, 2000.

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85. Gabel SA, London RE, Funk CD, Steenbergen C, Murphy E. Leukocyte-type 12-lipoxygenase deficient mice show impaired ischemic preconditioning-induced cardioprotection. Am. J. Physiol. 280: H1963-H1969, 2001.

86. Forbes RA, Steenbergen C, Murphy E. Diazoxide induced cardioprotection requires signaling through a redox sensitive mechanism. Circ. Res. 88: 802-809, 2001.

87. Petranka J, Forbes RA, Murphy E. Elevated calcium in preneoplastic cells enhances NF-κB binding to DNA and confers resistance to apoptosis. J. Biol. Chem. 276: 37102-37108, 2001.

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89. Avkirin M, Gross G, Karmazyn M, Klein H, Murphy E, Ytrehus K. Na+/H+ exchange in ischemia, reperfusion and preconditioning. Cardiovasc. Res. 50:162-166, 2001.

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91. Tong H, Imahashi K, Steenbergen C, Murphy E. Phosphorylation of glycogen synthase kinase-3β occurs during ischemic preconditioning through a phosphatidylinositol 3-kinase dependent pathway and is cardioprotective. Circ. Res. 90: 377-379, 2002.

92. Cross HR, Murphy E, Koch WJ, Steenbergen C. Male and female mice overexpressing the ß2-adrenergic receptor exhibit differences in ischemia/reperfusion injury: role of nitric oxide. Cardiovasc. Res.53: 662-671. 2002.

93. Cross HR, Murphy E, Bolli R, Ping P, Steenbergen C. Expression of activated PKC epsilon protects the ischemic heart without attenuating ischemic H+ production. J. Mol. Cell. Cardiol. 34:361-367, 2002.

94. Cross HR, Murphy E, Steenbergen C. Ca^{2+} loading and adrenergic stimulation reveal male/female differences in susceptibility to ischemia/reperfusion injury. Am. J. Physiol. 283: H481-489, 2002.

95. Cross HR, Murphy E, Black RG, Auchampach J and Steenbergen C. Overexpression of the A3 adenosine receptor decreases myocardial contractility. preserves energetics and protects the ischemic myocardium. Am J. Physiol. 283:H1562-1568, 2002.

96. Steenbergen C, Afshari, CA, Petranka JG, Collins J, Martin K, Bennett L, Haugen A, Bushel P, Murphy E. Alterations in Apoptotic Signaling in Human Idiopathic Cardiomyopathic Hearts in Failure. Am. J. Physiol. 284:H268-H276, 2003.

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99. Chen J, Petranka JG, London RE, Steenbergen C, Murphy E. Gender differences in sarcoplasmic reticulum calcium loading after isoproterenol. Am. J. Physiol. 285:H2657-H2662, 2003.

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101. Murphy E, Tong H, Steenbergen C. A role for the phosphatidylinositol-3-kimase pathway in preconditioning. In "Myocardial Ischemia and Preconditioning". N.S. Dhalla, N. Takeda, M. Singh, A. Lukas editors. Kluwer Academic Publishers, Boston, MA. pp 275-282, 2003.

102. Murphy, E, Afshari, CA, Petranka, JG, Steenbergen C. DNA microarray gene profiling: A tool for the elucidation of cardioprotective genes. In Proteomics and Genomic Analysis of Cardiovascular Disease (Jennifer E. Van Eyk and Michael J. Dunn Eds.) Wiley-VCH Publishers, Weinheim, Germany. pp 99-109, 2003.

103. Murphy E, Tong H, Steenbergen, C. Preconditioning: Is the Akt-ion in the PI3K pathway? J. Mol. Cell. Cardiol.35: 1021-1025, 2003

104. Murphy, E. Primary and secondary pathways in cardioprotection: converging on the mitochondria. Circ. Res. 94:7-16, 2004.

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108. Tong H, Koch WJ, Rockman H, Steenbergen C, Murphy E. G Protein coupled receptor internatization signaling is required for cardioprotection in ischemic preconditioning. Circ. Res: 94:1133-1141, 2004.

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