

**CURRICULUM VITAE**  
THOMAS R. SHANNON  
8/20/12

**CURRENT ADDRESSES**

Department of Molecular Biophysics and Physiology  
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**PERSONAL INFORMATION**

Birth Date and Place: January 19, 1964, Cincinnati, Ohio  
Citizenship: United States  
Marital Status: Single

**DEGREES EARNED**

D.V.M. from University of Missouri, Columbia, Missouri, May 1989  
Ph.D. from University of Missouri, Columbia, Missouri, December 1993

**POSITIONS HELD**

Associate Professor, Department of Molecular Biophysics and Physiology, Rush University, Chicago, Illinois, 2007-present

Assistant Professor, Department of Molecular Biophysics and Physiology, Rush University, Chicago, Illinois, 2002-2007

Research Assistant Professor, Department of Physiology, Loyola University-Chicago, Maywood, Illinois, 2000-2002.

Research Associate, Department of Physiology, Loyola University-Chicago, Maywood, Illinois, 1993-2000.

Postdoctoral Fellow, Department of Veterinary Biomedical Sciences, University of Missouri, Columbia, Missouri, 1989-1993.

Technical Assistant, Research Animal Diagnostic and Investigative Laboratory, University of Missouri, Columbia, Missouri, 1988-1989.

Assistant Librarian, University of Missouri Veterinary Teaching Hospital,

Columbia, Missouri, 1985-1989.

Technical Assistant, University of Missouri Veterinary Teaching Hospital, Columbia, Missouri, 1984-1987.

## **HONORS**

Brainard Teaching Award, Rush University, 2010

Ralph S. Zitnik, M.D. Clinical Research Investigatorship, American Heart Association, Metropolitan Chicago Affiliate, 1998 (awarded to highest scoring application)

University of Missouri College of Veterinary Medicine Annual Poster Competition (2<sup>nd</sup> place), 1991

Licensed Veterinarian- State of Missouri, 1989-present

Dean's List, 1982-1986

Recipient of Westlake Scholarship, 1982-1985

## **CURRENT RESEARCH INTERESTS**

Physiology and pharmacology of cellular ion movement and storage

Physiology and pharmacology of transport

Excitation-contraction coupling

Ion-motive ATPases

Sodium-calcium exchange

## **GRANT HISTORY**

National Institutes of Health, R01 award, \$200,000/yr, 2003-present

American Heart Association-Midwest Affiliate, Scientist Development Grant, \$80,000/year, 2000-2003

American Heart Association of Metropolitan Chicago, Senior Research Fellowship, 1998-2000

National Institutes of Health Individual National Research Service Award, 1995-1998

American Heart Association of Metropolitan Chicago, Junior Research Fellowship, 1995 (Funded but returned in favor of NRSA above)

American Heart Association-Missouri Affiliate Research Fellowship, 1993-1994

Pharmaceutical Manufacturers Association Research Fellowship, 1991-1993 (Last year funded but declined in favor of AHA fellowship above)

## **TEACHING**

Medical Physiology (Physiology 451), Rush University School of Medicine, Course Director, 2006-2009

Medical Physiology (Physiology 451), Rush University School of Medicine, Course Director, 2002-2005

Molecular and Cellular Biology, Loyola University-Chicago School of Medicine, 1998, 1999

Veterinary Cellular Biology and Biochemistry, University of Missouri College of Veterinary Medicine, 1991, 1992

## PROFESSIONAL SOCIETIES

Biophysical Society, 1992-present

American Veterinary Medical Association, 1989-1991

Missouri Veterinary Medical Association, 1989-1991

Student Chapter of the American Veterinary Medical Association, 1985-1989

## PUBLICATIONS

### PAPERS

Shannon, T.R., Milanick, M.A., Hale, C.C. (1994) Interaction of cardiac Na-Ca exchanger and exchange inhibitory peptide with membrane phospholipids. *Am. J. Physiol.* 266:C1350-C1356.

Shannon, T.R., Hale, C.C. (1994) Identification of a 65 kDa endothelin receptor in bovine cardiac sarcolemmal vesicles. *Eur. J. Pharmacol.* 267:233-238.

McCall, E., Li, L., Satoh, H., Shannon, T.R., Blatter, L.A., Bers, D.M. (1996) Effects of FK-506 on contraction and Ca transients in rat cardiac myocytes. *Circ. Res.* 79:1110-1121.

Qi, M., Shannon, T.R., Euler, D.E., Bers, D.M., Samarel, A.M. (1997) Downregulation of sarcoplasmic reticulum Ca<sup>2+</sup>-ATPase during progression of left ventricular hypertrophy. *Am J. Physiol.* 272:H2416-H2424.

Shannon, T.R., Bers, D.M. (1997) Assessment of intra-SR free [Ca] and buffering in rat heart. *Biophys. J.* 73:1524-1531.

McCall, E., Ginsburg, K.S., Bassani, R.A., Shannon, T.R., Qi, M., Samarel, A.M., Bers, D.M. (1997) Ca flux, contractility and excitation-contraction coupling in hypertrophic rat ventricular myocytes. *Am. J. Physiol.* 274:H1348-1360.

Shannon, T.R., Ginsburg, K.S., Bers, D.M. (1998) Reverse mode of the SR Ca pump limits SR Ca uptake in permeabilized and voltage clamped myocytes. *Ann. N.Y. Acad. Sci.* 853:350-352.

Cadre B.M., Qi, M., Eble, D.M., Shannon, T.R., Bers, D.M., Samarel, A.M. (1998) Cyclic stretch down-regulates calcium transporter gene expression in neonatal rat ventricular myocytes. *J. Mol. Cell. Cardiol.* 31:2247-2259.

Bassani, R.A., Shannon, T.R., Bers, D.M. (1998) Passive Ca<sup>2+</sup> binding in ventricular myocardium of neonatal and adult rats. *Cell Calcium* 23:433-42.

Shannon, T.R., Ginsburg, K.S., Bers, D.M. (2000) Reverse mode of the sarcoplasmic reticulum calcium pump and load-dependent cytosolic Ca decline. *Biophysical J.* 78:322-333.

Shannon, T.R., Ginsburg, K.S., Bers, D.M. (2000) Potentiation of fractional SR Ca release by total and free intra-SR Ca concentration. *Biophysical J.* 78:334-343.

Frank, K., Tilgmann, C., Shannon, T.R., Bers, D.M., Kranias, E.G. (2000) Regulatory role of phospholamban in the efficiency of cardiac sarcoplasmic reticulum Ca<sup>2+</sup>-transport. *Biochemistry* 39:14176-14182.

Shannon, T.R., Kranias, E.G., Bers, D.M. (2001) Phospholamban decreases the energetic efficiency of the SR Ca pump. *J. Biol. Chem.* 276:7195-7201.

Weber, C.R., Ginsburg, K.S., Philipson, K.D., Shannon, T.R., Bers, D.M. (2001) Allosteric regulation of Na/Ca exchange current by cytosolic Ca in cardiac myocytes. *J. Gen. Physiol.* 117:119-132.

Shannon, T.R., Ginsburg, K. S. Bers, D.M. (2002) Quantitative Assessment of the SR Ca Leak-Load Relationship. *Circ. Res.* 91:594-600.

Shannon, T.R., Guo, T., Bers, D.M. (2003) Ca<sup>2+</sup> Scraps: Local Depletions of Free [Ca<sup>2+</sup>] in Cardiac Sarcoplasmic Reticulum during Contractions Leave Substantial Ca<sup>2+</sup> Reserve. *Circ. Res.* 93:40-5.

Shannon, T.R., Pogwizd S. M., Bers, D.M. (2003) Elevated Sarcoplasmic Reticulum Ca Leak in Intact Ventricular Myocytes from Rabbits in Heart Failure. *Circ. Res.* 93:592-594.

Shannon, T.R., Bers, D. M. (2004) Integrated Ca<sup>2+</sup> Management in Cardiac Myocytes. *Ann. N.Y. Acad. of Sci.* 1015:28-38

Shannon, T.R., Wang, F., Puglisi, J., Weber, C.W., Bers, D.M. (2004) A Mathematical Treatment of Integrated Ca Dynamics Within the Ventricular Myocyte. *Biophys. J.* 87:1-21.

Launikonis, B.S., Zhou, J., Royer, L., Shannon, T.R., Brum, G., Rios, E. (2005) Confocal imaging of [Ca<sup>2+</sup>] in cellular organelles by SEER, shifted excitation and emission ratioing of fluorescence. *J. Physiol.* 567:523-43.

Shannon, T.R., Wang, F., Bers, D.M. (2005) Regulation of Cardiac Sarcoplasmic Reticulum Ca Release by Luminal [Ca] and Altered Gating Assessed with a Mathematical Model. *Biophys. J.* 89:4096-4110.

Ai X, Curran JW, Shannon T.R., Bers DM, Pogwizd SM. (2005) Ca<sup>2+</sup>/Calmodulin-Dependent Protein Kinase Modulates Cardiac Ryanodine Receptor Phosphorylation and Sarcoplasmic Reticulum Ca<sup>2+</sup> Leak in Heart Failure. *Circ. Res.* 97:1314-1322.

Launikonis, B.S., Zhou, J., Royer, L., Shannon, T.R., Brum, G., Ríos, E. (2006) Depletion “skraps” and dynamic buffering inside the cellular Ca<sup>2+</sup> store. *Proc. Nat. Acad. Sci.* 103:2982-2987,

Curran, J., Hinton, M.J. Ríos, E., Bers, D.M., Shannon, T.R. (2007)  $\beta$ -Adrenergic Enhancement of Sarcoplasmic Reticulum Ca Leak in Cardiac Myocytes Is Mediated by Ca-Calmodulin Dependent Protein Kinase. *Circ. Res.* 100:391-398.

Guo, T., Ai, X., Shannon, T.R., Pogwizd, S.M., Bers, D.M. (2007) Intra-Sarcoplasmic Reticulum Free [Ca<sup>2+</sup>] and Buffering in Arrhythmogenic Failing Rabbit Heart. *Circ. Res.* 101:820-810.

Shannon, T.R., Linking calsequestrin to luminal control of SR Ca<sup>2+</sup> release. (2007) *Circ. Res.* 101:539-541.

Shannon TR. (2009) Ryanodine Receptor Ca<sup>2+</sup> Sensitivity and Excitation Contraction Coupling in Muscular Dystrophy and Heart Failure: Similar and Yet Different. *Am. J. Physiol.* 297:H1965-1996.

Shannon, T.R., Lew, W.Y. (2009) Diastolic Release of Calcium from the Sarcoplasmic Reticulum: a Potential Target for Treating Triggered Arrhythmias and Heart Failure. *J Am Coll Cardiol.* 53:2006-20088.

Santiago, D.J., Curran, J.W., Bers, D.M., Lederer, W.J., Stern, M.D., Rios, E., Shannon, T.R., (2010) Ca Sparks Do Not Explain All Ryanodine Receptor-mediated SR Ca Leak in Mouse Ventricular Myocytes. *Biophys. J.* 98:2111-2120.

Curran, J., Hayes-Brown, K. Pogwizd, S., Bers, D.M., Shannon, T.R., (2010) Arrhythmogenic Spontaneous Ca Waves in Myocytes from Failing Hearts Are CaMKII-dependent. *J. Mol. Cell. Cardiol.* (in press).

Liu Y, Porta M, Qin J, Ramos J, Nani A, Shannon TR, Fill M. (2010) Flux Regulation of Cardiac Ryanodine Receptor Channels. *J. Gen. Physiol.* 135:15-27.

Picht E, Zima AV, Shannon TR, Duncan AM, Blatter LA, Bers DM. (2011) Dynamic calcium movement inside cardiac sarcoplasmic reticulum during release. *Circ Res.* 108:847-856.

Roof SR, Shannon TR, Janssen PM, Ziolo MT. (2011) Effects of increased systolic Ca<sup>2+</sup> and phospholamban phosphorylation during  $\beta$ -adrenergic stimulation on Ca<sup>2+</sup> transient kinetics in cardiac myocytes. *Am J Physiol*

301:H1570-8301:H1570-H1578.

Edwards JN, Cully TR, Shannon TR, Stephenson DG, Launikonis BS. (2012) Longitudinal and transversal propagation of excitation along the tubular system of rat fast-twitch muscle fibres studied by high speed confocal microscopy. *J Physiol.* 590:475-92.

Santiago DJ, Ríos E, Shannon TR (2012) Isoproterenol increases the fraction of spark-dependent RyR-mediated leak in ventricular myocytes *Biophys. J.* (submitted).

Curran J, Tang L, Roof SR, Velmurugan S, Millard A, Shonts S, Santiago DJ, Ahmad U, Perryman M, Bers DM, Mohler PJ, Ziolo MT, Shannon TR (2012) Nitric Oxide Mediates Increased Diastolic Sarcoplasmic Reticulum Calcium Release in Response to Adrenergic Agents *J. Am. Coll. Cardiol.* (submitted)

#### SELECTED ABSTRACTS

Shannon, T.R., Allert, J.A., LeBourveau, L.M., Adams, H.R., Hale, C.C. (1990) Partial characterization of an endothelin receptor in cardiac sarcolemmal vesicles, *Biophysical J.* 57:288a.

Shannon, T.R., Hale, C.C. (1992) Partial characterization of the endothelin-1 receptor binding site in cardiac sarcolemmal vesicles, *Biophysical J.* 61:A258.

Shannon, T.R., Milanick, M.A., Hale, C.C. (1993) Interaction of cardiac Na-Ca exchange and the exchange inhibitory peptide with membrane phospholipids. *Biophysical J.* 64:A400.

Shannon, T.R., Milanick, M.A., Hale, C.C. (1993) Exchange inhibitory peptide inhibition of Ca-Ca exchange. *FASEB J.* 7:A358.

Shannon, T.R., Hale, C.C., Milanick, M.A. (1994) Potency of exchange inhibitory peptide (XIP) inhibition of the Na-Ca exchanger in alternate transport modes. *Biophys. J.* 66:A332.

Shannon, T.R., Bers, D.M. (1996) Intra-SR free Ca in rat cardiac microsomes. *Biophys. J.* 70:A55.

Hüser, J., Shannon, T.R., Rechenmacher, C.E., Bers, D.M., Blatter, L.A. (1997) Confocal microscopic recording of membrane potential in single isolated cardiac mitochondria. *Biophys. J.* 72:A160.

Shannon, T.R., Ginsburg, K.S., Bers, D.M. (1997) SR Ca uptake rate in permeabilized ventricular myocytes is limited by reverse mode of the SR Ca pump. *Biophys. J.* 72:A167.

Shannon, T.R., Ginsburg, K.S., Bers, D.M. (1998) Rate of  $[Ca]_c$  decline decreases with increasing SR Ca load in patch clamped cardiac myocytes. *Biophys. J.* 74:A56.

Shannon, T.R., Ginsburg, K.S., Bers, D.M. (1998) Fractional SR Ca release is potentiated by increased SR  $[Ca]$ . *Biophys. J.* 74:A248.

Shannon, T.R., Chu, G., Kranias, E.G., Bers, D.M. (1999) Rate of SR Ca Leak and the Efficiency of the SR Ca Pump in Nonpentameric Phospholamban Mutant Mice. *Biophys. J.* 76:A297.

Shannon, T.R., Kranias, E.G., Bers, D.M. (2000) How Does Phospholamban Decrease SR Ca Content? *Biophys. J.* 78:A75.

Shannon, T.R., Blatter, L.A., Bers, D.M., Niggli, E. (2001) Ca Release Signals From SR Vesicles Imaged with Confocal Microscopy. *Biophysical J.* 80:589a.

Shannon, T.R., Bers, D.M. (2001) A Mathematical Model Describes the SR Load-Dependence of Ca Dynamics in Cardiac Myocytes. *Biophysical J.* 80:594a.

Shannon, T.R., Ginsburg, K.S., Bers, D.M. (2001) The Impact of Sarcoplasmic Reticulum (SR) Ca Leak Upon Ca Homeostasis in Intact Isolated Ventricular Myocytes. *Circ.* 104:II193.

Shannon, T.R., Ginsburg, K. S., Bers, D. M. (2002) Measurement of Load-sensitive Sarcoplasmic Reticulum (SR) Ca Leak in Intact Isolated Ventricular Myocytes. *Biophys. J.* 82:597a.

Shannon, T.R., Guo, T., Bers, D.M. (2003) Junctional Free Intra-SR Free  $[Ca]$  Declines to ~50% During Release in Intact Ventricular Myocytes. *Biophys. J.* 84:259a.

Shannon, T.R., Pogwizd, S.M., Bers, D.M. (2003) Sarcoplasmic Reticulum (SR) Ca Leak is Higher in Intact Isolated Ventricular Myocytes from Rabbits in Heart Failure. *Circulation* 108:IV-48.

Shannon, T.R., Wang, F., Bers, D.M. (2004) Evaluation of the Role of Free SR Ca in Cardiac EC Coupling Using a Mathematical Model. *Biophys. J.* 86:109a.

Curran, J., Rios, E., Bers, D.M. Shannon, T.R. (2004) Effects of Adrenergic

Stimulation Upon Sarcoplasmic Reticulum Ca Leak in Intact Rabbit Ventricular Myocytes. *Biophys. J.* 86:344a.

Santiago, D., Ríos, E., Shannon, T.R. (2004) Permeability Entry of Ca Precipitating Ions Into the Sarcoplasmic Reticulum of Mammalian and Amphibian Twitch Muscle. *Biophys. J.* 86:579a.

Launikonis, B.S., Zhou, J., Royer, L., Santiago, D.J., Shannon, T.R., Pizarro, G., Brum, G., Ríos, E. (2005) Control of Calcium Release by Intra-Store  $Ca^{2+}$ . *Biophys. J.* 88:13a.

Santiago, D.J., Shannon, T.R., Ríos, E., Stern, M.D. (2005) Skeletal and Cardiac  $Ca^{2+}$  Sparks "Mano A Mano". A Comparison of Source Kinetics by Morphometry and Modeling. *Biophys. J.* 88:86a.

Royer, L., Launikonis, B.S., Zhou, J., Shannon, T.R., Brum, G., Ríos, E. (2005) SEER (Shifted Excitation and Emission Ratioing) of Mag-indo Fluorescence. Description, Calibration In Situ and Measure of  $[Ca^{2+}]$  and Dye Concentration Inside the SR. *Biophys. J.* 88:89a.

Wang, F., Despa, S., Ginsburg, K.S., Shannon, T.R., Bers, D.M. (2005) Na Diffusion-Dependent Ca Handling in Rabbit and Mouse Ventricular Myocytes. *Biophys. J.* 88:137a.

Curran, J.W., Bers, D.M., Shannon, T.R. (2005) Ca-Calmodulin-Dependent Protein Kinase II Phosphorylation of the Ryanodine Receptor Increases SR Ca Leak. *Biophys. J.* 88:487a.

Guo, T., Shannon, T.R., Pogwizd, S., Bers, D.M. (2005) Decreased Intra-SR Free  $[Ca]$  in Rabbit Ventricular Myocytes in Heart Failure Model. *Circulation* 112:1157.

Curran, J., Huke, S., Pogwizd, S., Bers, D.M., Shannon, T.R. (2005) Increased Sarcoplasmic Reticulum Calcium Leak in Heart Failure is Due to Ca-Calmodulin-Dependent Protein Kinase II. *Circulation* 112:11277.

Curran, J.W., Guo, T., Bers, D.M. and Shannon, T.R. (2006) Simultaneous Measurements of Free Cytosolic and Free SR Ca Using Fura-2 and Fluo-5N to Assess SR Ca Leak in Cardiac Myocytes. *Biophys. J.* 90:68a.



Launikonis, B.S., Zhou, J., Royer, L., Shannon, T.R., Rios, E. and Brum, G. (2006) A Ca transient Inside the Sarcoplasmic Reticulum Accompanies Ca<sup>2+</sup> Release Induced by Low [Mg<sup>2+</sup>] in Frog Muscle Fibers. *Biophys. J.* 90:68a.

Zhou, J., Launikonis, B.S., Royer, L., Shannon, T.R., Brum, G., Rios, E. (2006) Skraps of Ca<sup>2+</sup> Depletion Suggest an Alternative Source for Ca<sup>2+</sup> sparks and Global Ca<sup>2+</sup> Release in Muscle. *Biophys. J.* 90:68a.

Santiago, D.J., Curran, J, Lucero, S.G., Ríos, E., Bers, D.M., Lederer, W.J., Stern, M.D. and Shannon, T.R. (2007) Relationship between Ca sparks and SR Ca leak in mouse ventricular myocytes. *Biophys. J.* 92:77a.

Curran, J., Hinton, M.J., Bers, D.M., Shannon, T.R.. (2007) Isoproterenol Enhances Diastolic Sarcoplasmic Reticulum Ca Leak in Rabbit Ventricular Myocytes in a Ca-Calmodulin-Dependent Protein Kinase II Dependent Manner and PKA-independent Manner.. *Biophys. J.* 92:133a.

Curran, J., Brown, K.H., Pogwizd, S., Bers, D.M. Shannon, T.R. (2007) Characterization of Ryanodine Receptor Ca Sensitivity in Rabbit Ventricular Myocytes and Propensity for Delayed Afterdepolarizations. *Biophys. J.* 92:133a.

Curran, J., Brown, K.H., Pogwizd, S., Bers, D.M. Shannon, T.R. (2008) Arrhythmogenic Spontaneous Ca Waves in Heart Failure Myocytes Are CaMKII-dependent. *Biophys. J.* 94:98a.

Shonts, S., Shannon, T.R., Bers, D.M. (2008) Measurement of SR Ca Accumulation in Sarcolemma Permeabilized Rabbit Myocytes Using the Low Affinity Ca-dependent Dye Fura-2. *Biophys. J.* 94:105a.

Santiago, D., Shonts, S., Guo, T., Bers, D.M., Kollmann, B.C., Shannon, T.R. (2008) Characterization of Ca Sparks in Transgenic Calsequestrin 2 Knockout Mice. *Biophys. J.* 94:312a.