

Michael Stickland

PhD

Associate Professor

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Professional Overview:

Postdoctoral Students, Graduate Students:

Vince Tedjasaputra, Heather Edgell, Linn Moore, Jon Elliot

Scientific Focus

Current Research Interests:

1. Carotid Chemoreception Control of Cardiovascular Function in Health and Disease

This work examining how activation/sensitization of the carotid chemoreceptor contributes to elevations in sympathetic nervous activity, negatively affecting cardiovascular function. Importantly, the carotid chemoreceptor has been shown to be sensitized in diseases such as chronic heart failure (CHF) and chronic obstructive pulmonary disease (COPD). Sensitization/stimulation of the carotid chemoreceptor results in increased sympathetic nervous activity, and chronic sympathetic vasoconstriction has been shown to have a number of deleterious effects on the cardiovascular system.

Seminal work published from my post-doc (Stickland et al. *Circ Res* 2007) showed that the carotid chemoreceptor contributes to sympathetic vasoconstrictor outflow in dogs during exercise and in chronic heart failure (CHF). These findings establish an important functional cardiovascular consequence of the enhanced carotid chemoreceptor sensitivity previously shown during exercise and in CHF. Follow-up studies examined the sympathetic control of blood flow in hypoxia (Stickland *Am J Physiol* 2009) and began to translate some of this work to the exercising healthy human by examining muscle sympathetic nerve activity (Stickland et al. *J Physiol* 2008). My MSc student examined the sympathetic nerve and heart rate variability response to physiological stress (DeBeck, *Am J Physiol* 2010), and more recently we demonstrated that the carotid chemoreceptors are important in the sympathetic control of muscle blood flow in health (Stickland et al. *J Physiol* 2011). Over the past few years my lab has received operating and salary funding from CIHR, Heart and Stroke Foundation, and Canadian Lung Association to examine the carotid chemoreceptor control of cardiovascular function in health, heart failure and in patient with chronic obstructive pulmonary disease.

2. Intra-pulmonary shunt and pulmonary gas exchange.

Previous work documented that exercise causes the recruitment of anatomical intra-pulmonary shunts in healthy humans, which contribute to an impairment in pulmonary gas exchange (Stickland et al. *J Physiol* 2004). Follow-up work done during my post-doc using microspheres in isolated lungs and animals confirm these findings (Stickland et al. *Am J Resp Crit Care Med* 2007). This basic pulmonary physiology work questions our fundamental understanding of the pulmonary circulation; that normal pulmonary blood flow is from pulmonary arteries to arterioles, capillaries, venules and finally to veins. This work remains controversial, as highlighted by a previous editorial (Lovering & Stickland *J Appl Physiol* 2010) and the recent Point-Counter Point discussion in *J Appl Physiol* that proposes that these pulmonary shunts are real and recruited during exercise (Lovering, Eldridge & Stickland, 2009).

Most recently, Dr. T. Bryan, a pulmonary fellow research trainee, completed a study demonstrating that anatomical intra-pulmonary shunts could be recruited pharmacologically with increasing cardiac output, which resulted in an impairment in pulmonary gas exchange (Bryan et al., *J Appl Physiol* in-press). Funding for this work to examine mechanisms and consequences of intra-pulmonary shunt recruitment is supported by a NSERC Discovery Grant and NSERC Research Tools and Instruments Grant.

3. Pulmonary Rehabilitation

As co-director of the Centre for Lung Health, which operates the primary pulmonary rehabilitation program in Edmonton, I facilitate clinical research/innovation within the Centre. Recent work includes: demonstrating efficacy of delivering pulmonary rehabilitation via telehealth (Stickland et al.

Can Resp Journal), and evaluating clinical characteristics that can predict success/drop-out in rehabilitation (Selzler et al., In-press). Ongoing work is examining how to increase adherence following rehabilitation, as well as how exercise rehabilitation improves the cardiovascular consequences of lung disease.

Publications:

Peer-Reviewed Original Research (trainees are underlined):

1. Selzler, A.M., L.G. Simmonds, Rodgers, W.M., Wong, E., **Stickland, M.K.** Pulmonary Rehabilitation in Chronic Obstructive Pulmonary Disease: Predictors of Program Completion and Success. J of COPD, Accepted June 2012.
2. Bryan, T., Van Diepen, S., Bhutani, M., Shanks, M., Welsh, R. **Stickland, M.K.** The effects of dobutamine and dopamine on intrapulmonary shunt and gas exchange in healthy humans. J Appl Physiol, Accepted June 2012.
3. Ospina M.B., Voaklander D., **Stickland M.K.**, King M., Senthilselvan A., Rowe B.H. Prevalence of Asthma and Chronic Obstructive Pulmonary Disease in Aboriginal and non-Aboriginal populations: A Systematic Review and Meta-analysis of Epidemiological Studies, Can Respir J, Accepted Feb 2012.
4. **Stickland, M.K.**, Rowe, B.H., Spooner, C.H., Vandermeer, B., Dryden, D.M. Effect of Warm-Up Exercise on Exercise-Induced Bronchoconstriction. Medicine and Science in Sports and Exercise, Med Sci Sports Exerc. 44:383-91, 2012.
5. **Stickland, M.K.**, Fuhr, D.P., Haykowsky, M.J., Jones, K.E., Paterson, D.I., Ezekowitz. J.I., McMurtry, S.M. Carotid chemoreceptor modulation of blood flow during exercise in healthy humans. Journal of Physiology, 589:6219-30, 2011.
6. **Stickland, M.K.**, Rowe, B.H., Spooner, C.H., Vandermeer, B., Dryden, D.M. Accuracy of eucapnic hyperpnea or mannitol to diagnose exercise induced bronchoconstriction. Annals of Allergy, Asthma & Immunology, 107:229-234, 2011.
7. Nelson, M.D., Haykowsky, M.J., **Stickland, M.K.**, Altamirano-Diaz, L.A., Willie, C., Smith, K., Petersen, S.R., Ainslie, P.N. Reductions in cerebral blood flow during passive heat stress in humans: partitioning the mechanisms. Journal of Physiology, 589:4053-64.
8. Nelson M.D., Altamirano-Diaz L.A., Petersen S.R., Delorey D.S., **Stickland M.K.**, Thompson R.B., Haykowsky M.J. Left ventricular systolic and diastolic function during tilt table positioning and passive heat stress in humans. American Journal of Physiology Heart Circulation Physiology, 301:H599-608, 2011.

9. Lovering A.T., **Stickland, M.K.**, Amann, M., O'Brien, M.J., Hokanson, J.S., Eldridge, M.W. Effect of a patent foramen ovale on pulmonary gas exchange efficiency at rest and during exercise. *Journal of Applied Physiology*, 110:1354-61, 2011.
10. **Stickland, M.K.**, Jourdain, T., Wong, E., Rodgers, W.M., Jendzjowsky, N.G., MacDonald, G.F. Effects of a Pulmonary Rehabilitation Program Delivered via Telehealth Technology in Chronic Obstructive Pulmonary Disease Patients. *Canadian Respiratory Journal*, 18:216-220, 2011.
11. Nelson, M.D., Haykowsky, M.J., Petersen, S.R., DeLorey, D.S., **Stickland, M.K.**, Cheng-Baron, J., Thompson, R.B. Aerobic fitness does not influence the biventricular response to whole-body passive heat stress. *Journal of Applied Physiology*, 109: 1545-51, 2010.
12. **Stickland, M.K.**, Spooner, C.H., Dryden, D.D., Rowe, B.H. The need for standardization in exercise challenge testing for exercise-induced asthma/bronchoconstriction. *Journal of Allergy and Clinical Immunology*, 126:878-880.e6, 2010 (note: rapid short report).
13. Debeck L.D., Petersen S.R., Jones K.E., **Stickland M.K.** Heart Rate Variability and Muscle Sympathetic Nerve Activity Response to Acute Stress: the Effect of Breathing. *American Journal of Physiology - Regulatory, Integrative and Comparative Physiology* 299:R80-91, 2010.
14. **Stickland, M.K.**, Smith, C.A., Soriano, B.J., Dempsey, J.A. Sympathetic Restraint of Muscle Blood Flow During Hypoxic Exercise. *American Journal of Physiology - American Journal of Physiology - Regulatory, Integrative and Comparative Physiology* 296:R1538-46, 2009.
15. Lovering A.T., **Stickland M.K.**, Amann M., Murphy J.C., O'Brien M.J., Hokanson J.S., Eldridge M.W. Hyperoxia prevents exercise-induced intrapulmonary arteriovenous shunt in healthy humans. *Journal of Physiology* 586: 4559-4565, 2008.
16. **Stickland M.K.**, Morgan B.J., Dempsey J.A. Carotid chemoreceptor modulation of sympathetic vasoconstrictor outflow during exercise in healthy humans. *Journal of Physiology*, 586: 1743-1754, 2008.
17. **Stickland M.K.**, Lovering A.T., and Eldridge M.W. Exercise-induced Arteriovenous Intra-Pulmonary Shunting in Dogs. *American Journal of Respiratory and Critical Care Medicine*, 176: 300-305, 2007.
18. **Stickland, M.K.**, Miller, J.D., Smith, C.A., Dempsey, J.A. Carotid chemoreceptor modulation of regional blood flow distribution during exercise in health and chronic heart failure. *Circulation Research*, 100: 1371-8, 2007.
19. Lovering A.T., **Stickland M.K.**, Kelso A.J., Eldridge M.W. Direct demonstration of 25 and 50 μm arteriovenous pathways in healthy Human and Baboon lungs. *American Journal of Physiology – Heart and Circulatory Physiology*, 292: H1777-8, 2007.

20. Amann M., Eldridge M.W., Lovering A.T., **Stickland M.K.**, Pegelow D.F., Dempsey J.A. Arterial oxygenation influences central motor output and exercise performance via effects on peripheral locomotor muscle fatigue. *Journal of Physiology*, 575: 937-52, 2006.
21. Lovering, A.T., **Stickland, M.K.**, Eldridge, M.W. Intrapulmonary Shunt during Normoxic and Hypoxic Exercise in Healthy Humans. *Advances in Experimental Medicine and Biology*, 588: 31-45, 2006.
22. Miller, J.D., Hemauer, S.J., Smith, C.A., **Stickland, M.K.**, Dempsey, J.A. Expiratory threshold loading impairs cardiovascular function in health and chronic heart failure during exercise. *Journal of Applied Physiology*, 101: 213-227, 2006.
23. **Stickland, M.K.**, Welsh, R.C., Haykowsky, M.J., Petersen, S.R., Anderson, W.D., Taylor, D.A., Bouffard, M., Jones, R.L. Effect of Acute Increases in Pulmonary Vascular Pressures on Exercise Pulmonary Gas Exchange. *Journal of Applied Physiology*, 100: 1910-1917, 2006.
24. **Stickland, M.K.**, Welsh, R.C., Petersen, S.R., Tyberg, J.V., Anderson, W.D., Jones, R.L., Taylor, D.A., Bouffard, M., Haykowsky, M.J. Does fitness level modulate the cardiovascular hemodynamic response to exercise? *Journal of Applied Physiology*, 100: 1895-1901, 2006.
25. **Stickland, M.K.**, Welsh, R.C., Haykowsky, M.J., Petersen, S.R., Anderson, W.D., Taylor, D.A., Bouffard, M., Jones, R.L. Intra-Pulmonary Shunt and Pulmonary Gas Exchange During Exercise in Humans. *Journal of Physiology*, 561: 321-329, 2004.
26. **Stickland, M.K.**, Anderson, W.D., Haykowsky, M.J., Petersen, S.R., Welsh, R.C. and Jones, R.L. The effects of prolonged exercise to exhaustion on left-ventricular function and pulmonary gas exchange in endurance athletes. *Respiration Physiology and Neurobiology*. 142: 197-209, 2004.
27. **Stickland, M.K.**, Jones, R.L., Haykowsky, M.J. and Petersen, S.R. Lactate steady state and 20 km simulated cycle racing. *Research in Sports Medicine*. 12: 59-70, 2004.
28. **Stickland, M. K.**, Petersen, S. R., Haykowsky, M.J., Taylor, D.A. and Jones, R.L. The Effects Cycle Racing on Pulmonary Diffusion Capacity and Left Ventricular Systolic Function. *Respiration Physiology and Neurobiology*. 138: 291-299, 2003.

Invited Refereed Review Articles:

1. Rowe, B.H., Bhutani, M., **Stickland, M.K.**, Cydulka R. The Assessment and Management of COPD in the Emergency Department and beyond. *Expert Review of Respiratory Medicine*, 5:549-59, 2011.

2. Marciniuk, D.D., Brooks, D., Butcher, S., Debigare, R., Dechman, G., Ford, G., Pepin, V., Reid, D., Sheel, A.W., **Stickland, M.K.**, Todd, D.C., Walker, S.L., Aaron, S., Balter, M., Bourbeau, J., Hernandez, P., Maltais, F., O'Donnell, D.E., Bleakney, D., Carlin, B., Goldstein, R., Muthuri, S.K. Optimizing Pulmonary Rehabilitation in COPD: Practical Issues A Canadian Thoracic Society Clinical Practice Guideline. *Canadian Respiratory Journal*, 17:159-68, 2010.
3. Lovering A.T., Eldridge M.W., **Stickland MK**. Last Word on Point:Counterpoint: Exercise-induced intrapulmonary shunting is imaginary vs. real. *Journal of Applied Physiology*. 107:1003, 2009.
4. Lovering A.T., Eldridge M.W., **Stickland MK**. Counterpoint: Exercise-induced intrapulmonary shunting is real. *Journal of Applied Physiology*. 107:994-7, 2009.
5. **Stickland, M.K.**, Lovering, A.T. Exercise-Induced Intra-Pulmonary Arteriovenous Shunting and Pulmonary Gas Exchange. Invited review for *Exercise Sport Science Reviews* 34:99-106, 2006

Invited Refereed Editorial/Commentaries:

1. Lovering, A.T., **Stickland, M.K.** Not hearing is believing: Novel insight into cardiopulmonary function using agitated contrast and ultrasound. *Journal of Applied Physiology*, 109:1290-1, 2010.
2. **Stickland, M.K.** Exercise-induced pulmonary edema in the athlete, or couch potatoe? Invited Commentary, *Journal of Applied Physiology* 109:1278, 2010.
3. **Stickland M.K.**, Miller J.D. The best medicine: exercise training normalizes chemosensitivity and sympathoexcitation in heart failure. *Journal of Applied Physiology* 105: 779-781, 2008.
4. Tyberg, J.V., **Stickland, M.K.**, Robinson, V.J.B. Active venoconstriction -- even more important in regulating end-diastolic volume / stroke volume? Invited letter to the Editor, *Journal of Applied Physiology* 101: 1267-8, 2006.
5. Lovering, A.T., **Stickland, M.K.**, Eldridge, M.W. Contrast Ultrasound Techniques in the Detection and Quantification of Patent Foramen Ovale: Myth Versus Reality - A Clarification. *Letter to the Editor: Stroke* 36: 1109, 2005.