BIOL4480: Directed Studies in Biology

Project Description

The endothelium, a single cell layer that lines all blood vessels in the human body and plays an important role in the mediation of shear-induced nitric oxide (NO), becomes dysfunctional when dietary sodium intake is increased[2,5]. According to Babcock (2018), excess dietary sodium intake also increases cardiac baroreflex sensitivity (cBRS) in healthy young normotensive adults with salt-resistant BP[3]. The diet of many Western individuals exceeds the World Health Organization's recommendation of <5 grams of dietary salt, increasing their risk of a dysfunctional endothelium, and thus cardiovascular disease[3,4,6]. To counteract endothelium dysfunction, it is thought that the glycocalyx, a network of polysaccharides connected to the endothelium, can be modified by exercise mediated increases in shear stress[1].

The goal of this study is to examine how baroreflex function and arterial blood pressure are affected under the condition of increased dietary sodium intake. During this study, participants will take gel capsules, which contain either sodium chloride or sugar. For the first seven days, half of the participants will be taking sodium chloride pills and the other half will be taking sugar pills. For the next seven days, participants will undergo a "wash-out" period without taking pills, before taking the opposite pill for an additional seven days. Throughout the 23-day protocol, participants will come to the lab on four separate occasions: day 0, day 8, day 15, and day 22. Arterial blood pressure will be examined using continuous blood pressure monitoring at rest and throughout baroreflex function testing. The baroreflex will be assessed in two ways 1) to assess the complete response 2) to assess the mechanical and neural aspects of the reflex. Baroreflex function measures how well the cardiovascular system adjusts to a change in blood pressure. Before and after the salt diet we will use a manipulation called the Valsalva maneuver to abruptly increase and decrease blood pressure. The Valsalva maneuver involves participants blowing into a pressure sensor at a constant pressure for 15 seconds, while their heart rate, arterial blood pressure, and carotid artery size are being continuously measured. The faster the cardiovascular system can return blood pressures to normal the more sensitive the baroreflex. The mechanical, or cardiac, aspect of the baroreflex will be analyzed using the traditional analysis method of graphing the slope of the relation between the participant's R-R interval and their arterial blood pressure during their recovery period post-Valsalva. We will also assess the neural, or sympathetic, aspects of the baroreflex by comparing the distention of the participant's carotid artery to their heart rate response. The mechanical versus neural components of baroreflex will then be compared.

This study requires approval from the Human Ethics Committee and the application has already been submitted.

Equipment to be Used

- Philips Epiqs 5 Doppler Ultrasound
- ECG
- CNAP System
- Powerlab

Learning Objectives

- Continue to learn how to organize, and coordinate a research project
- Continue to learn how to store, transfer, and analyze participant data
- Continue to gain knowledge, and skill using the Doppler Ultrasound
- To identify and assess the effects of an increased sodium intake on arterial blood pressure responses and the baroreflex.
- To improve scientific writing skills

Meeting Schedule

- On Tuesdays at 12:30 pm, Dr. Mark Rakobowchuk, Ms. Jeeva Gill (Honours student with Dr. Rakobowchuk), and I will meet in order to evaluate progress, discuss questions or concerns, and plan. Additionally, on Thursdays from 1:00 pm to 2:00 pm, Dr. Mark Rakobowchuk and I will meet, and he will provide feedback and guidance regarding techniques relevant to the Directed Studies.

Timeline

- <u>September 2022</u>
    - Practice Doppler Ultrasound techniques
    - Practice FMD techniques
    - Refine the data acquisition protocols
    - Advertise the study
- <u>October 2022</u>
    - Learn how to store, and transfer participant data
    - Recruit study participants
    - Begin study trials
- <u>November 2022</u>
    - Learn how to analyze participant data
    - Prepare participant data for analysis
    - Statistical analysis of participant data
    - Writing Directed Studies Report

Evaluation

- Directed Studies Report

References

1. Aldecoa, C., Llau, J.V., Nuvials, X., & Artigas, A. (2020). Role of albumin in the preservation of endothelial glycocalyx integrity and the microcirculation: a review. *Ann. Intensive Care* 10, 85. https://doi.org/10.1186/s13613-020-00697-1
2. Babcock, M. C., Brian, M. S., Watso, J. C., Edwards, D. G., Stocker, S. D., Wenner, M. M., & Farquhar, W. B. (2018). Alterations in dietary sodium intake affect cardiovagal baroreflex sensitivity. *American journal of physiology*. Regulatory, integrative and comparative physiology, 315(4), R688–R695. https://doi.org/10.1152/ajpregu.00002.2018
3. Babcock, M. C., Robinson, A. T., Migdal, K. U., Watso, J. C., Wenner, M. M., Stocker, S. D., & Farquhar, W. B. (2019). Reducing Dietary Sodium to 1000 mg per Day Reduces Neurovascular Transduction Without Stimulating Sympathetic Outflow. *Hypertension* (Dallas, Tex. : 1979), 73(3), 587–593. https://doi.org/10.1161/HYPERTENSIONAHA.118.12074
4. Olde Engberink, R. H., Rorije, N. M., Homan van der Heide, J. J., van den Born, B. J., & Vogt, L. (2015). Role of the vascular wall in sodium homeostasis and salt sensitivity. *Journal of the American Society of Nephrology* : JASN, 26(4), 777–783. https://doi.org/10.1681/ASN.2014050430
5. Sapp, R. M., Evans, W. S., Eagan, L. E., Chesney, C. A., Zietowski, E. M., Prior, S. J., Ranadive, S. M., & Hagberg, J. M. (2019). The effects of moderate and high-intensity exercise on circulating markers of endothelial integrity and activation in young, healthy men. *Journal of applied physiology (Bethesda, Md. : 1985)*, *127*(5), 1245–1256. https://doi.org/10.1152/japplphysiol.00477.2019
6. World Health Organization. (2022). Indicator metadata registry details. *World Health Organization.* https://www.who.int/data/gho/indicator-metadata-registry/imr-details/3082#:~:text=A%20salt%20intake%20of%20less,much%20more%20salt%20than %20recommended