APPLIED SCIENCES WEBINAR SERIES

MICRONEUROGRAPHY

POST WEBINAR HANDOUT 2 - PROFESSOR VAUGHAN MACEFIELD

Thank you for attending our Applied Sciences Webinar! Here's a quick recap of some of the highlights and some further reading you might be interested in.

MICRONEUROGRAPHY

Microneurography was developed in the mid '60s by Karl-Erik Hagbarth and Åke Vallbo. It uses micro electrodes to record nerve impulse traffic in both peripheral and cranial nerves.

It enables the recording impulses from nerves 1/5th the diameter of a human hair, including muscle spindles which are our primary proprioceptors!

Recently, advances in microneurography have been made - we can now record the activity of the vagus nerve by using electrodes inserted into the neck.

Macefield works with microneurography techniques to:

- Record the activity of sympathetic neurons that supply the skin and muscles.

- Combine it with fMRI, allowing the activity of particular neural regions in patients with obstructive sleep apnea to be monitored.

DID YOU KNOW?

Contrary to many textbooks, 80 m/s is the fastest nerve impulse speed in humans; the 120 m/s quoted comes from cat nerves.

NEURO AMP EX

Neuro Amp Ex is a signal processing unit integral to microneurography research.

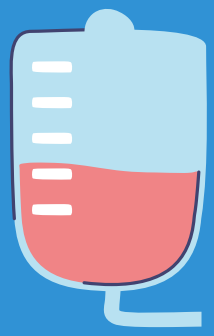
What does it do?

- It pre-amplifies the nerve signals before they reach the main signal processing unit to reduce interference from electrical noise in the surrounding environment.
- Entirely stainless steel design allows its use in conjunction with magnetic resonance technologies such as fMRI - a key application!

MSNA-COUPLED FMRI

Sympathetic nerves in muscles were stimulated in healthy young patients and those with obstructive sleep apnea. The data collected revealed coupling between different brain regions, implicating they are involved in sympathetic nerve activity.

What was found?



- The dorsolateral prefrontal cortex (dlPFC) is involved in the regulation of blood pressure. This helps explain the role of stress in blood pressure.
- Rostral ventrolateral medulla (the primary output area of sympathetic nerve activity) is functionally coupled to many regions in the brain including the ventromedial hypothalamus, dlPFC and the anterior insula.

These give further evidence to the top-down control structure of the brain, which allows higher order regions to influence regions. Together, they control homeostasis in the body.

What does this mean for us?

Well, this explains the physiological changes of:

- Decreases in blood pressure one undergoes due to emotional response, e.g. listening to music

Some Further Readings

El Sayed, K., Macefield, V., Hissen, S., Joyner, M., & Taylor, C. (2018). Blood pressure reactivity at onset of mental stress determines sympathetic vascular response in young adults. Physiological Reports, 6(24), e13944. doi: 10.14814/phy2.13944

Henderson, L., Fatouleh, R., Lundblad, L., McKenzie, D., & Macefield, V. (2016). Effects of 12 Months Continuous Positive Airway Pressure on Sympathetic Activity Related Brainstem Function and Structure in Obstructive Sleep Apnea. Frontiers In Neuroscience, 10. doi: 10.3389/fnins.2016.00090

Fatouleh, R., Hammam, E., Lundblad, L., Macey, P., McKenzie, D., Henderson, L., & Macefield, V. (2014). Functional and structural changes in the brain associated with the increase in muscle sympathetic nerve activity in obstructive sleep apnoea. Neuroimage: Clinical, 6, 275-283. doi: 10.1016/j.nicl.2014.08.021

Knellwolf, T., Burton, A., Hammam, E., & Macefield, V. (2018). Microneurography from the posterior tibial nerve: a novel method of recording activity from the foot in freely standing humans. Journal Of Neurophysiology, 120(3), 953-959. doi: 10.1152/jn.00937.2017