Spontaneous tympanic membrane displacement

Although previous studies have shown associations between patient symptoms/outcomes and the spontaneous tympanic membrane displacement (spTMD) pulse amplitude, the contribution of the underlying intracranial pressure (ICP) signal to the spTMD pulse remains largely unknown. We have assessed the relative contributions of ICP and arterial blood pressure (ABP) on spTMD at different frequencies in order to determine whether spTMD contains information about the ICP above and beyond that contained in the ABP.

Eleven patients, who all had invasive ICP and ABP measurements in-situ, were recruited from our intensive care unit. Their spTMD was recorded and the power spectral densities of the 3 signals, as well as coherences between the signals, were calculated in the range 0.1 - 5 Hz. Simple and multiple coherences, coupled with statistical tests using surrogate data, were carried out to quantify the relative contributions of ABP and ICP to spTMD.

Most power of the signals was found to predominate at respiration rate, heart rate, and their harmonics, with little outside of these frequencies. Analysis of the simple coherences found a slight preference for ICP transmission, beyond that from ABP, to the spTMD at lower frequencies (7/11 patients at respiration, 7/10 patients at respiration 1st harmonic) which is reversed at the higher frequencies (2/11 patients at heart rate and its 1st harmonic). Both ICP and ABP were found to independently contribute to the spTMD. The multiple coherence reinforced that ICP is preferentially being transmitted at respiration and respiration 1st harmonic.

Both ABP and ICP contribute independently to the spTMD signal, with most power occurring at clear physiological frequencies - respiration and harmonics and heart rate and harmonics. There is information shared between the ICP and spTMD that is not present in ABP. This analysis has indicated that lower frequencies appear to favour ICP as the driver for spTMD ¹.

1)

El-Bouri WK, Vignali D, Iliadi K, Bulters DO, Marchbanks RJ, Birch AA, Simpson DM. Quantifying the contribution of intracranial pressure and arterial blood pressure to spontaneous tympanic membrane displacement. Physiol Meas. 2018 Jul 12. doi: 10.1088/1361-6579/aad308. [Epub ahead of print] PubMed PMID: 29999499.

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