OPTIMAL FREQUENCY RANGE FOR ELECTRICAL IMPEDANCE TOMOGRAPHY OF NEURAL ACTIVITY IN PERIPHERAL NERVE
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BACKGROUND:
Time division multiplexing in EIT has been demonstrated [1], but is not compatible with real time operation. Frequency division multiplexing is promising for real time, but is restricted at the upper limit by the frequency roll off of the electrical impedance in neural tissue, and at the lower limit by the need to avoid the compound action potential (CAP) artefact

OBJECTIVE:
To determine the limits of the operating frequency range for frequency division multiplexed EIT of neural activity in peripheral nerve.

METHOD:
Lower frequency limit from frequency analysis of CAP using Fourier transform.
Upper frequency limit from impedance frequency roll off:
Transfer function across a resistor phantom: $H(f) = V_{out}/V_{in}$
Measurements in phosphate buffered solution: $V_1 = (1 / R_{PBS} + Z_{cuff}) H(f)$
Measurements in cadavers: $V_2 = (1 / R_{nerve} + Z_{cuff}) H(f)$
Nerve Impedance: $Z_{nerve} = V_2 - V_1 / H(f)$

RESULTS AND DISCUSSION:
CAP frequency dominant at 400 – 500 Hz, with significant drop between 500 Hz and 1 kHz, and negligible power above 3 kHz. Results are specific to paw stimulation and sciatic recording in cadaver of Sprague-Dawley rat.
Transverse impedance showed local maxima at 4 and 8 kHz, and decline between 8 and 32 kHz. In agreement with data in [1]. Moderate agreement with modelling in [2], although more data at higher frequencies needed.
Longitudinal impedance showed decline between 1 and 32 kHz, with 80% reduction at 20 kHz. In broad agreement with modelling in [2].

CONCLUSIONS:
• Upper frequency limit, 80% reduction in magnitude: 20 kHz with Longitudinal current; potentially higher with Transverse
• Lower frequency limit, to avoid CAP artefact: 2 kHz