Transfer function analysis

Transfer function analysis (TFA) of dynamic cerebral autoregulation (dCA) requires smoothing of spectral estimates using segmentation of the data (SD). Systematic studies are required to elucidate the potential influence of SD on dCA parameters.

Healthy subjects (HS, n=237) and acute ischemic stroke patients (AIS, n=98) were included. Cerebral blood flow velocity (CBFV, transcranial Doppler ultrasound) was recorded supine at rest with continuous arterial blood pressure (BP, Finometer) for a minimum of five minutes. TFA was performed with durations SD = 100, 50 or 25 s and 50% superposition to derive estimates of coherence, gain and phase for the BP-CBFV relationship. The autoregulation index (ARI) was estimated from the CBFV step response. Intrasubject reproducibility was expressed by the intraclass correlation coefficient (ICC).

In HS, the ARI, coherence, gain, and phase (low frequency) were influenced by SD, but in AIS, phase (very low frequency) and ARI were not affected. ICC was excellent (>0.75) for all parameters, for both HS and AIS. For SD=100s, ARI was different between HS and AIS (mean ± sdev: 5.70 ± 1.61 vs 5.1 ± 2.0; $p<0.01$) and the significance of this difference was maintained for SD = 50s and 25s. Using SD = 100s as reference, the rate of misclassification, based on a threshold of ARI ≤ 4, was 6.3% for SD = 50 s and 8.1% for SD = 25 s in HS, with corresponding values of 11.7% and 8.2% in AIS patients, respectively.

Further studies are warranted with SD values lower than the recommended standard of SD=100s, to explore possibilities of improving the reproducibility, sensitivity and prognostic value of TFA parameters used as metrics of dCA [1].

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Panerai RB, Intharakham K, Haunton VJ, Minhas JS, Llwyd O, Lam M, Salinet ASM, Nogueira RC, Katsogridakis E, Maggio P, Robinson TG. Chasing the evidence: the influence of data segmentation on estimates of dynamic cerebral autoregulation. Physiol Meas. 2020 Mar 9. doi: 10.1088/1361-6579/ab7ddf. [Epub ahead of print] PubMed PMID: 32150740.