Oscillating pressure infusion

Infusion tests are used to diagnose and select patients with idiopathic normal pressure hydrocephalus (INPH) for shunt surgery. The test characterizes cerebrospinal fluid dynamics and estimates parameters of the cerebrospinal fluid system, the pressure volume index (PVI) and the outflow conductance (Cout). The Oscillating Pressure Infusion (OPI) method was developed to improve the test and reduce the investigation time.

Infusion patterns and analysis methods used in current clinical practice are not optimized. Minimizing the investigation time with sufficient accuracy is of major clinical relevance. The aim of this study was to propose and experimentally evaluate a new method, the oscillating pressure infusion (OPI). The non-linear model of the CSF system was transformed into a linear time invariant system. Using an oscillating pressure pattern and linear system identification methods, C (out) and PVI with confidence intervals, were estimated in real-time. Forty-two OPI and constant pressure infusion (CPI) investigations were performed on an experimental CSF system, designed with PVI = 25.5 ml and variable C (out). The ARX model robustly estimated C (out) (mean C (out,OPI) - C (out,CPI) = 0.08 µl/(s kPa), n = 42, P = 0.68). The Box-Jenkins model proved most reliable for PVI (23.7 ± 2.0 ml, n = 42). The OPI method, with its oscillating pressure pattern and new parameter estimation methods, efficiently estimated C (out) and PVI as well as their confidence intervals in real-time. The results from this experimental study show potential for the OPI method and supports further evaluation in a clinical setting [1].

The Oscillating Pressure Infusion method produced real-time estimates of Cout including estimates of reliability that was in good agreement with the reference method and allows for a reduced and individualized investigation time [2].

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2)
Andersson K, Manchester IR, Laurell K, Giuliana Cesarini K, Malm J, Eklund A. Measurement of CSF dynamics with oscillating pressure infusion. Acta Neurol Scand. 2013 Jul;128(1):17-23. doi: 10.1111/ane.12063. Epub 2012 Dec 28. PubMed PMID: 23278837.