Cerebrospinal fluid pulse wave velocity

Intracranial and intraspinal compliance are parameters of interest in the diagnosis and prediction of treatment outcome in patients with normal pressure hydrocephalus and other forms of communicating hydrocephalus. A noninvasive method to estimate the spinal cerebrospinal fluid (CSF) pulse wave velocity (PWV) as a measure of compliance was developed using a multiband cine phase-contrast MRI sequence and a foot-to-foot algorithm.

Sonnabend et al. used computational simulations to estimate the accuracy of the MRI acquisition and transit-time algorithm. In vitro measurements were performed to investigate the reproducibility and accuracy of the measurements under controlled conditions. In vivo measurements in 20 healthy subjects and 2 patients with normal pressure hydrocephalus were acquired to show the technical feasibility in a clinical setting.

Simulations showed a mean deviation of the calculated CSF PWV of 3.41% ± 2.68%. In vitro results were in line with theory, showing a square-root relation between PWV and transmural pressure and a good reproducibility with SDs of repeated measurements below 5%. Mean CSF PWV over all healthy subjects was 5.83 ± 3.36 m/s. The CSF PWV measurements in the patients with normal pressure hydrocephalus were distinctly higher before CSF shunt surgery (33.80 ± 6.75 m/s and 31.31 ± 7.82 m/s), with a decrease 5 days after CSF shunt surgery (15.69 ± 3.37 m/s).

This study evaluates the feasibility of CSF PWV measurements using a multiband cine phase-contrast MRI sequence. In vitro and in vivo measurements showed that this method is a potential tool for the noninvasive estimation of intraspinal compliance [1].

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Sonnabend K, Brinker G, Maintz D, Bunck AC, Weiss K. Cerebrospinal fluid pulse wave velocity measurements: In vitro and in vivo evaluation of a novel multiband cine phase-contrast MRI sequence [published online ahead of print, 2020 Jul 21]. Magn Reson Med. 2020;10.1002/mrm.28430. doi:10.1002/mrm.28430