Device used in a experiment (named Cadence) consists of a small air-filled inelastic balloon (approximately 1.0 ml) implanted into the intracranial space and connected to an external programmable pump, triggered by an R-wave detector. Balloons were implanted into the epidural space above 1 of the hemispheres of 19 canines for up to 10 hours. When activated, the balloons were programed to cyclically inflate with the cardiac cycle with variable delay, phase, and volume. The ICP response was measured in both hemispheres. Additionally, cerebral blood flow (heat diffusion and laser Doppler) was studied in 16 canines. RESULTS This system, depending on the inflation pattern of the balloon, allowed a flattening of the ICP waveform, increase in the ICP waveform amplitude, or phase shift of the wave. This occurred with small mean ICP changes, typically around ± 2 mm Hg (15%). Bilateral ICP effects were observed with activation of the device: balloon inflation at each systole increased the systolic ICP pulse (up to 16 mm Hg, 1200%) and deflation at systole decreased or even inverted the systolic ICP pulse (-0.5 to -19 mm Hg, -5% to -1600%) in a dose-(balloon volume) dependent fashion. No aphysiological or deleterious effects on systemic pressure (≤ ±10 mm Hg; 13% change in mean pressure) or cardiac rate (≤ ± 17 beats per minute; 16% change) were observed during up to 4 hours of balloon activity.

The results of these initial studies using an intracranially implanted, cardiac-gated, volume-oscillating balloon suggest the Cadence device can be used to modify ICP pulsations, without physiologically deleterious effects on mean ICP, systemic vascular effects, or brain injury. This device and technique may be used to study the role of ICP pulsatility in intracranial hemo- and hydrodynamic processes and introduces the creation of a potential platform of a cardiac-gated system for treatment of acute and chronic low blood flow states, and diseases requiring augmentation of CSF substance clearance or delivery. [1)].

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Luciano MG, Dombrowski SM, Qvarlander S, El-Khoury S, Yang J, Thyagaraj S, Loth F. Novel method for dynamic control of intracranial pressure. J Neurosurg. 2016 Jul 15:1-12. [Epub ahead of print] PubMed PMID: 27419825.