Intracranial pressure dynamics are not linked to aqueductal cerebrospinal fluid stroke volume

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TO THE EDITOR: A recent study by Hamilton et al. (4) proposes that aqueductal cerebrospinal fluid (CSF) stroke volume (ASV) is significantly associated with the width of the second peak of the intracranial pressure (ICP) waveform in normal pressure hydrocephalus. Existing evidence and current understanding of ICP physiology do not support a mechanistic link between aqueductal CSF flow and ICP dynamics.

Penn et al. (5) were unable to detect ICP differences between intra- and extraventricular spaces in dogs with induced hydrocephalus. Chiang et al. (3) measured CSF flow through the aqueduct in healthy and hydrocephalic patients and predicted that the pressure difference that drives the aqueductal CSF pulsation is extremely small, on the order of 0.01 mmHg, consistent with the measurements by Penn et al. Therefore it is not expected that aqueductal CSF flow either modifies or affects the shape of the ICP waveform in general, nor only its second peak.

Second, CSF flow through the aqueduct is intracranial and does not contribute to the change in intracranial volume during the cardiac cycle. It is well established that ICP is determined by the monoeponential relationship between intracranial pressure and volume. Therefore, the shape of the ICP waveform is modulated by the change in intracranial volume during the cardiac cycle. The change in the intracranial volume during the cardiac cycle is determined by the momentary volumes of blood and CSF that enter and leave the cranium (1). A recent study by Carrera et al. (2) addressing the question “what shapes pulse amplitude of ICP?” reported an empirical relationship between the amplitude of the ICP pulse and the amplitude of the cerebral arterial blood volume in NPH, which is consistent with the fact that the ICP dynamics are primarily modulated by cerebral hemodynamics.

Hamilton et al. (4) conclude that “given the existing evidence that increased aqueductal CSF stroke volume is a marker of impaired CSF flow dynamics, ICP monitoring equipped with a metric of second peak width can thus offer continuous assessment of CSF dynamics change that mean ICP will fail to capture.” Work on the relationship between ventricular morphology and aqueductal CSF flow in healthy and communicat-