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LETTER TO THE EDITOR

Evaluation of a New Catheter for Simultaneous Intracranial Pressure Monitoring and Cerebral Spinal Fluid Drainage: A Pilot Study

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Dear Editor,

We read with interest the article by Liu et al. [1] which was published online in December 2018. This retrospective analysis examines evidence from six subjects and 34 events during which intracranial pressure (ICP) was measured before and after cerebral spinal fluid (CSF) drainage. The authors sought to evaluate ICP values and waveforms from two sources available with the FLEX (Integra®): from the sensor (ICP_f) and from the external drain (ICP_e). We applaud the authors for differentiating the source of the ICP based on device and location [2]. Moreover, the use of waveform analysis adds considerably to the body of knowledge.

While we agree that the results support the conclusion that there is concordance between ICP_f and ICP_e, this concordance has been demonstrated only when CSF drainage is not occurring. Ergo, the discussion and conclusion should focus on when the drain is clamped (not open). We raise the concern that within the discussion, the authors write that the study "…validated the usage of FLEX catheter for ICP monitoring, which can provide more information about ICP even during CSF drainage and can avoid missing events of elevated ICP." This may errantly lead readers to a false conclusion that this study provides evidence that ICP can be accurately measured during periods of drainage. ICP varies significantly over time (as demonstrated in authors' Fig. 1b). Moreover, there is significant within-subject variability of ICP values and waveform after CSF drainage [3]. The values reported by the two devices exhibit an offset (Fig. 3), with the external pressure sensor lower than the internally measured value. It would be interesting to know whether the authors hypothesize a reason for the offset.

The finding of nonsignificant difference in ICP_f and ICP_e among this small sample also seems insufficient to provide validity. The absolute value of the estimated standard error is approximately three times the absolute value of the point estimate of the parameter of interest. This resulted in an extremely wide confidence interval which suggests insufficient precision to justify the finding. We also note that a reading of $ICP_f = 20$ mmHg corresponds to a wide range of values of ICP_e. Treatment paradigms based on external drain measurements may not be fully applicable to internal pressure measurements. Resolving this discrepancy is critical to enable this technology to drive individual care decisions. Therefore, we conclude that the validity of obtaining an ICP during and immediately after CSF drainage has not yet been established.

Finally, we also note that in Fig. 3a and b there appear to be three distinct bands or clusters of paired observations, potentially with different offset values between internal and external pressure sensors. Given that subjects represented one of three diagnoses: traumatic brain injury, subarachnoid hemorrhage, and intraventricular hemorrhage, we were curious to know whether the clusters were related to the diagnosis (conceptually similar analysis to Fig. 5). If not, were there other variables such as Glasgow Coma Score or CSF drainage volume/duration that could potentially explain this phenomenon? The work by these authors is appreciated and provides insight

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