Intracranial pressure variability

Intracranial pressure variability (ICPV) can be defined over various time intervals. The slow-wave ICP amplitude, i.e. ICP oscillations with time periods at e.g. 15 to 55 s, is similar to “B waves” and is believed to represent the vasogenic response to blood pressure variations [1].

It was found that ICP variability (ICPV) predicted a favorable traumatic brain injury outcome [2].

Svedung Wettervik et al. hypothesized that ICPV may depend on intracranial compliance, unstable blood pressure, and cerebral vasomotion. In a study, they aimed to further investigate the explanatory variables for ICPV and its relation to outcome. Data from 362 TBI patients were retrospectively analyzed from day 2 to 5 post-injury. ICPV was evaluated in three ways. First, variability in the sub-minute time interval (similar to B waves) was calculated as the amplitude of the ICP slow waves using a bandpass filter, limiting the analysis to oscillations of 55 to 15 s (ICP AMP 55-15). The second and third ICPV measures were calculated as the deviation from the mean ICP averaged over 30 min (ICPV-30m) and 4 h (ICPV-4h), respectively. All ICPV measures were associated with a reduced intracranial pressure/volume state (high ICP and RAP) and high blood pressure variability in multiple linear regression analyses. Higher ICPV was associated with better pressure reactivity in the univariate, but not the multiple analyses. All ICPV measures were associated with favorable outcome in univariate analysis, but only ICP AMP 55-15 and ICPV-30m did so in the multiple logistic regression analysis. Higher ICPV can be explained by reduced intracranial compliance and variations in cerebral blood volume due to the vessel response to unstable blood pressure. As ICP AMP 55-15 and ICPV-30m independently predicted favorable outcome, it may represent general cerebral vessel activity, associated with better cerebral blood flow regulation and fewer secondary insults [3].

Svedung Wettervik et al. investigated the explanatory variables for ICPV in aSAH and its association with delayed cerebral ischemia (DCI) and clinical outcome.

In this retrospective study, 242 aSAH patients, treated at the neurointensive care, Uppsala, Sweden, 2008-2018, with ICP monitoring the first ten days post-ictus were included. ICPV was evaluated on three-time scales: (1) ICPV-1 m-ICP slow-wave amplitude of wavelengths between 55 and 15 s, (2) ICPV-30 m-the deviation from the mean ICP averaged over 30 min, and (3) ICPV-4 h-the deviation from the mean ICP averaged over 4 h. The ICPV measures were analyzed in the early phase (day 1-3), in the early vasospasm phase (day 4-6.5), and in the late vasospasm phase (day 6.5-10).

High ICPV was associated with younger age, reduced intracranial pressure/volume reserve (high RAP), and high blood pressure variability in multiple linear regression analyses for all ICPV measures. DCI was associated with reduced ICPV in both vasospasm phases. High ICPV-1 m in the post-ictal early phase and the early vasospasm phase predicted favorable outcomes in multiple logistic regressions, whereas ICPV-30 m and ICPV-4 h in the late vasospasm phase had a similar association.

Higher ICPV may reflect more optimal cerebral vessel activity, as reduced values are associated with an increased risk of DCI and unfavorable outcome after aSAH [4]

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