

## A Novel Index to Describe Response to CSF Drainage in Neurocritical Care Patients: The Pressure Equalization Ratio

Omer Doron; Carlos Candanedo MD; Fernando MD Ramirez de Noriega; Rani Patal MD; Jose Cohen; Guy Rosenthal MD

#### Introduction

Diversion of cerebrospinal fluid (CSF) with an external ventricular drain (EVD) is very efficient in lowering ICP when outflow obstruction of CSF occurs, but less so after traumatic brain injury (TBI) when a mass lesion and brain edema elevate ICP. The difference between these two clinical scenarios is widely recognized but seldom measured in the ICU. We sought to develop an index to characterize the response to CSF drainage in neurocritical care patients.

### Methods

We studied 60 consecutive patients, 36 severe TBI patients and 24 non-TBI patients (SAH and ICH). We recorded pre-drainage ICP, opened the EVD, and allowed CSF to drain until cessation of drainage occurred. The EVD was then closed and post-drainage ICP recorded. Pressure Equalization (PE) ratio was defined as follows:

PE ratio =ICP(initial) – ICP(post-drainage) / ICP(initial) – EVD height

# Results

We found a marked difference in the PE ratio between non-TBI patients and TBI patients (0.86  $\pm$  0.36 vs. 0.43  $\pm$  0.31, p<0.0001), indicating that non-TBI patients were better able to equalize pressure with the EVD height compared with TBI patients. Non-TBI patients had less signs of cerebral edema on CT scans and drained higher mean volumes of CSF (7 cc vs 4 cc, p < 0.01). In TBI patients with elevated ICP, PE ratio rose after mannitol administration (0.25  $\pm$  0.14 to 0.47 $\pm$ 0.22).

### Conclusions

PE ratio reflects the ability to equalize ICP to the preset height of an EVD. TBI patients are less apt to equalize pressure with EVD height and therefore generally have a lower PE ratio. Our findings suggest that the degree of brain edema influences PE ratio. Further studies are needed to assess whether PE ratio can be used as a surrogate marker for brain edema and to assess response to therapies to decrease cerebral swelling.



Pressure equalization (PE) ratio in TBI and non-TBI patients. Mean PE ratio is substantially greater in non-TBI patients, indicating that non-TBI patients are better able to equalize pressure with the height of an external ventricular drain.

### Learning Objectives

By the conclusion of this session participants will be able to describe a novel index, the pressure equalization ratio, that describes the response to cerebrospinal fluid drainage in neurocritical care patients and to explain the association of the pressure equalization ratio with brain edema.

[Default Poster]