

Early Systemic Insults after Traumatic Brain Injury. A Center-TBI Study on 1,695 ICU Patients

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Argomento: Neuroanestesia e neuroranimazione

Background: The outcome of traumatic brain injury (TBI) patients is mainly related to the severity of the primary injury and to the occurrence of secondary injury, influenced by systemic insults (SIs) such as hypoxia and hypotension. This study explores these complex interactions to comprehensively elucidate risk factors, treatment and impact on long-term outcomes of early SIs after TBI.

Methods: This is a secondary analysis of the CENTER-TBI study, focusing on the occurrence of SIs (hypoxia and/or hypotension) collected in prehospital settings and at hospital arrival. Only patients in the ICU stratum were included. Patients were allocated to one of the following groups according to events' occurrence: "None", "Hypoxia", "Hypotension", or "Both". We assessed both the 6-month mortality and neurological outcome (unfavorable defined as Glasgow Outcome Scale - Extended ≤ 4).

Results: Among the study population ($n=1,695$ patients), 158 (9.3%) had a hypoxic and 142 (8.4%) had a hypotensive event, while 115 (6.8%) suffered from both. At arrival, patients with SIs presented higher frequency of extracranial injuries and more severely deranged metabolic profile with higher brain biomarkers. During the ICU stay, they required more often intracranial pressure monitoring, higher therapy intensity level, and extracranial surgeries.

Overall, they displayed longer hospital/ICU stay, higher ICU mortality, and unfavorable neurological outcome (Figure 1). Multivariable analysis showed that hypotension alone or in combination with hypoxemia was independently associated with unfavorable 6-month neurological outcome (OR = 2.69, 95%CI = 1.77-4.29, $p<0.001$ and 1.76, 95%CI = 1.08-2.96 $p=0.03$, respectively), but not hypoxia alone (OR= 1.33, 95%CI = 0.85-1.93, $p=0.17$). Only the occurrence of both hypotension and hypoxemia was independently associated with 6-month mortality (HR= 2.06, 95%CI = 1.46-2.89, $p<0.001$).

Conclusions: Early SIs after TBI are rare but - especially when both present - have a significant impact on patients' physiology, therapeutic burden, and ultimately 6-month neurological outcome and mortality.

Figure 1: Outcome distributions in patients with and without SI.

