

In-Hospital Mortality Using Admission CT Perfusion in Severe TBI



Traumatic brain injury (TBI) is classified into mild, moderate, and severe categories, with severe TBI (defined by a Glasgow Coma Scale ≤ 8) being the leading cause of hospitalisation, disability, and mortality worldwide. Globally, over 50 million people suffer from TBI annually, costing around \$400 billion each year.

Severe TBI is a clinical emergency that requires rapid intervention, but despite intensive care, up to 50% of patients die within 48 hours of hospital admission. Mortality is influenced by pre-injury conditions and the severity of the injury. Many patients may already have irreversible brain damage upon admission, making diagnosis challenging. Brain death diagnosis typically relies on clinical examination, which is difficult in the [acute phase](#), leading to the use of elaborate and resource-heavy treatments despite uncertain outcomes.

Imaging is critical in diagnosing severe TBI, though routine imaging has limited ability to predict in-hospital mortality. Advanced imaging techniques, like CT Perfusion (CTP), offer functional and anatomical insights into brain function and may help identify risk factors for early mortality. CTP has shown promise in assessing brain death and predicting mortality in both cardiac arrest and TBI patients.

A new study aimed to validate the use of CTP at hospital admission to identify features of non-survivable brain injury and predict in-hospital mortality in severe TBI patients. Adult patients with severe TBI underwent whole head CTP imaging at their first imaging point. Two independent neuroradiologists interpreted the CTP images. Non-survivable brain injury was defined as a simultaneous decrease in cerebral blood flow (CBF) and cerebral blood volume (CBV) in the brainstem.

The primary outcome was in-hospital mortality, measured as a binary outcome. The main analysis focused on calculating the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of CTP features indicating non-survivable brain injury at admission, with 95% confidence intervals, compared to in-hospital mortality.

Out of the 201 patients initially enrolled in the study, 195 patients (mean age 42.9 years; 82% male) were included in the final analysis. Of these, 55 patients (28.2%) died during their hospital stay. The odds of in-hospital mortality were highest for the presence of intracranial haemorrhage (ICH) (OR 20.25) and gunshot wound (GSW) (OR 22.67). Age was also a factor, with every decade increasing the odds of mortality by 1.77 times.

Among the 55 patients who died, 17 (31%) met the criteria for non-survivable brain injury on CTP at hospital admission. Both CTP and CT-angiogram (CTA) had 100% specificity and positive predictive value (PPV). CTP demonstrated the highest sensitivity of 33% and an NPV of 80%, with an accuracy of 82% and an area under the curve (AUC) of 0.67.

The inter-rater reliability for CTP was variable, ranging from poor to fair, indicating inconsistent agreement between raters. In contrast, the inter-rater reliability for CTA was more consistent, ranging from fair to substantial. No complications were associated with CTP, confirming its safety.

This study is the first well-powered prospective cohort aimed at validating CTP features for identifying non-survivable brain injury in patients with severe TBI and predicting in-hospital mortality. The results confirm that CTP criteria for non-survivable brain injury are highly accurate for diagnosing in-hospital mortality, with a sensitivity of 33% and a specificity of 100%. CTP showed a 100% positive predictive value (PPV), meaning no patients with features of non-survivable brain injury on admission CTP survived. These findings highlight CTP as a potentially valuable diagnostic tool for predicting mortality in severe TBI cases.

Previous studies had underutilised CTP in severe TBI patients due to limited evidence of its effectiveness. This study builds on earlier research, showing that CTP can assist in triage decisions, especially within the first 48 hours after hospital admission, when most deaths occur. Accurate diagnosis of non-survivable brain injury could reduce unnecessary, resource-intensive treatments and better allocate resources, improving care for patients with a chance of survival. Additionally, it could facilitate timely organ donation discussions.

The study also noted variability in inter-rater reliability for CTP, which highlights the need for standardised interpretation and better training for radiologists.

While CTP shows potential in severe TBI management, further research is needed to fully validate its clinical utility and explore its role in predicting long-term outcomes beyond in-hospital mortality. This study highlights the potential of qualitative CTP features of non-survivable brain injury as a triage tool for diagnosing in-hospital mortality in severe TBI patients. While the tool has lower sensitivity, limiting its use for screening all severe TBI cases, the fair inter-rater reliability suggests the need for standardised interpretation criteria and improved training to enhance its effectiveness.

Source: [Critical Care](#)

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