

Diagnostic Accuracy of a Near-Infrared Spectroscopy Device for Detecting Intracranial Hemorrhage in Mild Closed Traumatic Brain Injury at a Philippine Trauma Center

Brent Andrew G. Viray MD, MPM-HSD¹; Halima O. Mokamad-Romancap, MD, FPCS²; Teodoro J. Herbosa, MD, FPCS, FACS²; Eric SM. Talens, MD, MSc, FPCS, FACS² and Nicole Rose I. Alberto³

¹Department of Surgery, ²Division of Trauma Surgery, Department of Surgery, Philippine General Hospital and ³College of Medicine, University of the Philippines Manila

Objective: This study aimed to evaluate the sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, and negative likelihood ratio of a handheld Near Infrared Spectroscopy (NIRS) device (Infrascanner 2000®) in detecting intracranial hemorrhage in mild, closed traumatic brain injury patients in the emergency room setting.

Methods: This prospective study evaluated the diagnostic validity of a NIRS device in hemodynamically stable patients with mild, closed traumatic brain injury. The authors included patients aged 15 to 65 years who were consecutively admitted to the Emergency Department of the Philippine General Hospital from June 2017 to September 2017. Patients were scanned by a trained research assistant with the NIRS device in the frontal, temporal, parietal, and occipital areas of the brain bilaterally. A cranial computed tomography scan was used as a reference standard for comparison.

Results: A total of 83 participants with mild, closed traumatic brain injury were included in the final analysis. There were 68 (82%) males, and the mean age was 29.52 years old. Of the 83 participants, 41 had intracranial hemorrhages (23 subdural, 13 epidural, 5 intraparenchymal). The NIRS device exhibited a sensitivity, 85.37% [55-96.19%]; specificity, 92.86% [85.07-100.00%]; PPV, 92.12% [83.53-100.00%]; NPV, 86.67% [76.74-96.60%]; PLR, 11.96 [3.99-35.82]; and NLR, 0.16 [0.07-0.33].

Conclusion: The NIRS device can reliably screen for hemorrhages in patients with mild, closed traumatic brain injury using CT scan results as the gold standard. These diagnostic values suggest the potential role of the NIRS device in the early evaluation of patients with traumatic brain injury requiring urgent care.

Key words: near-infrared spectroscopy, intracranial hemorrhage, mild traumatic brain injury

Traumatic brain injury (TBI) is a leading cause of death and disability worldwide, constituting a considerable

portion of the global injury burden at 27.08 million cases in 2016.^{1,2} Locally, the mortality of trauma patients in the Philippine General Hospital (PGH) has been reported to be 18.6% (4,947 admissions) of patients admitted from January 2004 to May 2007. Specifically, TBI accounted for 63.4% of central nervous system-related deaths,³ making the early identification of TBI essential. One hallmark pathological process in TBI is intracranial hemorrhage, which occurs in 45% of severe trauma cases.⁴

In 2015, 73 cases of TBIs were recorded at the PGH Emergency Department (ED).⁵ Headache, vomiting, loss of consciousness, post-traumatic seizure, or a Glasgow Coma Score (GCS) below 15 were the usual presenting symptoms. All these patients were subjected to cranial computed tomography (CT) scan. Of 73 patients, 40% (n=29) were reported to have an intracranial hemorrhage or hematoma. In a study conducted by Syed et al. (2007), patients with GCSs of 13 to 15 were subjected to a cranial CT scan, but only 15% of patients had abnormal results, and only 4% needed surgical intervention.⁶ In a setting with limited access to CT machines, it would be beneficial for patients suspected to require an immediate cranial CT scan to be screened and prioritized through an objective diagnostic procedure.

According to Leon-Carrion, et al. (2010), compared to urban areas, TBI patients in rural areas will require more time to be assessed and are more likely to encounter difficulties in gaining access to resources for diagnosis and treatment. Likewise, early surveillance of TBI is necessary to formulate a triage plan in mass casualty and the prioritization of more advanced imaging in the hospital, especially in the low-resource setting.⁷