Mild traumatic brain injury case series

2024

Retrospective analysis of hospital Emergency Department (ED) presentations and hospital admissions from all Western Australian hospitals for all patients with an ICD-10-AM diagnosis code for concussion and post-concussional syndrome (PCS) over the period 2002-2018. Data pertaining to concussion and PCS presentations were extracted from the WA Department of Health Emergency Department Data Collection (EDDC). Total case numbers were aggregated by year (2002-2018) and regions of WA.

Main outcome measures: The rates of diagnoses were calculated based on the population in the specific region and expressed as incidence rate per 100,000 person-years. The overall trends of diagnoses across the regions were analysed using negative binomial regression models and expressed as incidence rate ratio (IRR) with the corresponding 95 % CI, whilst adjusting for region. Tests for linearity were also performed.

Results: The rate of concussion diagnosis had significantly increased linearly over the years (p for trend: $p < 0.001$) whilst the rate of PCS diagnosis had significantly declined linearly over the same period (p for trend: $p < 0.001$).

There was significant increase in all-cause ICD-10-AM concussion diagnoses in WA emergency departments. To further clarify the incidence and prevalence of all-cause concussion in Australia, investigation must focus on truly reflective S06.0 codes and include data linkage to primary care data. Conversely PCS ED presentations reduced; whether this relates to a change in where presentations occur for management of such a diagnosis, improved early intervention or an alternative explanation warrants further investigation [1)].

2023

A total of 462 patients with mTBI and initial brain CT from 46 study centers were included. The median age was 19 (17-22) years, and 322 (70%) were males. CT imaging showed a traumatic intracranial pathology in 171 patients (37%), most commonly tSAH (48%), contusions (40%), and epidural hematomas (37%). Patients with a positive CT scan were less likely to achieve a complete recovery 12 months post-injury. The presence of any CT abnormality was associated with both lower GOSE scores (odds ratio [OR]: 0.39 [0.24-0.63]) and incomplete recovery (GOSE <8; OR: 0.41 [0.25-0.68]), also when adjusted for demographical and clinical baseline factors. The presence of intracranial traumatic CT pathologies was predictive of outcome 12 months after mTBI in young patients, which might help to identify candidates for early follow-up and additional care [2)].

A total of 228 mTBI patients older than 65 years were included in this study. mTBI was defined as an injury to the brain with a loss of consciousness of 30 min or less, a duration of posttraumatic amnesia of <24 h, and an admission Glasgow Coma Scale (GCS) score of 13-15. The Glasgow Outcome Scale Extended (GOSE), an outcome scale assessing functional independence, work, social activities, and personal relationships, was applied to assess the recovery of the patients. The clinical outcome was

divided into complete recovery (GOSE = 8) and incomplete recovery (GOSE ≤ 7) at 6 months after the injury. Multivariate logistic regression was applied to evaluate the association between the GNRI and recovery of elderly mTBI patients, with adjustment for age, sex, hypertension, diabetes, and other important factors.

The receiver operating curve (ROC) analysis demonstrated that the cutoff value of GNRI was 97.85, and the area under the curve (AUC) was 0.860. Compared to the patients with a high GNRI, the patients with a low GNRI were older, had a higher prevalence of anemia, acute subdural hematoma, and subarachnoid hemorrhage, had a higher age-adjusted Charlson Comorbidity Index value, and had lower levels of albumin, lymphocytes, and hemoglobin. Multivariable analysis showed that high GNRI was associated with a lower risk of 6-month incomplete recovery (OR, 0.770, 95% CI: 0.709-0.837, p < 0.001).

The GNRI has utility as part of the objective risk assessment of incomplete 6-month functional recovery in elderly patients with mTBI [3].

Shafiei et al. performed a retrospective cross-sectional study using the files of patients with mild traumatic brain injury who had cerebral contusions from 21 March 2021 to 20 March 2022. The severity of brain injury was determined using the Glasgow Coma Score. Furthermore, we used a cut-off value of a 30% increase in contusion size in the secondary CT scans (up to 72 hours) compared to the first one to define the significant progression of the contusions. For the patients with multiple contusions, we measured the biggest contusion.

705 patients with traumatic brain injury were found, the severity of the injury was mild in 498 of them, and 218 had cerebral contusions. 131 (60.1%) patients were injured in vehicle accidents. 111 (50.9%) had significant contusion progression. Most patients were conservatively managed, but 21 out of them (10%) required delayed surgical intervention.

They found that the presence of subdural hematoma, subarachnoid hemorrhage, and epidural hematoma were predictors of radiological contusion progression, and the patients with subdural hematoma and epidural hematoma were more likely to undergo surgery. In addition to providing prognostic information, predicting risk factors for the progression of the contusions is crucial for identifying patients who might benefit from surgical and critical care therapies [4].

A total of 1027 patients with mild TBI Glasgow Coma Scale (GCS) > 12 were enrolled from the Medical Information Mart for Intensive Care (MIMIC-III) database. The patients were classified into low-SpO2 (< 95%), moderate-SpO2 (95-98%), and high-SpO2 groups (> 98%). With 30- and 90-day mortality rates as the main outcomes, Cox regression and confined cubic spline models were adopted.

There was a U-shaped curve in confined cubic splines for the relationship between SpO2 and mortality. Compared with the moderate-SpO2 group, the high-SpO2 group exhibited a much higher risk of mortality after modification, with hazard proportions of 2.108 (95% CI 1.211-3.670, P < 0.05) for the 30-day mortality and 1.760 (95% CI 1.140-2.720, P < 0.05) for the 90-day mortality, and the low-SpO2 group exhibited a much higher risk of mortality after modification, with hazard proportions of 2.215 (95% CI 1.194-4.110, P < 0.05) for the 90-day mortality.

Among patients with mild TBI, the correlation between SpO2 level and 30- and 90-day mortality followed a U-shaped curve. Both low and high SpO2 levels exerted potentially harmful effects on the outcomes of patients with mild TBI. The SpO2 range of 95-98% could be the optimal SpO2 level for mild patients with TBI [5)]

A retrospective cohort study of adult (≥18 years) trauma patients included in the NTDB from 2007 to 2019 who had an emergency department Glasgow Coma Scale score 13-15, an intracranial hemorrhage (ICH), and no skull fracture. Neurosurgical intervention time trends were quantified for each ICH type using mixed-effects logistic regression with random slopes and intercepts for hospitals, as well as covariates for time and 14 demographic, injury, and hospital characteristics. In total, 666,842 ICH patients across 1060 hospitals were included. The four most common hemorrhages were isolated subdural hemorrhage (36%), isolated subarachnoid hemorrhage (24%), multiple hemorrhage types (24%), and isolated unspecified hemorrhages (9%). Overall, 49,220 (7%) patients received a neurosurgical intervention. After adjustment, the odds of neurosurgical intervention significantly decreased every 10 years by the following odds ratios (odds ratio [95% confidence interval]): 0.85 [0.78, 0.93] for isolated subdural, 0.63 [0.51, 0.77] for isolated subarachnoid, 0.50 [0.41, 0.62] for isolated unspecified, and 0.79 [0.73, 0.86] for multiple hemorrhages. There were no significant temporal trends in neurosurgical intervention odds for isolated epidural hemorrhages (0.87 [0.68, 1.12]) or isolated contusions/lacerations (1.03 [0.75, 1.41]). In the setting of complicated mTBI, the four most common ICH types were associated with significant declines in the odds of neurosurgical intervention over the past decade. It remains unclear whether changing hemorrhage characteristics or practice patterns drove these trends [6)].

2022

In a study of 495 patients in The Hague, out of the 74 patients who had traumatic intracranial lesions, 5 patients had a plasma S100B level below the cutoff value of 0.105 ug/L. For the detection of traumatic intracranial injury, S100B had a sensitivity of 0.932, a specificity of 0.157, a negative predictive value of 0.930, and a positive predictive value of 0.163.

Among patients undergoing guideline-based Computed tomography for mild traumatic brain injury, the use of S100B would result in a further decrease (14.8%) of CT scans but at a cost of missed injury, without clinical consequence, on CT.

Kulbe et al. used data from 1143 individuals with mild TBI (mTBI; defined as admission Glasgow Coma Scale [GCS] score 13-15) enrolled in TRACK-TBI, a prospective longitudinal study of level 1 trauma center patients. Plasma glial fibrillary acidic protein (GFAP) and high sensitivity C-reactive protein (hsCRP) were measured from blood collected within 24 h of injury. Two hundred and twenty-seven (19.9% of) patients had probable PTSD (PCL-5 score ≥ 33) at 6 months post-injury. Serum GFAP levels were positively associated (Spearman's rho = 0.35, $p < 0.001$) with duration of posttraumatic amnesia (PTA). There was an inverse association between PTSD and (log)GFAP (adjusted OR = 0.85, 95% CI 0.77-0.95 per log unit increase) levels, but no significant association with (log)hsCRP (adjusted OR = 1.11, 95% CI 0.98-1.25 per log unit increase) levels. Elevated day-of-injury serum GFAP, a biomarker of glial reactivity, is associated with reduced risk of PTSD after mTBI. This finding merits replication and additional studies to determine a possible neurocognitive basis for this relationship [7)].

2017

Peripheral blood samples were collected from 20 patients with mild TBI at day-1, day-2, day-3, day-4, and day-7 post TBI. The number of circulating Endothelial progenitor cells EPCs and the plasma levels of superoxide dismutase (SOD) and Malondialdehyde (MDA) were measured.

The average of circulating EPCs in TBI patients decreased initially, but increased thereafter, compared with healthy controls. Plasma levels of SOD in TBI patients were significantly lower than those in healthy controls at day-4 post-TBI. MDA levels showed no difference between the two groups. Furthermore, when assessed on day-7 post-TBI, the circulating EPC number were correlated with the plasma levels of SOD and MDA.

These results suggest that the number of circulating EPCs is weakly to moderately correlated with plasma levels of SOD and MDA at day-7 post-TBI, which may offer a novel antioxidant strategy for EPCs transplantation after TBI [8)].

1)
Thomas E, Chih H, Thorne J, Fitzgerald M, Cowen G. A retrospective analysis of concussion and post-concussional syndrome diagnoses in Western Australian emergency departments. Injury. 2024 Jan 20;55(3):111333. doi: 10.1016/j.injury.2024.111333. Epub ahead of print. PMID: 38280260.
2)
Riemann L, Mikolic A, Maas A, Unterberg A, Younsi A; Collaborative European NeuroTrauma Effectiveness Research in Traumatic Brain Injury (CENTER-TBI) Investigators and Participants. Computed Tomography Lesions and Their Association With Global Outcome in Young People With Mild Traumatic Brain Injury. J Neurotrauma. 2023 Jun;40(11-12):1243-1254. doi: 10.1089/neu.2022.0055. Epub 2023 Feb 24. PMID: 36578216.
3)
Zhu B, Ou Y, Guo X, Liu W, Wu L. Poor nutritional status is associated with incomplete functional recovery in elderly patients with mild traumatic brain injury. Front Neurol. 2023 Apr 4;14:1131085. doi: 10.3389/fneur.2023.1131085. PMID: 37082444; PMCID: PMC10110901.
4)
Shafiei M, Sabouri M, Veshnavei HA, Tehrani DS. Predictors of radiological contusion progression in traumatic brain injury. Int J Burns Trauma. 2023 Apr 15;13(2):58-64. PMID: 37215509; PMCID: PMC10195219.
5)
Sun W, Wang L, Yuan S, Liu R, Song P, Che W, Xu J, Lyu J, Zhang Y. Association Between Percutaneous Oxygen Saturation and Mortality of Patients with Mild Traumatic Brain Injury at ICU Admission: An Analysis of the MIMIC-III Database. Adv Ther. 2023 Apr 21. doi: 10.1007/s12325-023-02499-w. Epub ahead of print. PMID: 37084160.
6)
Orlando A, Coresh J, Carrick MM, Quan G, Berg GM, Dhakal L, Hamilton D, Madayag R, Lascano CHP, Bar-Or D. Significant National Declines in Neurosurgical Intervention for Mild Traumatic Brain Injury with Intracranial Hemorrhage: A 13-Year Review of the National Trauma Data Bank. Neurotrauma Rep. 2023 Mar 17;4(1):137-148. doi: 10.1089/neur.2022.0077. PMID: 36941880; PMCID: PMC10024583.
7)
Kulbe JR, Jain S, Nelson LD, Korley FK, Mukherjee P, Sun X, Okonkwo DO, Giacino JT, Vassar MJ, Robertson CS, McCrea MA, Wang KKW, Temkin N, Mac Donald CL, Taylor SR, Ferguson AR, Markowitz AJ, Diaz-Arrastia R, Manley GT, Stein MB; TRACK-TBI Investigators. Association of day-of-injury serum glial fibrillary acidic protein concentration and six-month posttraumatic stress disorder in patients with mild traumatic brain injury. Neuropsychopharmacology. 2022 Jun 18. doi:

10.1038/s41386-022-01359-5. Epub ahead of print. PMID: 35717463.
8)

Huang X, Wan D, Lin Y, Xue N, Hao J, Ma N, Pei X, Li R, Zhang W. Endothelial Progenitor Cells Correlated with Oxidative Stress after Mild Traumatic Brain Injury. Yonsei Med J. 2017 Sep;58(5):1012-1017. doi: 10.3349/ymj.2017.58.5.1012. PubMed PMID: 28792147.