An analysis of referral patterns of traumatic brain injury at Groote Schuur Hospital Trauma Centre

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Background. Traumatic brain injury (TBI) can result in significant morbidity and mortality if not diagnosed in a timely manner. Brain computed tomography (CT) is the diagnostic gold standard but is of limited availability in most South African public hospitals, resulting in transfer of TBI patients to tertiary hospitals.
Objective. To describe the referral patterns and outcomes of patients with TBI referred to Groote Schuur Hospital Trauma Centre.
Methods. This was a retrospective audit of all patients admitted to the Trauma Centre who had a brain CT scan for suspected TBI between 1 February 2022 and 31 March 2022. Demographic data (age, sex), mechanism of injury and Glasgow Coma Score were recorded. Referral pathways were determined, and final disposition of patients was recorded.
Results. A total of 522 patients had a brain CT for TBI. Of these, 314 (60.1%) were referred from other hospitals. CT scan was abnormal in 178 (34.1%) patients. Three hundred and two (58.6%) were discharged home within 24 hours. The mean time between referral and CT scan was 13 hours.
Conclusion. More than half of patients referred for a CT scan were discharged from the Trauma Centre within 24 hours of admission, which indicates additional costs and inefficiencies in the health system. These data are useful to guide resource planning and allocation for district hospitals, since less expensive point-of-care modalities now exist to diagnose TBI, and which are useful in indicating the prognosis of patients.
Key words: traumatic brain injury, computed tomography

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Globally, trauma accounts for a higher mortality than that of HIV, tuberculosis and malaria combined.[1,2] While low- and middle-income countries (LMICs) shoulder almost 90% of the global trauma mortality, limited research exists to guide policy-makers and stakeholders on the impact of trauma care in resource-constrained environments.[1] Traumatic brain injury (TBI) mortality in LMICs is reported to be three-times greater than that experienced by high-income countries.[3] The incidence rate of TBI in South Africa (SA) is estimated to be 1.5 - 3.5 times higher than the estimated global rate.[4,5]

Injury care contributes a massive burden to the government health sector in SA, and computed tomography (CT) plays a key role in the comprehensive work-up and management of the injured. Radiological service distribution across the country is inequitable, and in the Western Cape Province (WC), the private health sector has four times more CT scanners than the public sector, despite the latter treating 83% of the population.[5] Outside of large tertiary hospitals, public sector hospitals have no or limited access to CT scanning, resulting in a large number of TBI transfers.[5]

While some district hospitals in the WC have CT scanners on-site, this service is only available between the hours of 08h00 and 16h00 on weekdays. This means that patients who require after-hours or weekend CT scans must be transferred to a tertiary hospital that has 24-hour CT scanning facilities. Thus constraints on resource allocation and availability faced by district hospitals culminate in an increased burden of patients and overcrowding at tertiary hospitals.

The objective of this study was to describe TBI patients referred to Groote Schuur Hospital (GSH) Trauma Centre from other hospitals, and estimate the proportion that could have been treated at their original hospital if brain CT had been available.

Methods

This was a retrospective analysis that included all patients referred to the Trauma Centre at GSH who underwent a head CT scan during a 2-month period (1 February 2022 to 31 March 2022). Demographic and clinical data were captured from hospital medical records onto a standardised data collection form on REDCap (version 13.1.37). Variables included age, sex, mechanism of injury, Glasgow Coma Scale (GCS) score, admission type (interfacility transfer v. direct admission), transfer times and disposition. Potentially avoidable transfer was defined as those transferred from other health facilities who underwent brain CT, did not have a TBI, or had a TBI not requiring neurosurgical intervention or admission, were not admitted to the intensive care unit (ICU), or were discharged home within 24 hours. The Head Injury Guidelines Handbook for the WC are used in the management of patients with head injuries in the WC. All biostatistical data and figures were exported directly from REDCap for analysis. Date and time data were exported from REDCap and calculated using Excel (Microsoft, USA). Descriptive statistics were used for analysis of demographic data. Counts and percentages were used for reporting of categorical data.

Ethical approval

Ethics approval was granted by the Faculty of Health Sciences Human Research Ethics Committee at the University of Cape Town (ref. no. 455/2021).

Results

The GSH Trauma Centre admitted 1 429 patients during the 2-month study period (Fig. 1).

Of these, 522 (36.5%) underwent brain CT for suspected TBI. Of these, 314 (60.1%) were transferred from other health facilities and 208 (39.8%) were direct admissions. Of the total cohort of 522 patients, 178 (34.1%) had an abnormal CT scan that translated to a positive TBI, while 344 (65.9%) had a normal CT scan. Males accounted for 396 (75.9%) patients in the population, and the median (interquartile range (IQR)) age of patients was 32 (25 - 42.75) years. Blunt force trauma, sharp force trauma and gunshot wounds contributed to 87.5%, 4.0% and 3.6% of injuries, respectively.

Three hundred and fourteen (60.1%) patients were referred by a community health clinic (CHC) or district hospital, of whom 117 (37.2%) had an abnormal CT scan denoting a TBI. Two hundred and eight (40.9%) patients were brought by Emergency Medical Services (EMS) from the scene or were self-referred, and 58 (27.9%) of these patients had an abnormal CT scan denoting a TBI. The median GCS of patients at the referral facilities and GSH was 15 for both groups (standard deviation (SD) 2.87 and SD 3.02, respectively). The median Revised Trauma Score (RTS), Injury Severity Score (ISS) and Trauma and Injury Severity Score (TRISS) was 7.84 (IQR 7.84 - 7.84), 4 (IQR 1 - 10), and 99.80% (IQR 99.40% - 99.99%), respectively.

Three hundred and two (57.9%) patients were discharged from GSH's Trauma Centre, 254 of whom had been referred. Sixty (19.1%) patients were transferred back to the referring facility.

Forty-four patients were admitted to the ICU, 70 to high care wards and 84 to general wards. Three hundred and sixty-seven (71.8%) patients required neurological observation. Forty-eight (9.3%) patients underwent a neurosurgical procedure. Thirty-day mortality was 8.5%.

The mean (SD) time between referral to GSH and presentation at GSH was 5 hours and 5 minutes (SD 3 hours and 40 minutes). The mean (SD) time between referral to GSH and CT scan was 13 hours and 14 minutes (SD 7 hours and 23 minutes). The median (IQR) time between presentation at GSH and discharge from GSH was 1 (IQR 1 - 4) day.

Discussion

The Head Injury Guidelines Handbook for the WC exists to provide healthcare workers with a safe approach to patients with head trauma, and includes indications for CT scanning and referral to tertiary hospitals. Owing to the limited availability of CT scanning at district hospitals, GSH receives patients who require a CT scan but not necessarily tertiary level care. These patients are seen at GSH's Trauma Service, and ultimately contribute to overcrowding of patients in the Trauma Centre.

As per the Head Injury Guidelines Handbook, criteria for brain CT scanning (for management of patients in district level facilities) includes history of a significant head injury and any of the following: GCS <15 at any time following the injury, loss of consciousness, focal neurological deficits, history or evidence of penetrating trauma or skull fracture, amnaesia, persistent headache, emesis, seizures, previous head/brain injury, existing bleeding or clotting disorder, current anticoagulation therapy, >65 years of age and suspicion of non-accidental injury.[6]

The present study sought to describe the referral pathways and outcomes for patients with TBI at GSH. More than one-third of patients underwent a CT scan for suspected TBI during the study period, and nearly two-thirds of these patients were referred from a clinic, CHC or district hospital. Only 37.2% of the referred patients were diagnosed with TBI on CT scan. The majority of patients had minor injuries, with a median (IQR) ISS of 4 (1 - 10), and had favourable probabilities of survival with a median (IQR) trauma and injury severity score of 99.80% (99.4% - 99.99%). The mean turnaround time was 1 day between admission and discharge of patients referred for CT scans, and more than half of patients who were referred for a CT scan were discharged from the Trauma Centre. The majority of patients were transferred within 5 hours, and scanned within 9 hours of referral.

Both the Head Injury Guidelines Handbook for the Western Cape and the UK's National Institute for Health and Care Excellence (NICE) guidelines (the guidelines on which the former are based) recommend CT scanning for certain patients within 8 hours for specific indications (for example, dangerous mechanisms of injury and/or retrograde amnesia >30 minutes prior to the injury) and within 1 hour for specific indications (for example, GCS ≤14, open skull fractures, focal neurological deficit, seizures, patients with >1 episode of vomiting).[6,7] The average time for these patients to undergo the CT scan was 13 hours after referral (and not necessarily after the injury itself), which denotes a delay to optimal care, as guidelines recommend CT scanning within 8 hours post injury.[7,8]

Newer and potentially less expensive modalities that may aid in the diagnosis of TBI now exist, and should be considered in the work-up of TBI when CT scanning is not available. These modalities may aid in the

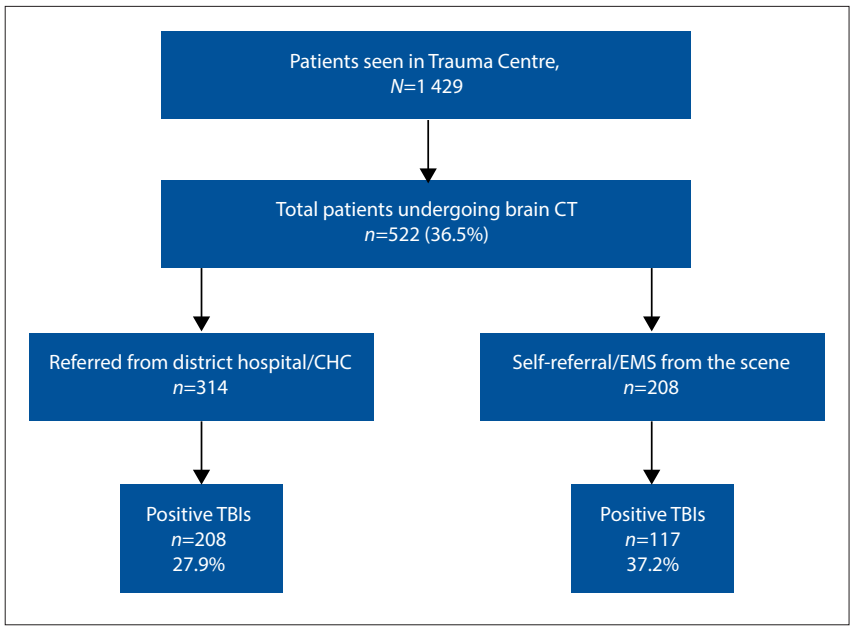

Fig. 1. Flow diagram depicting referral pathway observed and proportion of patients referred. (CT = computed tomography; CHC = community health centre; EMS = emergency medical services; TBI = traumatic brain injury.)

decision-making process of referral of patients. Two plasma proteins, glial fibrillary acidic protein (GFAP) and ubiquitin C-terminal hydrolase L1 (UCH L-1) have been found to act as biomarkers for patients with TBI.[8,9] These biomarkers not only have diagnostic value, but can also be used reliably to predict prognostic outcome of patients, and may be tested at point-of-care by means of a rapid plasma assay.[10] Both biomarkers are proven to be able to discriminate between patients with and without brain pathology on CT.[10] Transcranial Doppler monitoring is also useful as a diagnostic tool and as a prognostic indicator, and studies suggest that if performed on admission, this modality could be used for in-hospital triage of paediatric and adult patients with mild to moderate TBI to identify those at risk of neurological deterioration who may require referral to a tertiary centre.[11-14]

Study limitations

This study was a retrospective study, which posed limitations in terms of the granularity of certain data, most significantly date and time data relating to referral, admission to GSH and discharge from GSH. Date and time of the injuries sustained were poorly recorded in patient folders.

Conclusion

By analysing and describing the referral patterns and outcomes of patients with TBI, insight was provided into the pathway of care for patients. By calculating the times between referral to and arrival at GSH and between referral and CT scan, an estimate of time to definitive diagnosis was established. More than half of referred patients were discharged by GSH's Trauma Centre, and 11.7% were referred back to the district hospital from which they were referred, for further management. From this, it can be deduced that 71.8% of patients referred could have been managed by the referral district hospitals had they been scanned or diagnosed there. District hospitals who offer 24-hour emergency services and have on-site CT scanning facilities should be able to scan patients with suspected TBI on-site at any hour on any day of the week, to allow for minimal delays in the work-up and management of patients with head injuries and to minimise the burden on EMS and tertiary hospitals. It is also recommended that alternative, less expensive means of diagnosis be explored and implemented at district hospitals where CT scanning is not feasible.

Data availability. The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

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Author contributions. PN, KC and RM conceptualised the study. LM was responsible for creation of the data collection tool. NP, TN and ML collected data. NP additionally analysed the data and was responsible for the write-up. PN and CK participated in editing and review of the research.

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Conflicts of interest. None.

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