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ORIGINAL ARTICLE

What intracranial pathologies are most likely to receive intervention? A preliminary study on referrals from an emergency centre with no on-site neurosurgical capabilities

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ABSTRACT

Introduction: Access to neurosurgical facilities remains limited in resource-restricted medical environments worldwide, including Africa. Many hospitals refer patients to off-site facilities if they require intervention. Unnecessary referrals, however, can be detrimental to the patient and/or costly to the healthcare system itself. The aim of this study was to determine the frequency and associated intracranial pathology of patients who did and did not receive active neurosurgical intervention after having presented to an academic emergency centre at a hospital without on-site neurosurgical capabilities.
Methods: A one-year, retrospective record review of all patients who presented with potential neurosurgical pathology to a tertiary academic emergency centre in Johannesburg, South Africa was conducted.
Results: A total of 983 patients received a computed tomography brain scan for suspected neurosurgical pathology. There were 395 positive scans; 67.8% with traumatic brain injury (TBI) and 32.3% non-traumatic brain injury (non-TBI). Only 14.4% of patients received neurosurgical intervention, mostly non-TBI-related. The main intervention was a craniotomy for both TBI and non-TBI patients. The main TBI haemorrhages that received an intervention were subdural (SDH) (16.5%) and extradural (10.4%) haemorrhages. More than half the patients with non-TBI SDHs as well as those with aneurysms and subarachnoid haemorrhages received an intervention.
Discussion: Based on this study's findings, in a resource-restricted setting, the patients who should receive preference for neurosurgical referral and intervention are (1) those with intracranial haemorrhages (2) those with non-traumatic SDH more than traumatic SDH and (3) those patients with non-traumatic subarachnoid haemorrhages caused by aneurysms.

African relevance

- Access to neurosurgical facilities remains limited in resource-restricted countries; many hospitals do not have neurosurgical facilities on-site and patients in need, need to be transferred.
- Non-traumatic intracranial haemorrhages occur twice as much in low- and middle-income countries than in high-income countries; 89% of trauma related deaths occur in low- and middle-income countries.
- Referrals are often made unnecessarily and may lead to an increased burden on the healthcare system.

Introduction

The global burden of disease study from 2010 confirmed that trauma is the leading cause of disability and mortality. Of these trauma-related deaths, 89% occurred in low- and middle-income countries (LMICs) [1,2].

Neuro-trauma registries from high-income countries indicate that approximately 5.3 million people in the United States of America and 7.7 million people in Europe live with traumatic brain and spinal cord injury-related disabilities. Traumatic brain injuries (TBIs) are mostly caused by road traffic incidents and also affect older population groups [1]. Due to a lack of formal trauma registries in LMICs, especially neuro-trauma, incidence rates for TBIs are likely underestimated. However, TBI occurs more often in young adults due to the higher frequency of road traffic incidents (both pedestrian and motorist) as well as inter-personal violence

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in this cohort [1]. The incidence is also increasing due to the increased use of motor vehicles in LMICs [3].

The majority of neurosurgical research has been conducted in high-income countries. Evidence-based recommendations from this research may not always be transferable to LMICs due to the lack of well-funded and well-equipped neurosurgical facilities. Even amongst different LMICs, what may be a priority in one country may not be a priority for another [1].

Common haemorrhages that are non-traumatic in origin include intracranial (ICH) and subarachnoid (SAH) haemorrhages. Intracranial haemorrhages affect approximately 24.6 per 100,000 people per year and have a high mortality rate of up to 52%. They occur twice as often in LMICs than in high-income countries. Risk factors include ethnicity (higher in Black race group), hypertension, the use of anticoagulants, high alcohol intake and drug abuse (most notably, cocaine) [4,5].

Non-traumatic SAH are caused by a ruptured aneurysm 80–85% of the time [4,6,7]. This occurs in around 9–20 people per 100,000 per year. Similar to ICH, the leading risk factors include a history of smoking, alcohol and/or drug use, as well as the presence of hypertension. Female sex as well as a family history of cerebrovascular disease has also been associated with increased risk of aneurysm development [4,6–8].

In 1991, a study by Nell et al. found an incidence of 319 head injuries per 100,000 people per year in South Africa, which is double the rate for other developing countries (150–170 per 100,000) [9,10]. These figures are presumably even higher now as the incidence of homicide and road traffic incidents in South Africa are on the increase [11].

Based on 1998 statistics in a 2009 article, Taira et al. noted that access to neurosurgical procedures is very limited in sub-Saharan Africa, providing less than one neurosurgeon for every 6.4 million inhabitants [12]. South Africa is the exception with 212 registered neurosurgeons for a population of just under 55 million people (1:265,507), a ratio that has improved since 2013 (1:280,220), but which is still low compared to a ratio of 1:61,000 in the United States of America [13–15].

Even though South Africa has more neurosurgeons available than the rest of sub-Saharan Africa, numerous hospitals, including tertiary ones, do not have neurosurgical facilities on-site and patients in need of neurosurgical intervention need to be transferred to a referral hospital [10,16]. In 2007, Ashkenazi et al. assessed the effectiveness of teleradiology from a level two emergency centre that did not have neurosurgical services. They found that with a reliable system in place, strict patient selection criteria and committed staff members, teleradiology could be effective in reducing unnecessary transfers [17]. In Canada, a centralised, web-based teleradiology system was instituted called ENITS (the Emergency Neuro-Image Transfer System). Referring hospitals were able to send emergency computed tomography brain (CTB) images to ENITS where they could be accessed and viewed by the on-call neurosurgeon [18].

Despite the close proximity of our referral hospitals' Neurosurgical Department, the transfer of neurosurgical patients remains a challenge due to resource limitations. The aim of this study was to determine the frequency and associated intracranial pathologies of patients who did and did not receive active neurosurgical intervention after having presented to an academic Emergency Centre (EC) at a hospital with no on-site neurosurgical capabilities.

Methods

This was a one-year, retrospective record review of all patients who presented with potential neurosurgical pathology to a tertiary academic EC in Johannesburg, South Africa from 1 January to 31 December 2012. The EC receives approximately 60,000 patient visits per annum. Neurosurgical coverage is provided by the Department of Neurosurgery at another tertiary hospital, eight kilometers away. In the study EC, patients are evaluated and if indicated by their history and physical findings, a CTB is performed. Neurosurgery referrals are made telephonically – the necessary information is relayed to the neurosurgeon who then in turn either accepts or declines the transfer.

This research was approved by the Human Research Ethics Committee of the Faculty of Health Sciences of the University of the Witwatersrand [M121177]. Potential patients for inclusion were identified through the EC patient registers as well as the radiology department records of patients who were referred from the EC for a CTB. The files of these patients were then retrieved from the records department and the data captured by a single researcher. The records of the patients transferred to the referral hospital were also obtained and reviewed. Patients' demographic details, aetiology, CTB results, transfer information and neurosurgical interventions were extracted from the records. Descriptive statistics were used to analyse the data.

Results

A total of 983 patients received a CTB for suspected neurosurgical pathology comprising of 697 (70.9%) males and 286 females. Of those, 395 (40.2%) were positive for pathology and discussed with neurosurgery. The male to female ratio for TBIs was 7.7:1, and for non-TBI 1:1.7. The age range was 12–91 years old (mean 35.6 years old). Table 1 shows the breakdown of the patients who had pathology on their CTB where neurosurgery was consulted.

No neurosurgical intervention was performed on 91.4% of patients with TBI and 73.2% of non-TBI patients. The aetiologies of TBI were interpersonal violence (n = 114; 42%), road traffic incidents (n = 91; 34%), falls (n = 30; 11%) and sports injuries (n = 2; 1%). Mechanism of injury was not documented in 31 cases (12%).

Fig. 1 demonstrates the types and frequencies of the common neurosurgical procedures performed on the TBI and non-TBI patients.

Tables 2 and 3 summarise both traumatic and non-traumatic intracranial pathologies as well as the interventions that were performed.

Discussion

Almost 1000 patients with potential neurosurgical pathologies presented to the study EC in one year with just over one patient per day having significant pathology that required neurosurgical consultation. However, only one third of all patients with pathology were transferred with a minority of those patients receiving an intervention. The bulk of patients presenting to the EC with

Table 1
Summary of neurosurgical consultations and interventions.

	TBI n (%)	Non-TBI n (%)	Total n (%)
Discussed with Neurosurgery	268 (67.8)	127 (32.2)	395
No transfer	208 (77.6)	67 (52.8)	275 (69.6)
Transfer & return	18 (6.7)	3 (2.4)	21 (5.3)
Transfer & conservative management	14 (5.2)	13 (10.2)	27 (6.8)
Transfer & intervention*	23 (8.6)	34 (26.8)	57 (14.4)
No transfer/no intervention due to death/refused treatment	4 (1.5)	9 (7.1)	13 (3.3)
Insufficient information	1 (0.4)	1 (0.8)	2 (0.5)

TBI, traumatic brain injury.
* n = 3 of these patients died during the interventions (all craniotomies).

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