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Trauma

# An audit of the quality of care of traumatic brain injury at a busy regional hospital in South Africa

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## Abstract

Access to care by a dedicated neurosurgical unit is limited in the developing world, and the vast majority of patients who sustain a head injury are managed by general surgeons. Prevention of secondary brain injury is paramount. While the principles of management are relatively straightforward, delivering this care may be difficult. This audit looks at the spectrum of head injuries presenting to a busy regional hospital and attempts to measure the quality of care offered to these patients.

*Patients and methods.* The audit includes three separate sections. The first is a prospective audit of all patients with a traumatic brain injury presenting to the Accident and Emergency (AE) department at Edendale Hospital, Pietermaritzburg, over a 2-month period. The next two sub-audits consist of a random review of referral letters and AE clerking notes to assess the quality of care received by these patients. A total of 25 referral letters and 28 AE inpatient notes were randomly chosen for review and compared with agreed standardised markers for quality of care.

*Results.* Over the 2 months October and November 2007, 150 patients with a head injury were seen in the AE department. Of these 117 were male. A total of 76 were discharged home after investigation with a head injury warning chart, 49 were admitted to the general wards, 11 were admitted to the surgical intensive care unit, 10 were referred to the neurosurgical centre in Durban, and 4 died in the AE department. Of the 10 who needed advanced neurosurgical care, 3 required urgent burr-holes before referral. One of these patients died. All the remaining 9 patients who were transferred to the neurosurgery unit survived. The referral letters and AE clerking notes revealed major deficits.

*Conclusion.* Traumatic brain injury is a common problem. Only a small subset of patients require specialised neurosurgical care. Although many patients with intracranial injury can tolerate the delay associated with transfer, some cases are acute and urgent intervention by non-neurosurgeons is needed. Prevention of secondary brain injury is poorly understood and not prioritised. This situation needs to be improved. The introduction of formalised standard referral and management sheets may help to improve care.

Traumatic brain injury (TBI) is a common clinical problem with significant long-term morbidity. Minimising this morbidity requires aggressive attempts to prevent secondary brain injury. The major early causes of secondary brain injury are hypoxia, hypovolaemia, hypoglycaemia and raised intracranial pressure (ICP). The first three conditions may be prevented by relatively simple clinical interventions that can be performed at almost any level of health facility. However, a subset of patients will have an acute space-occupying lesion contributing to raised ICP, which exacerbates the ischaemic insult to the brain; reducing ICP is more difficult and may require more complex interventions. These range from simply placing the patient in the reverse Trendelenburg position to facilitate venous drainage of the cranium to administering mannitol and hypertonic saline, progressive hypocapnia, pharmacological manipulation using intravenous barbiturates, and possibly neuromuscular blockade, ventricular drainage and decompressive craniectomy. These interventions can only be undertaken at advanced facilities where specialist neurosurgical and intensive care is available. Limitations on resources mean that it is unlikely that all head-injured patients will have the benefit of care in a dedicated neurosurgical unit. The vast majority will continue to be managed by non-neurosurgeons, be they referring staff,

accident and emergency staff, paramedics, trauma surgeons or intensivists. This audit attempted to quantify the volume of TBI in a busy regional hospital with geographically remote specialised neurosurgical services and to assess the quality of the care rendered at the regional hospital to patients with TBI.

## Methodology

Edendale Hospital is a large regional hospital in Pietermaritzburg and admits over 300 trauma patients a month. It is the regional referral centre for western KwaZulu-Natal and serves a population of 3 million people. Although there is a tertiary hospital in the Pietermaritzburg metropolitan complex with advanced intensive care and radiological services, the nearest neurosurgical unit is situated at Inkosi Albert Luthuli Hospital in Durban, 80 km away. We follow the guidelines from the academic Department of Neurosurgery at the University of KwaZulu-Natal for the investigation and assessment of head injuries at our centre. Fig. 1 summarises these guidelines.

A prospective audit of all patients with a head injury presenting to the AE department at Edendale over a 2-month period was undertaken. Two sub-audits were performed. These consisted of a random review of referral letters and a random review of AE clerking notes and inpatient observations to measure the quality of care received. A total of 25 referral letters and 28 AE and inpatient observations were selected for review and compared against previously agreed standards for referral and management. These standards were agreed upon by the authors and were based on the management guidelines from the University of KwaZulu-Natal's Department of Neurosurgery and published international guidelines (listed in Figs 1 and 2). Fig. 3 is a copy of the head injury warning chart given to all caregivers of patients who are discharged from our institution after a head injury.

**Indications for urgent CT scan**

All with GCS 5 - 10
GCS 11 - 14 with
- Skull fracture
- Focal neurological signs

All with fixed dilated pupils
Any deterioration in level of consciousness

**CT scan during working hours**

GCS 11 - 14 for 48 hours
GCS 15 with a focal sign
GCS 15 with stab wound to head or deeply in-driven bone fragment

**Indications for a skull X-ray**

Loss of consciousness
Neurological symptoms
CSF from nose or ear
Suspected penetrating injury
Scalp bruising
Difficulty in assessing patient
No need for skull X-ray if CT scan indicated

**Indications for admission**

Loss of consciousness >5 minutes
Skull fracture
Neurological symptoms or signs
Difficulty in assessing
Other medical conditions

**Fig. 1. Head injury management criteria, University of KwaZulu-Natal.**

## Results

Over the 2 months October and November 2007, 150 patients with a head injury were seen in the AE department. Of these 117 were male. A total of 76 were discharged home, 49 were admitted to the general wards, 11 were admitted to the surgical intensive care unit, 10 were referred to the tertiary neurosurgical centre 80 km away, and 4 died in the AE department. Table I summarises details on the patients who required admission. The mechanism of injury was assault (41%), motor vehicle collision (28%), fall from a height (3%), and gunshot wound to the head (3%). In the remaining 25% of cases the mechanism was unrecorded. Of the 10 patients who required transfer to a neurosurgical unit 9 were males. The average age was 27 years (range 8 - 78 years). The mechanism was assault in 8 cases and a fall in 2. The documented pathology was extradural haematoma (4 cases), subdural haematoma (3), depressed skull fracture and contusion (2), and traumatic hydrocephalus (1). Of the group requiring transfer to the neurosurgical centre only 5 presented to the AE department on the day they were injured. In the remaining 5 the delay between injury and presentation was 2 days (2 cases), 4 days (1), 12 days (1) and 14 days (1). An operation was required in 8 of the referred group. The average length of stay was 9.8 days (range 1 - 16 days). There was 1 death in the operative group. The remaining patients who underwent operations were all subsequently discharged. The average delay in transportation of patients to the neurosurgical centre was 7 hours. In 3 of the patients with an acute extradural haematoma long delays in transfer and acute neurological deterioration necessitated emergency burr-holes being performed by the general trauma surgeons before transfer to the neurosurgical centre. One of these patients died. The patients who died in the AE department all had a GCS of 4 on presentation. Autopsy revealed diffuse axonal injury in all cases.

A random sample of 25 referral letters was selected for review. Table II summarises the referral letters. The history was recorded in all the referral letters reviewed, the GCS

All patients with a GCS of <9 must be intubated
Oxygen 40% via facemask or endotracheal tube if intubated
Elevated head of bed
Functional intravenous line
Glucose-containing fluid
Four-hourly glucose level assessment
Hourly BP, pulse, respiratory rate
Hourly GCS
Hourly record of state of pupils
Hourly neurological examination

**Fig. 2. Minimum expected level of care for a patient with TBI at Edendale Hospital.**

Head Injury Date

_____has had a head injury and is being discharged well from this hospital.
The following information is for the guidance of family and friends. Should any of the following occur please bring him back to hospital immediately:

- Increasing severe headache
- Persistent vomiting
- Confusion or abnormal behaviour
- Unconsciousness or difficulty in 'waking up'
- Convulsions (fits)

**Fig. 3. Edendale Hospital head injury warning chart (English version only).**

in 88%, a management plan in 75%, associated localising signs in 50%, and the condition of the pupils in 13%. In none of the referrals was an assessment of the integrity of the cervical spine recorded. A random sample of 28 inpatient records was also selected for review. Tables III and IV summarise the inpatient records and observations. In 57% of cases the reason for admission was not recorded, in 42% a skull radiograph was omitted despite being indicated, and in 15% a computed tomography (CT) scan was omitted despite the case meeting our criteria for this investigation. In the management plans of this group there were no recorded orders for supplemental oxygen and intravenous (IV) fluids. Clear instructions to perform neurological observations were omitted in all cases. In the observation charts of this group the GCS was recorded in 92%, the state of the pupils was recorded in 71%, pulse rate and blood pressure were documented in 70%, oxygen saturation was only recorded in 42%, and neither blood glucose readings nor core body temperature were ever recorded.

## Discussion

TBI is a major global public health problem and the World Health Organization (WHO) estimates that approximately 10 million people are affected annually.[1,2] This burden is spread throughout the world, but is especially acute in developing countries. WHO statistics show that Latin America and sub-Saharan Africa have a significantly higher incidence of TBI (150 - 170 per 100 000) than the global rate of 106/100 000. In the developing world there are many risk factors for TBI. Of note is that intentional trauma is more common than unintentional trauma as a cause of TBI. This is in keeping with most reported forms of trauma in South Africa.

Throughout the world, access to acute specialist neurosurgical services is limited.[3-6] This is especially true in our environment, and the situation is unlikely to change in the foreseeable future. The care of TBI will remain largely in the hands of generalists: referring staff, paramedical staff, AE doctors, trauma surgeons and intensive care staff. These diverse groups will interact with the patient as he or she passes along a continuum of care from initial receiving point to definitive management. It is imperative that the 'chain of care' should not be broken at any point. If the chain of care is broken, hypoxia, hypovolaemia or hypoglycaemia may develop and exacerbate the neurological damage.[7,8] The generalist's role is to co-ordinate this chain of care to prevent secondary brain injury while identifying patients who will benefit from advanced neurosurgical care. Once the need for

**TABLE I. DETAILS ON THE PATIENTS WHO REQUIRED ADMISSION**

| | No. | Average GCS | Range |
|---|---|---|---|
| **Ward** | **49** | **8** | **3 - 13** |
| **ICU** | **11** | **10** | **9 - 12** |
| **Referred to neurosurgery** | **10** | **11** | **9 - 13** |
| **Died in AE** | **4** | **4** | **<5** |

**TABLE II. SUMMARY OF REFERRAL LETTERS (*N*=25)**

| | Documented | Not documented |
|---|---|---|
| **GCS** | **22** | **3** |
| **Neurology** | **13** | **12** |
| **Pupils** | **3** | **22** |
| **Cervical spine assessment** | **-** | **25** |
| **Management plan** | **19** | **6** |

**TABLE III. SUMMARY OF AE ADMISSION NOTES (*N*=28)**

| | Performed as indicated | Not performed despite being indicated |
|---|---|---|
| **CT scan** | **24** | **4** |
| **Skull X-ray** | **16** | **12** |
| **Reason for admission** | **12** | **16** |
| **Instructions to perform neurological observations** | **-** | **28** |
| **Need for IV line** | **-** | **28** |
| **Need for oxygen** | **-** | **28** |

**TABLE IV. SUMMARY OF RECORDED OBSERVATIONS (*N*=28)**

| | Recorded | Not recorded |
|---|---|---|
| **Glucose** | **-** | **28** |
| **Oxygen saturation** | **12** | **16** |
| **Core body temperature** | **-** | **28** |
| **Pulse rate** | **20** | **8** |
| **Blood pressure** | **20** | **8** |
| **GCS** | **26** | **2** |
| **Pupils** | **20** | **8** |

specialist neurosurgical intervention has been identified, it is the responsibility of the managing generalist to ensure timely, safe and appropriate transfer to a definitive centre.

Referral of patients from peripheral hospitals to the regional centre appears to be problematic. The lack of information on key physiological parameters in the reviewed referral letters suggests that the pathology being treated is poorly understood. Poor referral and communication translates into poor management. The problem we have identified in our series is a common one throughout the literature.[9-13] Strategies designed to improve the level of communication generally revolve around the use of standardised referral letters and enforced protocols. These have been shown to improve the level of communication between units and hospitals and when combined with tick box style checklists act as prompts and stimuli for appropriate investigation and treatment.[9-13] Such a letter needs to be introduced on a region-wide basis to be effective.

More than half of the patients in our study did not require admission and were discharged to the care of their families. Provided there is no skull fracture and the patient is fully conscious with no significant loss of consciousness or amnesia, we are happy to discharge a patient into the care of accompanying and responsible family members. A document detailing signs of raised ICP and instructing the patient to return urgently if indicated is given to the accompanying family on discharge (Fig. 3). Loss of consciousness with amnesia, and signs and symptoms of raised ICP such as blurring of vision, headache, vomiting or a skull fracture, prompt admission.[7,8] The guidelines for CT scanning published by the academic department of neurosurgery are relatively conservative with regard to its use (Fig. 1). A GCS of 10 or lower and any depressed level of consciousness in the presence of a skull fracture or localising sign are indications for an urgent CT scan. Patients with a GCS of 11 - 14 and no localising signs or skull fractures only qualify for a CT scan during working hours. However, the international trend seems to be towards more liberal use of the CT scan.[14-17] The emphasis on managing patients who do not meet the criteria for emergency CT scan is admission and regular 'neurological observation'. The principle is that with adequate observation acute deterioration will be detected early and appropriate interventions instituted. However, our series highlights the concerns that physiological parameters are poorly monitored and that there is very little quality control of the neurological observations.

Inadequate observation of the head-injured patient in hospital is not unique to South Africa. In the USA it has been shown that the frequency of observations performed by the attending staff was inadequate to detect subtle and early signs of deterioration.[8,14,15] In the UK 'neurological observations' are generally performed by non-specialist nursing and medical staff without any neurological training. The situation is similar in our environment. Lack of basic observation as well as failure to check blood glucose and oxygen saturation levels imply that care is substandard. In a busy general ward with no dedicated neurosurgical nursing staff and without dedicated observation areas it is unlikely that we will be able to improve the quality of observation. Staff not adequately trained in neurological assessment are unlikely to detect subtle changes in the patient's condition.

One solution is to liberalise the indications for CT scanning. This has been the trend in most guidelines published in the developed world,[8,14-17] and there is good evidence that a negative CT scan after a head injury allows a clinician to discharge a patient safely. The international trend is towards a much more aggressive use of CT scanning than our local guidelines. However, this approach may not be easily appli-

cable in our setting as our radiological services are already overburdened. Liberalising the indications for CT scanning would place further demands on an already stretched system. A more practical solution may be to improve the quality of the observations being performed and to provide additional training for the staff performing these observations. Centralising all acute TBI patients into an acute high-care/observation area for at least 12 - 24 hours would be necessary to achieve this.

Of patients who require surgical admission, slightly less than 10% will require neurosurgical referral. This is consistent with most reported series. In our population patients requiring neurosurgical care seem to be a self-selected group. The fact that despite a significant delay in seeking help outcome is relatively good suggests that these pathologies are indolent and chronic rather than aggressive and acute. Considering the long delays in transfer inherent in our system, it would seem likely that many patients with a severe TBI die before reaching hospital.[18] Some patients with aggressive intracranial pathologies such as acute extradural haematomas do reach regional hospitals alive. These rapidly expanding lesions raise the ICP, resulting in death if intervention is delayed. Long delays in transportation between hospitals mean that patients with acute and aggressive intracranial lesions will be compromised unless temporising surgery can be performed on site. In our environment, where neurosurgical expertise is geographically remote, decompressive burr-holes performed by general surgeons as an emergency procedure are life saving.[19] The creation of burr-holes is a skill in which general and trauma surgeons need to be competent. Provided there are clear indications, burr-holes performed by non-neurosurgeons have been shown to be a safe and viable option. The deaths in the AE department represent unsalvageable injuries. All these patients had extremely poor coma scores on presentation and autopsy confirmed diffuse brain injury in all these patients. It is unlikely that any interventions would have been able to salvage these patients.

In our audit most of the deficits in care were acts of omission, i.e. failure to perform a necessary procedure. Although managing patients by protocol has disadvantages, it may help reduce errors of omission by forcing particular courses of action onto staff. This acts as a mechanical lock-out system. For example, failure to perform a CT scan or to obtain a skull radiograph would become a protocol violation. If a step in the protocol is omitted the onus is on the managing staff to justify deviation from protocol in the management of that patient. The successful use of protocols is widespread in the literature.[20] There are no national clinical guidelines in South Africa for TBI at present, although various local guidelines are in use (Fig. 1). However, our series revealed poor compliance with these. Skull radiographs were not done despite being indicated in just under half of the cases reviewed, and cervical spine assessment was not done at all. Compliance with CT scanning was much better, with only 15% of patients not being scanned when indicated. It would appear that our local guidelines are not being followed, and we need to find the reasons for such non-compliance.

To address the deficiencies highlighted by this study requires serious commitment. Generalist, trauma and neurosurgeons need to provide leadership and to be involved in ongoing outreach and education programmes at both peripheral and regional hospitals. It is apparent that the pathophysiology of TBI is poorly understood by health care providers along the chain of care. This needs to be addressed directly. Implementation and enforcement of standardised referral letters and protocols are essential. Dedicated and appropriately staffed and equipped observation areas need to be developed in busy hospitals. TBI is a major problem, and patients deserve a better level of care than that currently being offered.

## Conclusion

TBI is a major problem in South Africa. The vast majority of these patients will never see a neurosurgeon and their care will continue to rest with generalists. Unfortunately the care of TBI appears to be deficient in many respects, and TBI is a neglected problem in our hospitals. The quality of referral is poor and communication is lacking; in hospital there are major protocol violations and omissions. Failure to institute basic clinical interventions such as blood glucose level monitoring, intravenous fluid administration and supplemental oxygen will result in secondary brain injury which serves to exacerbate the primary injury. Many of the patients who are referred through to neurosurgical units are a self-selected group who have relatively chronic and indolent pathologies. In large general hospitals remote from specialised neurosurgical services, generalist trauma surgeons will need to be able to perform burr-holes as temporising measures in a select group of patients. It is important that this skill be taught and maintained.

In view of the volume of patients sustaining TBI it is of concern that care is poor. Referral and inpatient documentation implies that the pathophysiology is poorly understood and that relatively simple clinical interventions are being omitted. In general, protocols and guidelines are not being adhered to. It is unlikely that access to advanced acute neurosurgical care will improve in the immediate future in South Africa, and it will remain the responsibility of generalists to care for these patients. Surgeons involved in acute care at all levels need to provide leadership if we hope to improve the care offered to patients with TBI. We need to develop and enforce protocols and to agitate for resources to manage these patients more appropriately.

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