Groote Schuur Hospital neurosurgical intensive care unit: A 2-year review of admission characteristics

S Rashid,[1] MD; **I Joubert,**[2] MB BCh, DA (SA), FCA (SA) Crit Care;
P Semple,[1] MB ChB, FCS (Neurosurgery) (SA), MMed (Neurosurgery), PhD

[1] *Division of Neurosurgery, Department of Surgery, Faculty of Health Sciences, University of Cape Town, South Africa*
[2] *Division of Critical Care, Department of Anaesthesia and Perioperative Medicine, Groote Schuur Hospital and Faculty of Health Sciences, University of Cape Town, South Africa*

Corresponding author: *S Rashid (sakina.rashid@ymail.com)*

Background. At Groote Schuur Hospital (GSH), the neurosurgical intensive care unit (NsICU) is a 6-bed unit headed by a specialist neurosurgeon with extensive experience in neurocritical care, working in close collaboration with intensivists from the Division of Critical Care. There is currently no detailed analysis of the demographics, diagnosis and management of patients admitted to the NsICU at GSH.
Objectives. To provide a detailed descriptive analysis of the demographics, diagnosis and management of patients admitted to the NsICU at GSH from 1 January 2020 to 31 December 2021.
Methods. A retrospective descriptive analysis was done of patients who received treatment in the NsICU from 1 January 2020 to 31 December 2021.
Results. A total of 685 patients were admitted to the unit over a 2-year period, with a male preponderance (68.2%). The average age was 42.5 (standard deviation (SD) 17.2) years. The most common neurosurgical diagnoses were traumatic brain injuries (39.6%), brain tumours (22.6%) and aneurysmal subarachnoid haemorrhages (9.9%). Emergency admissions comprised 76.6% of the total and 86.7% of patients were admitted postoperatively. Three hundred and seventy-two patients (54.3%) required mechanical ventilation, 132 (19.3%) required both an intracranial pressure (ICP) monitor and brain tissue oxygenation monitor, 86 (12.5%) needed placement of an external ventricular drain, 50 (7.3%) needed placement of a tracheostomy tube and 16 (2.3%) needed placement of an ICP monitor only. The average duration of stay was 5.5 (1.3) days and NsICU mortality over 2 years was 11.1%.
Conclusion. The NsICU at GSH manages predominantly male trauma patients and a significant number of admitted patients require specialised invasive intracranial monitoring.

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Contribution of the study
This is the first in-depth analysis of patients managed in a dedicated neurosurgical intensive care unit in South Africa. The work defines the patient population, neurosurgical pathologies and service level requirements that would likely be encountered by teams building a similar service.

Groote Schuur Hospital (GSH), which is one of three tertiary-level state hospitals in the Western Cape Province, has a 6-bedded closed neurosurgical intensive care unit (NsICU) headed by a specialist neurosurgeon with extensive experience in neurocritical care, working in close collaboration with intensivists from the Division of Critical Care.

GSH serves as the teaching hospital affiliated to the University of Cape Town (UCT) and by extension the NsICU plays an important role in the training of neurosurgical registrars and critical care subspecialists. Decisions to admit patients with head injuries are guided by the unit's policy, which is based on Benatar *et al.*'s publication.[1] Admissions for other neurosurgical pathologies are based on a discussion between the neurosurgical team and intensivists managing the unit.

The demographics, diagnosis and management of patients admitted to the NsICU have not previously been described. It is anticipated that the admissions to the NsICU will not only reflect the specialised neurosurgical monitoring offered at GSH, but also the high volume of trauma cases that the facility currently manages.

Methods

Study design and population

This study is a retrospective descriptive analysis of patients who were admitted to the NsICU from 1 January 2020 to 31 December 2021. All patients admitted to the NsICU during the specified period were included in the study. There were no exclusion criteria.

Data collection

Demographic data recorded included age and sex. Admission variables included the neurosurgical diagnosis, source of referral, emergency v. elective admission and whether the patient was admitted postoperatively or required a neurosurgical intervention during their NsICU stay. Data points that related to each patient's NsICU stay included the need for mechanical ventilation, external ventricular drain (EVD) placement, intracranial pressure (ICP) monitor and brain tissue oxygenation monitor placement and whether the patient required a tracheostomy. Discharge variables that were recorded included the duration of stay, mortality while in the NsICU and the discharge destination.

Data management and analysis

Data were entered into an Excel spreadsheet (Microsoft Corp., USA). SPSS version 23 (IBM, USA) was used for data analysis. All variables were analysed descriptively; continuous variables are presented in the form of means (standard deviation (SD)) and categorical variables are presented as frequencies.

Ethical approval

The Human Research Ethics Committee (HREC), UCT, approved the study (ref. no. HREC: 297/2022). Data were extracted from the neurocritical care unit database (ref. no. HREC: R012/2015).

Results

Study population

A total of 685 (n=336 in 2020; n=349 in 2021) patients were admitted to the unit over a 2-year period, the majority being male (68.2%) (Table 1), and the average age was 42.5 (17.2) years. The most frequently admitted age groups were 41 - 50 years (21.0%), 31 - 40 years (20.0%) and 21 - 30 years (19.7%) (Fig. 1).

Admission characteristics

Most admissions were from the GSH trauma unit (n=243; 35.5%). Emergency admissions comprised 76.6% of all transfers to the unit; 86.7% of patients were admitted after a surgical intervention or were operated on during their NsICU stay (Table 1 and Fig. 2). The most common neurosurgical diagnoses were traumatic brain injuries (TBIs) (n=271; 39.6%), brain tumours (n=156; 22.6%) and aneurysmal subarachnoid haemorrhages (aSAHs) (n=68; 9.9%) (Table 1).

Table 1. Admission characteristics: Source of referral and admission diagnosis

Admission characteristics	*n* (%)
Source of referral	
GSH trauma unit	243 (35.5)
Neurosurgical ward	179 (26.1)
GSH medical casualty	151 (22.0)
Neurosurgical high-care unit	78 (11.4)
Other	34 (5.0)
Admission diagnosis	
TBI	271 (39.6)
Brain tumour	155 (22.6)
aSAH	68 (9.9)
Hydrocephalus	38 (5.5)
Intracranial sepsis	35 (5.1)
Spinal surgery	30 (4.4)
CSDH	26 (3.8)
Ischaemic stroke	16 (2.3)
AVM	12 (1.8)
sICH	12 (1.8)
Other	21 (3.1)

GSH = Groote Schuur Hospital; TBI = traumatic brain injury; aSAH = aneurysmal subarachnoid haemorrhage; CSDH = chronic subdural haematoma;
AVM = arteriovenous malformation; sICH = spontaneous intracranial haemorrhage.

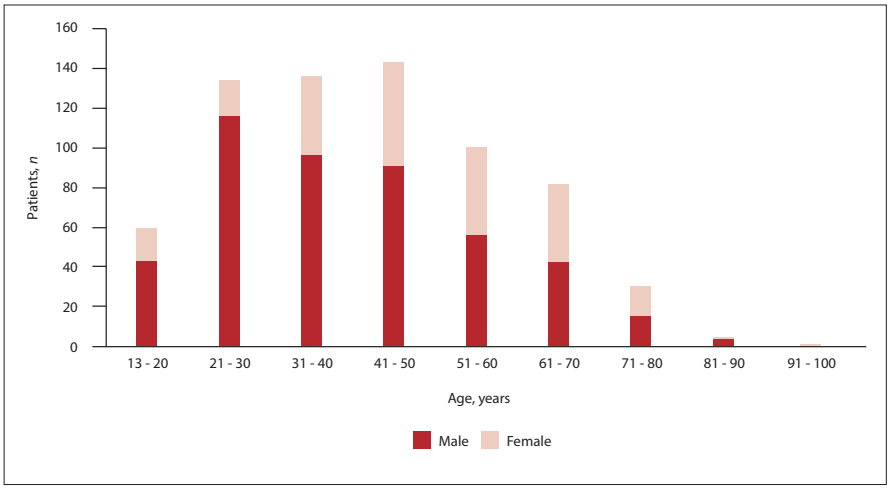

Fig. 1. Age and sex of patients admitted to the neurosurgical intensive care unit, Groote Schuur Hospital, between 2020 and 2021.

ICU stay

A total of 372 patients (54.3%) required mechanical ventilation (Table 2). One hundred and thirty-two patients (19.3%) required placement of ICP and brain tissue oxygenation monitors, 86 (12.5%) required placement of an EVD, 50 (7.3%) needed placement of a tracheostomy tube and 16 (2.3%) needed placement of an ICP monitor only (Table 2).

Discharge variables

The average duration of stay was 5.5 (1.3) days and the ICU mortality (<2 years) was 11.1%. The most common discharge destination was the neurosurgical ward (n=344; 50.2%) (Table 3).

Discussion

This is the first article describing the demographics, diagnoses and management of admissions to an NsICU in South Africa (SA). The most recent national audit of ICU resources in SA was conducted in 2009, which stated that there were 4 719 ICU and high-care beds available in the private and public sectors.[2] With a population of ~57 million in SA at the time, this translated to ~1 bed for every 12 000 people. Only 25% of these beds were in the public sector, which caters for 84% of the total population. The number of ICU beds available in SA was estimated to be between 3 300 and 7 000 in 2021.[2] It has never been described how many ICU beds are dedicated to neurosurgical services.

As a result of the divergent trajectories of development, general ICUs – which also cater for neurosurgical patients – and NsICUs worldwide are structured differently. The concept and evolution of neurocritical care services have been described previously.[3]

In most resource-constrained settings and in countries where critical care is in its infancy, general-open ICUs are the norm.[4-6] Patients with neurosurgical pathological conditions are nursed on the same floor as patients with other pathologies. General monitoring is standard across all patients; however, the provision of specialised neuromonitoring modalities is limited. At the opposite end of the spectrum from general ICUs, are dedicated NsICUs, often

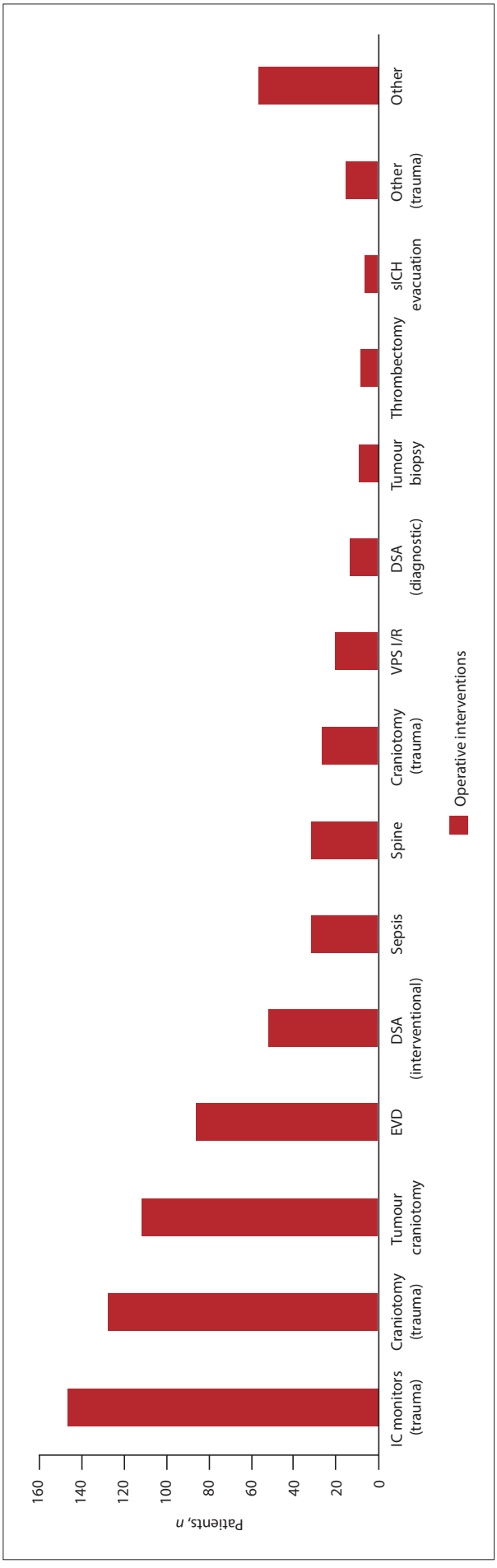

Fig. 2. Operative interventions for neurosurgical intensive care unit, Groote Schuur Hospital admissions. (DSA = digital subtraction angiography; EVD = external ventricular drain; IC = intracranial; sICH = spontaneous intracranial haemorrhage; VPS I/R = ventriculoperitoneal shunt, index/revision.)

Table 2. Neurosurgical diagnoses of patients who underwent ICP and brain oxygenation monitoring, required mechanical ventilation, placement of an EVD and tracheostomies

Neurosurgical diagnoses	*n* (%)
Mechanical ventilation	
TBI	211 (56.7)
aSAH	34 (9.1)
Sepsis	29 (7.8)
Stroke	26 (7.0)
Brain tumour	24 (6.5)
Other	58 (15.6)
Total	372 (100.0)
ICP and brain oxygenation monitor placement	
DBI	53 (40.2)
ASDH and DBI	44 (33.3)
ICH – trauma	15 (11.4)
AEDH and DBI	13 (9.8)
Other	7 (5.3)
Total	132 (100.0)
EVD	
aSAH/IVH	29 (33.7)
Intracranial sepsis	17 (19.8)
Tumour	14 (16.3)
TB meningitis with hydrocephalus	10 (11.6)
Trauma	4 (4.7)
Other	12 (14.0)
Total	86 (100.0)
Tracheostomy	
TBI	37 (74.0)
Intracranial sepsis	3 (6.0)
Other	10 (20)
Total	50 (100.0)

ICP = intracranial pressure; EVD = external ventricular drain; TBI = traumatic brain injury; aSAH = aneurysmal subarachnoid haemorrhage; DBI = diffuse brain injury; ASDH = acute subdural haematoma; ICH = intracerebral haemorrhage; AEDH = acute extradural haematoma; IVH = intraventricular haemorrhage; TB = tuberculosis.

Table 3. Discharge destination from the NsICU

	n (%)
Discharge destination	
Neurosurgical ward	344 (50.2)
Neurosurgical high-care unit	222 (32.4)
Other	31 (4.5)
Died	80 (11.7)

NsICU = neurosurgical intensive care unit.

university affiliated and part of neurosurgical training programmes.[7-9] Standard ICU services include, but are not limited to, continuous monitoring of vital signs, patient ventilation, inotropic support and renal replacement therapy. However, specialised multimodality neuromonitoring is often employed, which includes continuous or intermittent recording of intracranial pressure (via an external ventricular drain or intracranial monitor), brain tissue oxygenation, brain temperature and electroencephalography.

The male preponderance in the study is possibly a reflection of the trauma burden on the surgical services at GSH. An audit conducted in the GSH trauma unit demonstrated that, over the course of a year, 72.5% of patients were male.[10] It also demonstrated consistently higher levels of weapon-related injury, intentional trauma, weekend injuries and substance use disorders in males.[10] Admissions (35.5%)

to the unit are from the GSH trauma centre. Referral institutions may not have after-hours imaging facilities available, resulting in transfers to the GSH trauma unit as per the Western Cape Province substructure referral guidelines.

Compared with other NsICUs globally, the average age of our cohort was much lower: 42.5 years compared with 55.0, 56.4 and 59.2 years in Austria, the USA and South Korea, respectively.[11-13] This may be a reflection of the high incidence of trauma in young males in SA. Only 8.2% of admissions to the NsICU were for patients >60 years of age. Just over three-quarters of patients admitted to the NsICU were emergency admissions, reflecting the burden of neurosurgical emergencies.

The three most common neurosurgical diagnoses in patients admitted to the unit were traumatic brain injuries (TBIs), brain tumours and aSAHs. A review of neurosurgical and neurological ICUs in high-income countries demonstrated a different range and higher incidence of pathologies related to tumours and neurovascular conditions than in our unit.[11,14,15] The contrast is possibly due to a lower trauma burden in high-income countries and a larger proportion of an elderly population, resulting in a higher incidence of brain tumours and neurovascular conditions.

The NsICU at GSH offers continuous ICP and brain tissue oxygenation monitoring for TBI patients. Full-time staff are trained to interpret changes in real-time data and to translate these into interventions aimed at potentially improving patient outcome. A significant portion of NsICU resources is allocated to managing TBIs.

Patients with brain tumours comprised just >20% of admissions. These patients are often admitted after elective surgery, or after presenting with acute neurological deterioration requiring emergent surgery, or a period of mechanical ventilation.

GSH is one of three tertiary hospitals in the Western Cape that offers neuro-endovascular intervention procedures. Over a 2-year period, 68 patients were admitted to the unit with aSAHs and 52 (76.5%) underwent therapeutic endovascular procedures. Patients admitted after a mechanical thrombectomy for an ischaemic stroke are often only admitted for ≤24 hours for close observation. Patients admitted with a diagnosis of aSAH have a more variable length of stay before being transferred to the neurosurgical high-care unit or ward.

In the NsICU, EVDs are placed almost exclusively for temporary cerebrospinal fluid diversion and only 4.7% of drains were placed in trauma patients over the 2-year period. This contrasts with other NsICUs, where institutional practice dictates that EVDs also be placed for patients with severe TBIs to facilitate ICP control and to measure ICP.[16] Due to the higher risk of infection and haemorrhage with EVDs, placement of ICP monitors is preferred for TBI patients admitted to the NsICU.[17] TBI was diagnosed in 74.0% of tracheostomy patients, with poor neurological recovery.

The neurosurgical ward is the most common discharge destination for patients (n=344; 52.2%). A significant number of patients are also transferred to the neurosurgical high-care unit (n=222; 32.4%), which is managed by the same team. The decision regarding a patient's transfer out of the NsICU is influenced by the degree of neurological recovery and level of care required.

The NsICU at GSH is an academic unit with a high volume of admissions reflecting the nature of neurosurgical services offered in the Division of Neurosurgery, as well as the burden of trauma on the surgical service. A variety of neurosurgical conditions are managed in the unit, most commonly TBIs, brain tumours and aSAHs. Patients have the potential for rapid deterioration, requiring adequately staffed units with personnel who recognise such situations and promptly institute corrective measures.

Conclusion

The results of this study detail the nature of admissions to the GSH NsICU over a 2-year period. The NsICU manages predominantly male trauma patients and a significant number of patients requiring specialised neurosurgical monitoring. The results will also prompt further research to define prerequisites for an ICU and the pathway to establishing a unit that offers similar services, thus assisting in the planning of resource allocation for the improvement of neurocritical care services in low- and middle-income countries.

Declaration. The research for this study was done in partial fulfilment of the requirements for SR's MMed (Neurosurgery) degree at the University of Cape Town.

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Author contributions. SR designed the study protocol, completed the data collection and prepared the manuscript. IJ and PS supervised every stage of the work and provided guidance and input, as required.

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