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Review of Clinico-Demographic Patterns and Profiling of the Determinants of Outcome of Neurological Surgery Admissions in an Intensive Care Unit: Preliminary Study

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Abstract: ***To evaluate the clinico-demographic patterns, and assess the factors determining outcome of neurological surgery admissions to the intensive care unit (ICU) of a tertiary health institution in South -East, Nigeria. Methods: A retrospective study of all neurological surgery patients admitted into the general ICU of a tertiary health institution over 8 years that ended, March 2016. Relevant data from ICU admission-discharge registers and patients' case notes were collected on proformas. Analysis was done using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 20.0. Results: Neurosurgery ICU admissions were 539, males 405 (75.1%), and 134 (24.9%) females. Aged2 months to 80 years (mean 36.65 ± 19.41 years). 26.6% of the admissions in their first 3-decade of life. 75.7% were related to traumatic brain injury (TBI), with most of those injuries resulting from motorcycle and motor vehicular accidents. Other indications were post-operative patient monitoring (10.52%) and high cervical spinal cord injury (4.78%) and others. 141 patients (26.1%) had a neurosurgical intervention either prior to or during the ICU admission. Admission into the ICU was delayed in about 20%. The lengths of admissions ranged from ≤24 hours to 151 days (median 4 days, mode: ≤24 hours). 56.2% of admitted patients achieved significant recovery and were discharged. Less than 7 days admission had higher mortality and this was statistically significant. Conclusion: Severe TBI was the most common indication for ICU admission. Length of ICU stay influences outcome. More ICU facilities and personnel are needed to further improve outcomes.***

Keywords: severe TBI, neuro-critical care, trauma, monitoring

1. Introduction

Neurocritical care is very important to any standard neurosurgical service. The trend in developed countries is the management of critical ill patients in specialized care units, such as neurosurgical, neonatal, cardiac, burns units among others (Adudu OP, Ogunrin & Adudu OG., 2007). Patients with critical neurological injury are managed in a specialized neurosurgical intensive care unit (NSICU) or in a general intensive care unit (GICU) at the least (Adudu OP, Ogunrin & Aduudu OG., 2007; Howard, Kullmann & Hirsch., 2003; Tweedie., 2016).

Patients are admitted to the ICU for a variety of reasons. Some patients need close monitoring immediately after a major surgical operation or serious head injury. Others may have problems with their lungs that require mechanical ventilator to support respiration.

It is important to understand that even though modern medicine has come a long way over the past 30 years, not all diseases can be treated or cured. Patients may be transferred to the ICU because there is a chance they may die without intensive care treatment. And sometimes, despite the use of specially trained staff and advanced technology, doctors may not be able to reverse the dying process. There are times when the doctors may recommend against the use of life support machines and treatments

The benefits of NSICUs in terms of patients' survival, reduced length of intensive care stay, improved resource utilisation, decreased in-hospital mortality, and fiscal benefits have been documented (Howard, Kullmann & Hirsch., 2003; Diringer & Edwards., 2001; Lang, Meixensberger, Unterberg, Tecklenburg & Krauss., 2011). In developing countries like Nigeria however, there is paucity of such specialized ICUs due to infrastructural constraints and insufficient numbers of trained personnel in neuro-intensive care (Roka, Dhungana, Shrestha, Chaudhary, Puri & Aryal., 2011). Specialized care for neurosurgical patients is therefore usually provided in GICUs.

Our institution is located about 30 kilometres from the main city, a home to a major tertiary health institution with an ICU that provides advanced level of intensive care in thesub region. A previous study in this centre revealed that neurosurgical patients constitute the highest number of admissions by any specialty in the ICU (Onyekwulu & Anya., 2015).

The aim of this present study was to evaluate the pattern and profile the factors determining outcome of these neurological surgery admissions to the intensive care unit (ICU) of our institution over an 8-year period.

2. Materials and Methods

This is a retrospective longitudinal study. Secondary medical data was collected from case folders of all neurological surgery patients admitted to the ICU of our institution from 1st April 2008 to 31st March 2016.

Relevant data was extracted over three-week period using a questionnaire checklist primarily designed for this study. Information collected were; patients' demographic profile, ; source of admission, clinical presentations, causes of delay in ICU admissions, investigations, management, length of ICU admission, causes of morbidity and mortality in ICU and outcome. Staff profile in the ICU was also analysed.

Data was cleaned manually and analysis was done using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 20.0. Descriptive analysis was done for all the variables. Results are presented in tables and charts. Statistical tests were done using chi-square, with significance placed at $p < 0.05$.

Ethical approval
This study was reviewed and approval by the Health Research Ethics Committee of the institution. Anonymity of patients was preserved by non-inclusion of self-identifiers in the checklist

3. Results

A total of 539 Neurological Surgery ICU admissions were made within the period of study, constituted by 405 males (75.1%), and 134 females (24.9%), giving a male to female ratio of 3:1.

The ages ranged from 2 months to 80 years (mean 36.65 ± 19.41 years). Young adult patients 18 to 40 years constituted the largest age group (42.9%) of the admissions (table 1).

Table 1: Age distribution of Neurosurgery ICU admissions (Apr 2008–Mar 2016)

Age group (years)	Frequency	%
< 18	87	16.1
18 – 40	231	42.9
41 – 60	139	25.8
> 60	69	12.8
Unknown	13	2.4
Total	***539***	***100***

None of patients from the RICU records had an Advanced Directive AD (also called "health care proxy" or "living will")

The majority of patients (75.7%) were admitted for severe traumatic brain injury (TBI) or moderate TBI with deteriorating neurological status. Motorcycle and motor-vehicular accidents accounted for a combined 83% of such TBIs (fig 1).

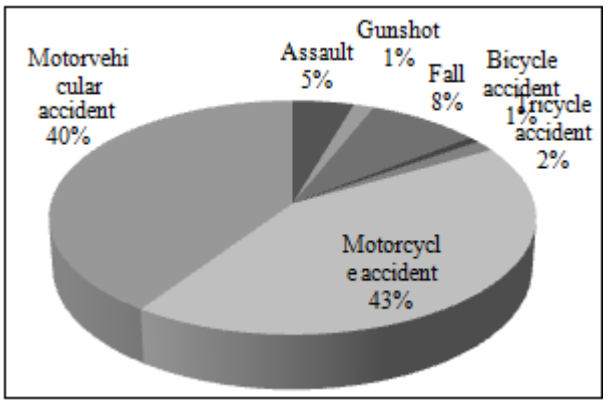

Figure 1: Distribution of head injured patients by aetiology of injury (n=408)

Other indications for ICU admission were post-operative monitoring following intracranial tumour resection (10.52%), high cervical spinal cord injury (4.78%), severe CNS infections (2.29%) neurological deterioration following cerebro-vascular events (3.05%), and other non-traumatic, non-infectious, non-neoplastic indications (3.63%).

Of the 425 patients admitted in coma (GCS 3-8), 92.2% were due to trauma, while the remaining 7.8% were for non-traumatic conditions such as spontaneous intracerebral haemorrhage, subarachnoid haemorrhage, and poor post-operative recovery. Analysis did not reveal any statistically significant difference in outcome between traumatic and non-traumatic coma (table 4).

The lengths of ICU admissions ranged from ≤24 hours to 151 days (median 4 days, mode: ≤24 hours). 141 patients (26.1% of all admissions) had a neurosurgical intervention either prior to or during their ICU admission.

Table 2: Distribution of neurosurgical ICU admissions by duration of admission

Duration of admission	Frequency	%
≤ 24 hrs	135	25
2 – 7 days	204	37.8
8 – 14 days	66	12.2
2 – 4 weeks	59	10.9
> 4 weeks	16	3
Unavailable	59	10.9
Total	*539*	*100*

56.2% of admissions achieved significant recovery and were discharge into the regular wards, or in a few cases, discharged home; while mortality rate of 43.8% was recorded. No patient of the total mortality recorded was denied of or disconnected from life support based on AD. There was a statistically significant relationship between length of ICU admission and outcome (survival vs. death as at ICU discharge). None was established for age, sex and type of coma. (Tables 4)

Table 4: Outcome of ICU admissions by age groups, sex coma type and duration of ICU admission

	Outcome at discharge from ICU		
Variable	***Dead***	***Alive***	**Total**
Age group (yrs.)			
< 18	31	56	87
18 – 40	87	144	231
41 – 60	70	69	139
> 60	39	30	69
Total	***227***	***299***	***526***
			p = 0.005
Sex			
Male	177	228	405
Female	54	80	134
Total	***231***	***308***	***539***
			p = 0.490
Coma type			
Traumatic	178	214	392
Non-traumatic	16	17	33
Total	***194***	***231***	***425***
**coma = GCS 3 – 8*			*p = 0.733*
Admission length			
≤ 24 hours	75	60	135
2 – 7 days	112	92	204
8 – 14 days	27	39	66
15 – 28 days	11	48	59
> 28 days	4	12	16
Total	***229***	***251***	***480***
			p = 0.000

Following clinical decision to do so, admission into ICU from the accident and emergency unit (A & E) was delayed in 90 cases, the recorded delay varying from 1hour to 8 days (mode: 1 hour). Mortality in this group of patients was 100%. The reasons for such delays were not stated in most of the case notes reviewed. Where stated however, the most common reasons were the lack of vacant ICU space and lack of vacant ventilator for respiratory support as at the time of consult for ICU admission. Other rare reasons for delay include insistence by anaesthetist following review that Neuro imaging be completed and this to some extent is also driven by lack of available financial resource

4. Discussion

A preponderance of male over female neurosurgical ICU admissions was recorded in this study, comparable with findings by other workers. In a profile of neurosurgical ICU admissions in Lagos, a M: F ratio of 1.2:1 was reported by Poluyi (Poluyi EO, Fadiran, Poluyi CO, Alabi & Falohun., 2016).A ratio of 2.1:1 was reported in a similar study in Nepal (Roka, Dhungana, Shrestha, Chaudhary, Puri & Aryal., 2011).

The large representation of young adults in the study population is also worthy of note. Adults, 18 – 40 years old constituted 42.9% of admissions. This is similar to what was reported in the Lagos and Nepal studies in which the 20 – 39 and 21 – 40 age groups dominated admissions (Roka, Dhungana, Shrestha, Chaudhary, Puri & Aryal., 2011; Poluyi EO, Fadiran, Poluyi CO, Alabi & Falohun., 2016).

The findings above are not surprising considering that we found traumatic brain injury to be the leading indication for ICU admission (75.7%), as has been observed in other similar reports from Nigeria and other developing countries (Roka, Dhungana, Shrestha, Chaudhary, Puri & Aryal., 2011; Poluyi EO, Fadiran, Poluyi CO, Alabi & Falohun., 2016; Ali, Khan, Kamran & Said., 2011).Young people are known to be very mobile due to their engagement in activities of livelihood and leisure, and are hence at risk of traumatic injuries (Ali, Khan, Kamran & Said., 2011).In the same vein, males are traditionally their families' breadwinners and are hence exposed to various forms of trauma in the course of trying to earn a living. Motorcycle and motor-vehicular accidents accounted for a combined 83% of TBIs in this study. Reckless driving/riding and poor road maintenance are some of the factors that have been identified as responsible for this trend (Poluyi EO, Fadiran, Poluyi CO, Alabi & Falohun., 2016).

Despite the practice of promptly transferring and admitting patients requiring neurocritical care to the ICU after they have been reviewed by the attending neurosurgeon and the anaesthetist on call, cases of delay in transfer and admission to the ICU after review were noted. The most common reason identified for such delays was the inadequacy of ICU facilities, particularly admission space and ventilators. This hospital being the major tertiary referral health centre in Southeast Nigeria has 5 ICU beds and is overwhelmed by the demand for such services not just by neurosurgical patients but also by the other multiple specialties providing health care services. Increasing shortage of intensive care resources is a worldwide problem, but seems even more prominent in developing countries (Zhou, Pan, Huang, Yu & Zhao., 2015).

The lengths of ICU admissions ranged from <24 hours to 151 days (median 4 days). Most of the patients (68.2%) were out within a week of admission, and only 16 patients (3%) stayed longer than 4 weeks. The few cases of prolonged stay may have been because this hospital currently has no dedicated high dependency unit (HDU) for early step down. Patients who have recovered sufficiently to be stepped down to a HDU often remain in the ICU longer than would otherwise be necessary, until they are fit for transfer to the regular ward. Making provision for step-down, second tier facility for treatment of critically ill neurosurgical patients following ICU admission to be clinically justified.[11] The exact length of admission was unavailable for 59 patients (10.9%), underlining the challenge of incomplete documentation, which is sometimes observed in this clinical setting, as has been documented by other workers in Nigeria (Onyekwulu & Anya., 2015; Poluyi EO, Fadiran, Poluyi CO, Alabi & Falohun., 2016). (p< 0.001)Mortality rate in ICUs depend on the severity of illnesses (as may be determined by various scoring systems), the patient population analysed, and the quality of care delivery (Mayr, Dünser, Greil, Jochberger, Luckner & Ulmer., 2006; Raj, Bendel, Reinikainen, Hoppu, Luoto & Ala-Kokko., 2016).In a multicentre study in the United States, of patients with intracerebral haemorrhage (ICH) who were admitted to neuro or general ICUs, Diringer and Edwards reported a mortality rate of 25% to 64% (Diringer & Edwards., 2001). Similarly, neurosurgical ICU mortality rates of 50.4% and 65.7% were reported from studies in Benin and Lagos respectively (Adudu OP, Ogunrin & Adudu OG., 2007;

Poluyi et al., 2016).There appears to be a potential for reducing the mortality rate even further below the 48% rate we recorded in the present study, giving that rates as low as 6.4% - 40% have been reported among critically ill patients in some general and neuro-ICUs in developed countries (Mayr, Dünser, Greil, Jochberger, Luckner & Ulmer., 2006; Raj, Bendel, Reinikainen, Hoppu, Luoto & Ala-Kokko., 2016).Remove 90 patients with delayed presentation; the mortality would have been 32%. This may be achieved by addressing such factors as the inadequacy of ICU spaces/ventilators and intensivists.

As many as 32.75% of all mortalities in this study occurred within the first 24 hours of ICU admission. This is consistent with findings by Ali where 27.67% of all mortalities in his study occurred within the first 24 hours of admission (Ali, Khan, Kamran & Said., 2011). It is however in variance with Mayr's report of no mortality within the first day of ICU admission in his study (Mayr, Dünser, Greil, Jochberger, Luckner & Umer., 2006).This difference may be due to the fact that Mayr's patient population majorly consisted of postoperative cardiac patients, rather than severely head injured patients as we had in our study. The major factor affecting mortality in our patient is the severity of injury. We found a significant statistical relationship between the length of ICU admission and outcome. Non-ICU survivors died early in the course of their ICU admission. The first 24 hours of admission were particularly critical, underlining the need for optimal patient support to maximize the chances of survival within this period. It also re-iterates why all delays to admission of patients requiring neurocritical ICU care must be eliminated, to give them the best possible chance of survival.

None of our patients had an Advance Directive (also called "health care proxy" or "living will"), which is a written statement, completed in advance of a serious illness that states patients' wishes about their medical care. This can make decisions about when to stop invasive management and withdrawal of ventilation support difficult. Such decisions are compounded by socio- cultural - religious values that oppose organ donation. Such belief includes re-incarnation and violating human body, whether living or dead (Oliver, Woywodt, Ahmed & Saif., 2011)

5. Limitations

The aims of this study were achieved. However being a hospital-based retrospective cross-sectional study, it cannot be used for postulation of incidence or for generalization in Nigerian or West African context. The challenge of incomplete documentation in some instances also limited the scope of our data acquisition and analysis.

6. Conclusion

Severe traumatic brain injuries account for most neurosurgical ICU admissions, with the majority of them resulting from motorcycle and motor vehicular accidents. The availability of neurocritical care via the ICU has impacted positively on the survival of critical neurosurgical patients. However, further improvement in outcome would perhaps be recorded if more resources in the form of ICU space, ventilators and trained neurointensivists were deployed to neurocritical care in this centre. Opening up more ICUs in other cities in SE Nigeria would likewise improve outcome by providing more options, hence eliminating vacancy-related delays in admitting patients in need of such services.

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