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NEUROSURGICAL IN-PATIENT PROFILE: A THREE-YEAR AUDIT IN A REGIONAL CENTRE

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Abstract
The burden of neurosurgical care in West Africa, compared with established facilities in Europe and America, is immense. The reasons include preventable neurotrauma, the dearth of specialists and a lack of a regional centre for neurosurgical care. The few unevenly spread established neurosurgical units can only meet the needs of a few. This study is an appraisal of neurosurgical care in a Teaching Hospital facility established in 1973, but commencing specialist neurosurgical care in 2006.
Nine hundred and twenty-six(926)bpatients were admitted into neurosurgical care. They were aged 16 days to 90 years. Male to female ratio was 3.3: 1; patients aged 21 to 40 years accounted for approximately 50%. The commonest indication for admission was traumatic brain injury, 66.5%. Mortality rate was 14% correlating with need for intensive care admission, percentage of severe traumatic brain injuries and advancing age.

Introduction

Neurosurgery is a specialized area of medicine that uses surgery and non-surgical care-such as prevention, evaluation, diagnosis, treatment, critical care and rehabilitation to manage disorders of the nervous system [1,2,3] The management of head and spinal injuries is a major challenge as many of these occur in the off-hours [2,3,4,5]

The paucity of data on neurosurgical care and the dearth of neurosurgical care specialists have resulted in significant underestimation of the burden of neurosurgical disease in West Africa[4]. While the demand for neurosurgical care is on the increase, few can afford the required care and many more present late.

This study looks at the various indications for neurosurgical admission and outcomes over a period of three years at the University of Benin Teaching Hospital. Also emphasized is the need for establishment of regional referral centres for neurosurgical care.

Patients and Methods

One thousand and forty-six (1046) patients were referred to the Neurosurgical unit through the Accidents and Emergency department, Neurosurgical out-patients clinics and by transfer from the paediatic, medical, orthopaedic and general surgical departments.

KEY WORDS: *Neurosurgical Disease; Neurosurgical Care; Intensive Care; Neurotrauma; Regional Centre.*

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Admission protocol included detailed neurosurgical, radiological and laboratory evaluation. Patients referred from other departments within the hospital included those with medical conditions complicated by intracranial haemorrhages, abscesses, hydrocephalus and vertebral collapse and/or cord compression. Other referrals from neonatal unit included various congenital anomalies.

Radiological evaluations (plain radiographs of the spine and /or skull, computed tomography (CT) and /or magnetic resonance imaging (MRI) and ultrasonography) were used to determine which patients required neurosurgical intervention and, thus, neurosurgical admission and transfer into the neurosurgical ward (see exclusion criteria below). Those patients who were in or were at risk of respiratory insufficiency were admitted into the intensive care unit. Essential laboratory evaluation included full blood counts, serum biochemistry, clotting profile, fasting and random blood glucose and cerebrospinal fluid (CSF) chemistry, microbiology and cytology.

Some patients underwent emergency surgical intervention while others had elective surgery after thorough multidisciplinary evaluation which included ophthalmic, otorhinolaryngologic and cardiologic reviews.

Exclusion criteria

One hundred and twenty patients were excluded from the study. They included: Polytraumatized patients with suspicion of head injury, but lacking in clinical or radiologic evidence of the same; patients who died during resuscitation in the Emergency unit, patients with suspicion of cord compression after prolonged medical treatment for other myeloradiculopathies, patients who suffered neurological deterioration during treatment for non-neurological conditions and patients with mild traumatic brain injuries who were neuroradiologically normal observed and discharged from the Emergency unit. The others were patients with severe maxillo-facial injuries without neurological deficits, those with ear, nose and throat tumours - with minimal intracranial extensions and no neurological deficits – jointly managed with the Otorhinolaryngology department and neonatal patients who died from severe malformations before transfer to the Neurosurgical unit. Also excluded were patients who requested for discharge against medical advice or those referred out for lack of bed space and/or facility for continued care.

Results

Of a total of 1046 patients, 120 were excluded and 926 were admitted into, and managed by, the neurosurgical unit between June 2006 and May 2009. i.e. an average of 300 admissions per year.

The age of admitted patients ranged from 16 days to 90 years (16 day-old male with spina bifida and a 90 year-old woman with chronic subdural haematoma). Most neurosurgical admissions were in the third decade of life, 30%, and they consisted mainly of patients who suffered cranio-spinal trauma, tumours, abscesses and hydrocephalus. Together, patients aged 21-40 years made up 46.5%, almost half of neurosurgical admissions. This was followed by patients aged $\leq$ 10 years. Overall male to female ratio was 3:1; though in the fourth decade the ratio was 6:1, male preponderance was 3:1 in all the other age groups (Table 1).

The indications for admission were: Traumatic brain injury (TBI) accounted for 599 patients, 64.7%. The others were spinal cord injury (SCI) 13.5%, hydrocephalus 6.6%, brain (and skull in 2 patients) tumours 5.7%, compressive myelopathies 1.7%, spinal bifida 1.2%, intracranial abscess 1.6%, chronic subdural haematoma 4.3% and occipital Encephalocoele 0.4%. Two patients were missed diagnoses, admitted with cerebrovascular accident and meningo-encephalitis (Table II).

Neurosurgical ward admissions accounted for 87% and intensive care unit (ICU), 13%. Thus, ratio of ward to ICU admission in our service was 7:1. Intensive care admissions were mostly patients with severe TBI (101, i.e. 17% of 599 cases of TBI) and chronic subdural haematoma (CSDH) - 10, i.e. 25% of 40. The latter were admitted into ICU on grounds of poor neurological status following evacuation of haematoma, while ICU admission of head injuries reflected the proportion of patients with severe TBI for whom there was ICU bed space, rather than all the TBI patients with Glasgow coma score $\leq$8. Rarely (4% of patients with brain tumours and 3% of patients with hydrocephalus), patients required intensive care after surgery. These were patients in imminent tentorial herniation or those at risk of brain stem dysfunction (Table II).

Overall, 125 of 926 neurosurgical admissions i.e. 13.5%, died: 79% of deaths were males and 21% females i.e. 4:1. Most deaths occurred in the third decade, i.e.25%. Together, 21-40 year age group accounted for 43% of neurosurgical facilities. This resulted from the relatively high figures for severe TBI and SCI involving the young, active population. The other peak for mortality was in the elderly (>60 years), 17.6% of overall mortality (Table III).

Compared with number of admissions per age group, neurosurgical mortality was highest among the elderly i.e 22%. Others were 0-10 years (6.25%), 11-20 years (16.5%), 21-30years (11.3%), 31-40 years (14.6%), 41-50 years (15.3%) and 51-60 years(16%).The lowest mortality rate was in children <10 years; the other age group had similar mortality rates.

Causes of death

Sixty-eight (68) of 118, i.e 50%, of ICU admissions died while 57 of 808, i.e 7% of ward admissions died. ICU admission was a strong predictor of mortality.

Overall contribution to neurosurgical mortality by each diagnosis: TBI (75%), SCI (13%), brain tumours (6.4%), brain abscess (2.4%), CSDH (1.6%), hydrocephalus (0.8%).

Likelihood of death for each neurosurgical pathology: neurosurgical mortality was highest for intracranial abscesses i.e 20%. Others were TBI (15.7%), SCI (12.8%), Hydrocephalus (1.6%) brain tumours (15%), and CSDH (5%).

Operative interventions

Three hundred and thirty (330) patients i.e. 35.6% underwent 364 operations. There were 34 reoperations for recurrences or second part of two-staged operations. There were 22 (15 males, 7 females) perioperative deaths, i.e. 6%.

Table I: Age and Sex Distribution of Neurosurgical Admissions

AGE(YEARS)	MALE	FEMALE	TOTAL	%
0-10	89	55	144	15.6
11-20	63	22	85	9
21-30	217	56	273	29.5
31-40	135	22	157	17
41-50	77	21	98	10.6
51-60	53	16	69	7.5
>60	74	26	100	10.8
TOTAL	708(76.5%)	218(23.5%)	926	

Table II: Neurosurgical In-Patient Profile: Indications for Admission

DIAGNOSIS	WARD	I.C.U	TOTAL	%
TRAUMATIC BRAIN INJURY	498	101	599	64.7
SPINAL CORD INJURY	124	1	125	13.5
HYDROCEPHALUS	59	2	61	6.6
COMPRESSIVE MYELOPATHIES	15	1	16	1.7
SPINA BIFIDA	11	0	11	1.2
ENCEPHALOCOELE	4	0	4	0.4
BRAIN TUMOURS	51	2	53	5.7
BRAIN ABSCESS	14	1	15	1.6
CHRONIC SUBDURAL HAEMATOMA (CSDH)	30	10	40	4.4
OTHER	2	0	2	0.2
TOTAL	808(87%)	118(13%)	926	

Table III: Mortality from Neurosurgical admissions: Age and Sex Distribution (125/901=14%)

AGE(YEARS)	MALE	FEMALE	TOTAL	%
0-10	5	4	9	7.2
11-20	11	3	14	11.2
21-30	23	8	31	24.8
31-40	20	3	23	18.4
41-50	14	1	15	12
51-60	11	0	11	8.8
>60	15	7	22	17.6
TOTAL	99(79%)	26(21%)	125	

Table IV: Causes of Death

DIAGNOSIS	WARD	I.C.U	TOTAL	%
TRAUMATIC BRAIN INJURY	36	58	94	75
SPINAL CORD INJURY	15	1	16	13
HYDROCEPHALUS	1	0	1	0.8
COMPRESSIVE MYELOPATHIES (SPINAL CANAL STENOSES)	0	0	0	
SPINA BIFIDA	0	0	0	
ENCEPHALOCOELE	0	0	0	0
BRAIN TUMOURS	2	6	8	6.4
BRAIN ABSCESS	2	1	3	2.4
CHRONIC SUBDURAL HAEMATOMA (CSDH)	O	2	2	1.6
OTHER	1	0	1	0.8
TOTAL	57(46%)	68(54%)	125	

Table V: Neurosurgical Operative Interventions.

DIAGNOSIS	TBI		SCI		HYROCEPHALUS		CSDH		ABSCESS		ENCEPHALOCOELE		CANAL STENOSES		BRAIN TUMOURS		SPINA BIFIDA		TOTAL		
AGE(yrs)	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Total
0-2	3	1	0	0	18	16	0	0	0	3	4	0	0	0	0	0	4	6	29	26	55
3-10	4	4	0	0	5	8	0	0	0	0	0	0	0	0	3	1	1	0	13	13	26
11-20	9	2	4	0	7	2	0	0	3	0	0	0	0	0	2	3	0	0	25	7	32
21-30	30	4	25	3	3	0	1	2	4	0	0	0	0	0	10	3	0	0	73	12	85
31-40	22	2	14	4	2	0	6	0	2	0	0	0	1	1	7	3	0	0	54	10	64
41-50	3	2	12	1	0	0	3	3	2	0	0	0	0	0	1	2	0	0	21	8	29
51-60	2	0	4	0	0	0	7	2	0	0	0	0	4	3	5	4	0	0	22	9	31
>60	5	2	2	0	0	0	13	3	1	0	0	0	3	4	6	3	0	0	30	12	42
TOTAL	78	17	61	8	35	26	30	10	12	3	4	0	8	8	34	19	5	6	267	97	364
Grand Total	95		69		61		40		15		4		16		53		11		364		

TBI: Traumatic Brain Injury

SCI: Spinal Cord Injury

CSDH: Chronic Subdural Haematoma

Discussion

Traumatic brain injury is the most common indication for neurosurgical referral in most tertiary facilities; at our facility, this is followed by spinal trauma. Our study indicates the prevalence of trauma-related neurosurgical problems making neurotrauma a predictive index of mortality and morbidity in persons aged 21 to 40 years and accounting for 80% and 90% of neurosurgical in-patient admissions and mortality, respectively [5,6,7]

Our institution is a 700-bed tertiary institution which is the only neurosurgical facility within a 200 to 300 kilometer radius including four states and serving a population of twelve million. It is the epicenter of several poorly-maintained interstate highways making it the major neurosurgical referral centre in the Niger Delta and South of Nigeria. The average yearly in-patient admission was 300 on thirty neurosurgical beds and 10-15 beds in other wards in the hospital. In contrast, some major neurosurgical centers in the United Kingdom and North America have 6,000 in-patient admissions yearly on 200 beds, 120,000 out-patients, 8,000 day cases, 32 out-patient consulting rooms and 15 to 20-bed neurosurgical intensive care unit with a century or more of excellence-driven, research-oriented top quality patient care facilitated by government policy [1,3,8] .

Unlike our setting of one neurosurgeon to twelve million, in Ontario, Canada, there were 65 neurosurgeons in 13 hospitals, serving the same population of 12 million in the year 2007 [1,9] . Predictably, our efforts are concentrated on saving lives as our admission profile showed, due to poor resource allocation, inadequate man-power training, and obsolete facility [4,5,10,11]

Neurosurgical diseases affected all ages in this study from the first few days of life to the 10th decade, but especially young persons in their third and fourth decades of life.[4]

The burden of neurosurgical conditions increases with age and so is the burden of these conditions on the affected individuals, their families and the society [9]. This study showed emphasis on the young and middle-aged due to two factors: prevalence of neurotrauma and our relatively shorter life expectancy or younger population. E.L. Odeku noted in 1962: In various parts of Nigeria, like much else anywhere in Africa, many neurological problems remain inadvertently neglected for the more pressing consideration of the common tropical diseases and general surgical emergencies[10]. Despite sporadic emergence of some neurosurgical facilities in West Africa since then, the consideration has not altered much.

The usual causes of morbidity and mortality in the neurosurgical patient besides the primary intracranial pathology include: deep venous thrombosis, fluid and electrolyte disturbances, sepsis, vascular shock, disordered blood gas analyses and acute, subacute and chronic nutritional problems; thus, the fully trained resident must demonstrate proficiency and expertise in the care of all these as well as neurosurgical emergencies, principles of pre-and post-operative surgical care, the use of antibiotic therapy and understanding of the complications of antibiotic prophylaxis[3]

Neurosurgical conditions are a major source of mortality and morbidity resulting in high costs to individual, their families and society - imparting negatively on the

person's quality of life and the lives of their caregivers and are an economic burden on the individuals and society.[9,12]

The estimated total direct cost for only three neurosurgical conditions - brain tumours, head injuries and spinal injuries - was $311.7 million in Canada in 2000/01 [9]. These constitute 86% of the neurosurgical demand in our distinct geographical situation. Since the incidence of neurosurgical conditions increases with age, the burden of the conditions on the individuals, their families and society may increase as the population ages[9] . One out of every seven patients in our facility was admitted into the intensive care unit, increasing the financial and emotional burdens for families and society over critically ill neurosurgical patients, only 40% of whom may survive.

In the first year of inception of neurosurgery in Ibadan, Nigeria, Odeku performed 340 procedures - 206 neuroradiologic and 134 neurosurgical [10]. This study, showing a similar average for neurosurgical operative interventions in the first year, reaffirmed Odeku's difficulties 50 years ago, namely, one specialist, a population teeming with neurosurgical needs and tenuous facility assigned to seemingly more important needs [4,10] . In Ottawa, 30,700 neurosurgical operations were performed yearly by 2007 [1]. Neurosurgery, being a specialised service, should be influenced by and impart on many of governments' health care priorities [1]. It is poor patient care to transfer people who need emergency care out of their provinces or to make anyone who needs neurosurgery wait longer than they should and risk more harm [1].

Overall neurosurgical mortality in this study was 13.5%, especially high with respect to ICU admissions, severe traumatic brain injury, elderly patients, intracranial abscesses and brain tumours. Operative mortality was 6%. Emejulu reported an overall neurosurgical mortality of 13.9% (2009) and Odeku reported an operative mortality of 10.4% (1962) [4, 10].

In this study, patients who underwent tumour surgery suffered 15% mortality representing 6% of total neurosurgical mortality. Postoperative pulmonary embolism, from deep venous thrombosis, and postoperative meningitis contribute significantly to morbidity and mortality associated with intracranial tumours [13,14,15]. This is also true in patients with pre-existing infection, trauma and shunt-related surgeries [14].

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