Adverse Events after Cranial Surgery at Department of Neurosurgery Bir Hospital: An Institutional based Quality Assessment Prospective Study

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ABSTRACT

INTRODUCTION: Surgical complications are often broadly defined as "any deviation from the normal postoperative course." This definition is clearly subjective and prone to inter-observer variability. It's our first major step to identify the post-operative status of our patients who underwent major cranial surgery in terms of morbidity and mortality and find out the preventable cause which enhance the best possible care to reduce the morbidity and mortality.

METHOD: A prospective observational study was conducted at Department of Neurosurgery, Bir Hospital, Kathmandu, Nepal. All patients who underwent cranial surgeries between March 2017 to April 2018 were included in the study. Demographics, clinical diagnosis, surgical procedure, and intraoperative and postoperative complications were prospectively documented and analyzed.

RESULT: A total of 364 patients underwent cranial surgeries during the study period. Two-thirds (62%) were male and 38% were female. Mean age was 40.39 ±20 years. Most common pathologies treated were brain tumor (133) followed by trauma (67), vascular problems (64) and hydrocephalus (65). Overall post-operative complications were seen in 35.16.% while 7.96% had intraoperative complications. Pulmonary complication was the most common adverse event (13.73%) followed by electrolyte imbalance (2.74%) and urinary tract infection (2.74%). Overall mortality rate was 8.24%. Most common cause of death was aspiration pneumonia (36.66%).

CONCLUSION: The overall perioperative complication and mortality rates after cranial surgery were 43.12% and 8.24% respectively. Pulmonary complication was the most common post-operative adverse event and the cause of death. We recommend a provision of involvement of neuro intensivist or pulmonologist and a dedicated neurophysiotherapist in neuro intensive care unit to improve and enhance the post-operative outcome of neurosurgical patients.

KEY WORDS: *Adverse events, Cranial surgery, Morbidity, Mortality, Outcome.*

INTRODUCTION

Surgical complications are more common than appreciated and result in substantial morbidity and mortality.[1] Specific adverse events such as surgical site infection or ventilation acquired pneumonia are often measured at an institutional level.[2-4]

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In order to improve health outcomes by reducing complications, actual estimation of adverse events is the very initial step forward. To date, most reports on the incidence of adverse events in cranial surgery have been retrospective and dependent on data abstraction from hospital based administrative databases. Prospectively examining the adverse events in a tertiary center would provide one estimate of anticipated complications rates. We believe that perhaps there were complications related to neurosurgical procedures that were amenable to improvement and that could only be captured by doing prospective analysis. To our knowledge, there has been no previous prospective analysis of all adverse events occurring in the entire population of

patients presenting to an academic tertiary center in Nepal who received cranial surgical intervention. To this end, we designed a prospective observational study to document and analyze all intraoperative as well as postoperative adverse events associated with intracranial surgeries in the department of neurosurgery Bir Hospital Kathmandu Nepal.

METHOD

A prospective observational study was designed. All newly admitted patients of all age group who underwent neurosurgical cranial surgeries between March 2017 to April 2018 in the Department of Neurosurgery, National Academy of Health Sciences, Bir Hospital were included. Patients who underwent procedures other than cranial surgery and patients who had cranial surgeries before the start of this study were excluded in the analysis. Demographics, clinical diagnosis, surgical procedure, intraoperative and postoperative adverse events were prospectively collected in a preformed proforma by the team members.

Outcome variables

Adverse events related to surgical procedure (categorized as intraoperative and postoperative complications)

Surgical mortality defined as mortality during hospital admission after surgery

Statistical analysis

It was a descriptive study so all the data/results generated during our study were presented as tabulated or figures in numbers and percentages using IBM SPSS Statistics 23.0.

RESULT

Of the 364 patients, majority was male with male to female ratio of 1.6:1. (Figure 1) Mean age was 40.39 ±20 years. Among them, 16.75% were elderly with age above 60 years and 5% were infants.

Of the total surgical procedures, 133 (32.84%) were operated for brain tumor, 67 (16.54%) for brain trauma, 64 (15.8%) for vascular disease, 18 (4.4%) for congenital and 17 (4.2%) for infective pathology while 65 patients were treated with VP shunt for CSF diversion. (Figure 2).

In case of tumor surgery, glioma represented the highest percentage (21%), followed by meningioma (8%) and sellar/suprasellar tumors (14%) (Figure 3). Among the vascular pathologies, microsurgical clipping of aneurysm was the most common procedure in 68.75% followed by evacuation of intracerebral hematoma in 17%. (Figure 4). Cerebral abscess was the most common infective pathology requiring surgical intervention found in 11 patients. Distribution of traumatic and congenital pathologies treated surgically were as shown in figures 5 and 6 respectively.

Overall adverse events were noted in 43.12% with 7.96% during surgery and 35.16.% during post-operative period.

Brain swelling was the commonest intraoperative complications (15), followed by intraoperative bleeding (8), intraoperative aneurysm rupture (4) and venous air embolism (2) as shown in figure 7.

Pulmonary complications were the most common post-operative adverse events found in 50 cases (13.73%) which was mostly seen among patients treated for vascular pathologies (29.68%) followed by oncology patients (16.54%). The details of the postoperative complication are represented in tabulated form in Table 1.

Overall mortality was seen in 30 cases (8.24%). Mortality rate was highest among brain tumor surgeries (12%) followed by vascular surgery (10.93%). With regard to the cause of death, aspiration pneumonia was the most common cause found in 11 patients attributable to 36.66% of all mortality (Table 2).

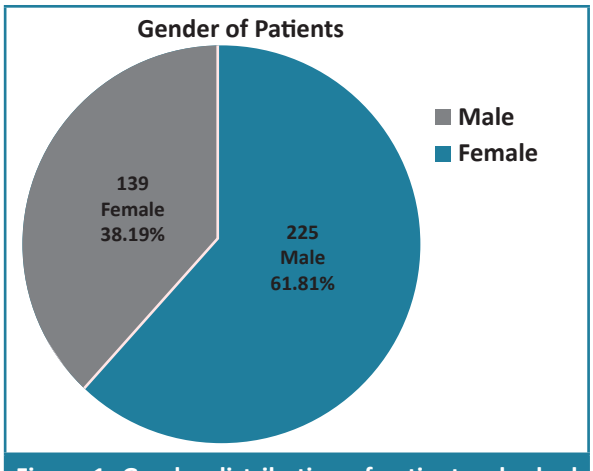

Figure 1: Gender distribution of patients who had undergone cranial surgery

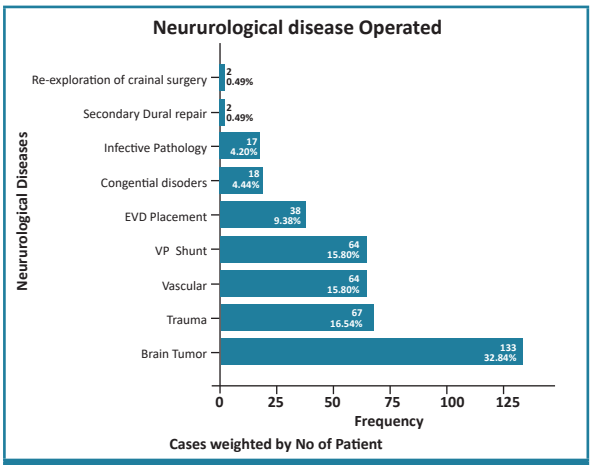

Figure 2: Procedures performed as per categories of neurological diseases and management

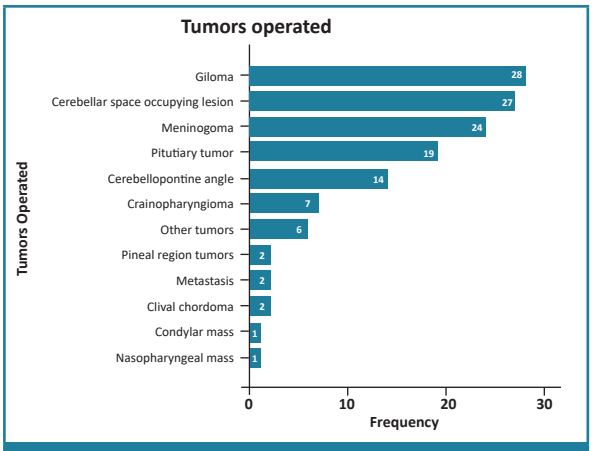

Figure 3: Various types of tumors operated

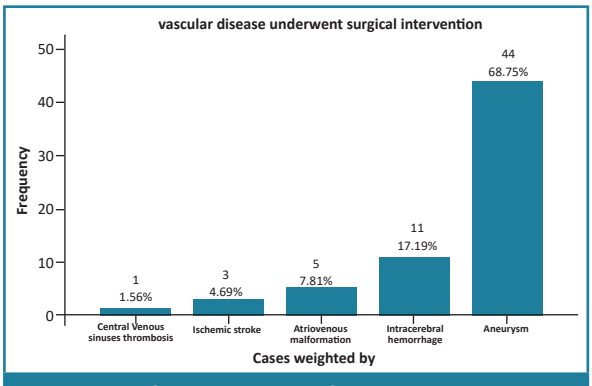

Figure 4: Different pattern of vascular disease who underwent surgical intervention

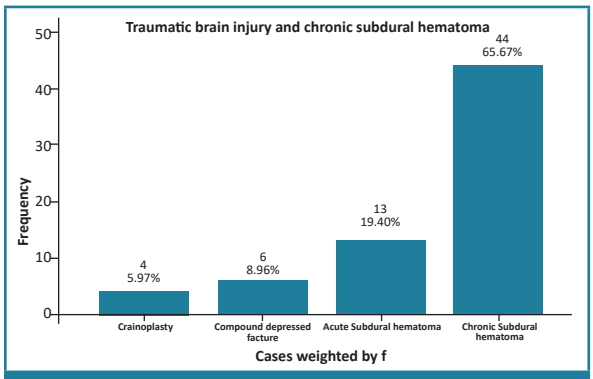

Figure 5: Distributions of traumatic brain injury patients

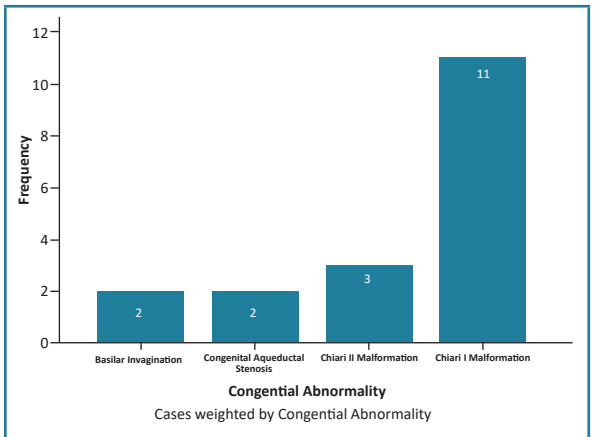

Figure 6: Congenital anomalies who underwent surgery

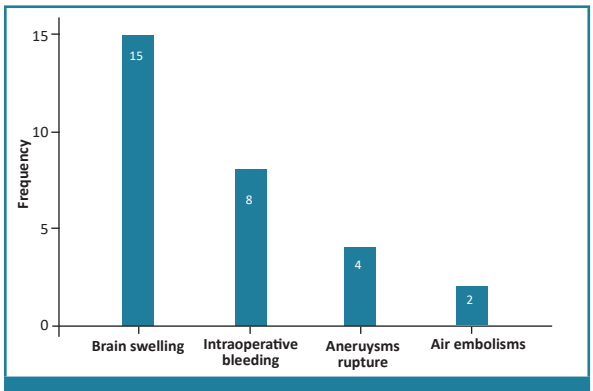

Figure.7: Intraoperative adverse events

Table 1: Frequencies of post-operative adverse events after cranial surgery

Post-operative adverse events	Number (%)
Pulmonary complications	50 (13.73)
Electrolyte imbalance	10 (2.74)
Vasospasm/ infarction	7 (1.92)
Hematoma collection (EDH, SDH, ICH) *	4 (1.1)

CSF leakage/pseudomenigngocele	9 (2.47)
VP shunt blockage	6 (1.64)
DVT (deep vein thrombosis)	3 (0.82)
UTI (urinary tract infection)	10 (2.74)
Pressure sore	9 (2.47)
Hydrocephalus	7 (1.92)
Subdural abscess	2 (0.54)
Wound dehiscence	4 (1.09)
Neurologic deficit	7 (1.92)
Total	(35.16)

*EDH-Extradural hematoma, SDH-Subdural hematoma, ICH-Intracerebral hematoma

Table 2: Different causes of death after cranial surgery

Cause of death	Numbers (%)
Aspiration Pneumonia	11(3.02)
vasospasm	6 (1.64)
CNS infection	6 (1.64)
Malignant cerebral edema	5 (1.37)
Malignant Hyperthermia	1 (0.27)
Venous air embolism	1 (0.27)
Total	30 (8.24)

DISCUSSION

Minimizing surgical complications has been a goal in neurosurgery ever since Harvey Cushing began rigorously documenting his own surgical errors more than a century ago.[5] The nature of diseases for bringing one to cranial neurosurgery are neoplastic, vascular, infectious, trauma and congenital.

Rabadan AT et al looked at surgical complications following malignant brain tumor resection within 30 days in patients of all ages (range, 19-89 years). Age >60 years was not associated with an increase in postoperative complications.[6] We had similar experience, total number of patients above 60 years was 61 and average age of elderly was 72 years. The number of patients who underwent craniotomy appeared to be 27 (7%), while rest of the patient underwent VP shunt and burr hole and evacuation for chronic subdural hematoma

According to John DR et al, surgical complications increase the cost of health care worldwide and directly contribute to patient morbidity and mortality.[7] In an effort to mitigate morbidity and incentivize best practices, stakeholders such as health insurers and the US government are linking reimbursement to patient outcomes which showed 14.3% rate of complication in neurological surgeries. Even with the facility of insurance, the complication occurred were not minimized as most of the complications were unavoidable. In our setting complications occurred in 35. 15% of cases, which is higher in comparison to the other studies. However, the overall mortality in our cohort was 8.24% which was comparable to previous studies.

Intraoperative complications

Meixensberger J et al found that poor preoperative clinical condition (ASA score), intra- and postoperative bleeding and CSF disturbances were significantly associated with a subsequent decrease of quality of life.[8] In our study, 7.96% of patients had intraoperative complications. Brain swelling was the commonest intraoperative complications seen in 15 patients followed by intraoperative bleeding (8 cases), intraoperative aneurysm rupture (4 cases) while venous air embolism occurred in 2 cases. Lawrence FM et al, in their study described massive intraoperative brain swelling is an infrequent but catastrophic occurrence.[9] In their initial 11 cases (5 arteriovenous malformations, 4 hematomas, and 2 penetrating injuries), this approach produced the following outcomes: 6 patients made a good recovery, 2 are moderately disabled, 1 is severely disabled, and 2 are dead. In our institution, such case was observed which showed good recovery. This showed that malignant intraoperative brain swelling, which once was considered unmanageable, can indeed be managed and that treatment often results in an acceptable outcome.

The rates of postoperative hemorrhage after intracranial surgery vary greatly in the literature; ranging from 0.77–50%.[10] Some studies defined it as any hemorrhage within the operative bed. Many studies have found that the majority of postoperative hematomas were epidural or intraparenchymal, which was comparable to our study which showed 38% of intraoperative bleeding of which epidural hematoma was the most common form.

The risk of developing a venous air embolism exists for all kinds of neurosurgical procedures; however, its incidence is higher for procedures done in a sitting or semisitting position.[11, 12]

Air embolism occurs in the presence of a pressure differential at two different sites of the venous system, which in turn causes a negative pressure or

sub-atmospheric gradient between the right atrium and the cranial venous sinuses. When the venous system of the central nervous system is exposed to environmental pressure and there is a difference of at least 5 cm of H_2O between the two sites, there will be air inflow.[13] Venous air embolism appeared to be rare but dreadful intraoperative complication which usually occurs in surgeries in sitting and semi-sitting position, in our setting two patients had intraoperative venous air embolism.

Post-operative complications

Major complications after intracranial surgery occurs in 13–27% of patients.[14] These complications may be neurologic, haemodynamic, metabolic or respiratory in nature. Major neurologic complications include postoperative haematomas, cerebral oedema and seizures, and should be differentiated from minor events, such as postoperative nausea and vomiting (PONV), pain and hyperglycaemia. However, there is a possible relationship between events.

A study by Laurent L et al showed that most commonly observed neurological complications in the postoperative period of elective skull surgeries include decreased level of consciousness, cerebral vasospasms, refractory seizures, reoperation, hemiparesis and intraparenchymal hematoma.[15] In non-elective surgeries, intracranial hypertension, motor deficits, recurrent subdural hematoma, intraparenchymal hemorrhage, vasospasms, and seizures are also reported. Systemic complications in the postoperative period of elective neurosurgeries include nausea and vomiting, hypotension, respiratory distress, and surgical site infection. For non-elective surgeries, pain and nosocomial infections are also observed. In a study by Manninen PH and Sogame LC et al, postoperative pulmonary complications (PPCs) predominantly include pneumonia, bronchitis, atelectasis, deterioration of lung disease and respiratory failure, which together account for 11.2-24.6% of all pulmonary-associated complications.[16, 17] In the study carried out by Bharati SJ et al showed post-operative respiratory complications (PRCs) in patients with intracranial lesions can lead to significant increase in the intensive care unit (ICU)/hospital stay, morbidity and mortality.[18] One hundred and thirty-seven (14.3%) patients developed respiratory complications in the post-operative period. In our study almost 13.73% of the cases had respiratory complications, which is comparable to previous studies.

Other postoperative complication consists of variables which were found to be associated with post-operative respiratory complications were associated co-morbidities, preoperative cranial nerve palsies, preoperative motor deficits, position during surgery, haemodynamic disturbances (hypertension, hypotension, tachycardia), amount of blood loss, intraoperative blood transfusion, duration of surgery, post-operative ventilation, post-operative neurological complications (Glasgow Coma Scale (GCS) deterioration, new neurological deficits, haematoma formation, cerebral infarct, post-operative hydrocephalus, generalized seizure, meningitis), electrolyte imbalances (hypokalemia, hypernatremia, hyponatremia), fever and diabetes insipidus (DI).

The Hunt-Hess scale was developed in 1968 as a clinical grading system to predict prognosis and outcome in patients with subarachnoid hemorrhage (SAH). A higher grade predicts a poor outcome and lower likelihood of survival.[19] In a study done by Lantigua et al, in-hospital mortality was 18 % (216/1200): 3 % for Hunt-Hess grade 1 or 2, 9 % for grade 3, 24 % for grade 4, and 71 % for grade 5.[20] In our study, all patients who died after microsurgical clipping had grade 3 or more Hunt-Hess grade.

Complications from specific procedures are also reported in different literatures reports, such as CSF complications.[21, 22] However there are few if any reports on overall service specific complications. Studies from developed world has reported complications rate as high as 16% resulting in significant morbidity and in more than 50% of the adverse events second surgery was required.[23] Rolston et al reported complications occurring in 14.3% of neurosurgical cases. They found that cranial cases were 2.6 times more likely to have complications than spine case and the most frequent complications were bleeding requiring transfusion and reoperation within 30 days of the initial operations.[24]

Adverse events are commonly taken as a yard stick to measure the quality of care. Complications not only increase the cost of health care but also directly contribute to major morbidity and mortality.This study though descriptive in nature is an attempt to identify the major adverse events after cranial surgery in a tertiary neurosurgical referral center in

Nepal. Implementing guideline to address the major complications will help in reducing the complication and enhancing the outcome of neurosurgical patients.

CONCLUSION

The overall perioperative complication and mortality rates after cranial surgery were 43.12% and 8.24% respectively. Pulmonary complication was the most common post-operative adverse event and the cause of death. We recommend a provision of involvement of neuro intensivist or pulmonologist and a dedicated neurophysiotherapist in neuro intensive care unit to improve and enhance the post-operative outcome of neurosurgical patients.

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