Clinical and Radiological Profile and Early Outcome of Skull Base Surgeries in a Tertiary Care Center in Eastern Nepal

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Abstract

Introduction: Surgery of the skull base is challenging due to its complex anatomy and relative inaccessibility. Surgical anatomy and approaches to the cranial base have been well described in the neurosurgical literature.

Materials and Methods: This is an analytical observational study consecutively treated from November 2019 to October 2021. Clinical, radiological, intraoperative ad outcome data were retrieved through the chart review and prospectively collected computer database of the neurosurgery department. The outcome was accessed using mRS. Data was analyzed using Statistical Package for the Social Sciences (SPSS) 25th version. Mean, median, percentage were analyzed. Chi-squared test was used to find out association between two populations for categorical variables. Logistic regression analysis was used to analyze preoperative selected variables and outcome. Outcome was assessed at discharge and in six months.

Results: A total of 61 cases were included in the study. There was a female preponderance in 73.8%. The mean age of the study population was 48.5 years. Headache was the most common presenting feature (45.9%) followed by loss of consciousness (21.3%). In the present study, 33 (54%) had aneurysms, and 25 (40.9%) had brain tumors. The most common approach was anterolateral 67.2% The most common complication observed was hydrocephalus (8.1%). The median duration of hospital stay was 12 days. The obese patients had significantly longer hospital stays (15 days). At discharge, a favorable outcome (mRS grade ≤ 2) was observed in 83.6%. The preoperative Glasgow coma scale (GCS) was significantly associated with the outcome.

Conclusion: Proper pre-operative evaluation and selection of appropriate approaches for the particular patients are key to achieving a good outcome in skull base surgery. The outcome is directly related to preoperative GCS and obese patients tend to have a longer hospital stay.

Key words: Skull base surgery, Brain tumor, aneurysm, mRS

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Introduction

Surgery of the skull base is challenging due to its complex anatomy, and narrow corridor of access to varied pathologies. Lesions of the skull base often pose special problems for diagnosis and treatment because of the involvement of multiple specialties and vague presenting symptoms[1] Surgical anatomy and approaches to the skull base have been well described in the neurosurgical literature.[2,3] However, skull base surgery in a resource-limited environment is challenging where the late presentation of patients and unavailability of preoperative imaging and intraoperative safety gadgets make the treatment of these complex pathologies even more complex. Though there are many papers from neighboring countries, studies exclusively analyzing the skull lesions have not yet been published in Nepal.[3,4] The aim of this study is to evaluate the data on the clinical outcome of patients following skull base surgery from a tertiary care center in the eastern part of Nepal.

Materials and Methods

This is an observational analytical study of consecutively treated patients over a period of 2 years period from November 2019 to October 2021. Ethical clearance was obtained from the institutional review committee of our hospital.

Hospital records and computer database of all patients who have undergone skull base surgeries during the study period were retrieved. A total of 66 skull base surgeries were reviewed. Five cases were excluded from the study because of missing data. Sixty-one patients were selected for final analysis. Different study variables were age, sex, diagnosis, Imaging findings, surgical approach, complication, and mRS score at discharge and in six months. All the skull base lesions were operated on both by the open or minimally invasive technique and those who completed a six-month follow-up were included in the study.

All the cases who presented to us were evaluated clinically and relevant investigations as dictated by the likely pathology such as computed tomography (CT), magnetic resonance imaging (MRI), and cerebral angiogram were performed and the diagnosis was made. Based on the pathology and getting consent for surgery either from the patient or the legal guardian, appropriate surgical approaches were chosen. In most of the cases, a standard anterolateral skull base approach was performed. The outcome was accessed using the modified Rankin scale (mRS). [4]

Data was analyzed using Statistical Package for the Social Sciences (SPSS) 25th version. Mean, median, and percentage were analyzed. The Chi-square test was used for analyzing categorical variables. Univariate and multivariate logistic regressions were used to analyze the association between certain preoperative variables and the outcome.

Results

There was a strong female preponderance in the present study [45 (73.8%)]. The mean age of the study population was 48.5±13.5 years. Obese patients (BMI >30) were 18(30.5%). The different age group of the study population is shown in *table 1*.

Clinical Presentation:

The most common clinical presentation was headache followed by loss of consciousness as shown in *table 2*. The median presenting GCS was 15 with an interquartile range of 2. GCS of 15 was seen in 59%, 14 in 14.8%,13 in 16.4%, 12 in 3.3% and GCS 11,10,9,5 in 1.6% each. Most of the cases (n=39,66.1%) were elective whereas 20 (33.9%) were emergency cases.

Diagnosis:

Out of the total study population, 33 (54%) were aneurysms, 25 (40.9%) of tumors and one case was arteriovenous malformation. A patient was brought to the emergency department with a complaint of headache. His computed tomography head is shown in *figure 1*. The most common diagnosis was spontaneous subarachnoid hemorrhage secondary to ruptured anterior communicating artery aneurysm followed by cerebellopontine angle tumor as shown in *table 3*.

Skull base surgical approach:

The most common surgical approach in the present study was anterolateral (67.2%). Other skull base approaches were posterior skull base (21.3%), transnasal transsphenoidal endoscopic surgery (8.2%), and transnasal endoscopic spontaneous cerebrospinal fluid leak repair (3.3%). Intraoperative images of the different approaches are shown in *figure 2*.

Postoperative complications:

The overall complication rate in the present study was 36.06%. Other than the electrolyte disbalance in the postoperative period, the most common complication observed was hydrocephalus (8.2%) whereas clinical vasospasm (12.12%) was the most common complication in aneurysm cases. Other complications are shown in *table 4*.

Duration of hospital stay:

The median duration of hospital stay was 12 days with an interquartile range of 5. Patients who were obese had a significantly longer duration of hospital stay (15 days, IQRof 6) when compared to patients who were not obese (11 days, IQRof 4, $p < 0.01$).

Outcome:

The outcome was measured using a mRS. The outcome was dichotomized into good and bad grades using mRS 3 or less considered as a good grade. A good grade was seen in 83.6%. The overall mRS outcome of the present study is shown in *table 5*.

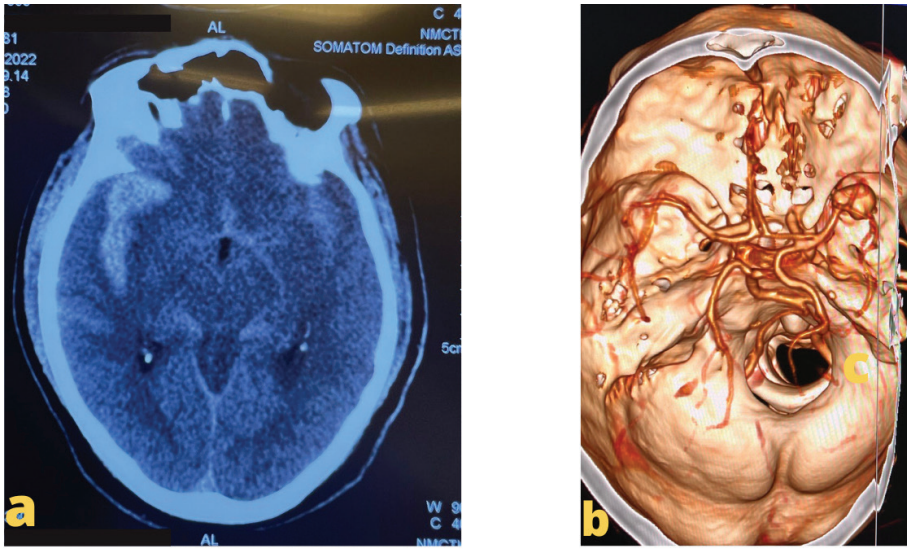

Figure: (a) Non-contrast computed tomography of patient with spontaneous subarachnoid hemorrhage showing dense hematoma (blue arrow head) in right sylvian fissure, (b) CT angiography of the same patient showing large MCA bifurcation aneurysm (yellow arrow head)

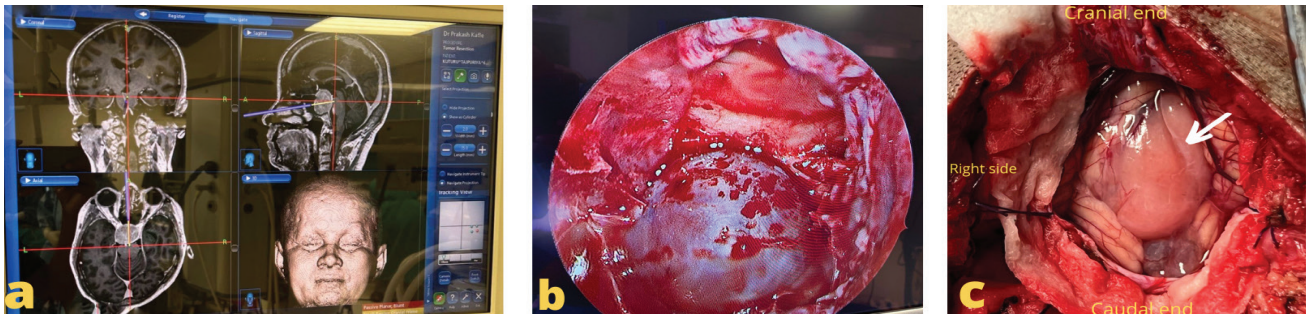

Figure 2:(a) navigation guided pituitary macroadenoma localization, (b) pituitary macroadenoma before opening dura via endoscopy, (c) Telovelar approach to excise medulloblastoma

Table 1: Cross-tabulation of gender with the age category (Only one table looking at the age group should be enough here)

Gender	Age category (Years)	Frequency	Percentage
	<20	2	3.3
	21-40	13	21.3
	41-60	15	24.6
	>60	31	50.8
Total		**61**	**100**

Table 2: Clinical presentation

Clinical presentation	Frequency	Percent
Headache	28	45.9
Loss of consciousness	13	21.3
Seizure	4	6.6
Focal neurological deficit	2	3.3
Speech Problem	2	3.3
Visual Disturbance	5	8.2
Gait disturbance	3	4.9
Lower cranial nerve Palsy	1	1.6
Vomiting	1	1.6
Spontaneous CSF rhinorrhea	2	3.3
Total	**61**	**100**

Table 3: Diagnosis

Diagnosis	Frequency	Percentage
ACOM Aneurysm	20	32.8
CP angle Tumor	7	11.5
Olfactory groove meningioma	1	1.6
Intraventricular Tumor	3	4.9
MCA Aneurysm	4	6.6
PCOM aneurysm	3	4.9
Basilar Top Aneurysm	1	1.6
Bilateral MCA Aneurysm	1	1.6
MICAs	3	4.9
DACA Aneurysm	1	1.6
Pituitary Macroadenoma	4	6.6
Tuberculum Sella Meningioma	1	1.6
Sphenoid Wing Meningioma	1	1.6
Petro-clival Meningioma	1	1.6
Tentorial Meningioma	3	4.9
Cerebellar Hemangioma	1	1.6
AVM	1	1.6
Parasagittal Meningioma	1	1.6
Deep Glioma	1	1.6
Medulloblastoma	1	1.6
Spontaneous CSF rhinorrhea	2	3.2
Total	**61**	**100**

ACOM: anterior communicating artery; CP: cerebellopontine angle; MCA: middle cerebral artery aneurysm; PCOM: posterior communicating artery aneurysm; MCA: middle cerebral artery aneurysm; MICA: multiple intracranial aneurysms; DACA: distal anterior cerebral artery aneurysm; AVM: arteriovenous malformation

Table 4: Post-operative complications

Complications	Frequency
Hydrocephalus	5
Vasospasm	4
Meningitis	2
Chest infection	3
Pseudo meningocele	2
Surgical site infection	1
DVT/Pulmonary embolism	1
Ventriculitis	1
Facial Palsy	1
Transient CN-III Palsy	1
Seizure	1

Table 5: Outcomes at the time of discharge

Outcomes	Frequency	Percentage
No Symptoms	13	21.3
No significant disability despite symptoms; able to carry out all usual duties and activities	28	45.9
Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance	8	13.1
Moderate disability; requires some help, but able to walk unassisted	2	3.3
Moderately severe disability; unable to walk unassisted and unable to attend to own bodily needs without assistance	2	3.3
Dead	8	13.1
Total	**61**	**100**

The preoperative GCS was significantly (x^2=96.64, df=35, $p<0.01$) associated with mRS grade of the patient. Those with poor GCS had a bad grade of mRS. Similarly, the preoperative GCS was significantly (x^2=96.64, df=35, $p<0.01$) associated with the mRS grade of the patient.

Discussion

Understanding the anatomy of the skull base has revolutionized the outcome of the lesions that require skull base approaches. Further modification of illuminating power of microscope and other newer gadgets in neurosurgery like a neuronavigation system, neurophysiological monitoring devices, and intraoperative imaging technology like ultrasound, intraoperative MRI, and ultrasonic aspirator system have made the surgery safer and easier. Lesions that were considered inoperable in the past before the advancement in technology have become a day-to-day practice in the modern era. At our institute, most of the modern gadgets have been installed which has made surgery safe. This article is probably the first of its kind on skull base surgery from Nepal as extensive literature yields no publication on this heading.

In the present study, vascular lesions were the most common, spontaneous SAH following ACOM aneurysm rupture comprised of 32.8% which was treated by the anterior lateral base approach. In a series of 10000 aneurysm surgery by Hernesniemi *et al.*[5], ACOM aneurysms comprised 38% which were treated with clipping. Though the treatment of aneurysms has progressed towards endovascular modality in recent days. To date, microsurgical clipping is the gold standard

treatment which has been evidenced by ten years of follow-up of the BRAT trial.[6] Significant difference in outcome was not seen between microsurgical clipping and coiling.[6]

The most common approach in the present study was anterolateral skull base basically for aneurysm, olfactory groove meningioma, and tuberculum sella meningioma. Many surgeons perform olfactory groove meningioma via bifrontal craniotomy and basefrontal approach. In a study,[7] this approach was used in 64.4% of the patients. But in the present study anterolateral skull was sufficient enough to provide adequate exposure to the lesions with minimal brain retraction.

The second common (11.5%) lesion was the CP angle tumor. The retrosigmoid approach was used for all the cases with gross total excision of the tumor. The advantages of retrosigmoid approach are: no tumor size limitation, preservation of hearing, wide exposure to the brain stem, consistent facial nerve exposure, and familiar approach to all neurosurgeons.[8]

Transsphenoidal surgery for the pituitary yields an opportunity to decompress the optic apparatus with less manipulation of other vital structures. In the present study, there was 6.6% of pituitary adenoma who underwent transnasal endoscopic surgery. Nowadays, Endoscopic transsphenoidal surgery is the preferred method of surgery.[3]

Though there are no randomized control trials to help guide the management of patients with vestibular schwannoma through radiation oncology discipline has shown unparalleled advantages.[9,10]

A recent study of comparatively evaluating linear accelerator-based stereotactic radios surgery (SRS) versus Hypo-fractionated stereotactic radiotherapy (hypoFSRT) delivered in 3 or 5 fractions for VS reported a high rate of local control with no significant differences between treatment schedules.[11]

Spontaneous CSF rhinorrhea is one of the indications for endonasal endoscopic surgery as this modality has replaced more traumatic and extracranial procedures.[12] In our series two cases of spontaneous CSF leak were repaired with a multilayer technique with fat, fascial lata, and fibrin glue. This modality has some advantages like preservation of smell, fewer hospital stays, and avoiding craniotomy. The exact accuracy of surgery makes this technique very valuable in CSF rhinorrhea which has been regarded as the choice of treatment for CSF rhinorrhea.[13,14]

Commonly reported complications in the literature of skull base surgery include meningitis, CSF leak, visual changes, cerebral infarct, subdural hemorrhage, epidural abscess, hydrocephalus, chronic rhinosinusitis, sinonasal mucocele, hematoma, epistaxis, and death.[15] In our study, similar complications were noted.

Hydrocephalus was seen in 8.2% of our study. Vasospasm was seen in 12.2% of ruptured aneurysm. In a study by I Izawa[16] acute hydrocephalus, and delayed vasospasm occurred in 29% and 7% respectively. In studies by Hussein and McClelland[17,18], meningitis following craniotomy was seen in 0.3%–8.6%. In the present study, the incidence of meningitis was 3.27% which responded well with intravenous antibiotics as per the CSF culture sensitivity report. The mean duration of hospital stay was 12 days. In a study by Bilal *et al*.[19], the duration of hospital stay was between >8 days for 58.26% of cranial surgeries.

The outcome following cranial surgery is a major concern. In the present study, a good outcome was seen in 83.6%. In a study by Elina et al. 17% had a greater mRS score at discharge and 24% at 30 days post-surgery.[18]

Conclusion

Proper pre-operative evaluation and selection of appropriate approach for the particular patients yield better and comparable outcomes. Outcome after surgery is directly related to preoperative GCS status and diagnosis.

Limitation of study

This is a single-center study with small sample size. The generalization of the present result and outcome needs to be compared with another study with a larger sample size.

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