



DEPARTMENT OF NEUROSURGERY

FUNCTIONAL OUTCOME OF SURGICALLY TREATED INTRACRANIAL MENINGIOMAS AT AABET HOSPITAL, ADDIS ABABA, ETHIOPIA

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Abstract

Background: Intracranial meningiomas are the most common brain tumors operated in Addis Ababa burn, emergency and trauma hospital (AABET), St. Paul Hospital Millennium medical college (SPHMMC). This study reviews the functional outcome of surgically treated intracranial meningiomas in a resource-limited setup.

Objective: - The objective of this study was to assess functional outcome of surgically treated intracranial meningiomas at AABET hospital, Addis Ababa, Ethiopia

Methods: - A retrospective cross sectional single institution-based study was conducted among patients who had undergone surgery for intracranial meningiomas at AABET hospital, Addis Ababa, Ethiopia over 4 years' period (between January 1, 2018 to December 30, 2021). All patients who were operated in the study period with histologic diagnosis of meningioma who fulfilled the inclusion criteria were included. Patient data regarding sociodemographics, presenting complaint, neurologic deficit, preoperative imaging findings, postoperative neurologic findings, intraoperative findings including degree of resection, and histopathologic results were collected from patient charts. The current functional status was assessed using Karnofsky Performance Status Scale (KPS) for adult and Lansky performance scale (LPS) for age 16 years and below via in person interview or phone interview by trained junior neurosurgical residents using pretested questionnaires. Descriptive summary measures were used to analyze the specific objectives. Multi variate analysis was used to assess association between multiple independent variables with the dependent variable. P value less than 0.05 was taken as statically significant.

Results: Out of 134 patients operated for intracranial meningioma in the study period, the study was conducted on 112 patients who fulfilled the inclusion criteria. The mean follow-up period was 20.4 months (range from 3 to 53 months). Meningioma was common in females (n=81, 72.3%) with a female to male ratio of 2.6:1. The mean age at presentation was 43.2 years $\pm$ 12.8 years with a range of 12 to 75 years of age. Headache (n=106, 94.6%), followed by cranial nerve palsy (n=53, 47.3%), motor deficit (n=47, 42%) and seizure (n=47, 42%) were the most common presenting symptoms.

The most common tumor locations were convexity (n=27, 24.1%) followed by parasagittal (n=20, 17.9%) and sphenoid wing (n=17, 15.5%), respectively. Most of the patients had tumor size > 5cm (n=69 ;61.6%) while only 2 patients (1.8%) had tumor size < 3cm. Significant number of our patients had WHO grade I tumor (n=101, 90.2%) with

Meningothelial(n=63,56.3%) subtype accounting for the majority of the cases. Gross total resection (Simpson grade 1 to 3) was achieved in 71 patients (63.4%) and subtotal resection (Simpson 4 & 5) was done for 41(36.6%).

Twenty-seven (24.3%) patients in our study had reoperation. The most common indication was postoperative infection. Thirteen (11.6%) patients had post-operative infection, of which 9 (9.1%) of them require surgery. The surgical mortality rate was 4.5%.

Thirty-two (28.6%) patients had poor final functional outcome with KPS score of less than 70% and the rest (n=80,71.4%) had good functional outcome with KPS of 70% and above. Multivariate analysis showed the presence of preoperative focal neurologic deficit and post-operative complications were an independent predictor of poor functional outcome in this study. Those patients who had preoperative focal neurologic deficit were having 9.067 times more likely to have poor functional outcome than those who presented without focal deficit (AOR=9.067,95%CI:1.025,82.705 and p value of 0.041). Patients who had post-operative complications were 4.906 times more likely to have poor functional outcome compared to those patients who had no postoperative complications (AOR=4.906,95%CI:1.568,15.350 and p value of 0.006). This study didn't show significant association between age, tumor size, tumor location, extent of resection & WHO grade with functional outcome.

Conclusion: The presence of preoperative focal neurologic deficit and post-operative complications were associated with poor functional outcome. It was shown that the functional outcome of patients with surgically treated intracranial meningioma is encouraging in resource limited set up.

Key words: Intracranial meningioma, functional outcome, Karnofsky score

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Acronyms

AaBET :Addis Ababa Burn, Emergency and Trauma center

CNS:Central nervous system

CT: Computed tomography

ECOG:Eastern Cooperative Oncology Group

DI:Diabetes Insipidus

ETB:Ethiopian Birr

GC:Gregorian Calendar

HRQoL:Health-Related Quality of Life

HRQOL:health related quality of life

ICU: Intensive care unit

IRB: Institutional review board

KPS:Karnofsky Performance Status Scale

LPS: Lansky performance scale

MD :Medical Doctor

MRI: Magnetic resonance imaging

PI: Principal Investigator

PROs:patient reported outcomes

SPHMMC:Saint Paul'sHospital Millennium Medical College

SPSS:statistical package for social science

WHO: World Health Organization

1. Introduction

1.1 Background

Meningiomas are slow growing, usually benign, extra-axial brain tumors, arising from arachnoid cap cells. They are the most common primary intracranial tumors, representing 36.4% of central nervous system tumors [1]. The incidence of meningioma increases with age, peaking in the third to sixth decade, and shows a female predominance, with a female to male ratio of 2:1. As many as 3% of autopsies on patients age greater than 60 years of age reveal a meningioma [2].

Convexity, parasagittal, and sphenoid ridge meningiomas account for approximately 70% of meningiomas [3]. Most meningiomas are benign, corresponding to World Health Organization (WHO) grade I, whereas atypical meningiomas (WHO grade II) comprise 5%-7% of all meningiomas [3,4]. Malignant meningiomas (WHO grade III) occur relatively rarely, with an incidence of 0.7 per 100,000 persons per year [5].

Complete surgical resection can be regarded as the most important modality of treatment because most meningiomas are benign in nature [6]. Extent of surgical resection primarily determines the recurrence of meningiomas. This was well illustrated by Simpson [7], who clearly showed the correlation of extent of surgical resection and late tumor recurrence.

The short-term goal of surgical resection is targeted toward having minimal surgery-related mortality and morbidity [8]. The long-term goals mainly deal with the control of disease progression. These can be assessed in terms of recurrence rate, progression-free survival, and overall survival [7]. It is also crucial to evaluate quality of life and functional status of operated patients after the surgery. The pre- and postoperative status of operated patients can be evaluated mainly by functional status and different parameters that assess quality of life. The oldest and most commonly used measure of functional status is the Karnofsky Performance Status Scale (KPS) [9]. The KPS is the most common measurement used in brain tumor studies for age greater than 16 years. Lansky performance scale (LPS) is a scale used to assess performance status in pediatric patients (age $\leq$ 16 years). KPS/LPS are the gold standard to assess functional outcome in oncology. Both are validated, reliable and reproducible [7].

Although there are many reports from around the world on the outcome of patients operated for intracranial meningiomas, there are very few African studies published on this subject matter. These African studies showed a comparably good outcome in line with other studies done

outside of Africa [8,9]. In Ethiopia one retrospective study done at Addis Ababa University, Black lion hospital and Myungsung Christian Medical Center showed that among 88 patients with a postoperative Karnofsky Performance Status Scale score, 43% achieved a postoperative score >70. The study concluded that Meningioma size determines the outcome of the patients. It was shown that the functional outcome of patients is encouraging even though further improvement on neurosurgical care is needed [10].

1.2. Statement of the problem

In recent years, there has been increasing emphasis on the patient-reported outcomes (PROs) in tumor treatment in addition to length of survival. PROs include, in order of increasing specificity, health-related quality of life (HRQOL), functional status, and measures of specific neurological deficits [6]. *Functional status* is an individual's capacity to perform the normal activities of daily living; for adults, this includes self-care and work. Performance status is an important patient reported outcome measure in brain tumor. Patients with intracranial tumors in Africa typically have delayed diagnosis due to late presentation, which has been reported to be 2 years on average, thus making the prognosis bleak. Older age, larger tumor size, lower pre-operative KPS, malignant histology, higher Simpson grade, skull base location are associated with poor functional outcomes from previous studies. Intracranial meningioma was the most common brain tumor operated at AaBET hospital between January to December 2021. The functional outcome of these patients was not known before this study.

1.3 Rationale of the study

For patients with meningioma, surgery is the main treatment modality and offers the possibility of cure. The goal of surgery is maximal safe resection, aiming for a gross total resection (GTR). Nevertheless, surgery may cause significant complications. Despite this, the functional outcome of meningioma patients, particularly after surgical resection, has been understudied in Africa, particularly in our country where limited microsurgical instruments, neurophysiological monitoring and the advent of high-end technologies are lacking compared to the westerns. This perceived gap has led us to study outcomes of intracranial meningioma cases operated at our hospital. Information about anticipated clinical course, including the short-term risks, is needed for patient information and informed consent. This is a common dilemma in surgery, weighing the risk of short-term complications and neurological impairment against natural history of disease and the expected long-term results. This study reviewed the functional outcome of surgically treated intracranial meningioma's in a resource-limited setup and helped to identify factors associated with good and poor functional outcome after meningioma surgery. We hope that the results of this study will translate in to better understanding of our patients' functional outcome enabling us to provide them with a higher standard of care.

2. Literature review

Meningiomas are slow growing, usually benign, extra-axial brain tumors, arise from arachnoid cap cells. They are the most common primary intracranial tumors, representing 36.4% of central nervous system tumors [1]. The incidence of meningioma increases with age, peaking in the third to sixth decade, and shows a female predominance, with a female to male ratio of 2:1. As many as 3% of autopsies on patients age greater than 60 years of age reveal a meningioma [2].

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In different studies intracranial meningiomas account for 25%-35% of all primary tumors of the central nervous system in clinical practice [11-13] and over the past decades, their incidence has been increasing due to an aging population and widespread use magnetic resonance imaging (MRI). The treatment of meningiomas that are symptomatic or show growth on serial imaging is typically surgical resection, even at advanced ages [14-16]. The goal of surgery is maximal safe resection, aiming for a gross total resection (GTR)[17,18]. Continuous improvements in microsurgical techniques, neurophysiological monitoring and the advent of high-end technologies are assets in maximizing the rates of GTR[19].

In stark contrast to outcome parameters such as extent of resection (EOR), complications and predictors of overall survival (OS), and progression-free survival (PFS), there is paucity with respect to data on long-term functional outcomes of meningioma patients, especially given the

high incidence of meningiomas in daily neurosurgical practice. Probable contributing factors are a biased attention of neurosurgeons on technical, histopathological, and radiological factors, a scarcity of neuropsychologists in clinical neurosurgical departments, and heterogeneity in the follow-up of patients, both with respect to timing and outcome measures [20,23]

A bewildering variety of end points have been used in cancer outcome studies, many of which are useful in brain tumor reports [7]. The original criterion for success of brain tumor surgery was operative mortality, and overall patient survival is still the gold standard for success in therapy of malignant brain tumors, including low-grade gliomas. A survey of neurosurgeons showed that mortality was considered the most important end point far more often than morbidity or quality of life [7]. Survival (or overall survival) is usually defined as the time from initial surgery, date of diagnosis, or date of trial registration until death. Survival is an ideal end point for diseases with high acute mortality, such as glioblastoma. In diseases with longer expected survival, progression-free survival may be a more practical end point. It typically reflects a period of relatively symptom-free time for the patient as well as being an excellent surrogate for overall survival [7].

In surgical studies, operative mortality is a short-term end point of importance to many investigators. In recent years, there has been increasing emphasis on the patient-reported outcomes (PROs) in cancer therapy in addition to length of survival [7,9,11,12]. PROs include, in order of increasing specificity, health-related quality of life (HRQOL), functional status, and measures of specific neurological deficits. In the WHO framework for discussing health-related problems, decreases in overall HRQOL correspond roughly to “handicap,” deficits in functional status to “disability,” and specific symptoms to “impairment”[7].

HRQOL is a measure of an individual’s satisfaction with life insofar as it is affected by health. It excludes many domains of quality of life defined generally, such as financial security, political and religious freedom, quality of interpersonal relationships, and so on, except as they are affected by the person’s health status. Generic HRQOL measures are applicable to all individuals regardless of health state; these include familiar instruments such as the short form 36 (SF-36) [9].

Functional status is an individual's capacity to perform the normal activities of daily living; for adults, this includes self-care and work. All brain tumor studies should include functional status in baseline descriptions because this is a very strong predictor of both outcome and survival [11,12]. Commonly used scales include the KPS and the Eastern Cooperative Oncology Group (ECOG) scale [12]. Performance status is an important prognostic factor for survival in brain tumor patients. Examining the KPS itself, it is clear that the difference between some levels is subjective and can be difficult to assign reliably, especially the highest levels of the scale. For example, history of a single seizure curtails driving in most jurisdictions even if seizures are controlled; whether such a patient can be assigned a KPS score of 100 (normal) or even 90 (capable of normal activity) is ambiguous. In a general cancer practice setting, interrater agreement on the KPS is generally good; in one study, raters agreed on KPS 59% of the time and disagreed by one level (10 points) 32% of the time, with 7% of ratings differing by 20 or 30 points [15]. In longer term outcome studies, KPS is used in defining independent or functional survival.

Similar to what has been suggested in glioma therapy, the endpoints of meningioma treatment (regardless of management) should not be restricted to OS and PFS, since they do not reflect patient autonomy and ability to live their activities of daily life in accordance to their expectations. So functional outcome and quality of life should be considered in meningioma surgery because most meningiomas can be cured by surgery. Being able to provide good quality of life and functional outcome in addition to increased residual life-years after surgical treatment should therefore be a priority[7,9].

One nationwide study in Sweden assessed short term outcome of surgical treatment of meningioma in all adults with histopathologically verified intracranial meningioma between 2009 and 2015 were [17]. In total, 2324 patients, with a mean age of 58.7 years (SD 13.5), underwent surgery for intracranial meningioma and 14.1% of the patients were asymptomatic before the intervention. The most common symptom prior to treatment was focal deficit, which occurred in 1450 patients (62.4%). Moreover, within 30 days after surgery, 344 patients (14.8%) developed new neurological deficits and new-onset seizures occurred in 105 patients (4.5%), while 8.3% of asymptomatic patients developed neurological deficit and 3.7% new-onset seizures. Due to complications, reoperations were performed in 120 patients (5.2%). The

postoperative 30-day mortality in the whole cohort was 1.5%. This study concluded that surgical decision-making is a careful consideration of short-term risk versus long-term benefit, this information may be useful for both caregivers and patients [17].

Another study on functional outcome and quality of life after meningioma surgery systematically reviewed the literature on health-related quality of life (HrQoL) and functional disability (FD) of patients after surgery for intracranial meningiomas. Using PRISMA 2015 guidelines, they screened 289 abstracts and 43 titles were re-tained for full-paper screening. 15 articles did not present enough data to meet the inclusion criteria and 7 articles failed to assess functional assessment and HrQoL. Twenty-two articles were included in their review. HrQol was assessed in N = 18 publications, most frequently using SF-36 (N = 10), followed by EQ5D-5L (N = 4), EORTC- QLQ (N = 4), and the FACT questionnaire (N = 2). The assessment of FD was reported in N = 11 publications, mostly using the KPS (N = 8). The Barthel index was used in N = 2 publications. Follow-up was reported in N = 12 publications, ranging from 6 months to 9 years. In this systemic review ,86% of the patients had returned to their normal/pre-morbid level of functioning (including return to work) with favorable outcome with KPS of 70% and above. and 80% of the patients were satisfied with their HrQoL This study concluded that the assessment of long-term post-operative HrQol and FD in patients undergoing meningioma surgery is heterogeneously reported, using various scales and follow-up protocols. Efforts should be undertaken to uniformly assess long-term functionality in patients with surgically managed meningiomas, since postoperative impaired functional outcomes are increasingly reported[23].

Another retrospective study by Chan et al assessed morbidity,mortality and outcome after surgically treated intracranial meningioma in 257 patients with average follow up of 9 years showed that he size and location of tumors, the degree of tumor excision, the histological features, and the preoperative condition of the patients are important in both duration of survival and quality of life and good functional outcome following surgery for intracranial meningiomas. The quality of survival was assessed both pre- and postoperatively and graded according to the Karnofsky rating scale. Sixty(23%) of the 257 patients failed to achieve a Karnofsky rating of 70 preoperatively. Eleven (18%) of these 60 patients never achieved independent living postoperatively. In that series ,the 30-day incidence of perioperative mortality was 4.0% and 87 % of patients achieved KPS 70 and above postoperatively[25].

A retrospective analysis of 385 patients with a histologically defined cranial meningioma were studied by . Meixensberger et al to analyze the impact of characteristic factors on morbidity and mortality after modern cranial meningioma surgery. Mortality was 4.2% one month and 7.3% six months after operation. Age, poor preoperative clinical condition (ASA score), intra- and postoperative bleeding and CSF disturbances were significantly associated with a subsequent decrease of quality of life and poor functional outcome. First symptoms like intracranial hypertension, seizures, aphasia and hemiparesis were correlated with an increase of postoperative Karnofsky performance. Postoperative quality of life decreased in patients with optic and other cranial nerve disturbances significantly. Tumour size, location and histological diagnosis did not influence surgical outcome. This information may be useful in management decisions regarding asymptomatic meningiomas in elderly and high-risk patients [26].

A multicenter study done by Zamanipoor et al to assess determinants of the long-term disease burden in meningioma patients done on 190 patients showed that lower preoperative KPS was the major determinant for long term quality of life and good functional outcome. Tumor location, age, edema on MRI, WHO grade, tumor size before intervention, surgical complications, reoperation, and radiotherapy were not determinants [27].

A prospective study done in Norway to assess mortality, morbidity and the functional outcome following intracranial surgery for meningiomas in elderly patients (age ≥ 60 years), 54 patients were included and found that overall mortality was 9.3%. Preoperatively, 42 patients (84% of the survivors) reported KPS ≥ 80 , whereas 35 patients (70% of the survivors) reported KPS ≥ 80 post-operatively. This difference was not statistically significant. There was no difference in the proportion of patients (16.7%, nine patients) reporting KPS ≤ 70 pre- and post-operatively. The study concluded that meningioma surgery in the aging patient carries a higher risk of mortality and morbidity compared to intracranial tumor surgery in general. Their findings indicate, however, that the survivors have improved cognitive function and acceptable QoL, and did not see any significant decrease in the proportion of independent patients according to the KPS [28]

In Ethiopia one retrospective study done at Addis Ababa University, Black lion hospital and Myungsung Christian Medical Center [10] on functional outcome of surgically treated intracranial meningioma, a total of 91 patients were enrolled in the study. Tumor size was estimated in 79 cases (86.8%). Fifty-one tumors (64.6%) were >5 cm in diameter, whereas 28

(35.4%) were <5 cm. Only 4 patients had tumors <3cm (5.1%). Tumor size was shown to be related to post- operative functional outcome ($P = 0.032$). The surgical mortality rate, which was defined as death within 1 month, was 14.3%. Among 88 patients with a postoperative Karnofsky Performance Status Scale score, 43% achieved a postoperative score >70. The study concluded that Meningioma size determines the outcome of the patients. It was shown that the functional outcome of patients is encouraging even though further improvement on neurosurgical care is needed[10].

3. Objectives

3.1 General objective:

The general objective of this study is to assess functional outcome of surgically treated intracranial meningiomas at Aabet hospital, Addis Ababa, Ethiopia

3.2 Specific objectives

- To determine functional outcome of surgically treated intracranial meningiomas using Karnofsky Performance Status Scale (KPS) /Lansky performance scale (LPS)
- To describe location, extent of resection and histologic patterns of surgically treated intracranial meningiomas at AaBET hospital
- To determine factors associated with good and poor functional outcome in surgically treated intracranial meningiomas

4. Methods

4.1. Study area

The study was conducted at AaBET hospital, an affiliate of SPHMMC. It is Burn, Emergency and trauma hospital, found in Addis Ababa, Ethiopia. It is a major center for SPHMMC department of neurosurgery. Additionally it is a higher center in the referral system across the nation. It is also a teaching hospital for SPHMMC & other medical school students in the city for both under graduate and post graduate studies. In addition to neurosurgery, it also gives orthopedics, plastic & reconstructive surgery and emergency services for clients. Unpublished data from the hospital annual reports showed neurosurgical patients occupy a sizable amount of the hospital's case load. Neurotrauma, neuro-oncology, degenerative spine are major services given under the department of neurosurgery at AaBET. Currently, the neurosurgery department has 26 dedicated beds at AaBET hospital (21 adult & 5 pediatrics) & uses the ICU as well as beds at emergency. On average a total of 21 patients are operated for neurological related disease per week (unpublished data from morbidity mortality session reports).

4.2. The study design and period

A retrospective cross-sectional single institution-based study was conducted among patients who underwent surgery for intracranial meningioma at AaBET hospital during the time period between January 1, 2018 to December 30, 2021. The time of data collection was from May 1, 2022 to May 30, 2022.

4.3. The source/Reference population

The source population for this study were all patients operated for brain tumours at AaBET hospital

4.3.1. Study /sample population

The study population consisted of all patients operated for histologically confirmed intracranial meningioma at AaBET hospital

4.3.2 Study unit

All patients operated for intracranial meningioma at AaBET hospital between January 1,2018 to December 30,2021

Inclusion criteria

- ✓ All patients with histologic diagnosis of intracranial meningioma operated in the study period were included

Exclusion criteria

- ✓ All patients operated for recurrent meningiomas were excluded from the study
- ✓ Patients with imaging diagnosis of meningioma but histology showed other diagnosis or no documentation about histology on the chart was found
- ✓ Patients who did not have follow-up for at least three months (except patients who died in their one-month post-operative period)
- ✓ Patients who did not give oral consent to participate in the study

4.4 Sample Size

One study at Addis Ababa University, Blacklion hospital showed functional outcome of patients operated for intracranial meningioma with 47% of patients have good KPS(>70). I took 47% proportion rate ($p=0.47$) to determine maximum sample size. The sample size was determined by using single population proportion statistical formula

$$n = Z_{\frac{\alpha}{2}}^2 \frac{P(1-P)}{d^2}$$

Where:

- n =sample size
- N = source of study population
- Z = standard deviations corresponding to 95% confidence interval =1.96
- P = proportion among the study population = 0.47
- d = degree of accuracy required or desired precision (maximum allowable error of the estimate) =0.05

$$n = \frac{z^2 p(1-p)}{d^2} = 382$$

- Since, $n/N > 0.05$ the finite population correction is used to determine the final sample size.
- $n = \frac{n_0}{1 + n_0/N} = 357$

Adding 10% for non- respondent rate give as a final sample size to be 393.

But all patients who were operated during the study period included on the study using quota sampling technique.

4.5 Data collection procedure

Patients who underwent surgery for brain tumor during the study period were identified from OR registration log book/Department Excel format. Those patients with histologic diagnosis of intracranial meningioma and who fulfilled the inclusion criteria were identified and chart review was done. Data regarding sociodemographics, presenting complaints, neurologic deficit, preoperative imaging, functional status, histologic subtype, extent of tumor resection, size of tumor, postoperative neurologic findings, and mortality was collected from patients' medical records. Patient follow-up was traced from patient's medical records. Patients were contacted through telephone and asked to come for follow up if they can or were asked about their current functional status by phone.

Data was collected by trained junior neurosurgical residents (year 1 and year 2) using the pretested structured questionnaire.

4.6. Data processing

Data handling.

The collected data was cleaned, stored and checked for its completeness and internal consistency. The soft copies of the data were stored on hard drive and back up copy was stored on separate drive.

Data analysis

- Code was given to completed questionnaire. The data was cleaned and entered in to and processed using SPSS version 26. Descriptive summary measures including, mean, median, relative frequency and standard deviation was used to analyze the specific objectives. Association between each independent variables and dependent variable was assessed using binary logistic regression. At 20% level of significance bivariate analysis($p=0.2$); those independent variables with p value of ≤ 0.2 were entered to multivariate analysis to determine the independent predictor of outcome. Crudes Odds ratios, adjusted Odds ratios and confidence interval were calculated to determine the strength of association of selected variable. P -value <0.05 was taken as statistically significant association.

4.7 Data quality assurance

To assure the quality of data, properly designed data collection questionnaire was employed. The collected data was reviewed and checked for completeness and relevance by the supervisors and principal investigator each day. Data quality was also assured during data entry by randomly checking 10% of data and data cleaning was also done after entry. Pretest was done on 5 % of the sample size out of the actual data to assure quality of the data.

4.8 Study Variables

Dependent variables: -Functional Outcome using KPS /LPS

Independent variables: -age, sex, tumor location, size of tumor, WHO grade, extent of resection, comorbidities, duration of symptoms, intraoperative blood loss, duration of anesthesia, postoperative complications, recurrence

4.9 Operational Definitions

1.Intracranial Meningiomas: intracranial mass above foramen magnum with histologic result of Meningioma

2.Functional outcome: an individual's capacity to perform the normal activities of daily living; for adults, this includes self-care and work.

3.Karnofsky Performance Status : The most commonly used measure of functional status in cancer studies (score from 0 to 100)

Lansky performance scale: functional outcome measure for pediatric patients (≤ 16 yrs)

Score in percentage	KPS for adults(>16yrs) Condition	LPS for pediatric(≤ 16 yrs) Condition	Score in percentage
100	Normal; no complaints; no evidence of disease.	Fully active, normal	100
90	Able to carry on normal activity; minor signs or symptoms	Minor restrictions in physically strenuous activity	90
80	Normal activity with effort; some signs or symptoms of disease.	Active, but tires more quickly	80
70	Cares for self; unable to carry on normal activity or to do active work	both greater restriction of, and less time spent in, active play	70
60	Requires occasional assistance but is able to care for most of his needs	up and around, but minimal active play; keeps busy with quieter activities	60
50	Requires considerable assistance and frequent medical care	gets dressed, but lies around much of the day; no active play;	50
40	Disabled; requires special care and assistance	mostly in bed; participates in quiet activities	40
30	Severely disabled; hospitalization necessary; active supportive treatment is necessary	in bed; needs assistance even for quiet play	30
20	Very sick; hospitalization necessary; active supportive treatment is necessary	often sleeping; play entirely limited to very passive activities	20
10	Moribund; fatal processes progressing rapidly	no play: does not get out of bed	10
0	Dead.	Unresponsive	0

Sources (lansky, et al, Abernethy et al, peus, et al)[24]

4. Good functional outcome: KPS $\geq$ 70

5. Poor functional outcome: KPS $<$ 70

6. Simpson grading: Grading scale, for defining the surgical extent of resection for meningioma documented on the operation note by the surgeon (from 1 to 5)

Simpson Grade	Description
Grade 1	macroscopically complete removal with excision of dural attachment and abnormal bone (including sinus resection when involved)
Grade 2	macroscopically complete with endothermy coagulation (Bovie, or laser) of dural attachment
Grade 3	macroscopically complete without resection or coagulation of dural attachment or of its extradural extensions (e.g. hyperostotic bone)
Grade 4	partial removal leaving tumor in situ
Grade 5	simple decompression ($\pm$ biopsy)

Source (Simpson D. The recurrence of intracranial meningiomas after surgical treatment. J Neurol Neurosurg Psychiatry. 1957; 20:22–39)[8]

7: Operative mortality: Any death, regardless of the cause occurring within 30 days after intracranial meningiomas surgery in or out of the hospital and after 30 days during the same hospitalization subsequent to the operation

8. Operative Morbidity: refers to adverse events and complications following surgery: This may include Post Op hematoma collection requiring re operation, post OP infection, Post OP pneumonia, DVT, UTI, post OP Hydrocephalus, CSF leak...etc

4.10 Ethical Consideration

Official letter was obtained from the department and the college institutional review board (IRB) before data collection. Patients name was not mentioned in the questionnaire and the information, they gave had no impact on the service delivery to the client. Confidentiality, accountability and neutrality was kept throughout.

5. Result

5.1 Patient characteristics

Out of 134 patients operated for intracranial meningioma in the study period, the study was conducted on 112 patients who fulfilled the inclusion criteria. All had pathology proven meningiomas of different grades. Amongst which, 81 (72.3%) were female and 31 (27.7%) were male with a female to male ratio of 2.6:1. The mean age at presentation was 43.2 years $\pm$ 12.8 years with a range of 12 to 75 years of age. [Table 1]

Table 1 Frequency and percentages of socio-demographic characteristics of patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021 G.C

		Frequency(n=112)	Percent (%)
Sex	Female	81	72.3
	Male	31	27.7
Age	10-20	3	2.7
	21-30	19	20
	31-40	30	26.8
	41-50	30	26.8
	51-60	22	19.6
	>60	8	7.14
Mean age $\pm$ SD(range)(years)		43.2 $\pm$ 12.8 (12 - 75)	

5.2 Clinical presentation

Headache was the most common presenting complaint found in 106 (94.6%) of the patients followed by cranial nerve palsy in 53 (47.3%) patients. The most common cranial nerve palsy was optic nerve (CN-II) deficit which was found in 41 (36.6%) patients followed by Olfactory nerve (n=7, 6.25%).

Other common complaints included motor deficit(paresis/plegia) (n=47, 42%), seizure (n=47, 42%), change in mentation (n=31,27.7%) and vomiting (n=25, 22.3 %). [Table 2]

Of 112 patients, 35 (31.3%) had comorbidities including hypertension (n =15; 13.4%), diabetes mellitus(n=8;7.1%) and bronchial asthma (n=4;3.5%). Other comorbidities seen were cardiac

illness (1 patient with atrial fibrillation and 1 patient with degenerative valvular heart disease) and HIV infection, thyrotoxicosis, neurofibromatosis type 2 (2 patients each) [Figure 1]

The mean time period from onset of symptoms to presentation was 16.8 ± 1.76 months with a range of 0.3 months to 84 months.

Table 2 Frequency and percentages of clinical presentation of patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021 G.C

	Frequency (n=112)	Percent (%)
Headache	106	94.6
Cranial nerve palsy	53	47.3
CN-I	7	6.3
CN-II	41	36.6
CN-III	3	2.7
CN-IV	2	1.8
CN-V	5	4.5
CN-VI	1	0.9
CN-VII	1	0.9
CN-VIII	5	4.5
CN-IX	5	4.5
CN-X	3	2.7
CN-XI	2	1.8
CN-XII	2	1.8
Paresis/plegia	47	42
Seizure	47	42
Vomiting	25	22.3
Change in mentation	31	27.7
Incontinence	19	17
Aphasia	11	9.8
Proptosis	7	6.3
Balance disturbance	6	5.4
Scalp swelling	3	2.7
Others*	10	8.9
Mean duration of symptoms ±SD(range)(months)	16.8 ± 1.76 (0.3 - 84)	

* Amenorrhea, eye pain, sleep disturbance, forgetfulness, lack of motivation, facial swelling and frontal swelling

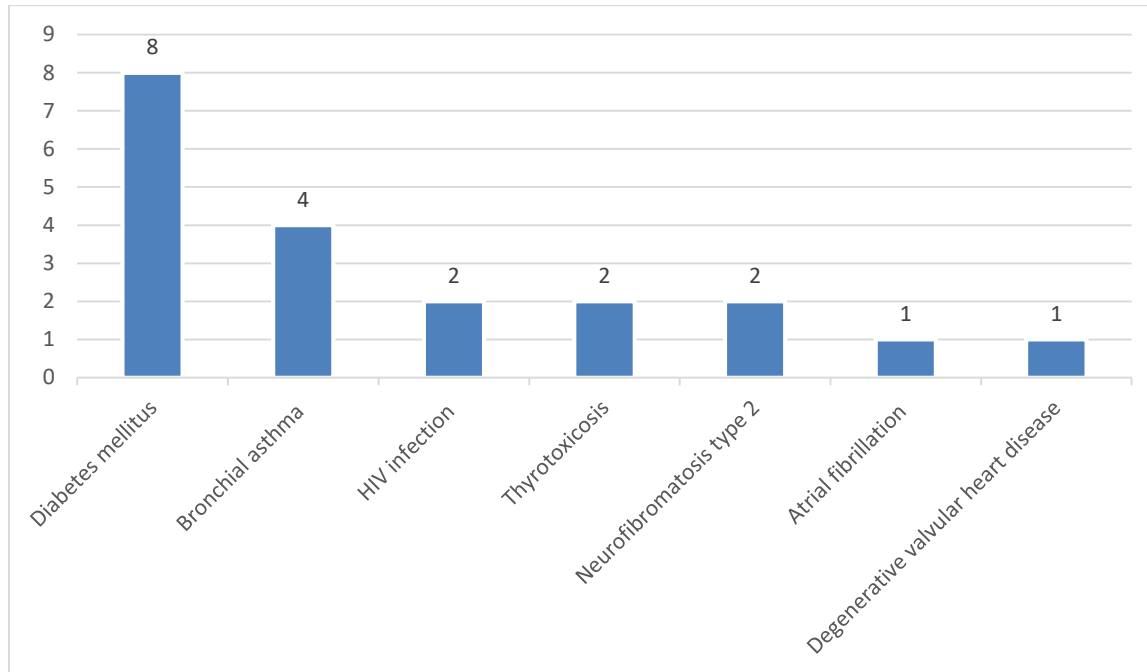


Figure 1 Frequency of comorbidities in patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021 G.C

5.3 Preoperative management

Majority of patients enrolled in the study were put on steroid (n=97, 86.6%) and out of these patients, most were on steroid for 1 to 2 weeks (n=47, 42%).

Similarly significant number of patients were on anticonvulsants (n=104, 92.9%) and phenytoin was the most common anticonvulsant used either alone or in combination (n=103, 92%). [Table 3]

Table 3: Frequency and percentages of preoperative management of patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021 G.C

	Frequency(n=112)	Percent (%)
Steroid	97	86.6
	< 1 week	34.8
	1 to 2 weeks	42.0
	>2 week	9.8
Anticonvulsant	104	92.9
	Prophylactic	52.7
	Therapeutic	40.2
Anticonvulsant Type	Phenytoin	92
	Sodium Valproate	4.5
	Carbamazepine	1.8
	Phenobarbital	0.9

5.4 Tumor characteristics

Upon preoperative imaging findings, tumor diameter of >5 cm accounted for 69 (61.6%) cases, while 3 to 5 cm and <3 cm accounted for 41 (36.6%) and 2 (1.8%) cases respectively. In addition, 73 (65.2 %) patients had perilesional edema on imaging [Table 4].

The most common tumor locations were convexity (n=27, 24.1%) followed by parasagittal (n=20, 17.9%) and sphenoid wing (n=17, 15.2%), respectively. One hundred four (92.9%) patients had supratentorial meningiomas whereas 8 patients (7.1%) had infratentorial meningiomas. Skull base meningioma was seen in 62 (55.4%) of patients . [Figure 2]

Based on postoperative histological examination, 101 (90.2 %) of the patients had WHO grade I lesion, the rest 11(9.8%) patients had WHO grade 2 and WHO grade 3 histology. Amongst the grade 1 subtypes, Meningothelial (n=63, 56.3%), Transitional (mixed) (n=14, 12.5%) and Psamomatous (n=12, 10.7%) were commonly identified. [Table 4]

Tumor removal was graded based on the Simpson grading system. Gross total resection (Simpson grade 1 to 3) was achieved in 71 patients (63.4%) and subtotal resection(Simpson 4 & 5) was done for 41(36.6%) .Almost all patients who underwent STR had Simpson 4 resection (n=40,35.7%) with the exception of one patient with petroclival meningioma who had Simpson

V resection[Table 5]. Among 62 patients with skull base tumor, only 32(51.6%) had GTR and the rest 30(48.4%) had STR. GTR was achieved in 72%(n=36) of cases among the remaining 50 patients with non-skull base meningiomas.

Table 4: Frequency and percentages of tumor characteristics of patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021 G.C

	Frequency(n=112)	Percent (%)
Tumor diameter		
< 3 cms	2	1.8
3 – 5 cms	41	36.6
>5 cms	69	61.6
WHO grade		
Grade I	101	90.2
Meningothelial	63	56.3
Fibrous (Fibroblastic)	5	4.5
Transitional (mixed)	14	12.5
Psamomatous	12	10.7
Angiomatous	3	2.7
Microcytic	4	3.6
Grade II	7	6.
Choroid	1	.9
Atypical	6	5.4
Grade III	4	3.6
Rhabidoid	1	.9
Anaplastic	3	2.7
Perilesional edema		
Yes	73	65.2
No	39	34.8

Table 5: Frequency and percentages of Simpson resection grade in patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021 G.C

Simpson tumor resection grade	Frequency (n=112)	Percent
Grade I	24	21.4
Grade II	23	20.5
Grade III	24	21.4
Grade IV	40	35.7
Grade V	1	0.9

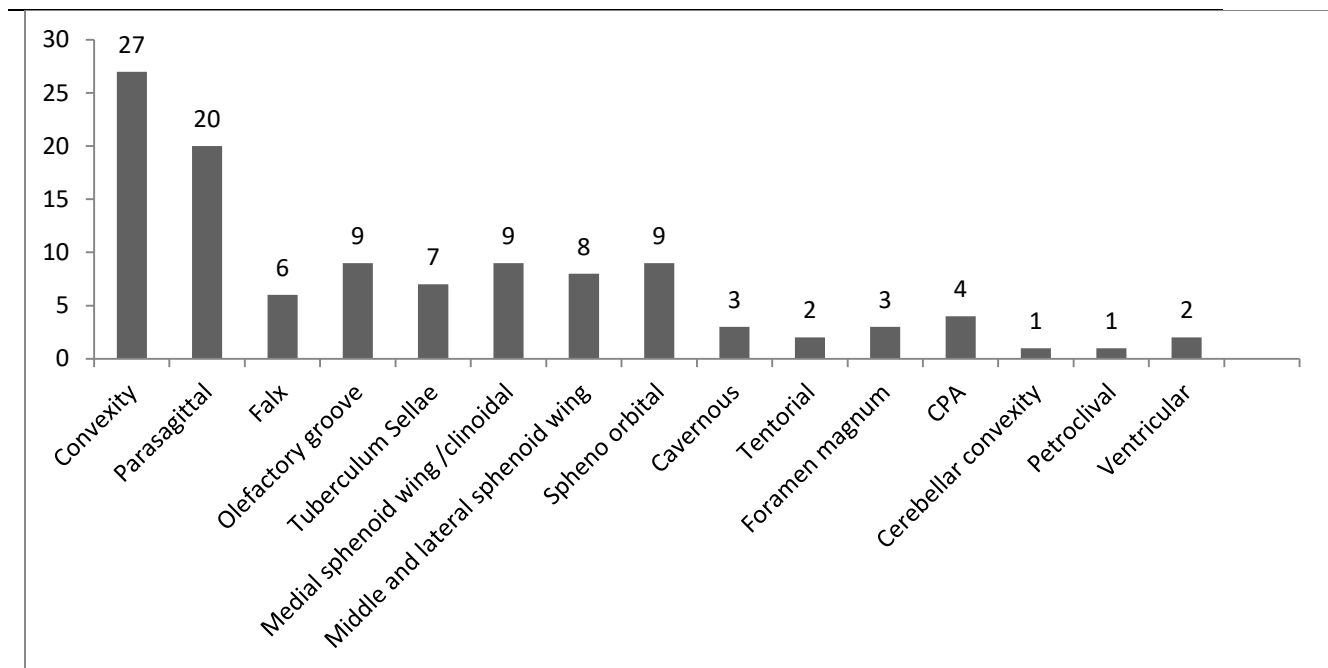


Figure 2: Meningiomas classified according to their location.CPA-cerebello pontine angle

5.5 Surgical Morbidity and Mortality

Among 112 patients ,27 (24.2 %) were reoperated. Postoperative infection (n=9, 8.0%) was the most commonly identified indication for reoperation followed by the presence of residual tumor (n=8, 7.1%) [Table 6]. Some patients had re operations for more than one indication. Among 62 patients with skull base tumors,18(29.0%) of them had reoperation whereas only 9(18%) of patients had reoperation from 50 patients with non-skull base Tumors. Among 8 patients re operated for residual tumor 2 patients were operated on emergency basis during their initial

operation (they come poor clinical condition attributable to intracranial hypertension) and tumor was left intentionally to shorten anesthesia time with planned second look. In the other 6 patient's operation was aborted due to significant intraoperative bleeding and persistent hypotension.

Post-operative morbidity was also assessed and postoperative seizure was the most common cause identified in 24 (21.4%) of patients followed by postoperative wound infection (n=13,11.6%). Among 47 (42.0%) patients who had seizure as initial presentation, 14 (29.8%) had seizure postoperatively and on the other hand only 10 (15.4%) patients who didn't initially have seizure developed new onset seizure postoperatively.

The average preoperative and postoperative hospital stay were 9 ± 5.1 days (range: 0 to 28 days) and 10.7 ± 7.9 days (range: 3 to 44 days), respectively.

There was one intraoperative death caused by hemorrhagic shock. Surgical mortality, defined as death within 30 days of surgery irrespective of the cause, was 4.5%(5). The causes of death were sepsis, PTE, unknown, gunshot in each case [table 6]. There was no death among patients with tumor size <3 cms. One death was a patient with parasagittal meningioma and the rest all deaths were patients operated for skull base tumor.

Table 6: Frequency and percentages of morbidity and mortality in patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021 G.C

	Frequency(n=112)	Percent (%)
Reoperation		
Postoperative infection	9	8.0
Residual tumor	8	7.1
CSF leak	6	5.4
Postoperative hematoma	5	4.5
Hydrocephalus	4	3.6
Cranioplasty	2	1.8
Others*	2	1.8
Postoperative morbidity		
Postoperative seizure	24	21.4
Wound infection	13	11.6
HAP	11	9.8
New motor deficit	8	7.1
New CN palsy	6	5.4
CSF leak	6	5.4
Postoperative hematoma	5	4.5
Meningitis	4	3.6
Hydrocephalus	3	2.7
DVT	2	1.8
Others**	8	7.1
Surgical Mortality	5	4.5
Hemorrhagic shock	1	0.9
Sepsis	1	0.9
PTE	1	0.9
Accidental (Gunshot)	1	0.9
Unknown	1	0.9

*bone replacement, pack removal

**contracture, skin necrosis, delirium, DI, frontal lobe syndrome, phenytoin toxicity, upper airway obstruction, postoperative aphasia

Among 46 patients who initially had paresis/plegia and had survived the operation, 34 (74%) showed improvement in motor function while 6 (13.0%) had same motor function and the rest 5 (10.9 %) had deterioration in motor function in their final follow-up. Considerable number of patients, 34 (74%), received physiotherapy.

On the other hand, 13 (24.5%) out of 53 patients with CN palsy showed improvement in CN function while 35 (66%) had same function and the rest 5 (9.4%) had deterioration in CN palsy on final follow up.

11 patients had aphasia on presentation and almost all (n=10 ,91.0%) had improvement in speech at final follow up. However, only 1 (9.1%) out of the 11 patients received speech therapy.

The mean follow-up period was 20.4 months (range from 3 to 53 months). Eighty-five (75.8%) of patients had more than 1 year follow up. During follow up, 7 (6.3%) patients were identified to have recurrence. Of these, 3 (42.9%) had parasagittal tumors and the rest had skull base tumors. Four (57.1%) of the patients with recurrence had Simpson grade IV tumor resection, 2 patients were with Simpson 3 tumor extirpation and 1 patient with Simpson 2 tumor extirpation. There was no recurrence among patients with Simpson 1 tumor extirpation. The minimum time to recurrence diagnosis was 35 months (2.9 years).

5.6 Assessment of functional outcome

Among the 112 patients operated for intracranial meningioma, 32 (28.6%) patients had poor functional outcome with KPS score of less than 70% and the rest (n=80,71.4%) had good functional outcome. An additional 3(2.7%) patients died during follow up making the total mortality rate 7.1%(8). According to verbal autopsy none of the deaths were not surgery or tumor related (1 patient due to car accident at 9 months post operative period, 1 patient died due to pregnancy related complication at 3rd years post operative period and 1 patient died at 47 months post operative period with sudden death) [Table 7].

Excluding the deaths at final follow up 6 patients(5.4%) had KPS score of 100%, 44 patients (39.3%) had KPS of 90%, 29 (25.9%) patients had KPS score of 80%, 12(10.7) had KPS of 70%, 15(13.4%) had KPS of 60% and 9 (8%) patients had KPS of 50%. [Table 7]

Binary logistic regression and multivariate analysis was done to assess the independent predictors of functional outcome. At 20% level of significance bivariate analysis; the presence of preoperative neurologic deficit, post operative complications, re-operation for complications and

the presence of tumor recurrence showed significantly associated with poor functional outcome. According to multivariate analysis of binary logistic regression the presence of preoperative focal neurologic deficit and post operative complications were an independent predictor of poor functional outcome in this study. Those patients who had preoperative focal neurologic deficit were having 9.067 times more likely to have poor functional outcome than those who presented without focal deficit (AOR=9.067, 95%CI:1.025, 82.705 and p value of 0.041). Patients who had post operative complications were 4.906 times more likely to have poor functional outcome compared to those patients who had no postoperative complications (AOR=4.906, 95%CI:1.568, 15.350 and p value of 0.006) [Table 8]. Although re-operation for complications and the presence of tumor recurrence did not show significant correlation on multivariate analysis in this study, they had significance on bivariate analysis with p value of 0.09 and 0.01 respectively.

Table 7: Frequency and percentages of functional outcome in patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021 G.C

Final KPS	Frequency(n=112)	Percent (%)
0	8	7.1
50	9	8
60	15	13.4
70	12	10.7
80	29	25.9
90	44	39.3
100	6	5.4
Poor (<70)	32	28.6
Good (≥ 70)	80	71.4

Table 8: Bivariate and multivariate analysis for factors associated with functional outcome in patients who underwent surgery for intracranial meningioma at AaBET Hospital from January 2018 to December 2021

Variables	Functional outcome		COR(95%CI)	AOR(95%CI)	P value
	Poor	Good			
Tumor size					
>5cm	20	49	1.232(0.531,2.859)	1.153(0.427,3.113)	0.779
≤5cm	12	31	1.00	1.00	
Tumor location					
Skull base	20	42	1.508(0.651,3.491)	1.818(0.634,5.210)	0.266
Nonskull base	12	38	1.00	1.00	
Extent of resection					
STR(SimpsonIV&V)	14	30	1.296(0.564,2.980)	1.381(0.510,3.736)	0.525
GTR(SimpsonI,II,III)	18	50	1.00	1.00	
WHO grade					
WHO 2&3	4	7	0.778(0.217,2.789)	0.489(0.090,2.661)	0.489
WHO1	25	75	1.00	1.00	
Postop Morbidity					
Yes	25	35	4.592(1.780,11,842)	4.906(1.568,15.350)	*0.006
No	7	43	1.00	1.00	
Re operation					
Yes	13	14	0.293(0.117,0.735)	1.567(0.512,4.796)	0.431
No	18	66	1.00	1.00	
Recurrence diagnosed					
Yes	5	2	6.531(2.228,9286)	5.771(0.753,44.200)	0.092
No	27	73	1.00	1.00	
Preoperative focal neurologic deficit					
Yes	31	61	9.654(1.325,75.519)	9.067(1.025,82.705)	*0.041
No	1	19	1.00	1.00	
Preop duration					
≥1 week	18	40	1.286(0.564,2.922)	0.877(0.252,3.053)	0.837
<1week	14	40	1.00	1.00	
Durationof symptoms					
≥12 months	22	39	2.313(0.972,5.502)	2.644(0.855,8.177)	0.091
<12 months	10	41	1.00	1.00	
Age					
≥50years	15	23	0.457(0.196,1.066)	2.108(0.687,6.463)	0.192
<50years	17	57	1.00	1.00	

Note:COR,crude odds ratio;AOR,Adjusted odds ratio;CI,confidence interval ; *p-value <0.05 shows statistically significant association in multivariate analysis

6. Discussion

6.1 Patient demographics and clinical presentation

One hundred twelve patients with pathology-proven meningioma were enrolled in the study. There was female predominance (n=81;72.3%), which is similar to different studies across the globe and in this country [2,10-13]. One study done in TAH and MCH with a total of 91 patients operated for intracranial meningiomas showed that 70% of patients with meningioma were female [10]. It is thought that this female predilection correlates, at least in part, with endogenous sex hormone levels and is even higher (~3:1) during child-bearing years [9]. Likewise, this study shows a female to male ratio of 2.6 to 1. In addition, the most common age group affected in this study was 31 to 40 and 41 to 50 years with median age being 43.2 ± 18.2 years with a range of 12 to 75 years of age. This finding is in agreement with many studies and authors who reported that incidence peaks at 45 years of age and between the third to sixth decade of life [1,2,9,10].

Headache (n=106,94.6%), followed by cranial nerve palsy (n=53,47.3%), motor deficit (n=47,42%) and seizure (n=47,42%) were the most common presenting symptoms according to our finding. Agreeably, different studies identify headache as the most commonly identified complaint with minor differences in the order of other complaints [10,11,14]. Optic nerve palsy is the most commonly observed CN palsy in patients with meningioma according to our finding and research done by Laeke et al.[10]. The mean time period from onset of symptoms to presentation was 16.8 ± 1.76 months with a range of 0.3 months to 84 months. One study done in Ghana also showed that patients in Africa has delayed presentation after the onset of symptoms with mean time period of 2 years [16].

6.2 Tumor characteristics

More than half of the patients (n=69,61.6%) had tumor size greater than 5 cm while only 2(1.8%) had tumor size less than 3 cm at time of diagnosis. This finding is similar to other researches done in Africa setup given the fact that most patients seek healthcare late [10,16].

Significant number of our patients had WHO grade I tumor(n=101,90.2%) with Meningothelial(n=63,56.3) subtype accounting for the majority of the cases. The most common tumor locations were convexity(n=27,24.1%) followed by parasagittal(n=20,17.9%) and

sphenoid wing(n=17,15.2%) in order of decreasing frequency. This is similar to most other studies [16,18]. However, some studies show that the most common location for intracranial meningioma is the falx and parasagittal region [11,17]. Many different researches worldwide show similar numbers regarding WHO grades of intracranial tumors [1,9,10,11,16].

Gross total resection (Simpson grade 1 to 3) was achieved for 71 patients (63.4%) and subtotal resection (Simpson 4 & 5) was done for 41(36.6%). This result showed lower rate of gross total resection compared with other studies [10,11,17] where GTR was possible in more than 90% of the cases. The fact that we had more patients with Simpson IV resection might reflect the current philosophy of safe maximal resection. This can be also explained by relatively higher number of skull base tumors (n=62,55.4%) than convexity tumors (n=50,44.6%) in this study (n=62) compared to other studies where more than 50% of their meningiomas were convexity [10,23,25].

6.3 Surgical Morbidity and Mortality

Twenty-seven (24.3%) patients in our study had reoperation, compared with 13.2 % reoperation rate found in a study done in other hospitals in Ethiopia by Laeke et al.[10]. In addition, according to our study the most common indication was postoperative infection (n=9,8.1%) while postoperative hematoma was the most common indication for reoperation in Sweden and other Ethiopian studies [10,17] with 3.25% and 3.3%, respectively. In our study 13 (11.6%) patients had post-operative wound infection, of which 9 (9.1%) of them required surgery. This number is higher compared to other studies which showed craniotomy wound infection is less than 3 to 4% after meningioma surgery [17,23,25,26]. Infection in this study is also higher than a study done in Ethiopia by Laeke et al[10] where only 5(5.5%) of their patients had post operative infection out of 91 patients operated for intracranial meningioma and only 2(2.2%) of their patients require surgery for post operative wound infection[10]. In this study 5(4.5%) patients had postoperative hematoma requiring surgical evacuation which is slightly higher than other western studies [23,25-27], but comparable with the other Ethiopian study [10].

The surgical mortality for intracranial meningiomas according to our study was 4.5% which is similar with most researches done in developed world [7,13,25-27] but significantly lower compared to a research done in other Ethiopian hospitals that showed a surgical mortality of 14.3%[10]

The average preoperative and postoperative hospital stay was 9 ± 5.1 days (range: 0 to 28 days) and 10.7 ± 7.9 days (range: 3 to 44 days), respectively. This is longer compared to other African studies [16,18] but comparable to the other Ethiopian study [10] which showed average pre-operative stay 11.7 days, with a median stay of 6.5 days (range, 1 to 63 days). This longer preoperative inpatient hospital stay is because of scarce ICU space and mechanical ventilators in the hospitals, which forced surgeries to be postponed at times. Our study also showed a longer post-operative stay than other African study [18], but showed comparable result with Ethiopian study [10]. The possible reason for this could be that the increased number of post-operative complications in our study.

6.4 Functional outcome

Among the 112 patients operated for intracranial meningioma, 32 (28.6%) patients had poor final functional outcome with KPS score of less than 70% and the rest (n=80,71.4%) had good functional outcome with KPS of 70% and above. This functional outcome is slightly inferior to other western studies. A systematic review by Corniola et al to assess functional outcome and quality of life after meningioma surgery which included 8 papers that used KPS as outcome measure (with mean follow up of 6 months to 9 years) showed that 86% of the patients had returned to their normal/pre-morbid level of functioning (including return to work) with favorable outcome with KPS of 70% and above [23]. Another retrospective study by Chan et al assessed morbidity, mortality and outcome after surgically treated intracranial meningioma in 257 patients with average follow up of 9 years, showed 87% patients had good functional outcome with KPS of 70 % and above [25]. A prospective study done in Norway by Konglund et al. assess mortality, morbidity and the functional outcome following intracranial surgery in elderly patients (age ≥ 60 years), 57 patients included in the study and showed that 70 % of their patient had KPS ≥ 80 at 6 months follow up [28]. Our study is in sharp contrast with study done in Ethiopia by Laeke et al in which their study showed only 43% of patients showed KPS of 70% and above with mean time of follow-up was 36.4 days [10]. This significant difference with the same country (set up) may be due to we are being more conservative by applying maximal safe resection rule, in our cases only 63.4% of patients had GTR where as according to Laeke et al [10] they achieved GTR for 82.4% of their cases out of 91 patients. Another possible reason

may be this study is done a decade later and might show the progress of neurosurgery in Ethiopia.

According to multivariate analysis of binary logistic regression the presence of preoperative neurologic deficit and post-operative complications were an independent predictor of poor functional outcome in this study. Those patients who had preoperative focal neurologic deficit were having 9.067 times more likely to have poor functional outcome than those who presented without focal deficit (AOR=9.067, 95%CI:1.025,82.705 and p value of 0.041). Patients who had post operative complications were 4.906 times more likely to have poor functional outcome compared to those patients who had no postoperative complications (AOR=4.906, 95%CI:1.568,15.350 and p value of 0.006). These findings are in line with other previous researches [23,25-28].

Although re-operation for complications and the presence of tumor recurrence did not show significant correlation on multi variate analysis in this study, they had significance on bivariate analysis with p value of 0.09 and 0.01, respectively. This association is showed in different studies [23,26,27].

However this study didn't show significant association between age, tumor size, tumor location, extent of resection & WHO grade with functional outcome. This does not go with some studies which showed increased age (age ≥ 70 years), larger tumor size, skull base location, subtotal resection and higher WHO grade were associated with poor functional outcome [23,25,26,27]. There are studies also that support our finding where age does not affect functional outcome. A Konglund et al study in elderly patients (age ≥ 60 years), 57 patients included showed that 70 % of their patient had KPS ≥ 80 at 6 months follow-up [28]. Similarly, a study in Ethiopia by Laeke et al on 91 patients showed that only tumor size ≥ 5 cm had significant association with poor functional outcome and tumor location, WHO grade, extent of resection and age were not predictors of outcome like our study [10].

7.Limitation of the study

The retrospective nature of the study was associated with inherent problems related to data quality and lower chart retrieval rates. We have tried to mediate these problems by using in person interviews or in-depth phone interviews to calculate KPS score. Even though different studies showed that pre-operative functional status affects final outcome, this study could not compare pre and post-operative KPS due to lack of documentation on pre-operative functional status of patients on chart.

The other major limitation was the small sample size (n=112) that we had to work with. This is smaller than the calculated sample size.

8.Conclusion:

Our study showed the relatively higher occurrence of intracranial meningioma in patients 4th and 5th decade of life. Meningioma is common in female with female to male ratio 2.6:1. Convexity, parasagittal and sphenoid wing meningiomas were the most common meningioma based on location. Most patients had tumor size greater than 5 cm. Gross total resection (Simpson grade 1 to 3) was achieved for 71 patients (63.4%). 90% of patients had WHO grade 1 meningioma with Meningothelial type histology being the commonest (56.3%). Surgical mortality was relatively 4.5% lower compared with other similar setups. 71.4% of patients had good functional outcome with KPS of 70% and above. This shows the beneficial role of meningioma surgery in a resource-limited setup with room for further improvement. The presence of preoperative focal neurologic deficit and Post operative complications were an independent predictor of poor functional outcome. Age, tumor size, WHO grade, extent of resection and tumor location did not affect functional outcome in this study.

Despite the mentioned limitations, the researchers believe this study provides credible contributions and shows neurosurgical practice in resource limited set up, sub-Saharan Africa

9.Recommendations

Based on our findings, we recommend surgery with maximal safe resection be used in patients with intracranial meningioma.

Emphasis need to be given to early intervention before patients develop significant neurologic deficit preoperatively to achieve a better long term functional outcome. In this regard, physicians working in a primary care setting need to familiarize themselves with brain tumors particularly meningiomas in order to facilitate early diagnosis and referral of these patients. Health sector organizations should also work on community awareness about brain tumor so that patients can come early while they have generalized symptoms.

Emphasis should also needs to be given to decrease post operative complications such as post op hematoma collection, post operative infection, new postoperative neurologic deficits which affects functional outcome. We recommend the use of hemostatic agents to decrease post op hematoma collection. Appropriate infection prevention strategies have to be applied in patients throughout their hospital stay and intraoperatively. Intra operative neuromonitoring and modern microsurgical instruments will help to decrease new post operative neurologic deficit.

We also encourage future large scale multicenter prospective studies to be done on this arena. This will answer many provoking questions raise by this research, including why post operative wound infection is higher in our center.

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Annex I- Data collection format (Questionnaires)

I SOCIO-DEMOGRAPHICS

1. MRN_____
2. Age_____
3. Sex_____
4. Phone number: _____

II Pre-op status

1. Clinical findings

Clinical presentation	Mark right if pt has the mentioned symptom
Headache	
Vomiting	
Cranial nerve palsy (mention the nerve 1 to 12)	
Paresis/pelagic	
Seizure	
Change in mentation	
Incontinence	
Aphasia	
Pre-OP KPS	
Others (hormonal problem, balance problem....)	

2. Duration of symptoms (time in which earliest symptom seen) in months _____

3. Pre op managements

3.1 For how long pt was on steroid pre op

☐ Not on steroid ☐ < 1week ☐ 1 to 2 weeks ☐ > 2weeks

3.2 Pre-Op anticonvulsant ☐ Prophylaxis ☐ Therapeutic

3.3. Anticonvulsant type ☐ Phenytoin ☐ Others

3.4. Comorbidities ☐ DM ☐ HTN ☐ Cardiac illness ☐ Asthma

☐ Others mention

4. Tumor characteristics

4.1 Tumor size on pre op image ☐ < 3 cm ☐ 3 - 5 cm ☐ > 5cm

4.2 Edema on pre op image ☐ Yes ☐ No

4.3 Location of the tumor

Location	Mark right
Convexity	

Parasagittal	
Falx	
Olfactory groove	
Planum sphenoidale	
Tuberculum Sellae	
Medial sphenoid wing /clinoidal	
Middle and lateral sphenoid wing	
Spheno orbital	
Cavernous	
Tentorial	
Foramen magnum	
CPA	
Cerebellar convexity	
Peritorcular	
Falcotentorial	
Petroclival	
Meningiomas of the Temporal Bone	
Pineal region	
Ventricular	
Multiple meningioma	mark double right on the operated and single right on the non operated
Others (mention)	

4.4 Extent of resection by Simpson grading

☐ Grade 0 ☐ Grade 1 ☐ Grade 2 ☐ Grade 3 ☐ Grade 4 ☐ Grade 5

4.5 Tumor histology

WHO Grade	Subtype (circle the type)
Grade 1	Meningothelial
	fibrous (fibroblastic)
	transitional (mixed)
	Psammomatous
	Angiomatous
	Microcystic
	Secretory
	Lymphoplasmacyte rich
	Metaplastic
Grade 2	Chordoid
	clear cell(intracranial)
	Atypical
Grade 3	Papillary
	rhabdoid (see text)
	Anaplastic

4.6 If Histology showed WHO 2/3, Was the patient referred for radiotherapy

☐ Yes

☐ No

4.7 If yes does the patient get radiation treatment ☐ Yes ☐ No

III SURGICAL TREATMENT

1. Mode of surgery ☐ Elective ☐ Emergency

2. Estimated blood loss in ml _____

3. Intra operative systolic blood pressure record < 90 mmhg ☐ Yes ☐ No

4. Patient transfused ☐ Yes ☐ No

5. Duration of the anesthesia in hrs _____

6. Intra OP death ☐ Yes ☐ No

7. If yes for question 6 ,what was the cause of intra OP death

☐ Hemorrhagic shock ☐ Air embolism ☐ Sudden Cardiorespiratory arrest

☐ Others mention _____

IV Post-op period and follow up

1. Was patient re operated ☐ Yes ☐ No

2. If yes what was the indication

☐ Post - OP hematoma collection ☐ Post OP infection ☐ Residual tumor

☐ PACK removal ☐ Hydrocephalus ☐ CSF leak

☐ Cranioplasty ☐ others mention _____

3. Post OP morbidity

☐ Wound infection ☐ New cranial nerve palsy (1,2,3,4,5,6,7,8,9,10,11,12)

☐ Post op seizure ☐ Worsening of motor function

☐ DVT ☐ HAP

☐ Bed sore ☐ Post Op aphasia ☐ others mention _____

4. Neurologic condition at final follow up

A. Motor function ☐ Improved ☐ Same ☐ Deteriorated

B. Cranial nerve function (1,2,3,4,5,6,7,8,9,10,11,12)

☐ Improved ☐ Same ☐ Deteriorated

C. Aphasia ☐ Improved ☐ Same ☐ Deteriorated

5. Did the patient get physiotherapy service (for patients with paresis/plegic)

☐ Yes ☐ No

6. Did the patient get speech therapy service ☐ Yes ☐ No

7. Pre-OP stay in days _____ 8. Post OP stay in days _____ 9. Total stay in days _____

10. Death within 30 days ☐ Yes ☐ No

11. If dead within 30 post op days, what was the cause of death

☐ Increased ICP ☐ Bleeding ☐ Sepsis ☐ Meningitis
☐ HAP ☐ PTE ☐ Sudden cardiac arrest ☐ Others mention _

12. Recurrence diagnosed on follow up image ☐ Yes ☐ No

13. Duration of follow up in months _____

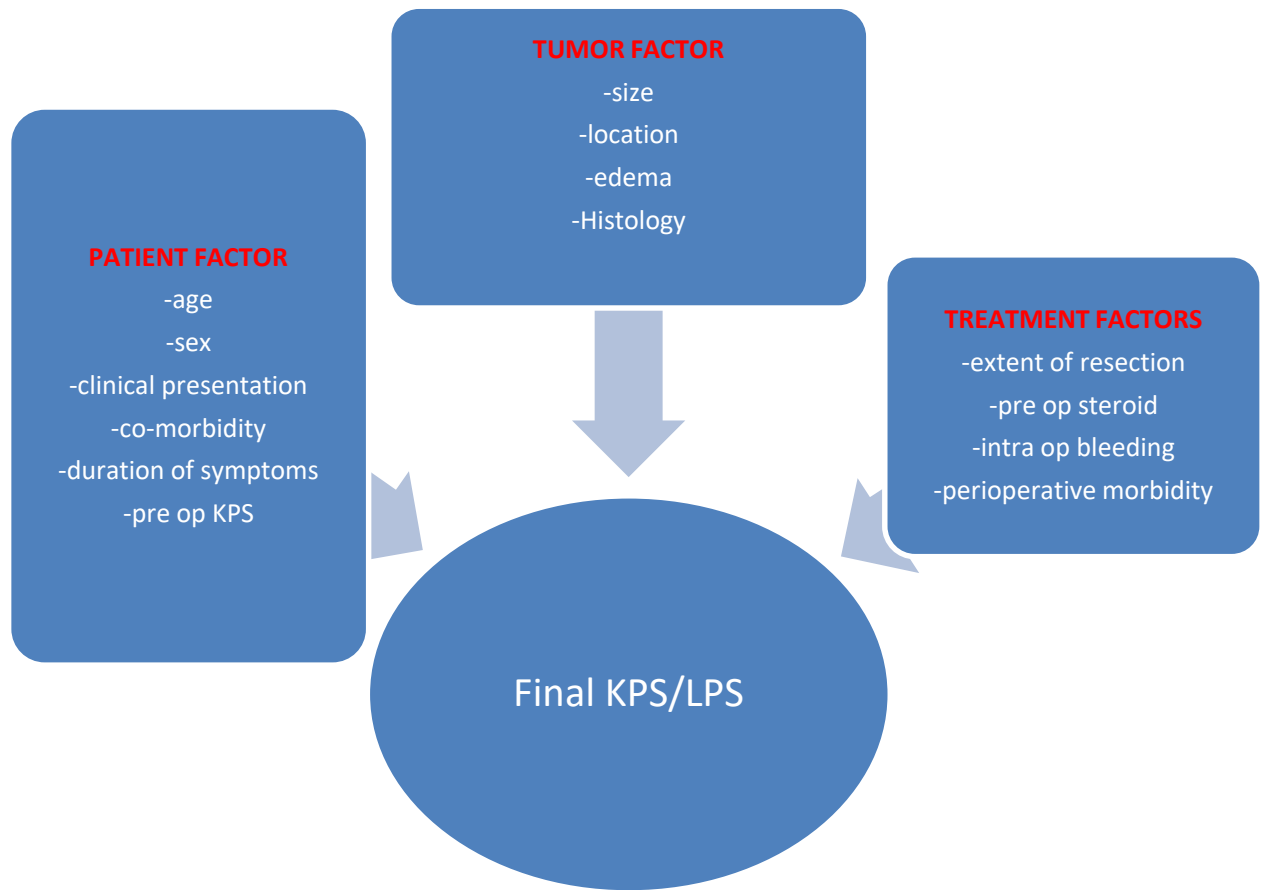
14. Current KPS/LPS scale (use the following algorithm to ask KPS/LPS, 0 to 100) _____

Proposed algorithm for KPS/LPS questioning

Initial questions	Follow-up questions		Symptom characterization	KPS /LPS%	Comments
Is the patient able to carry on with his/her normal work or activity? YES → NO → Is the patient bedridden for more than half a day? YES → NO →	A	Does the patient have symptoms (pain, loss or gain of weight, reduced energy etc.)	No symptoms	100	Normal, no complaints, no evidence of disease
			Mild symptoms	90	Able to carry on normal activity, minor signs or symptoms of disease
			Moderate symptoms	80	Normal activity with effort, some signs or symptoms of disease.
	B	Does the patient need assistance? (Grooming, food intake, dressing, other daily activities)	No assistance	70	Cares for self, unable to carry on normal activity or to do active work.
			Occasional assistance	60	Requires occasional assistance, but is able to care for most of his needs
			Considerable assistance.	50	Requires considerable assistance and frequent medical care
	C	What is the patient's degree of disability in terms of bed confinement?	Bedridden in more than 50% of the time.	40	Disabled, requires special care and assistance.
			Almost completely bedridden.	30	Severely disabled, hospitalization is indicated although death not imminent.
			Completely bedridden and dependent upon extensive nursing care by professionals and/or family.	20	Hospitalization necessary, very sick, active supportive treatments necessary
			Completely bedridden and comatose or barely arousable.	10	Moribund, fatal processes progressing rapidly
			Dead.	0	Dead

(Source: Péus et al. BMC Medical Informatics and Decision Making 2013, Page 5)

Annex II: conceptual framework



Assurance of Principal Investigator

I the undersigned agree to accept all responsibilities for the scientific and ethical conduct of the research project. I declare that this is my original work and has not been presented in this or any other institution and all sources of materials used for this Student Research Report Project have been duly acknowledged. I will provide timely progress report to my advisor and seek the necessary advice and approval from my primary advisors in the course of the research. I will communicate timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of the student: _____

Signature: _____

Date: _____

Approval of the Primary Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

Approval of the Primary Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

