Clinical Outcome of Operated Intracranial Meningiomas: An Ethiopian Experience

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BACKGROUND: **Intracranial meningioma is the most common brain tumor operated in the 2 teaching hospitals in Ethiopia. This study reviews the clinical outcome of intracranial meningiomas in a resource-limited setup.**

METHODS: **This is a retrospective study undertaken at 2 neurosurgical teaching hospitals: Black Lion Specialized Hospital and Myungsung Christian Medical Center. It includes all operated patients with intracranial meningioma during the time period January 2009 to December 2013. Patient data regarding sociodemographics, presenting complaint, focal neurologic deficit, preoperative imaging, postoperative neurologic findings, intraoperative findings, and histopathologic results were collected and analyzed.**

RESULTS: **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 <3 cm (5.1%). Tumor size was shown to be related to postoperative 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.**

CONCLUSIONS: **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.**

INTRODUCTION

Meningiomas are the most common extra-axial intracranial neoplasms, accounting for 13%–26% of all intracranial 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.[2]

Convexity, sphenoid ridge, and parasagittal 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 is targeted toward having minimal surgical-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.

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.

Our study evaluated the short-term outcomes and postoperative complications of meningioma surgery in the 2 teaching hospitals in Ethiopia.

Key words
- Intracranial meningioma
- Karnofsky score
- Resource-limited setup
- Tumor size
- WHO grading

Abbreviations and Acronyms
CI: Confidence interval
CT: Computed tomography
ICU: Intensive care unit
KPS: Karnofsky Performance Status Scale
MRI: Magnetic resonance imaging
WHO: World Health Organization

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MATERIALS AND METHODS

This is a hospital-based retrospective review of patients who underwent craniotomy in Black Lion Specialized Hospital and Myung Sung Christian Medical Center between January 2009 and December 2013. Both hospitals are the main sites where major neurosurgical procedures in general and tumor surgery, in particular, are done. All patients operated for recurrent meningiomas were excluded from the study.

Data regarding sociodemographics, presenting complaints, focal neurologic deficit, preoperative imaging, functional status, histologic subtype, extent of tumor resection, size of tumor, postoperative neurologic findings, and mortality were collected from patients' medical records and death summaries.

Tumors are classified according to location and size based on preoperative imaging, clinical assessment, and intraoperative findings. Patient follow-up was traced from patient's medical records and a computerized data registry system. Patients were contacted through telephone and asked about their functional status.

Preoperative Assessment

Prior to the day of surgery, the responsible physician evaluated patients' clinical presentation and performance status using the KPS score, where 10 is the lowest and signifies the most severe form of disability and 100 is the highest and signifies normal with no complaints.

The responsible anesthesia team before surgery also evaluated and optimized the patient to fit surgery. Baseline investigations done preoperatively included preoperative imaging, computed tomography (CT) scan, and/or magnetic resonance imaging (MRI). The images were used to characterize the tumor based on location and size.

Most patients were put on intravenous dexamethasone preoperatively, regardless of the extent of brain edema. Some patients were also given prophylactic anticonvulsants or continued with anticonvulsant treatment. All patients were given prophylactic antibiotics.

Anesthesia Techniques

Preanesthetic evaluation was done 1 day before surgery. Blood was cross matched and prepared beforehand.

Patients were given general anesthesia. Induction of anesthesia was done with propofol 2–3 mg/kg, and maintenance of anesthesia was continued with 1 mg/min of continuous propofol infusion and isoflurane <1 mean alveolar concentration.

Blood transfusion was administered after a patient bleeds more than allowable blood loss, which was calculated as the difference between patients' hematocrit and target hematocrit divided by the patients' hematocrit multiplied by the total blood volume.

Surgical Techniques

Patients were positioned according to the site of the tumor after localization of tumor was made. Localization was made using mainly craniometric surface landmarks. Stereotactic neuronavigation was not available and not used in all surgeries. Three-point head fixation was used for all posterior fossa and skull base tumors. Skin was prepared and draped after strict antiseptic technique. Scalp flap was made, and bone was drilled open using a manual drill. Bone was cut open using a Gigli saw. Bleeding points on dural surfaces were cauterized before opening.

Intraoperative Hemostasis Technique

Different hemostasis techniques were used intraoperatively. Hemostasis agents, such as surgical gel foam and bone wax, were not routinely available. Visiting volunteer neurosurgeons brought all the hemostat agents used. Hydrogen peroxide–soaked gauze and cottonoids were used routinely to pack bleeding sites.

Dural Closure

Closure of dura was made primarily in a watertight manner. If primary dural closure was difficult, duraplasty was made using either pericranial tissue or tensor fascia latae.

Postoperative Assessment

After surgery, extent of surgical resection was determined from the surgeon's intraoperative judgment, which was retrieved from the operation's notes. Postoperative imaging was also used to see the extent of resection in those patients having postoperative imaging. Postoperative CT scans were ordered for all patients. However, some patients do not have postoperative CT scans because of financial constraints. Based on these findings, extent of surgical resection was estimated using the Simpson grading system.

Intensive care unit (ICU) care was decided according to the duration of anesthesia and the relative risk of the operation depending on the tumor location. It was impossible to admit all operated patients to the ICU because of resource limitations. Postoperative neurologic and medical conditions were recorded to detect any complications related to the procedure done. Patients were discharged with improvement from the ward after postoperative complications were ruled out. Surgical mortality was defined as all deaths occurring while under the care of a neurosurgeon and deaths before discharge.

Clinical Follow-Up

Patients were appointed to a neurosurgical clinic for follow-up after discharge. The follow-up pattern was recorded. Patients were also asked through telephone calls about symptoms they experienced, if any, and their functional status. Functional status was measured using the KPS. The best KPS score achieved was recorded. The progress of clinical symptoms and new neurologic findings were also noted.

Histopathologic results were collected from the pathology department. Accordingly, if the results showed WHO grade 2 or 3 subtype, patients were given whole brain radiation therapy.

Statistical Analysis

Patient sociodemographic data, clinical history, imaging findings, mortality, histopathologic tests, and outcome were analyzed after collecting the data using a structured pretested questionnaire. Data analysis was performed using IBM SPSS Statistics Software 21 (IBM, New York, USA). The χ^2 test was used to assess association between variables. $P < 0.05$ was considered statistically significant. Odds ratio with 95% confidence interval (CI) was used to assess the degree of association.

RESULTS

Patient Characteristics

A total of 91 patients operated for intracranial meningiomas were enrolled in the study, of which 58 (63.7%) were operated at Black Lion Specialized Hospital and 33 (36.3%) were operated at Myung Sung Christian Medical Center. All had pathology-proven meningiomas of different grades. Sixty-four patients (70%) were women, and 27 (30%) were men. The mean age at presentation was 39.7 ± 12.6 years, with a range from 12 to 75 years (Table 1).

Clinical Presentation

The most common presentation symptom was headache in 87 patients (95.6%) (Table 2), followed by cranial nerve palsy in 43 patients (47.3%). Optic nerve palsy was the most common cranial nerve deficit, with 33 patients (36.3%) having visual complaints. Anosmia was found in 5 patients (5.5%), and facial palsy in 5 patients (5.5%).

Thirty-seven patients (40.7%) had weakness of the extremities. Seizure was evident in 31 patients (34.1%). Altered mentation was a presenting symptom in 10 patients (11%), whereas 10 patients (11%) had incontinence as their presenting symptom. The KPS score was ≤60 in 61 patients (67%), whereas 30 patients (33%) had a KPS score ≥70.

Of 91 patients, 16 (17.6%) had comorbidities such as diabetes mellitus (n = 5; 31.25%), hypertension (n = 5; 31.25%), and bronchial asthma (n = 5; 31.25%). Only 1 patient (6.25%) was known to have depression on psychiatric evaluation.

Preoperative Imaging Modalities

All patients had CT scan and/or MRI. CT scan was the most common imaging modality in 49 patients (53.8%). Fifteen patients (16.5%) had both CT scan and MRI, and 27 (28.6%) had only MRI as the imaging modality.

Table 1. Sociodemographic Characteristics of Operated Patients for Intracranial Meningioma Between January 2000 and December 2013

Characteristics	Value
Sex	
Female	64 (70)
Male	27 (30)
Age (years)	
10–20	5 (5.5)
21–30	19 (20.9)
31–40	31 (34.1)
41–50	21 (23.1)
51–60	10 (11.0)
>60	5 (5.5)
Mean age ± SD (range) (years)	39.7 ± 12.6 (12–75)

Values are number of patients (%) or as otherwise indicated.

Preoperative Medications

Ninety patients (99%) were put on preoperative steroids and maintained on steroids postoperative with gradual tapering. Prophylaxis anticonvulsants were given for 7 patients (7.7%), whereas 24 of the 31 patients (77.4%) with a history of preoperative seizure were put on anticonvulsant treatment.

The anticonvulsant drug of choice was phenytoin, which was given 1 g loading dose orally and continued with a maintenance dose of 100 mg orally every 8 hours.

Tumor Characteristics

Based on the preoperative imaging reports and the surgeon's intraoperative observation, tumors were characterized depending their size and location. Diameters of the tumors were <3 cm (n = 4, 5.1%), 3–5 cm (n = 24, 30.4%), and >5 cm (n = 51; 64.6%). Convexity meningioma was the most common tumor in 31 patients (34.1%), followed by sphenoid wing meningioma in 22 patients (24.2%). Parasagittal, olfactory grove, and falx meningiomas were seen in 11 (12.1%), 9 (10%), and 5 (5.5%) patients, respectively, while sellar, parasellar, and clinoidal meningiomas together constituted 6 (6.6%) of the cases (Figure 1).

Meningiomas were also classified based on their histopathology (WHO 2007 grading system) (Table 3). Sixty-seven patients (73.6%) had WHO grade I meningioma. Meningothelial subtype constituted for 34 (37.3%) of all the cases. Five patients (5.5%) had WHO grade II meningioma, of which chordoid subtype was the most common in 3 patients (60%). WHO grade III meningioma was found in 2 patients (2.2%). Seventeen patients (18.7%) had no specified grade.

Tumor removal was graded based on the Simpson grading system (Table 4). Grade I removal was achieved in 14 patients (15.4%), whereas grade II removal was possible in 55 patients (60.4%). Grade III and IV tumor removal was done in 16 (17.6%) and 6 (6.6%) patients, respectively.

Surgical Morbidity and Mortality

Twelve patients were reoperated (13.2%). Of these, 6 (50%) had sphenoid wing meningioma, and 5 (41.7%) had convexity meningioma. The remaining 1 (8.3%) had falx meningioma. Tumor location was strongly associated with reoperation (95% CI,

Table 2. Clinical Presentation of Operated Patients for Intracranial Meningioma Between January 2000 and December 2013 (N = 91)

Clinical Presentation	Number of Patients (%)
Headache	87 (95.6)
Cranial nerve palsy	43 (47.3)
Paresis	37 (40.7)
Seizure	31 (34.1)
Change in mentation	10 (11.1)
Incontinence	10 (11.1)
Aphasia	5 (5.5)

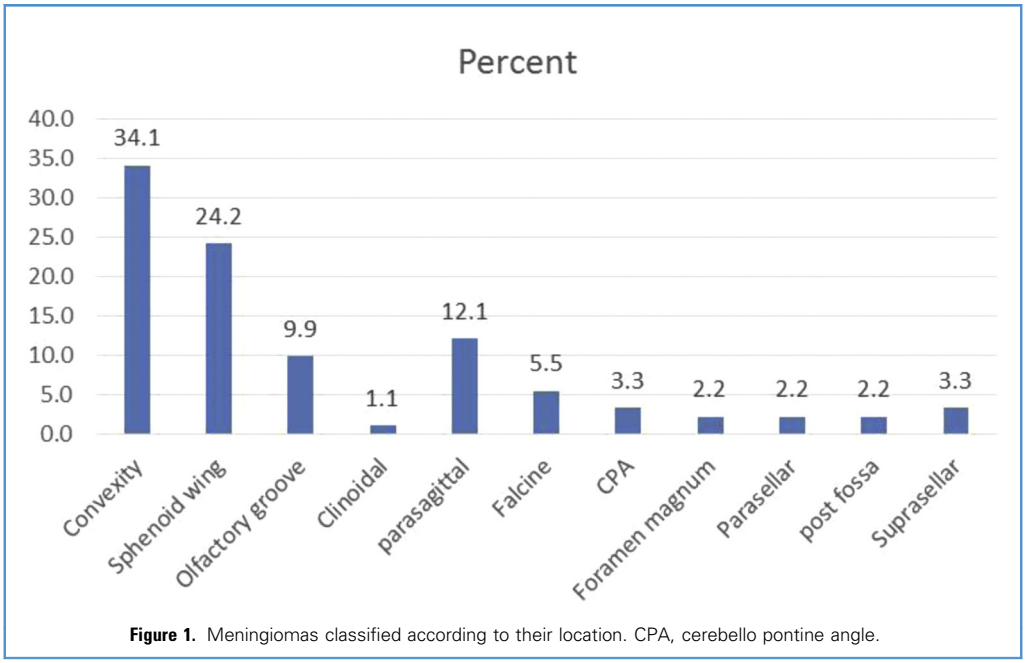

Figure 1. Meningiomas classified according to their location. CPA, cerebello pontine angle.

1.101–13.634; P = 0.035). Hematoma collection was the most common indication, in 3 patients (25%), out of which 2 patients (16.7%) had extensive intraoperative bleeding, which forced the operating surgeon to pack the bleeding site with cotton patties and reoperate the patients after a few days. Two other patients (16.7%) required reoperation for postoperative infection. Hydrocephalus, cerebrospinal fluid leak, and residual tumor removal were indications in 1 patient (8.33%) each. Cranioplasty was done for 2 patients (16.7%), for whom grade I resection of tumor was performed.

The mean inpatient preoperative hospital stay was 11.7 days, with a median stay of 6.5 days (range, 1–63 days). The average patients' hospital stay (pre- and postoperative) was 21 days (range, 5–156 days).

Thirteen patients died within 30 days of surgery, with a surgical mortality rate of 14.3%. Eleven of the patients (84.6%) were <50 years of age. All of the deaths were in patients with a tumor size >5 cm. Of those who died, 7 patients (54%) had sphenoid wing meningioma and 2 (16.66%) had cerebello pontine anglemeningioma. Postoperative intracranial pressure increment with fast deterioration was attributed as a cause for mortality in 5 of 13 patients (38.5%), whereas intracranial rebleeding with increased

Table 3. Histologic Subtypes of Operated Intracranial Meningiomas of Operated Patients for Intracranial Meningioma Between January 2000 and December 2013 (N = 91)

Grade	Subtype	Number of Patients	%
Grade 1	Meningothelial	34	37.3
	Fibrous	14	15.3
	Transitional	3	3.3
	Psammomatous	1	1.1
	Unspecified	6	6.6
	Mixed	9	9.9
Grade 2	Atypical	1	1.1
	Chordoid	3	3.3
	WHO grade II with unspecified subtype	1	1.1
Grade 3	Anaplastic	1	1.1
	WHO grade III with unspecified subtype	1	1.1
	Meningioma with no grading	17	18.7

WHO, World Health Organization.

Table 4. Extent of Tumor Resection and Size of Tumor in Operated Patients for Intracranial Meningioma Between January 2000 and December 2013

	Tumor Size			
Simpson Grading	<3 cm	3–5 cm	>5 cm	Number of Patients (%)
I	2	2	8	12 (15.2)
II	2	19	29	50 (63.3)
III		2	11	13 (16.5)
IV		1	3	4 (5.1)
Total				79 (100)

intracranial pressure was the cause in 2 patients (15.4%). Sepsis, meningitis, and hospital-acquired pneumonia were incriminated in 3 (23.1%), 2 (16.66%), and 1 (8.33%) patients, respectively. Three patients developed sudden cardiorespiratory arrest (2 operated for cerebello pontine angle meningioma and 1 operated for sphenoid wing meningioma). Five patients (5.5%) developed postoperative wound infection. Of the 87 patients with recorded preoperative motor function, 34 (39.1%) had weakness in >3 major muscle groups. Preoperative motor function was compared with postoperative status: improvement in motor function was evident in 24 out of 34 patients (70.5%), 9 (26.5%) had the same motor function as preoperative, and 1 (2.9%) had worsening of weakness. Fifty of the patients (57.5%) had no detectable paresis both pre- and postoperative. Of the 33 patients (36%) with visual impairment, 6 (18.2%) had improvement.

Out of the 91 patients, 10 (11%) developed postoperative seizure. Of these, 6 patients (60%) had seizure as their major complaint. They developed seizure despite administration of the anticonvulsant drugs preoperatively. There was a significant association between preoperative seizure history and postoperative seizure ($P = 0.001$). One of the patients (10%) developed new-onset seizure postoperatively despite the prophylactic anticonvulsant given. Three patients (30%) that developed postoperative seizure were not put on prophylactic anticonvulsants.

KPS score was recorded for all patients. Thirty-four patients (37.4%) showed improvement in their KPS score, whereas 38 (42%) had the same pre- and postoperative KPS score. Six patients (6.6%) had deterioration in their KPS score. Four of the 6 patients (66.7%) with a deteriorated KPS score had a tumor size >5 cm. Tumor size had a significant association with functional outcome (95% CI, 1.029–23.507; $P = 0.032$). The odds of deterioration in patients with tumor size >5 cm (95% CI, 1.029–23.5) are 5 times that of patients with tumor <5 cm.

Of the 16 patients with comorbidities, 2 (12.5%) had deterioration in their KPS score, whereas 4 (5.3%) deteriorated among the 75 patients with no comorbidities. The association of comorbidities with KPS outcome was not significant ($P = 0.655$).

Sixty-five patients (71%) appeared for their first follow-up. The mean time of follow-up was 36.4 days (median, 25 days; range, 2–224 days). Forty-one patients (63%) came within 30 days of the operation.

DISCUSSION

Ninety-one patients with pathology-proven meningioma were enrolled in the study. There was female predominance, which is similar to Wiemels et al.[2] The age of patients showed uneven distribution, 83.5% and 91.2% of patients were <50 and 60 years of age, respectively, and the peak incidence was in the age group of 31–40 years (34.1%); this finding is in agreement with many studies and authors who reported that incidence peaks at 45 years of age and the third to sixth decade of life.[1,2,10-13]

Headache was the most common presentation, which is in agreement with Maurice-Williams and Kitchen[14] and other similar studies,[11] followed by cranial nerve palsy, weakness, seizure, altered mentation, and incontinence, in decreasing order of frequency.

Our study showed a significant association between pre- and postoperative seizure, which is different from other studies.[15]

Most patients (67%) were admitted with a low performance status (KPS score <70), and 33% had a KPS score ≤40. These figures confirm that our patients came at an advanced stage compared with other studies. Postoperatively, 41% showed improvement in KPS score. Another 41% had the same KPS score as preoperative status. However, 3.3% deteriorated and 15% died within a month of surgery. Of those patients with a preoperative KPS score ≥70, 9 (30%) improved, 13 (43.3%) had the same KPS score, 3 (10%) deteriorated, and 5 (16.7%) died. Thirty-eight of the 88 patients (43%) achieved a postoperative KPS score ≥70.

Most meningiomas were >5 cm (64.6%) in diameter, which is similar to the findings in an African setup.[16] The size of the tumor was strongly associated with postoperative functional outcome ($P = 0.032$). The odds of deterioration of patients with a tumor size >5 cm was 5 (95% CI, 1.029–23.507). These findings strengthen previous results of similar studies.[11,17,18]

Based on the tumor site, the most common meningiomas were convexity and sphenoid wing. This result is in sharp contrast with other studies, which might be attributed to the early stage of neurosurgical practice in our setup.[11,17]

Most patients (60%) had Simpson grade II tumor resection, whereas 15.4% had grade I resection. Grade III and IV resections were possible in 17.6% and 6.6%, respectively. Among patients ($n = 51$) with a tumor size >5 cm, 72.5% had grade I or II resection, and the rest had grade III or IV resection. Grade I and II resections were achieved in 87.5% of patients with a recorded tumor size <5 cm.

In agreement with other studies, ours also showed a WHO grade I meningioma predominance, with the most common subtype being meningothelial.[2,16] Five patients (5.5%) had grade II meningioma, with chordoid type found in 3 patients. Grade III meningioma was found in 2 patients (2.2%).

Preoperative inpatient hospital stay was long. This is because of scarce ICU space and mechanical ventilators in the hospitals, which forced the surgery to be postponed now and then. Our study showed a longer average duration of inpatient stay compared with other similar African studies.[17] Postoperative stay was also long. Patients traveled far from the hospital and usually stay long before they are discharged home.

Surgical mortality rate was 14.3%, which was relatively higher than other studies.[17,19] The most common cause of death was increased postoperative intracranial pressure with fast deterioration, followed by postoperative infection with sepsis. Postoperative wound infection was diagnosed in 5 patients (5.5%). This shows a relatively smaller figure than a retrospective study done in a larger population group in 1984 in Canada.[11] All patients who died had a tumor size >5 cm. This finding substantiates the fact that outcome is associated with tumor size.

Among patients with preoperative weakness, 70.6% showed improvement and visual improvement was witnessed in 18.2%.

Twelve patients (13.2%) were reoperated, with the most common indication being postoperative hematoma collection, which was evident in 3.3% of all operated patients. Previous studies give different figures on the rate of postoperative hematoma collection, ranging from 6% to 20%. Intraoperative bleeding which necessitated packing with cotton patties and second-look surgery for removal of the cotton patties was an indication for reoperation in 2 patients (2.2%). Two patients (2.2%) were reoperated with an indication of postoperative infection.

Hydrocephalus, postoperative cerebrospinal fluid leak, and residual tumor removal were the other indications for reoperation, constituting 1.1% each among all operated patients.

Patients after discharge were appointed for a serial postoperative follow-up to assess their progress. Of all operated patients, 71% appeared for their first follow-up. Follow-up pattern decreased subsequently, with 42% of all patients coming for second follow-up, and 15.4% coming for third follow-up.

CONCLUSIONS

Our study showed the relatively higher occurrence of intracranial meningioma in patients <60 years of age. Most patients in the study group sought medical attention at a low performance scale (KPS score <70). It has been shown that tumor size is associated with operative outcome. The most common indication for reoperation was postoperative hematoma collection, and sphenoid wing meningioma was the most common meningioma to be reoperated. Surgical mortality was relatively higher compared with other setup studies. Patient selection should be an integral part of the surgical management of integral meningioma because very large skull base meningiomas with poor KPS scores might not be good candidates for surgery with bad postoperative outcome. Most patients had either improvement on their postoperative KPS score or their KPS score was the same as their preoperative KPS score. This shows the beneficial role of meningioma surgery in a resource-limited setup with room for further improvement.

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