Original Article

Management of intracranial meningiomas in Enugu, Nigeria

Wilfred C. Mezue, Samuel C. Ohaegbulam[1], Chikandu A. Ndubuisi[1], Mark C. Chikani,
David S. Achebe[1]

Department of Neurosurgery University of Nigeria Teaching Hospital, [1]Memfys Hospital for Neurosurgery, Enugu, Nigeria

E-mail: *Wilfred C. Mezue - mezuec@hotmail.com; Samuel C. Ohaegbulam - samcohaegbulam@hotmail.com; Chikandu A. Ndubuisi - chikandu@yahoo.com;
Mark C. Chikani - markochikani@yahoo.com; David S. Achebe - sndu2000davej@yahoo.com
*Corresponding author

Abstract

Background: Meningiomas may range on presentation from incidentally identified small lesions to large symptomatic tumors in eloquent areas of the brain. Management options correspondingly vary and include careful observation, surgical excision, and palliative application of very limited therapeutic maneuvers in select cases. This paper discusses the options and difficulties in the management of meningiomas in a developing country.

Methods: This study is a retrospective analysis of prospectively recorded data of patients managed for intracranial meningioma between January 2006 and September 2011 at Memfys Hospital for Neurosurgery, Enugu. Radiographic diagnosis of meningioma was based on computed tomography (CT) and or magnetic resonance imaging (MRI) criteria in all cases, but only patients who had surgery and a histological diagnosis were analyzed.

Results: Seventy-four patients were radiographically diagnosed with intracranial meningioma over the period under review. Fifty-five patients were operated upon and 52 (70.3%) with histological diagnosis of meningioma were further analyzed. Histological diagnosis was complete in 42 (56.8%) patients and in 10 (13.5%) patients the subtype of meningioma was not determined. The male to female ratio was 1:1.08. The peak age range for females was in the 6th decade and for males in the 5th decade. The locations were olfactory groove (26.9%), convexity (21.2%), parasagittal/falx (19.2%), sphenoid ridge (15.4%), tuberculum sellae (7.7%), tentorial (3.8%), and posterior fossa (5.8%). The most common clinical presentation was headaches in 67.3% followed by seizures (40.4%) and visual impairment (38.5%). Histology was benign (World Health Organization [WHO] grade 1) in 39 patients. One patient harbored an atypical and two had anaplastic tumors. Gross total resection of the tumor was achieved in 41 patients. Surgical mortality was 3.9%.

Conclusion: Effective management of meningioma depends largely on adequate and complete surgical resection and results in good outcomes. Adequate preoperative assessment, including visual assessment, and hormonal assessment in olfactory groove and sphenoid region meningiomas, is necessary.

Key Words: Intracranial meningioma, management, outcome, tumors

INTRODUCTION

Meningiomas constitute about 20–30% of primary intracranial neoplasms in Africa[13,17,23,33] and are more common in females.[30] They are extra axial tumors arising from the meningothelial cells covering the brain. It is therefore possible to completely excise them with microsurgical techniques without significant morbidity in the majority of cases. It is generally agreed that surgical resection provides the best possibility of disease control and may result in the best recurrence free survival. It may even provide a cure if resection is complete as in Simpsons grade 1.[34] Histological diagnosis is essential for prognosis and planning of further management. Meningiomas are classified as grade 1–3 based on World Health Organization (WHO) histological criteria.[19,27] Grade 1 lesions are benign and constitute about 90% of all meningiomas.[2] Grade 2 tumors (atypical meningiomas) represent 5–7% and display a number of specific features that predict a more aggressive growth pattern. Grade 3 tumors show clear features of malignancy but account for fewer than 3% of all meningiomas. Various histological subtypes are recognized for each grade [Table 4].

In the cohort of patients followed up over a period of 22 years in Nigeria, recurrence was reported in 11.4% but this was not characterized by histological grade or location.[23] Yang et al. estimated that up to 2% of lower grade meningiomas progress to higher grade over 40–90 month period.[41] Age < 60 years, completeness of surgical resection, and histological grade were all independent prognostic factors for survival.[7]

Adjuvant radiotherapy is used as second tier treatment for recurrent and inoperable tumors. Stereotactic radiosurgery is now increasingly used for incomplete resections and those in anatomically difficult locations.[3] Chemotherapy has proven to be of limited value in meningioma management thus far because of low mitotic activity in most tumors and nontargeted activity and low specificity.[15,22]

This work was done at Memfys Hospital for Neurosurgery (MHN) a private hospital that receives no funding from government or nongovernmental organization (NGO). The hospital is located at Enugu in south-east Nigeria with a population of about 723,000 (2006 National Census).[40] Two other neurosurgical services in the catchment area are located at Public hospitals in the outskirts of Enugu city 15 km away and at Nnewi town, about 80 km to the south. However, MHN currently has the best facilities that include computed tomography (CT), magnetic resonance imaging (MRI), high speed drills, and operating microscope. Complex neurosurgical cases including meningiomas are referred to MHN from the entire south-east and the neighboring states of Nigeria with a catchment population of about 20 million.

Poverty is a major factor that adversely influences patient care all over the world. Neurosurgical investigations and treatment are relatively costly compared with the per capita income in Nigeria currently put at $2500 (WHO).[39] The minimum wage for workers was only recently increased to about N18,000.00 ($120) per month, but many people earn much less than that. The cost of a CT scan is about N40,000 ($300), while the cost of an MRI scan is about $400–600, thereby making them unaffordable to most people. The admission deposit for a major neurosurgical operation is about $3250, while the total cost at time of discharge may be twice as much. Patients often get help from extended family members, friends, NGOs, religious bodies as well as from the hospital itself. At MHN, about 30% of the patients at time of discharge from the hospital are unable to clear their bill.

Patients are referred to MHN from doctors working in public and private hospitals. The hospital has an open door policy and admits patients of all socio-economic status even when they are unable to pay the full admission deposit. These factors notwithstanding, late presentation of patients to the hospital is common and necessary further treatment and follow up are often incomplete.

Availability of resources and cost consideration also affect referral patterns as patients sometimes present without formal referral after having exhausted cheaper alternative therapies such as faith-based healing and traditional medicine. Meningiomas if diagnosed early are potentially curable. The difficulties with their management in Nigeria, apart from insufficient investment in infrastructural support include limited financial resources, lack of a functional health insurance scheme and inadequacy and underutilization of neurosurgical services.[25]

Radiotherapy services are inadequate in Nigeria. At the time of this report there are still only five functional radiotherapy units and no radiosurgery services in Nigeria. There is no radiotherapy service in the entire catchment area of MHN where this study was performed hence patients have to be referred to other distant, out-of-state centers for adjuvant treatment. There is no reported experience with chemotherapy in the management of meningiomas in Nigeria nor are the authors aware of any studies addressing this problem. Only one other study has examined the problems associated with patients diagnosed with meningiomas in Nigeria.[23]

Fiscal and resource difficulties dictate that management of meningiomas in Nigeria remains primarily surgical. The experience at a private neurosurgical hospital in eastern Nigeria is hereby reported.

MATERIALS AND METHODS

This paper is a retrospective analysis of prospectively recorded data of patients managed for intracranial meningioma between January 2006 and September 2011 at MHN in Enugu, Nigeria. The hospital is a privately run, well-equipped neurosurgical center that is accredited for postgraduate training in neurosurgery by the West African College of Surgeons. The analysis considered only patients who had surgery for their tumor. The first two authors operated upon all the patients. Demography, clinical history and duration, imaging findings, operational details, histology, and outcome were analyzed. Tumor location, size, presence or absence of calcification, and peri-tumor edema was determined on imaging. Tumor size was measured as the widest diameter on CT, edema was measured in centimeters, and brain shift was graded as less than 5, 5–10, and >10 mm. Indications for surgery were defined as follows: Patients who are symptomatic or manifested with increasing size of their tumor on serial follow up. Following acute neurosurgical interventions, patients were often transferred to acute or chronic rehabilitation in other hospitals. All patients had anticonvulsants and steroids preoperatively. At discharge steroids were continued and slowly weaned over 4 weeks unless patient is awaiting radiotherapy and anticonvulsants are continued for 18 months. All patients had prophylaxis for deep vein thrombosis. Postoperatively, patients were assessed clinically, functionally using the Karnofsky Performance Score (KPS), and radiologically. Patients were followed up at 6 weeks and 3 months at which time a postoperative MRI scan was done for patients who can afford the cost of the study. Films were reported by the radiologist and reviewed by the neurosurgeon for clinical correlation. Subsequent clinical follow up was yearly. Further MRI was done at 18 months and 3 years where possible. Seventeen patients were followed postoperatively for up to 3 years but only 10 of these had follow-up imaging. Longest continuous follow up period was over 5 years (2 patients) and shortest over 3 months (43 patients). The classification in terms of location was based on preoperative CT and MRI studies. Tumor size was based on the greatest diameter.

Data was entered in SPSS database (IBM SPSS statistics 20). Correlation between prognostic variables (demography, imaging characteristics, surgery, and outcome) was analyzed using chi-square (χ^2), and Pearson's correlation (r).

RESULTS

Demographics and presenting symptoms

Seventy-four patients were diagnosed with intracranial

Table 1: Demographics and location

| | Age | | | | | | | | | |
	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80		
Male	1	-	3	4	9	4	2	2	Male	Female
Female	-	-	1	5	7	11	3	-		
Olf. Groove	-	-	1	1	6	2	3	1	8	6
Convexity	-	-	1	3	3	4	-	-	3	8
Parasag/Falx	-	-	1	4	2	1	1	1	8	2
Sphen Ridge	-	-	-	1	4	3	-	-	3	5
Tubercullum S	1	-	1	-	1	1	-	-	2	2
Post Fossa	-	-	-	-	-	3	-	-	2	1
Tentorial	-	-	-	-	-	1	1	-	-	2

Table 2: Computed tomography findings in patients with Meningiomasw

| Location No. (%) | Tumor Size | | | Other CT Findings | | | | |
| | 1–5 cm | 5–10 cm | > 10 cm | Calcification | Hyperostosis | Peritumor edema (cm) | Midline Brain shift (mm) | |
							5–10	>10
Olf. Grove 14 (26.9)	1	11	2	5	2	8	3	1
Convexity 11 (21.2)	3	8		3	3	9	3	5
Parasag/Falx 10 (19.2)	4	6		4	2	7	3	4
Sphen Ridge 8 (15.4)	2	5	1	3	5	4	2	
Tuberculum 4 (7.7)	2	2		1		1		
Tentorial 2 (3.8)	2					1		
Post Fossa 3 (5.8)	3			1	1	2		

Table 3: Clinical features and time to presentation

Clinical Presentation		Onset of Symptoms to presentation				
Symptoms	No. (%)	<72 hours	3–7 days	7–14 days	14–28	>28 days
Headache	35 (67.3)	2	6	4	9	14
Seizures	21 (40.38)	11	5	2	1	2
Impaired vision	20 (38.5)	1	4	7	5	3
Personality	10 (19.2)	2	1	2	-	5
Hormonal	5 (9.6)			1	1	3
Anosmia	11 (21.2)	-	-	2	6	3
Vomiting	7 (13.5)	-	4	3	-	-
Hemipa resis/plegia	8 (15.4)	-	1	-	5	2
Speech-impairment	6 (11.5)	1	3	1	1	-

Table 4: Tumor characteristics and surgical details

Tumor Characteristics	No.	Extent of Surgical Resection (Simpson's Grade)				Average Duration Surgery (h)	Average Blood Need (Units blood)	Average Length of Hospital Stay (Days)
		S1	S2	S3	S4-5			
<5 cm	17	8	5	4		3	2	13
>5 cm	35	6	7	12	11	5	4	25
Skull Base	29		2	16	11	5	6	27
NonSkull Base	23	14	9			4	3	10

Table 5: Histological diagnosis

WHO Histology Grade	Subcategory	Frequency	Percentage
Grade1	Psammomatous	13	25.0
	Meningothelial	12	23.1
	Fibroblastic	6	11.5
	Angiomatous	4	7.7
	Transitional	3	5.8
	Microcystic	1	1.9
Grade 2	Atypical	1	1.9
Grade 3	Anaplastic	2	3.8
	Meningioma Unspecified	10	19.2

meningioma over the period under review. Of those, 52 (70.3%) patients operated upon, who had histological diagnosis of meningioma, formed the subject of this study. Male to female ratio in this cohort was 1:1.08. The peak age range for females was in the 6th decade and appeared a decade later than for males [Table 1]. The locations were olfactory groove (26.9%), convexity (21.2%), parasagittal/Falx (19.2%), sphenoid ridge (15.4%), Tuberculum Sellae (7.7%), Tentorial (3.8%), and posterior fossa (5.8). There were no differences in location for males and females. Table 2 shows the CT characteristics of tumors in the different locations. Moreover, 70% were reported as isodense to brain, 10% hypodense, and 20%

hyperdense. The widest tumor dimension ranged from 28 to 111 mm (mean 54.2 mm). Most of the larger tumors were in less eloquent areas. About 61.5% had documented edema. Midline shift occurred in 40.4% and was related to presence of edema, tumor size, and location but not to histological type [Table 7].

Table 3 shows the time from onset of symptoms to presentation against the dominant clinical presentation. The most common clinical presentation was headache 67.3% followed by seizures 21 (40.38%) and visual impairment 20 (38.5%). Patients with these symptoms tend to present late after 2 weeks except for patients with seizures that presented earlier. Tuberculum Sellae (TS) and sphenoid region tumors with visual impairment also presented relatively early. Five (9.6%) patients presented with hormonal abnormality. Four of these (three with tumors in the tuberculum sellae (TS) area and one in the sphenoid ridge) presented with prolactinemia and one patient with large olfactory groove tumor presented with diabetes insipidus.

Surgical approaches
Forty-four patients had surgery after initial diagnosis and a further eight patients after an average follow up period of 2 years. Surgical approach for olfactory groove meningioma was subfrontal[8] in 8 (57.1%), and interhemispheric[20] in 6 (42.9%). Pterional approach was used for smaller sphenoid wing meningioma and fronto-

Table 6: Three-year follow-up Outcome (N = 17)

Location	Persisting neuro-deficit	Seizure	Recurrence	Dead	No Imaging	0–30 Adm	0–30 FU	40–60 A	40–60 FU	70–100 A	70–100 FU
Olf Gr (3)		1	1		2	-	-	2	-	1	3
Convex (3)		1		1	1	-	1	1	-	2	2
Parasag (6)	1	1	3	1	2	-	1	3	-	3	5
Sphen (2)		1	1			-	1		-	2	1
Tuber S (2)		1	1			-	1	1	-	1	1
Tent (1)					1	-	-	1	-	-	1
Total		3	5	4	7	-	4	8	-	9	13

(The Karnofsky Performance header spans the last six columns: 0–30 (Adm, FU), 40–60 (A, FU), 70–100 (A, FU))

Two patients with postoperative seizure disorder had recurrence

Table 7: Correlation for prognostic factors

	Location	Size	Edema	Brain shift	Surgery extent	Surgery duration	Blood loss	Histology	Discharge KPS	3 year follow-up	Hospital Stay
Demography											
Age	0.250	0.495	0.451	0.421	0.302	0.023	0.517	0.007	0.492	0.655	0.475
Sex	0.781	0.101	0.205	0.673	0.206	0.827	0.384	0.178	0.320	0.409	0.544
Imaging											
Location		0.068	0.194	0.007	0.000ω	0.017	0.000ω	0.997	0.283	0.495	0.000ω
Size			0.196	0.001ω	0.000ω	0.000ω	0.000ω	0.663	0.081	0.098	0.000ω
Edema				0.000ω	0.502	0.698	0.059	0.554	0.160	0.576	0.952
Brain Shift					0.090 ^	0.070	0.001ω ^	0.338	0.018	0.285	0.533
Surgery											
Surgical extent						0.019	0.000ω	0.109	0.909	0.847	0.000ω
Duration surgery							0.000ω	0.891	0.470	0.128	0.001ω
Histology								0.863		0.077	0.009	0.935

^ Brain shift and blood loss show apparent significance but poor correlation ($\chi^2 P = 0.001$, r $P = 0.643$, s $P = 0.661$), ω significant

temporal access was chosen in the majority of cases with extradural drilling of the clinoid in 3 patients. In patients with parasagittal and falx meningiomas the approach was via a craniotomy extending across the midline with meticulous care for the sagittal sinus. Histological diagnosis was corroborative for meningioma in all patients but the subtype of meningioma was not reported in 10 patients from the earlier series. Among the meningiomas that were fully characterized, WHO grade 1 was the most common histological type found [Table 4].

Outcome

The extent of surgical excision was classified by Simpson's criteria.[34] Gross-total resection (Simpson Grade 1–3) was achieved in 41 (78.8%). Eleven patients presented with large skull base tumors and of these, eight had a subtotal resection only and three had a simple debulking. Table 5 shows the tumor characteristics and surgical details. Patients with large tumors (>5 cm) and or located in the skull base had less complete resection at Simpson's grade 3–5 (P < 0.005, Table 7). The blood loss and duration

of surgery were also more for patients with large tumors (P < 0.005) but duration of surgery was not significantly increased in patients with skull base lesions (P = 0.017). The average length of hospital stay was, however, longer for the both subgroups (P < 0.005).

Patients were either discharged home or to rehabilitation in lower cost centers. Mean length of hospital stay in MHN was 7.5 days. About 84.6% were discharged to home. Six patients (11.5%) were sent to other facilities for financial reasons, four to acute rehabilitation care, and two to long-term rehabilitation for ongoing preoperative morbidity. The size and location of the tumor as well as the duration and extent of surgery significantly affected the length of hospital stay.

Twenty (38.5%) patients presented with visual impairment. Of these 55% reported improvement in vision, 35% reported stabilization without further deterioration, and 10% complained of worsened vision following surgery. Postoperative complications included cerebrospinal fluid (CSF) leak in two patients, infection in one, severe brain

edema in two. There were two postoperative deaths (3.9%), both from severe postoperative brain swelling in the week following surgery. Morbidity was measured using the Karnofsky performance score (KPS). The KPS was >70 on admission in 30 patients and postoperatively in 43. The discharge KPS was not significantly affected by age, sex, imaging characteristics, or surgical factors [Table 7].

The option of radiotherapy was discussed with all 11 patients with skull base tumors and 4 (36.4%) refused the treatment. Six patients had whole brain radiotherapy in centers in Nigeria and one had stereotactic radiosurgery outside Nigeria. During the period of follow-up, one of these patients died, one did not continue follow-up after the first year and the other five had not shown any progression. However, associated morbidity in the form of hair loss was noted in all. Of the four that refused radiotherapy, two showed evidence of tumor progression over a 3-year period of follow-up but there was no clinical or functional deterioration. The other two did not continue follow up after the first visit for uncertain reasons.

Only 17 patients were followed-up for up to 3 years and the outcome is shown in Table 6. Follow up imaging could not be obtained in seven of these patients. Among those with follow up MRI, there were five recurrences/tumor progression but only two were considered significant enough for referral to radiotherapy. None of the patients had a re-operation in MHN. Four patients were known to have died during this period, one from unrelated road traffic accidentterminally managed in MHN, one postradiotherapy patient from pulmonary embolism, and the others based on phoned in reports from family. The cause of death could not be determined with certainty in these two.

DISCUSSION

Surgery remains the mainstay of management for symptomatic or growing meningiomas and complete excision, the desired goal. Complete surgical excision, however, is not always possible without causing significant neurological morbidity even for the benign grade 1 lesions, depending on the location and size of the lesion at the time of diagnosis. Simpson[34] proposed a scheme for grading completeness of resection that is still used today. Surgery in our series was graded accordingly and found to be macroscopically complete in 78.8% of patients, 15.4% had a subtotal (grade 4) resection, and in three3 patients only a Simpson grade 5 resection could be achieved. The extent of resection was dependent on the location of the tumor with Simpsons grade 3 achieved at best for skull base lesions.

Various surgical series have suggested that the classical Simpson's grading may not be applied in all locations especially in the skull base and eloquent areas and have advocated 'maximal safe resection' even for WHO grade 1 meningiomas.[21,31] A more recent review of Simpson's grading for WHO grade 1 meningiomas showed that 5-year recurrence rates did not differ significantly between different Simpson resection grades.[36] In grade 3 meningiomas, gross total surgical resection at initial operation did not result in improved survival and attempts at total resection may result in significant neurological abnormality.[35] With the increasing use of stereotactic radiosurgery and fractionated radiotherapy, maximum safe surgery has become the accepted modality for surgical treatment of meningiomas in selected cases. Knowing these arguments, we still advocate aggressive resection where this can safely be achieved, given the unavailability of adequate radiotherapy support in Nigeria. In addition, there are relatively few neurosurgeons in Nigeria (1 for 10 million of population)[9,24] and a general lack of information about and confidence in the health care system. These factors and limited financial resource[25] dictate that the first surgical opportunity be maximized.

Forty-four (59.5%) patients diagnosed with meningioma in this series had surgical treatment immediately following diagnosis. Operation was delayed in the remaining patients due in part to the inability of patients to afford the treatment immediately and also due to the indications for surgical intervention. It is the practice at MHN to expectantly follow up patients, who present with incidental meningiomas and only recommend surgery if the tumor is increasing rapidly in size or becomes symptomatic. On this basis, a further 8 (10.8%) had surgery over the period of the study.

Most of the patients in this series had grade 1 meningiomas and the predominant locations were in the olfactory groove, the convexity, and the parafalcine regions. Of the olfactory groove meningiomas, 11 were midline and 3 were paramidline.[16] Convexity meningiomas were frontal precoronal in three, and coronal/postcoronal in four. Two were parietal and two parieto-occipital.[11] With careful microsurgical techniques, surgical excision (Simpson grades 1-3) was possible in 78.8% of the patients in this series. The surgical approach to olfactory groove meningioma at MHN has gradually changed from frontotemporal-subfrontal in the past to subfrontal interhemispheric from 2009. This was based on the large sizes of the tumors presenting technical difficulties. This approach has improved completeness of resection from 50% (4 of 8) to 83.3% (5 of 6). No intraventricular meningiomas were documented in this series. Eight patients had sphenoid ridge meningiomas four in the clinoidal region, and three in the middle third of the sphenoid ridge and one laterally. Clinoidal tumors are often difficult to resect completely especially when of large size on presentation as in the cases with involvement of the adjacent optic nerve and the internal carotid artery (ICA) and its branches. For these patients

maximum safe surgery was the goal in spite of the fact that they had separate arachnoid plane between tumor and ICA (Al-Mefty grade 2).[1] Series in the literature report rates of total resection for these tumors from 23% to 50%.[28] These results can be further improved using skull base techniques[38] and like most surgical series, the higher the volume a surgeon or center has performed, the better the results.[4] Although there is enough evidence to suggest that meningioma surgery should be concentrated in centers with higher case loads,[4] this ideal scenario cannot currently be implemented in Nigeria due to the paucity of resources. The two tentorial meningiomas were intermediate in location (T4).[42] The three posterior fossa tumors were located in the cerebellar convexity.[32]

It is essential to plan each surgical approach carefully to enable early intraoperative control of proximal vascular supply.[6] Preoperative embolization is of benefit in selected cases and locations where the blood supply will be difficult to access during surgery.[10] This modality was not available at MHN and in spite of careful planning and meticulous attention to hemostasis, the average transfusion rate of 4–6 units of blood in large tumors in difficult locations remains unacceptably high. However, it has been reported that such embolization can affect the accuracy of the histopathologic analysis following resection.[18] The resulting ischemic and associated cytologic changes after embolization appear similar to changes seen in the higher-grade meningiomas and the pathologist needs to be informed if preoperative embolization has been carried out.[18]

Radiation is used as second-line therapy for managing recurrent or otherwise inoperable intracranial meningiomas. Recurrent malignant meningioma was a particular challenge in one of the cases. We advised radiotherapy following initial surgery for tumors in difficult locations because of anticipated difficulties with follow up and secondary surgery. The acceptance rate to pursue radiotherapy was, however, low. Reasons for this most likely include additional costs, inability to fully understand the importance of such treatment, distance to radiation center, and fear of associated morbidity.[5] It is interesting that among those who refused radiotherapy 50% remained under good control over 3-years follow up, questioning the utility of this practice. One patient with a sphenoid wing meningioma who could afford referral overseas had stereotactic radiosurgery. This modality has assumed an increasing role in tumors in challenging anatomical areas[3] and stereotactic radiosurgery has become an attractive alternative to open surgical resection in select cases.[12,26] This service is still to become available in Nigeria.

Visual improvement was reported in 55% and visual stabilization in another 35%. This is similar to reports from other series.[29,43] Surgical mortality was low in the series at 3.9%. Preadmission morbidity as measured by the KPS was considerable. This could be accounted for on the basis of late presentation. Since seizures are still generally stigmatized, the fact that occurrence of seizures results in earlier presentation than the presence of other symptoms emphasizes the fact that societal pressures can be a great motivator. The Karnofsky score improved postoperatively to over 70 in 13 patients. The mean length of hospital stay was 7.5 days. Transferring patients when appropriate to step down care shortened hospital stay. This was greatly appreciated by patients as it results in cost saving and better support from family. The recurrence rate in this series of 20% over 3 years is higher than previously reported in Nigeria.[23] This is unlikely to reflect the true pattern because of the short duration and incompleteness of follow up. Apart from extent of surgical resection, other factors that may influence recurrence in the series include tumor size and skull base involvement and invasion.[14]

Although health awareness has increased and patients demand and receive more services, the health care costs are still predominantly borne by the individuals and their families. This makes investigations and treatment unaffordable for the majority. Until medical resource availability improves, surgery will represent the best cost-benefit option for patients with meningiomas in Nigeria. Even where resources are not as limited surgical costs although initially higher compared with radiotherapy, tend to balance out over time.[37] Meningiomas are potentially curable and little additional investment in infrastructure will achieve this for majority of Nigerian patients with cranial meningioma. The case for more investment in health infrastructure and the development of a viable health insurance scheme has been argued by Ohaegbulam *et al.*[25]

CONCLUSION

Surgical outcome for the treatment of uncomplicated meningioma is generally good even in resource poor areas. Intervention should be as early as possible in symptomatic cases as size and location of tumor affect completeness of resection. Adequate preoperative assessment, including visual assessment and hormonal assessment in olfactory groove and sphenoid region meningiomas, is necessary. There is a need for increased investment in radiotherapy support in Nigeria.

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