Sphenoid Wing Meningiomas: Surgical Treatment and Outcome in Viet Duc University Hospital, Vietnam

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Abstract

Sphenoid wing meningiomas pose a challenge for radical resection due to its complex anatomy of the sphenoid region. This study objectives were to evaluate the surgical outcome of middle and medial sphenoid ridge meningiomas in Vietnam. A prospective study was conducted from August 2017 to June 2018 in Viet Duc University Hospital, Vietnam. Altogether 14 cases diagnosed with sphenoid ridge meningiomas were included in this study. Median age of the patients was 47-year old (range: 38–55 years old). Medial sphenoid ridge meningiomas accounted for 78.5% of the cases. All patients received surgical treatment. The median size of the tumors was 5 cm (range: 3–6 cm). On CT angiogram, internal and external carotid arteries fed the tumor in half of the cases. Selective embolization was carried out before surgery in 8 cases and 7 cases were successful cases. Simpson grade I, II, III, IV, and V was seen in 2, 2, 1, 8 and 1 cases, respectively. Median karnofsky performance score was 85 at 3 months postoperative. On histological analysis, meningioma grade I, II and III were 9, 2 and 1 cases. One case was seen as atypical meningioma and received adjuvant radiotherapy and showed no recurrence at 6 follow-up months. One mortal case occurred within 24 hours after surgery. One case was fatal in 2 weeks and showed soft palate carcinoma invading the skull base and showed intraparenchymal hemorrhage and brain edema. Hence, this showed that most of the sphenoid ridge meningiomas were grade I on histology. Most cases were managed successfully with no complications but few cases fatal. The radical resection was found appropriate treatment for sphenoid wing meningiomas.

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Introduction

Meningiomas are the most common brain tumors, i.e. 20% of primary brain tumor as well as the most common intradural spinal tumor.[1,2] But the prevalence of subclinical disease in about 1.6% of the population[3] and higher prevalence in older age and female.[4] Most of meningioma are benign, but sometimes they are malignant.[5]

The meningiomas can be classified according to the location: falx and parasagittal (18–25%); convexity (19–34%); sphenoid wing (20%); olfactory groove (10%); suprasellar (10%); posterior fossa (10%); sagittal 3%; intraventricular (2%).[6] Sphenoid wing meningioma was common (15–20%). Menigniomas arised from sphenoid ridge often compress optic nerve, cavernous sinus, and encircle internal carotid artery, and cranial nerve III, IV, V and VI.[7-9]

Clinical manifestations occur gradually and vary depending on its location especially when the huge tumors compress the brain parenchyma, and cranial nerves. Location of tumor is a critical factor and determines the prognosis and treatment options, especially surgical resectability.[10] Spine tumors comprise a small percentage of reasons for back pain and other symptoms originating in the spine.[11] The majority of meningiomas are found in the supratemporal compartment, most commonly along the dural venous sinuses in the cerebral convexity, parasagittal, and in sphenoid wing regions.[11,12] Surgery is the fundamental treatment but radical resection with no neurological deficits has been a challenge. Nowadays, advances in

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the surgical techniques and postoperative radiotherapy has increased the treatment outcome of medial and middle sphenoid meningioma. Determining risk factors for postoperative recovery and prognosis is critical.

In Vietnam, although there is high prevalence of sphenoid meningioma, very few data are available till date. Therefore, this study aims to describe the clinical manifestations and imaging features of medial and middle sphenoid meningiomas and to evaluate surgical outcomes of medial and middle sphenoid meningiomas.

Materials and methods

Study design

A prospective study was conducted from August 2017 to June 2018 in Viet Duc University Hospital, Vietnam. The study objectives were to evaluate the surgical outcome of middle and medial sphenoid ridge meningiomas in Vietnam.

Subject details

Altogether 14 cases diagnosed with sphenoid ridge meningiomas were included in this study. Diagnosis of meningiomas were done from the clinical examination and imaging findings. Out of 14 patients, 7 were males and 7 were females. Median age of the patients was 47-year old (range: 38–55 years old).

Inclusion criteria

Patients diagnosed with sphenoid meningioma based on clinical manifestations and imaging, and agreed to participate in the study

Exclusion criteria

Patients had recurrent or reoperation or multiple meningiomas.

Diagnosis

Diagnosis was done from clinical examination, diagnostic imaging and histological examination.

Treatment received

All patients received surgical treatment.

Statistical analysis

Analysis was done using SPSS Statistics Software (version 18) with the level of significance (α) = 0.05.

Results

Clinical manifestations

Sign and symptoms

The clinical manifestations of the 14 cases showed as headache 71.4 (%), nausea and vomiting (12.3%) and consciousness disorder (12.3%). There was no vertigo, blurred vision, paralysis, speech disorder, paralysis, seizures and eye protrusion.

Neurological findings

It included intracranial hypertension (85.6%), loss of vision (7.2%), Seizures (7.2%). No evidence of oculomotor nerve palsy, diplopia, fifth nerve palsy, hemiparalysis, and mental disorders.

Karnofsky Performance Scale (KPS)

This index is an assessment tool for functional impairment and used to assess the prognosis in individual patients. Table 1 shows the comparison of pre- and post-operative Karnofsky performance. It showed that KPS decreased with time.

	KPS at preoperative	KPS at discharge	KPS 3-month postoperative
Median (IQR)	85 (80-90)	85 (70-90)	85 (70-90)
Min	50	10	0
Max	90	90	90

Table 1. Pre- and Post-Operative Karnofsky Performance Scale.

Diagnostic imaging

The results of diagnostic imaging are shown as follows:

X-rays

It showed 3 characteristics suggesting meningioma are hyperostosis of adjacent skull, blood vessel proliferation, and calcification.

Computed tomography (CT)

Enhanced CT showed the typical meningioma is usually isodense or slight hyperdense (Fig. 1). The tumor is usually homogeneous hyperdense and has clear

boundaries. Enhanced CT showed the typical meningioma often enhanced vigorously and homogeneously (90%). CT Angiography (CTA) showed whether feeding vessels are inside or outside a tumor.

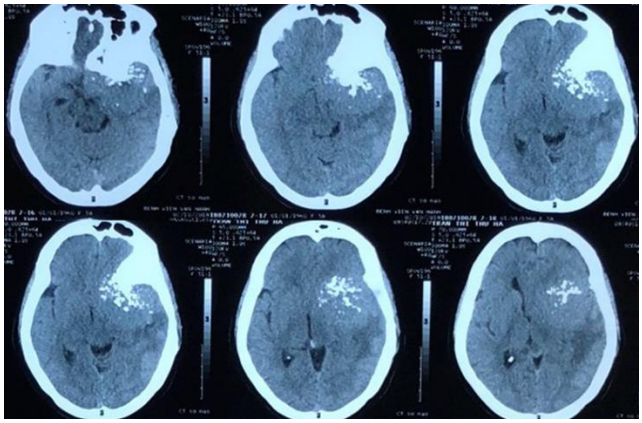

Figure 1. CT of A Patient Showing with the Calcification in Meningiomas.

The results showed that 3 cases (22%) were medial and 11 cases (78%) were middle sphenoid meningiomas. Osteolysis and bone invasion was seen in 3 cases (21.4%). Figure 2 shows the different size of the meningiomas in 14 cases. Majority of the tumor was medium (2-4 cm) to huge (> 6 cm).

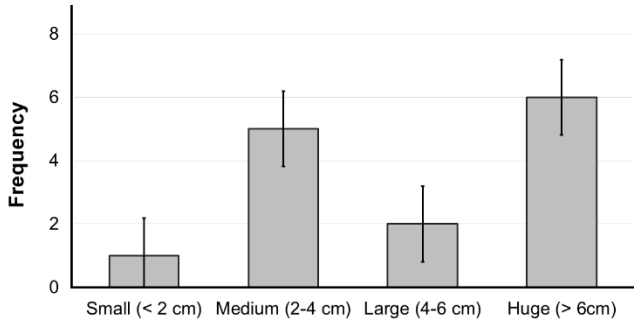

Figure 2. Size of the Meningiomas in CT.

Magnetic resonance imaging (MRI)

It helped to see the morphology (shape, site and mass effect), hyperostosis, calcification, vascular invasion, feeding vessels and drainage veins (Fig. 3). A thin layer of cerebrospinal fluid was present between the tumor and the surrounding brain. In addition, it showed broad attachment to the dura, which is also known as “Dura tail” sign. Peritumoral edema was also present.

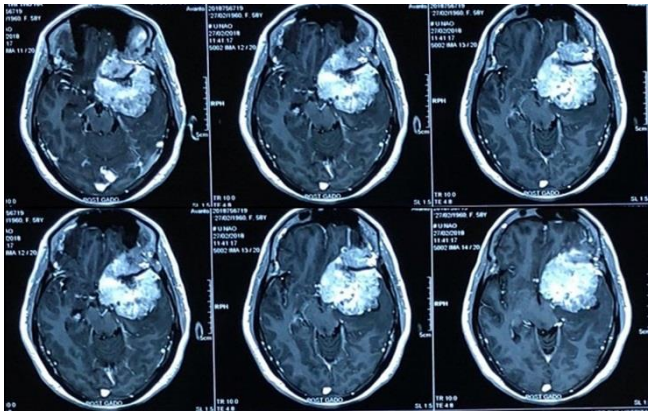

Figure 3. Magnetic Resonance Imaging (MRI) of the Patient Showing Hyperostosis, Calcification, Vascular Invasion, Feeding Vessels and Drainage Veins.

MRI Angiography (MRA)

MRA helped to assess the skull inside and outside circulation of the tumors, and density of blood vessels around the tumor. Medial and middle sphenoid meningioma can invade the cavernous sinus, thus MRA can assess preliminarily vascular components in cavernous sinus, such as internal carotid artery, middle cerebral artery. This is helpful for neurosurgeons to choose the approach to the tumor. However, MRA does not accurately assess the feeding vessels of tumor.

Digital Subtraction Angiography (DSA)

It helped clearly to visualize abnormal blood vessels in a bony or dense soft tissue environment which determined the supply and distribution of blood vessels for tumors, arterial movement, feeding arteries, and the collateral circulation of the brain (Fig 4). The feeding arteries of the sphenoid meningioma in various cases is shown in Figure 5. Hypervascularity was seen in 10 cases (71.42%).

Preoperative embolization

The time between embolization and surgery is very important which is about 7-9 days. If the tumor is removed within 24 hours after embolization, the risk of bleeding is quite high. The selective embolization was done of external carotid artery in 7 cases (87.5%) and middle cerebral artery in 1 case (12.5%). The success was in 7 cases (87.5%).

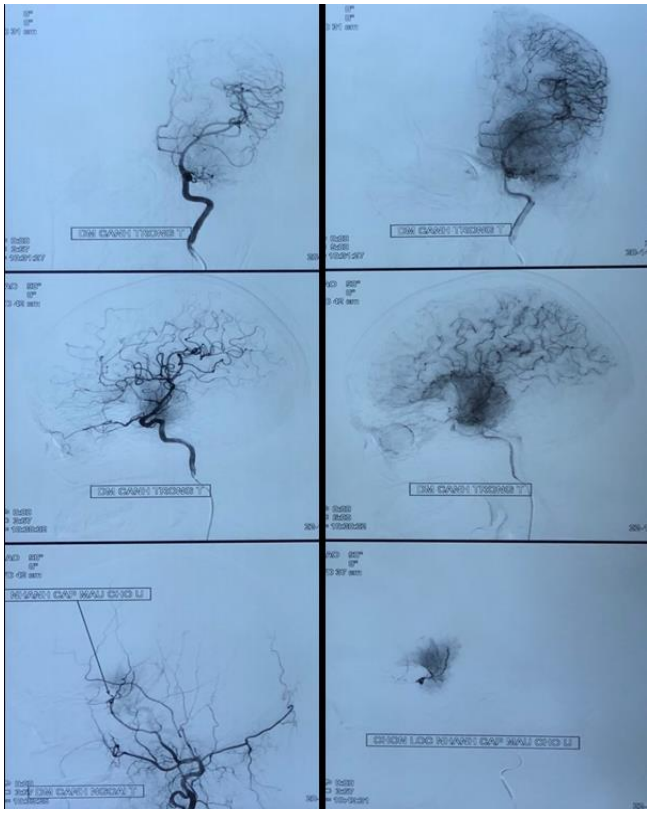

Figure 4. Digital Subtraction Angiography (DSA) of A Case Showing the Feeding Arteries from Internal Carotid Artery (ICA) and External Carotid Artery (ECA) Before and After Embolization of the Sphenoid Meningioma.

Surgical treatment

All patients received surgical treatment. The median size of the tumors was 5 cm (range: 3–6 cm). On CT angiogram, internal and external carotid arteries fed the tumor in half of the cases. Selective embolization was carried out before surgery in 8 cases and 7 cases were successful cases. Simpson grade I, II, III, IV, and V was seen in 2, 2, 1, 8 and 1 cases, respectively. Median karnofsky performance score was 85 at 3 months postoperative. On histological analysis, meningioma grade I, II and III were 9, 2 and 1 cases. One case was seen as atypical meningioma and received adjuvant radiotherapy and showed no recurrence at 6 follow-up months. One mortal case occurred within 24 hours after surgery. One case was fatal in 2 weeks and showed soft palate carcinoma invading the skull base and showed intraparenchymal hemorrhage and brain edema. There was no recurrent of tumor after the radiotherapy.

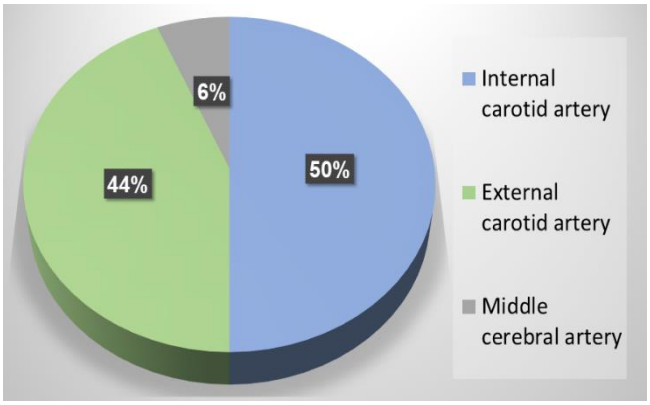

Figure 5. The Feeding Arteries of the Sphenoid Meningioma in This Study.

The mean duration from diagnosis to surgery was 9 days. The mean duration from embolization to surgery was 5 days. Craniotomy approach was from frontotemporal in all cases. The surgical techniques used for the tumor removal are shown in Table 2. In majority of the cases (78.58%), segmental resection was done.

Technique	Frequency	Percentage
En-bloc resection	3	21.42%
Segmental resection	11	78.58%
Opening of Sylvian fissure	3	21.42%
Drilling of sphenoid bone	4	28.57%
Drilling of orbital roof	0	0%

Table 2. Different Surgical Techniques Used for Tumor Removal.

The Simpson grading scale (Grade I-V) was used to grade the meningioma resection in this study as shown in Table 3. Majority of the cases was in grade IV.

Simpson Grade	Middle	Medial	Total
I	0	2	2
II	1	1	2
III	0	1	1
IV	2	6	8
V	0	1	1

Table 3. TheSimpson Grading Scale for Tumor Removal.

Intraoperative complications seen were: middle cerebral artery injury, bleeding, and optic nerve injury in 1 case each. The pathological details are shown in Table 4. Majority of the cases include secretory subtypes.

Grade	Pathology	Frequency	Percentage (%)
I	Meningothelial	2	16.6
	Transitional	2	16.67
	Angiomatous	2	16.67
	Secretory subtypes	3	25
	Chordoid subtypes	2	16.67
III	Papillary subtypes	1	8.33

Table 4. Pathological Subtypes of the Meningiomas.

Post-operative complications seen were: intraparenchymal hemorrhage and cerebral edema in 1 case each, and mortality of 2 cases. For the complication management, reoperation was done in 1 case. Recurrent meningioma was seen in 1 case at 3 months follow-up. Table 5 shows the postoperative Karnofsky performance scale (< 3 months). It showed that there was no difference in the mean KPS between post-operative < 3 months and > 3 months.

Grading	Post-operative Karnofsky performance scale	
	< 3 months	> 3 months
Good (80-100)	9 (64.3%)	8 (57.14%)
Fair (50-70)	3 (21.42%)	4 (28.57%)
Mortality	2 (14.28%)	2 (14.29%)

Table 5. Postoperative Karnofsky Performance Scale < 3 Months and > 3 Months.

Radiotherapy

Postoperative radiotherapy was done in 2 cases (14.28%) with medial meningiomas.

Discussion

The malignant spinal cord and vertebral tumors mostly present in in elderly population. The surgical outcome, in terms of recovery and spinal stability, of benign tumors, is comparatively better than malignant ones.[13] The most common chief complaint of sphenoid meningioma in our study was intracranial hypertension (86% of the cases). Headache and consciousness disorder accounted for 71.4% and 12.3% of the cases, respectively. This is consistent with other studies.[11,12] In addition, the ocular signs were less which may be due to unnoticeable. In our study, the sphenoid meningioma appeared most commonly at age of 47 which in good agreement with the study by Russel and Benjamin (2008).[14] On CT and MRI, the mmeningiomas is usually typical but sometimes varied.

In our study, medial sphenoid meningioma was in 78% of the cases, and only 22% were middle sphenoid meningioma, in which 3 cases have skull bone invasion. There was one case of tumors less than 2 cm in size, the rest were mainly greater than 6 cm (42.86%). All 14 cases had preoperative digital subtraction angiography and 8 out of 14 cases were selective embolization to reduce the risk of bleeding. In which, feeding vessels of 8 cases were internal carotid arteries, 7 cases were the external carotid arteries and 1 case was the middle cerebral artery. There were 3 cases of internal carotid artery in tumor, and 1 case of middle cerebral artery in tumor. There were 2 cases of vascular injury when removing the tumor.

Regarding the resection technique, most of the surgeon agree that segmental resection is preferred technique.[5,14] In our study, we used segmental resection in 11 out of 14 cases. In the remaining cases, the tumors were small and middle sphenoid ridge, so we used en bloc resection. Of the 14 patients, 2 (14.28%) had Simpson Grade I and 2 (14.28%) Simpson Grade II, 1 (4.7%) had Simpson Grade III, 8 (57.14%) had Simpson Grade IV and 1 (4.7%) had Simpson Grade V resections. Similar study done by Russel and Benjamin[14] in 24 cases found that the tumor size ranged from 2 to 8 cm (mean, 4.5 cm). Of the 24 patients with purely intradural tumors, 4 (17%) had Simpson Grade I and 19 had Simpson Grade II resections; 23 (96%) had gross total resections. Of the 11 patients with tumors extending extradurally (i.e., cavernous sinus), 1 (9%) patient had a Simpson Grade II resection, whereas 9 (82%) had Simpson Grade III resections, with the latter being all visible tumor removed except that in the cavernous sinus. The overall morbidity rate was 18%. There was no surgical mortality or symptomatic cerebral infarction.

Regarding postoperative complications, there were one case of intraparenchymal hemorrhage, and one case of cerebral ischemia due to vascular injury. Both cases were expired. The mortality rate was higher than the study done by Sandalcioglu et al.[15] where they did study in 131 cases and found the permanent operative morbidity in 3% and mortality in 0.8%.

Another study done by Yoon et al.[16] in 61 cases found that 29 patients (79.4%) cases experienced clinical improvement after surgery. The extent of tumor resection at the first operation was Simpson Grade I in 10 patients, Grade II in 17, Grade III in 4, Grade IV in 6, and unknown in one. They did not experience recurrent cases with Simpson grade I, II, or III resection. There were 6 recurrent cases, consisting of 5 cases with an extent of Simpson grade IV and one with an unknown extent. A study done in Korea foud that the overall survival rates for those with a primary malignant spine tumor were 87.0%, 75.3%, and 70.6% at 3, 12, and 24 months, respectively.[17] It showed that the male sex, medicare insurance were significantly positive factors affecting survival after a diagnosis of primary malignant spine tumor.

In our study, 2 cases received postoperative radiotherapy and had good results. Yoon et al.[16] did radiation therapy as a surgical adjunct in 4 patients (10.5%). While doing radiotherapy in the treatment of spinal meningioma the potential damage caused by radiation should be considered. Two cases were recurrent lesions that could not be completely resected. The other 2 cases were malignant meningiomas. But no immediate postoperative death occurred in the patient group. In our study, 2 recurrent occurred at 3 months follow-up and was surgery was done again.

Studies have shown that the patients with spinal cord tumors who participate in rehabilitation programs show general improvement in function, mood, quality of life, and survival.[18-20] Adaptations to care plans should be made to accommodate medical co-morbidities from cancer and its treatment, patient perceptions, and prognosis.

Conclusion

Medial and middle sphenoid meningiomas are mostly benign, however, the surgical outcomes of sphenoid meningioma are poor due to huge tumors, large blood vessels invasion (internal carotid artery, middle cerebral artery). Therefore, subtotal resection, cerebral edema, intraoperative and postoperative vascular injury were high. Postoperative radiotherapy is one of the solutions for those subtotal resection cases. This improves treatment outcomes.

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Declaration of Interest

The authors report no conflict of interest.

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