The foramen magnum meningioma - 3 consecutive cases with particular association with multiple aneurysms

A. Iordache[1], Mihaela Cosman[2], A.Şt. Iencean[2], Z. Fayad, I. Poeată[1]

[1]University of Medicine and Pharmacy "Gr.T. Popa" Iasi
[2]Hospital "N. Oblu" Iasi

Abstract

Intracranial meningioma represent a quite frequent pathology but those located in the foramen magnum are quite rare. We have described a small number of cases with their singularities – FMM associated with vagal disorders and associated with multiple aneurysms - operated in a short period of time along with reviewing the literature concerning the topic – frequency, type of approach, clinic signs.

Keywords: meningioma, foramen magnum, aneurysm associated with meningioma

Introduction

Meningiomas represent 25 – 30 % of all hospital-based primary intracranial neoplasms. The foramen magnum meningiomas constitutes 1 – 3 % of all cranial meningiomas. The female to male ratio is 2,6:1. The mean age at presentation is 55,9 years for female and 56,4 years for male. (8, 14)

The neuroanatomical and vascular content of the foramen is very important for the surgeon. The neural elements are represented by the inferior vermis, cerebellar tonsils, fourth ventricle, lower cranial nerves from 9 – 12th, caudal aspect of the medulla oblongata, rostral aspect of the spinal cord and upper cervical nerves C1 and C2. The vascular structures which the surgeon must be aware of, are: vertebral arteries, posterior inferior cerebellar arteries, the meningeal branches of the vertebral artery, the posterior and anterior spinal arteries and the venous plexus. (3)

Classification of foramen magnum meningiomas (FMM) depending on:

a) their compartment of development: intradural (most commonly), extradural (invasive into the bone, nerves and vessels sheaths) and intra-extradural.

b) their dural insertion: anterolaterally, posterolateral, purely posterior, entirely anterior.

c) their relation to the VAs: above (the position of the lower cranial nerves cannot be anticipated), below (the lower cranial nerves are pushed cranially and posteriorly) and on both sides. (3)

The clinical signs and symptoms are variable and depends on the structures that is affected. The patient may present with headache, cervical pain, occipital pain and other symptoms like lower cranial nerve palsies, long tract deficits, long tract deficits – sensory and motor deficite starting in one arm and spreading to the other extremities, Lhermitte's sign cerebellar dysfunction. They may have slow athetosic-like movements on their arms and hands (9, 12)

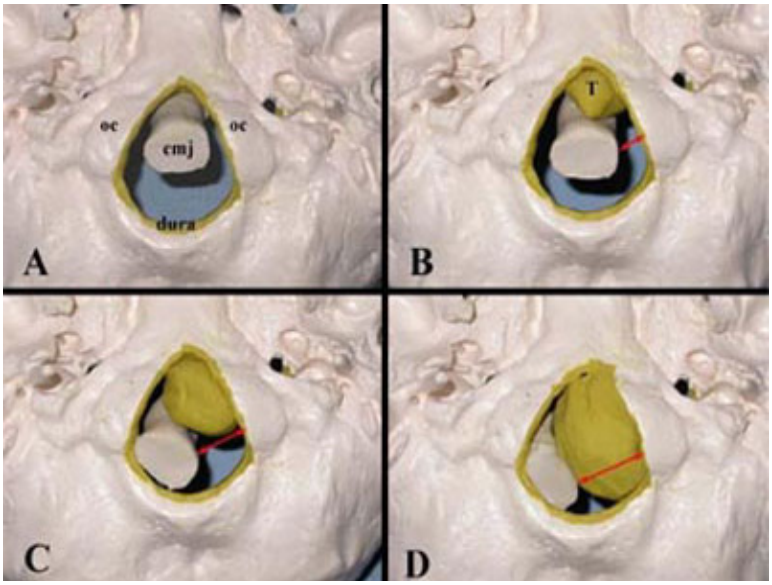

Figure 1 Illustration of the surgical corridor.
A: Normal relationship of brainstem to foramen magnum. OC = occipital condyle; CMJ = cervicomedullary junction. **B-D**: As the tumor (T) enlarges, it displaces the brainstem posteriorly and typically to one side, naturally creating a widened surgical corridor. **B**: A narrow corridor of less than 1 cm between the condyle and cervicomedullary junction. **C**: Adequate corridor with a 1-2 cm distance. **D**: Large corridor (> 2 cm) that allows relatively easy access to the anterior foramen magnum. (2)

MRI is the choise for detecting tumors of the foramen magnum but we can also use CT scan and MRI angiography. In T2-weighted images meningiomas appears as isointense to slightly hyperintense in comparison with normal brain. T1-Gd enhanced contrast imaging can define the dural attachment site of the tumor.(17)

MRI angiography define the vascular anatomy and the relations between vascular structures and the tumor.

CT scanning demonstrate the osseous anatomy, the presence of calcifications and hyperostosis. The tumor appear as a hemispherical or round mass isodens to hiperdens in comparison with normal brain.(9)

Surgical approach

In planning the surgical approach we have to consider the following:

1. the location of the tumor
2. the extent of the tumor (above the foramen magnum)

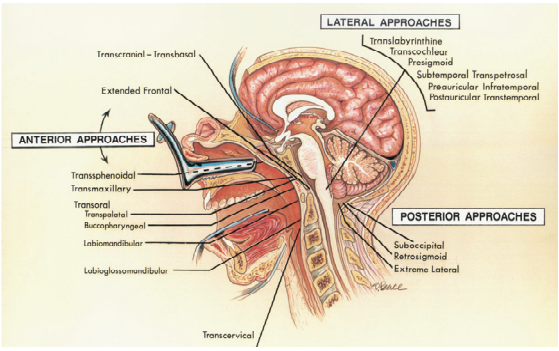

Figure 2 Surgical approaches of the foramen magnum – posterior (for intradural lesions), lateral (intradural lesion situated lateral to and / or in front of the brainstem), anterior (for extradural lesions) (13)

3. the relation of the tumor with the vertebral artery and with the origin of posterior inferior cerebellar artery (6)

Case Reports

Case 1

A 77-year-old female presented at our institution with headache, dizziness, swallowing disfunction, dysarthria, ataxia,

right facial palsy and spastic weakness of the extremities. The weakness started in the ipsilateral upper extremity then included the lower extremity with the controlateral lower extremity involvement and finally controlateral upper extremity. She had noticed gradual worsening of the symptoms in the last 6 months after onset. From her personal history we found important cardiovascular disorders: hypertension, heart failure NYHA II, atrioventricular block grade I.

CT scan illustrates a mass lesion located at the foramen magnum with the insertion at occipital condyle level, well delimitated, homogeneus and with portions spontaneously enhanced. (Figure 3)

Magnetic resonance (MR) imaging with gadolinium shows a homogeneus enhanced mass lesion extending from the foramen magnum which compresses the medulla oblongata (Figure 4, 5). The lesion occupies the posterolateral portion of the foramen.

It was performed a suboccipital approach with a C1 laminectomy, with a complet removal of the macroscopical tumor and coagulation of dural attachment.

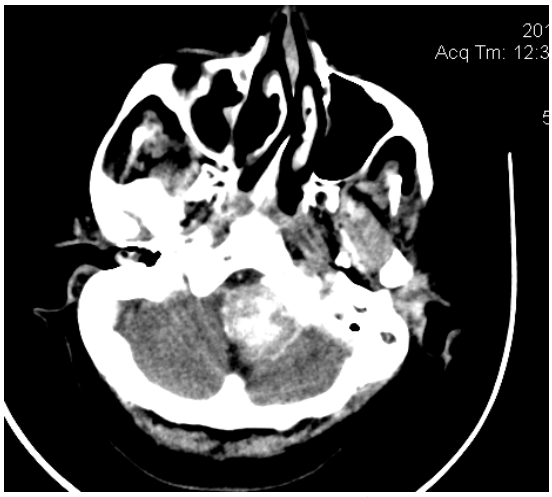

Figure 3 CT scan, axial view

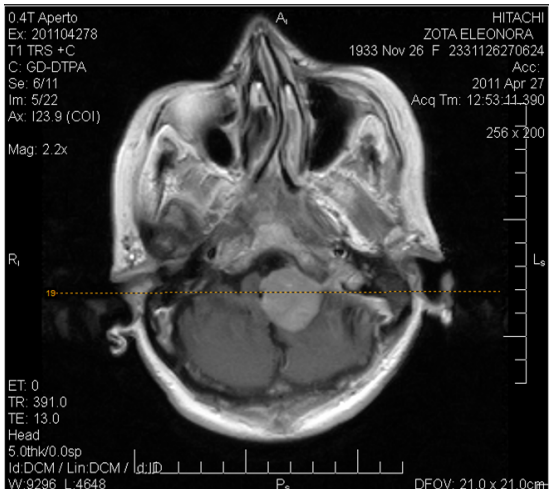

Figure 4 Axial and coronal T1w contrast –enhanced MR image

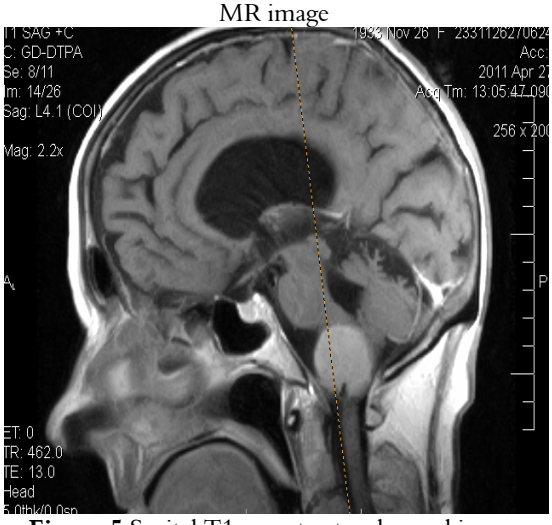

Figure 5 Sagital T1w contrast-enhanced image

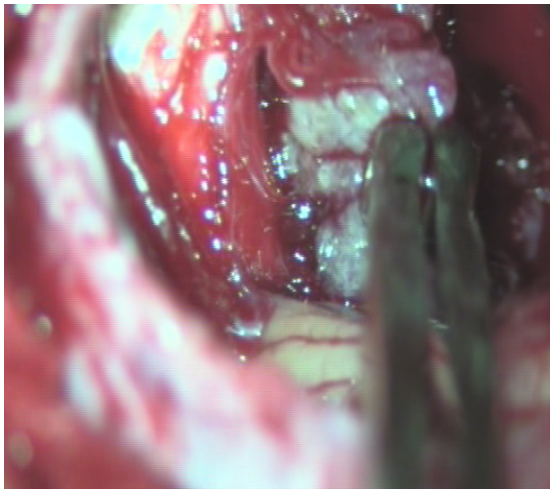

Figure 6 Intraoperative image

The histological diagnosis was meningothelial meningioma. The postoperative evolution was relatively good with the improvement of the facial and limbs weaknes. After 2 weeks from operation she presented fever (no more than 38.5° C) with diarrhea – lumbar puncture with CSF cultures, hemocultures and urocultures were negative. She was transferred to infectious disease department. She improved her general condition and there was no germ identified causing the gastrointestinal problems. She was admitted again for control in our department.

Case 2

A 61 years-old male presented with headache, vomiting, dizziness and ataxia. He presented those symptoms for two days. From his personal history we found that in 2002 he had a myocardial infarction, after that he was operated on and he needed also a coronary stent.

CT scan with enhancement (Figure 7) evidenced a hemispherical mass isodens to hyperdens in comparison with normal brain located in the ventrolateral part of the foramen magnum and two anevrismal dilatation located on both middle cerebral arteries (Figure 8). Because of this we performed an angio-CT. A three dimensions reconstructions confirmed three aneurisms (Figure 9).

It was performed a suboccipital approach with a C1 laminectomy and with a complet removal of the macroscopical tumor and coagulation of dural attachment (Figure 10). Postoperative evolution was good and the symptoms were improved.

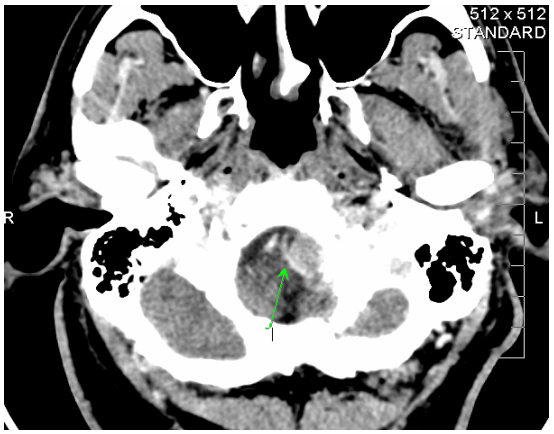

Figure 7 Axial CT scan imaging preoperative

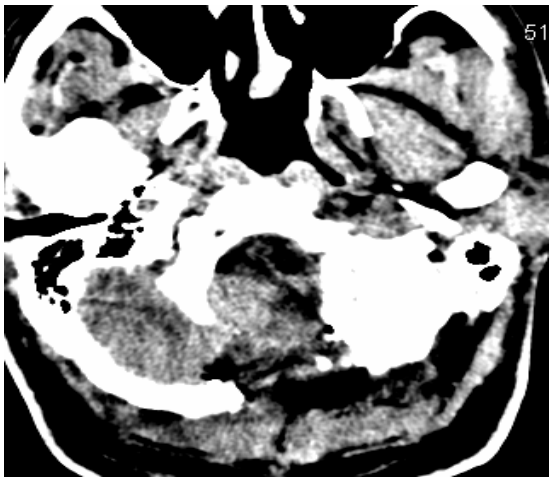

Figure 8 Postoperative control

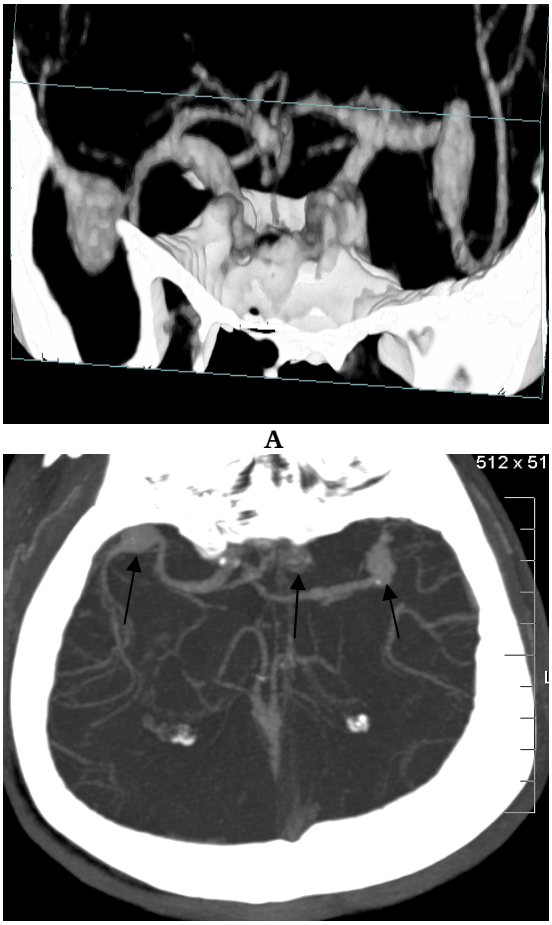

Figure 9 Angio-CT with 3D reconstructions shows 3 aneurysms – middle cerebral artery bilaterally and left ophthalmic artery

Case 3

A 49 years-old female presented tetraparesis with prevalence of right hemiparesis. The paresis evolution was slowly progressive and the onset was 9 month ago. She had others symptoms like: vesicourethral dysfunction, dysphonia, dysphagia, headache and neck pain. From his history we found that she had hypertension and diabetes mellitus tipe II. MR imaging (Figure 11) showed a well circumscribed mass located to the foramen magnum with extension at inferior clivus.

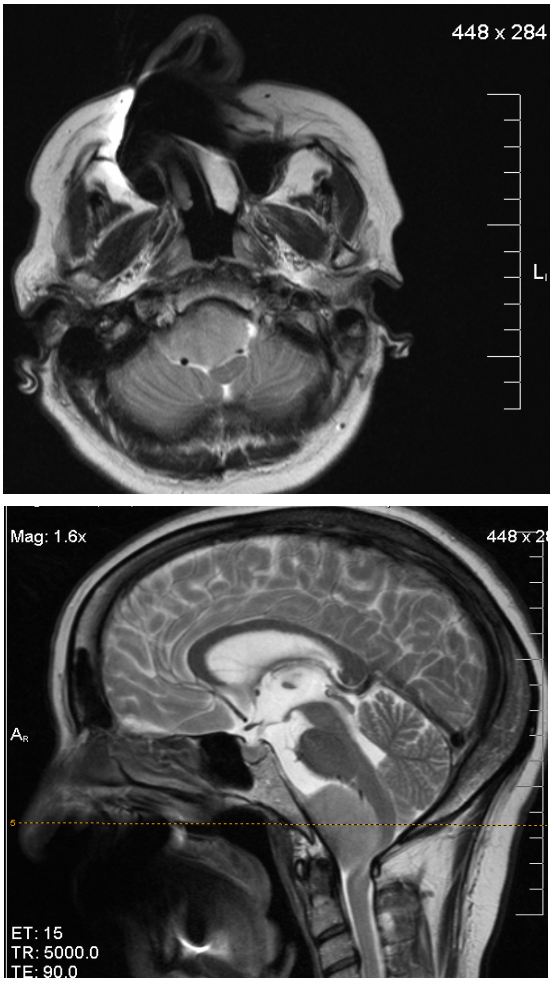

Figure 11 Axial and sagital MR imaging

Figure 12 Postoperative CT scan

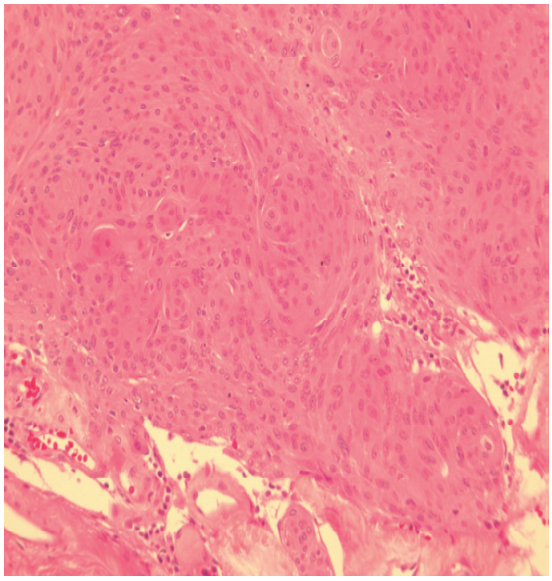

Figure 13 Meningothelial meningioma

A complet removal of the macroscopical tumor and coagulation of dural attachment was performed choosing a suboccipital approach (Figure 12). The histological diagnosis was meningothelial meningioma (Figure 13) (9). The postoperative evolution was relatively good with the improvement of the symptoms.

Discussions

Foramen magnum meningiomas represent a relatively rare condition. In our experience we have mainly elderly patients affected. All the patients present clinically motor deficits of both limbs and lower cranial nerves associated with intracranial hypertension syndrome. The onset of the clinical signs was mainly insidious but in one case was sudden onset. The imagery diagnosis was both CT scan and MRI. We have used the suboccipital approach and the transcondylar approach. Both approaches has no complications. The postoperative neurological status improved in all the 3 cases. In one case postoperatively the patient maintain gastrointestinal dysfunction for which no infectious cause was found so we supposed that it may be linked to medulla oblongata compression.

The association between meningiomas and aneurysm is an extremely rare condition but in most of the cases of aneurysms associated with tumors, the tumor diagnosed concomitantly is a meningioma. Frequently in those cases we have ruptured aneurysms and we discovered incidentally a meningioma (11). In the case studied we have no ruptured aneurysms and there is an unusual association (usually there is an association between MCA artery and sphenoid ridge meningioma) and actually there is no case cited of association between foramen magnum meningioma and both MCA (mirror aneurysms) and ophtalnic artery aneurysms. There was no intervention for the aneurysm for the moment (nor operative or endovascular) and we have no decompensation of the cerebro - vascular anomalies.

In our cases we limit our discussion to suboccipital and far-lateral transcondylar approaches because those are used more often. For suboccipital approach we place the patient in the lateral oblique position. The head is in neutral flexion and the thorax can be elevated with 15 degrees. We may use a vertical midline or hockey-stick incision. The last one starts over the mastoid, passes the superior nuchal line and descends in the midline of the cervical spine. The muscles are incised in the avascular midline plane down to the laminar arches of C1 and C2. At 1 cm medial and inferior to the asterion is made the burr hole. The occipital flap is cut with a pneumatic craniotome and the foramen magnum is opend with a rongeur. The

horizontal segment of vertebral artery is mobilized and the lateral laminar arch of C1 can be removed safely. The dural incision starts at C1, descends vertically to foramen magnum and ascends laterally to the apex of craniotomy. After the tumor is resected, the dura is closed, the bone flap is replaced , the cervical muscle, the fascia and the skin are sutured in layers. A sterile non compressive dressing is applied to the operative site. (16, 7, 1)

The advantage of suboccipital approach is represented by a good visualization of the tumor, vertebral artery, cranial nerves and brainstem. The disadvantage includes the interposition of the brainstem between an anterior tumor and the neurosurgeon. (3)

Regarding transcondylar approach in literature are two major forms: far lateral approach which includes a suboccipital approach with appropriate soft-tissue dissection and transcondylar approach which requires occipital condyle resection. (4) For the last one the patient is placed in the lateral position with the neck slightly flexed and the vertex slightly down. The curvilinear skin incision begins at 2 to 3 cm behind the ear descending to C3 or C4. The underlying musculature is dissected: the superficial layer (sternocleidomastoid and trapezium) and the middle layer (splenius capitis, longissimus capitis and semispinalis capitis) are reflected to expose the suboccipital triangle which is bordered by the third layer (superolaterally – superior oblique muscle; inferior – inferior oblique and medially – rectus capitis). The suboccipital triangle includes the dorsal ramus of C1 nerve root and horizontal segment of vertebral artery which is dissected subperiosteal to reduce bleeding. A lateral suboccipital craniotomy is performed and an ipsilateral hemilaminectomy of C1 improves the dural exposure and prevent future complications. The occipital condyle is resected and this increases the ventral aspects of the craniocervical junction, avoiding brainstem retraction. (10, 15)

One of the advantages of this approach is that it can be used if there is a posterior protrusion of occipital condyle which interferes with neurosurgeons view, condylar resection increases foramen magnum exposure. (18)

Conclusions

Foramen magnum meningiomas are rare entities that can be solved successfully with little complications. In our limited number of cases (operated on in just one month) we have used both main approaches with microsurgical resection of the lesions – Simpson grade II and Kobayashi grade II (5). We have achieved a good improvement from neurological point of view with no further deficit linked to the intervention. The particular case of foramen magnum meningioma associated with 3 different aneurysm is a unique case that was not cited until now.

References

1. Badie B, Neurosurgical operative atlas, New York, Thieme, 2007, pp 233-237
2. Bassiouni H, Ntoukas G, Asgari S, Foramen magnum meningiomas: clinical outcome after microsurgical resection via a posterolateral suboccipital retrocondylar approach. Neurosurg , Vol 59, No 6, 2006
3. Boulton MR, Cusimano MD, Foramen magnum meningiomas: concepts, classifications and nuance. Neurosurg Focus 14, 2003
4. Bruneau M, George B, Foramen magnum meningiomas: detailed surgical approaches and technical aspects at Lariboiseur Hospital and review of literature. J Neurosurg 31(1) , 19-33, 2008
5. Ciurea AV, Iencean StM, Actualitati in tumorile intracraniene. Bucuresti, Editura Universitara, 2011, 199
6. Fessler RG, Sekhar LN, Atlas of neurosurgical techniques-brain. New York, Thieme Medical

Publisher, 2006 pp731-732
7. Goel A, Desai K, Muzumdar D, Surgery of anterior foramen magnum meningiomas using a conventional posterior suboccipital approach: a report on an experience of with 17 cases. Neurosurgery Vol 49, No1, 2001
8. Kano T, Kawase T, Horiguchi T, Yoshida T, Meningiomas of the foramen magnum and lower clivus factors influencing surgical morbidity, the extent of tumor resection and tumor reccurence. Acta Neurochir 152:79-86 , 2010
9. Lee JH, Meningiomas: diagnosis, treatment and outcome . London, Springer, 2008 pp: 449-450
10. Liu JK, Couldwell WT, Far-lateral transcondylar approach:surgical technique and its application in neureteric cysts of cervicomedullari junction. Neurosurg Focus 19 (2): E9, 2005
11. Marwan W Najjar, Saleh S Baeesa, Sattam S, Liugawi: Association between intracranial meningiomas and aneurysms: It is a coincidence ? Pan Arab Journal of Neurosurgery, Vol 11, No1, april 2007
12. Pamir MN, Black PM, Fahlbush R, Meningiomas a comprehensive text. Philadelphia, Saunders, 2010, pp: 165-169
13. Rhoton AL, The Foramen Magnum. Microsurgical anatomy. Neurosurgery, Vol 47, No3, September 2000, Supplement pp 155-177
14. Rockhill J, Mrugala M, Chamberlain MC, Intracranial meningiomas: an overview of diagnosis and treatment. Neurosurg Focus 23 (4): E1, 2007
15. Tange Y, Uto A, Wachi A, Koike J, Transcondylar fossa approach to treat ventral foramen magnum meningioma. Neurol Med Chir (Tokyo) 41, 458 – 462, 2001
16. Tew JM, von Loveren HR, Atlas of operative microneurosurgery – aneurysms and arteriovenous malformations vol I. Philadelphia, W.B. Saunders Co, 1994, pp 67-73
17. Tom JC,nWestphal M, Rutka JT, Grossman SA, Neuro-oncology of CNS tumors.Berlin, Springer, 2006, pp 86-88
18. Wanebo JE, Chicoine MR, Quantitative analysis of the transcondylar approach to the foramen magnum. Neurosurgery Vol 49, No 4 , 2001