Foramen Magnum Meningiomas and Its Approaches
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Abstract
Introduction: Foramen magnum meningiomas arise from arachnoid at the craniospinal junction. The foramen magnum contains several critical neuroanatomical and vascular structures of which the surgeon must be aware. Classic foramen magnum syndrome is defined by development of unilateral arm sensory and motor deficits. Every attempt should be made to keep the arachnoid with these structures and to perform surgery on the tumor’s side of the nerves and vessels during dissection. Surgical dissection in which the cranial nerves and vascular structures are preserved is integral to foramen magnum tumor management.

Case Study: Frequent symptoms are cervical and occipital radicular pain, dizziness, dysphagia, dyspnea, hoarseness, long-tract deficits, muscular atrophy of limbs, and cerebellar ataxia. CT axial scans may provide information about the size of occipital condyle and lateral mass of C1, and the angulations between these structures, important factors to be considered in the surgical planning. The encasement and narrowing of the vertebral artery (VA) is assessed with MRVA or angiography. The foramen magnum can be approached with three basic surgical approach, each was developed to deal with specific problems and to serves important function. Postoperative complications include intracranial hematomas, CSF leakage, meningitis, lower cranial nerve palsies, hemiparesis, quadripareisis, and aspiration pneumonia.

Results: Anterior, lateral, and posterior approaches used in foramen magnum meningiomas have their own advantages and disadvantages and definite goals are to achieve the largest tumor removal; and the lowest morbidity rate as possible. Suboccipital craniotomy, or craniectomy, with or without cervical laminectomy represents the classic approach. The approach used are considered to allow adequate controls of important neurovascular structures, providing low rates of morbidity and mortality.

Conclusion: The posterior approach is the most common surgical approach used to obtained appropriate exposure to foramen magnum meningiomas.

Key words: foramen magnum, meningiomas, neurosurgery
INTRODUCTION
Meningiomas are slow-growing benign tumors that arise at any location where arachnoid cells reside. Although meningiomas account for a sizable proportion of all primary intracranial neoplasms (14.3–19%), only 1.8 to 3.2% arise at the foramen magnum.\(^1\)\(^,\)\(^2\)\(^,\)\(^3\)

Foramen magnum (FM) meningiomas are those arising anteriorly from the inferior third of the clivus to the superior edge of the C2 body, laterally from the jugular tubercle to the C2 laminae, and posteriorly from the anterior border the occipital squama to the spinal process of C2. Despite locating in a narrow region, they have a slow growth pattern with insidious clinical symptoms and late diagnosis, generally after reach a considerable size. Location close to important neurovascular structures requires special skills for its surgical resection. Choice of the surgical approach, extent of bone resection, management of the vertebral artery (VA) and involvement of lower cranial nerves (CN), are the points of concern.\(^1\)\(^,\)\(^2\)\(^,\)\(^4\)\(^,\)\(^5\)

The foramen magnum contains several critical neuroanatomical and vascular structures of which the surgeon must be aware. The neural structures include the cerebellar tonsils, inferior vermis, fourth ventricle, caudal aspect of the medulla, lower cranial nerves (ninth–twelfth), rostral aspect of the spinal cord, and upper cervical nerves (C-1 and C-2).\(^3\)\(^,\)\(^4\)\(^,\)\(^5\)\(^,\)\(^8\)

Foramen magnum meningiomas can be approached from posterior, posterosilateral, and anterior directions. A standard midline suboccipital craniectomy with an upper cervical laminectomy (C-1, occasionally C-2) is the preferred approach for most of the lesions originating posteriorly to the dentate ligaments. The anterior approach for anterior or anterolateral FMMs, via transoral or transcervical routes, has been described for treatment of anteriorly located lesions, but never gained wide acceptance.\(^4\)\(^,\)\(^5\),
Common complications associated with anterior approaches include a higher risk of CSF leakage and infection. In addition, inadequate exposure of lateral margins of the tumor and inadequate proximal control of the Posterior and posterolateral FMMs can be safely resected via a standard midline suboccipital approach. Controversy still exits, however, regarding the optimal management of ventral or ventrolateral lesions. In those cases, surgery could result in undue brainstem retraction, higher rates of subtotal resection (STR), and postoperative morbidity, due to inadequate exposure. It has been suggested that patients operated on via conventional suboccipital approaches have worse clinical outcomes than patients operated on via the transcondylar route.3,4,5,6

Those findings were contested by Goel et al., who reported gross-total resection (GTR) of 14 anterior or anterolateral FMMs through a conventional posterior suboccipital approach, similar to the results obtained by other authors. The endoscopic extended endonasal approach has recently gained attention for treatment of anteriorly located FMMs. Despite their theoretical potential to minimize surgical morbidity, its actual clinical indications remain unclear. The surgical technique described below is the far-lateral approach and its variants for the resection of anterior and anterolateral FMMs.7,8,9

Operative mortality for FM meningiomas has significantly decreased over the last two decades. Nevertheless, postoperative morbidity remains high and the best surgical approach for its resection is controversial. This study aimed to analyze the clinical outcome of a group of patients with FM meningiomas operated in a public general hospital.8,9,10

**CASE STUDY**

The clinical presentation of foramen magnum meningiomas is protean, and the mean length of symptoms prior to diagnosis is 30.8 months, even in the era of MR imaging. The clinical differential diagnosis includes multiple sclerosis, amyotrophic lateral sclerosis, syringomyelia, and cervical spondylosis.4,5,6
In a cursory examination the physician may miss subtle findings early in the stage of the progression, but later symptoms are often advanced, undeniable, and lead to significant and often permanent neurological deficit. Early features of foramen magnum meningiomas include occipital headache and upper cervical pain, which is often exacerbated by neck flexion or Valsalva maneuvers. Classic foramen magnum syndrome is defined by development of unilateral arm sensory and motor deficits, which progress to the ipsilateral leg, then the contralateral leg, and finally contralateral upper extremity.\(^7\,8\,9\,10\)

Frequent symptoms are cervical and occipital radicular pain, dizziness, dysphagia, dyspnea, hoarseness, long-tract deficits, muscular atrophy of limbs, and cerebellar ataxia. CT axial scans may provide information about the size of occipital condyle and lateral mass of C1, and the angulations between these structures, important factors to be considered in the surgical planning. The encasement and narrowing of the vertebral artery (VA) is assessed with MRVA or angiography.\(^7\,8\,9\,10\)

The foramen magnum can be approached with three basic surgical approach, each was developed to deal with specific problems and to serves important function. The foramen magnum can be approached via anterior, lateral, and posterior approaches. Each approach serves an important function and each was developed to deal with specific problems. The anterior transoral approach to the foramen magnum is rarely conducted to reach intradural lesions such as meningiomas because of problems with dural repair, risk of CSF leakage, and meningitis. Debate about foramen magnum meningioma resection primarily involves the posterior suboccipital craniectomy and posterolateral approaches, which necessitate drilling of the occipital condyle. We limit our discussion to these approaches.\(^6\,7\,8\,9\)

To simplify understanding of approaches to this region, we advocate the use of the terms of suboccipital craniotomy and transcondylar approach. Both require laminectomy, although the transcondylar is more commonly associated with mobilization of the VA from its lateral attachments to widen the surgical corridor. The approach used are considered to allow adequate controls of important neurovascular structures, providing low rates of morbidity and mortality. We have tended to err on the side of recommending resection to patients with reasonably sized tumors in the foramen magnum (even with minimal symptoms in younger patients) of the lack of space for future tumor growth or swelling during other treatments such as radiotherapy.\(^5\,6\,7\,8\)

The ideal treatment of meningiomas is a safe and complete resection. If contraindications to surgery exist or if the patient elects not to undergo surgical resection, then radiotherapy should be considered. Because of the critical anatomy within the foramen magnum and the size of most tumors (3 cm in maximum dimension), we usually recommend focused GKS rather than standard conformal radiotherapy.

28 Patients with small residual tumors under Cerebrospinal fluid leakage and transient worsening of preoperative symptoms were the only surgery related complications.\(^6\,9\,10\)

**RESULTS**

The foramen magnum contains several critical neuroanatomical and vascular structures of which the surgeon must be aware. Foramen magnum meningiomas can be approached from posterior, posterolateral, and anterior directions. Anterior, lateral, and posterior approaches used in foramen magnum meningiomas have their own advantages and disadvantages and definite goals are to achieve the largest tumor...
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CONCLUSION
Foramen magnum (FM) meningiomas are those arising anteriorly from the inferior third of the clivus to the superior edge of the C2 body, laterally from the jugular tubercle to the C2 laminae, and posteriorly from the anterior border the occipital squama to the spinal process of C2. The foramen magnum contains several critical neuroanatomical and vascular structures of which the surgeon must be aware. Choice of the surgical approach, extent of bone resection, management of the vertebral artery (VA) and involvement of lower cranial nerves (CN), are the points of concern. Foramen magnum meningiomas can be approached from posterior, posterolateral, and anterior directions. The posterior approach is the most common surgical approach used to obtained appropriate exposure to foramen magnum meningiomas. Early reports of resection in cases of foramen magnum meningiomas were associated with a surgery related mortality rate of 5 to 13% and morbidity rate of 36%. Postoperative complications include intracranial hematomas, CSF leakage, meningitis, lower cranial nerve palsies, hemiparesis, quadripleasis, and aspiration pneumonia.
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