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CASUISTIC PAPER

Total resection of foramen magnum meningioma via a far-lateral approach – a case report

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ABSTRACT

Introduction and aim. The foramen magnum is a rare location of meningioma development, accounting for 1.8 to 3.2% of all reported tumors of this type. Microsurgical resection, representing a gold standard in foramen magnum meningioma treatment, may result in various neurological deficits or incomplete resection due to challenging anatomical conditions. Currently, even surgical resections of foramen magnum meningioma conducted by experienced neurosurgeons are burdened by a relatively high complication rate of 17.2%

Description of the case. We report the case of a 25-year-old male who presented increasing headaches and decreasing activity for 5 months. In his medical history, the patient had been diagnosed with cerebral palsy, autism spectrum disorder, and suffered partial seizures. Magnetic resonance imaging revealed anterolateral foramen magnum meningioma. The tumor was resected via a far-lateral approach. After the surgery, the patient maintained a preoperative neurological state without additional neurological deficits. The post-operative magnetic resonance imaging demonstrated complete tumor removal. Histopathological examination revealed transitional meningioma (WHO grade I).

Conclusion. Our case demonstrates that the far-lateral approach can be efficient for the resection of anterolateral foramen magnum meningioma. In such cases, Simpson grade 1 can be achieved without complications, providing immediate relief of symptoms and minimizing the risk of recurrence.

Keywords. case report, far lateral approach, foramen magnum meningioma, meningioma, transitional meningioma

Introduction

Meningiomas constitute the most frequently reported primary central nervous system (CNS) tumors (39% of all CNS tumors), with an incidence rate of about nine cases per 100,000 individuals.[1] The foramen magnum is a rare location of meningioma development, accounting for 1.8 to 3.2% of all reported tumors of this type.[2] Foramen magnum menigiomas (FMM) are defined as me-

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ningiomas arising from the arachnoid cells in the dura mater in the anatomical area described by George et al. – bounded anteriorly from the superior edge of the C2 vertebral body to the lower third of the clivus, posteriorly between the C2 spinous process and the anterior border of the occipital bone and laterally from the upper margin of C2 laminae to the jugular tubercle.[3] This region is abundant in multiple vital neural and vascular structures such as lower cranial nerves (IX-XII), upper cervical nerves (C1 and C2), cerebellar tonsils, brainstem, V3 and V4 segments of the vertebral artery, and posterior inferior cerebellar artery (PICA).[3] Therefore, FMM may result in various neurological deficits and technically challenging surgical resection, which represents the golden standard in FMM treatment.[4] Currently, even surgical resections of FMM conducted by experienced neurosurgeons are burdened by a relatively high complication rate of 17.2%.[2]

Aim

The present article, prepared according to Surgical CAse REport (SCARE) 2020 guidelines (Supplementary Material No. 1), describes a case of a 25-year-old man with a large FMM treated at the Department of Neurosurgery of the Independent Public Teaching Hospital No. 4 in Lublin, Poland.[5] The main aim of this paper was to present an overview of the clinical presentation of FMM in the young patient and provide an example of effective surgical management of FMM via a far-lateral approach.

Description of the case

Patient information

A 25-year-old Caucasian male with increasing headaches and decreasing activity for 5 months, was presented to the emergency department on 18th September 2020 because of a grand mal seizure. The patient had been diagnosed with pediatric cerebral palsy and autism spectrum disorder. Since the age of 17, the patient was treated for focal seizures. He had a penicillin allergy. In 2014, FMM was diagnosed in the patient based on a performed MRI scan. Since then, the patient remained under regular clinical and radiological follow-up. Smoking, alcohol, or other stimulant abuse were absent. The patient's social, family, and occupational history were unremarkable.

Clinical findings

At admission (18.09.2020), the patient was in a general average condition, conscious, and complying with simple commands. The neurological examination revealed hypoglossal nerve palsy. Apart from that, the patient preserved arbitrary limb movements without paresis. The verbal contact with the patient was hampered due to his autism spectrum disorder.

Diagnostic assessment

The patient was assessed by physical and neurological examination, laboratory examinations, and radiological imaging (computed tomography (CT) and MRI). The initial laboratory examinations revealed abnormalities including leukocytosis, increased RBC, HGB, and HCT levels, and increased level of C-reactive protein (CRP). CT scan of the head performed on the day of admission revealed a tumor in the area of the craniocervical junction, measuring 38×27×29 mm, with significant compression of the medulla oblongata. Radiologically, the tumor was diagnosed as anterolateral FMM. Compared with radiological examinations performed at diagnosis, the volume of the tumor significantly increased. Cerebellar atrophy and enlargement of cerebrospinal fluid spaces of the posterior cranial fossa were comparable. Magnetic resonance imaging (MRI) of the head performed on 3rd September 2020 revealed similar findings (Figure 1a, 1b). Based on these results, the patient was qualified for neurosurgical treatment.

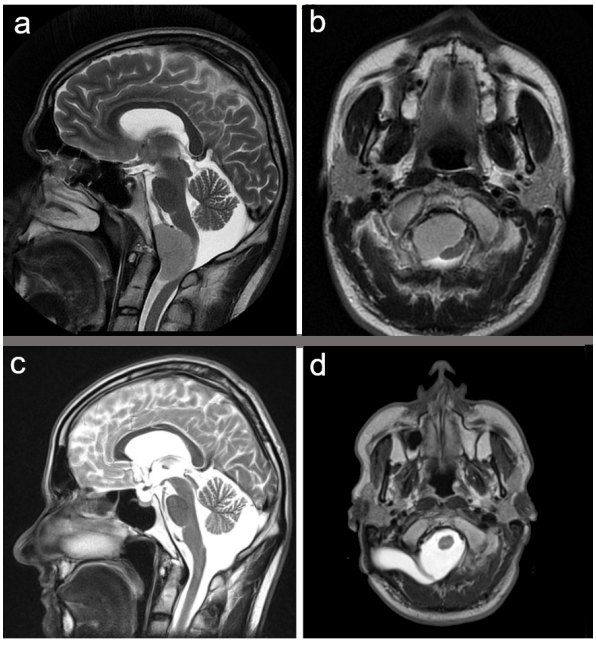

Fig. 1. Foramen magnum meningioma tumor in a 25-year-old man visualized on MRI (T_2 sequence): sagittal section (a), transverse section (b), post-operative MRI (T_2 sequence) performed 2 years after surgery, demonstrating no lesion at the foramen magnum: sagittal section (c), transverse section (d)

Surgical intervention

After obtaining informed consent from the patient, surgical resection of FMM was planned. The surgical procedure was conducted on 29.09.2020 by an experienced neurosurgeon.

The surgery was performed via the right far-lateral approach with the use of microscopic magnification, neuronavigation, lower cranial nerves electroneuro-

myography, and motor and sensory evoked potentials. The patient was placed in the lateral park bench position with the head fixed in the Mayfield frame. The skin incision was S-shaped extending from above the right auricle to the C3 level in the midline. After the muscle retraction, a suboccipital craniotomy was performed, and a free bone flap was created. Subsequently, the opening was extended to the foramen magnum with partial mastoidectomy and removal of one-third of the right occipital condyle. The dura mater was opened in a hockey stick fashion. After the cerebrospinal fluid aspiration from the cerebellomedullar cistern, the gray-pearlescent tumor was visualized.

The tumor capsule was incised and a fragmented specimen of 2.5 cm in diameter collectively was obtained for histopathological examination. After the localizations of IX, X, and XI cranial nerves tensioned on the tumor surface were confirmed, the tumor mass was totally removed with the use of an ultrasonic aspirator. Thereafter, lower cranial nerves were separated from the tumor capsule, and the capsule was removed in a few fragments.

The vertebral artery and lower cranial nerves were preserved without any damage. The Simpson Grade I had been achieved.

Follow-up and outcomes

After the surgery routine clinical observation and follow-up were implemented. The patient maintained their preoperative neurological state and was in good general condition, without additional neurological deficits. The control post-operative head MRI demonstrated an image corresponding to complete tumor removal. At 8 days post-surgery, the patient was discharged from the neurosurgical department with no severe complications, appropriate surgical wound adaptation, and minor subaponeurotic fluid collection at the surgical site.

Histopathological examination revealed a transitional meningioma (WHO Grade I).

Post-operative control MRI examinations were performed every 6 months after surgery, and none revealed tumor recurrence. At 2 years post-surgery, the clinical and neurological examination did not indicate the presence of a recurrent tumor and the MRI demonstrated no lesion at the foramen magnum (Figure 1c and 1d).

The order of events in the patient's history are presented in Figure 2.

Discussion

Despite the development of neurosurgical operative techniques in recent decades, obtaining total resection of a FMM with minimal morbidity remains a challenge, even for experienced skull base surgeons.

Several surgical approaches can be considered when the FMM resection is planned including the midline suboccipital approach, far-lateral approach, extreme-lateral approach, and anterior approach.[6] It is generally accepted that the extreme-lateral approach and far-lateral approach are used for anteriorly located FMMs, whereas posterior FMMs are feasible for the standard midline suboccipital approach.[7] That statement is caused by the fact that resection of anteriorly or anterolaterally localized FMMs via posterior midline approach resulted in a lower extent of resection and high morbidity due to significant brainstem retraction.[8] Moreover, in the suboccipital approach, safe visualization of VA is limited.[9] On the other hand, anterior approaches are not generally accepted due to the difficulty in achieving total resection and the high risk of complications such as infection and CSF leakage.[10] Currently, the posterior-lateral approaches including the far-lateral approach and extreme-lateral approach provide the best surgical access for anterior and anterolateral FMMs.[11] However, complications such as lower cranial nerve deficits, CSF leak, VA injury, or hydrocephalus are still common in FMM resections via these approaches.[10]

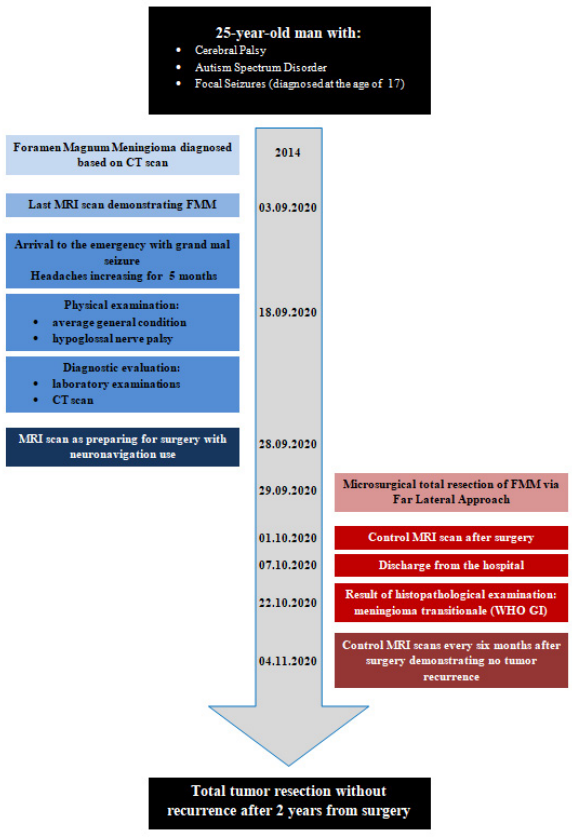

Fig. 2. The timeline representing the sequence of events in the patient's history

Although the choice between the far-lateral and extreme-lateral approach should depend on the location of the lesion in relation to the clivus, contralateral foramen magnum part, and jugular foramen, the latter technique is burdened with more limitations. Compared with the

far-lateral approach, the extreme-lateral approach requires more time and more extensive condylectomy, which increases the risk of craniocervical junction instability.[12] Moreover, postoperative complications such as CSF leakage and lower cranial nerve damage were more commonly observed in the extreme-lateral approach than in the far-lateral approach.[12] On the other hand, the extreme-lateral approach provides an extended surgical corridor and increased exposure compared with the far-lateral approach.[2] In our case, the far-lateral approach was implemented due to anterolateral localization of the tumor with achieving Simpson grade 1 and recurrence-free survival. Furthermore, we did not observe post-operative complications such as vascular damage, neurological deficits, or infections.

During the far-lateral approach, condylectomy significantly reduces the working distance and expands the lateral angle of exposure, which contributes to better access to the FM lesions.[13] However, the higher extent of occipital condyle removal results in a higher risk of occipitocervical joint instability.[14] There is still no consensus concerning the safe extent of condylectomy to date and available evidence suggests that the removal of more than 50% of occipital condyle results in major instability.[15] In these cases, stabilization of the occipitocervical joint is highly recommended. In our case, one-third of the occipital condyle was removed. Thus, according to the literature, the risk of craniovertebral junction instability was low and occipitocervical fusion was not necessary. Furthermore, postoperative instability of the craniovertebral junction was not observed.

In the reported patient, histopathological examination revealed transitional meningioma, which is classified as Grade I by the 2021 WHO Classification of CNS Tumors.[16] The histological image of transitional meningioma combines the characteristics of fibrous meningioma and endothelial meningioma.[17] Since this histological type of meningioma is relatively rare, evidence about their risk of recurrence is scarce. A recent study on 298 cases of transitional meningiomas reported recurrent tumors in 8.6% of patients.[18] For better estimation of the recurrence risk, p53, and Ki67 proliferation index may be helpful tools.[19] However, in our patient, these parameters were not evaluated.

The patient described in our case presented a constellation of characteristic symptoms and diseases, including spontaneous development of generalized seizures, autism spectrum disorder, and the presence of large, infratentorial meningioma. Considering additionally the young age, the genetic background could be suspected as the cause of the patient's complaints. However, genetic testing has not been conducted in the case of our patient and should be considered to elucidate the above disorders. Given the clinical image of the patient, genetic syndromes such as NF2, Cowden syndrome, BAP1 predisposition syndrome, or Rubinstein-Taybi syndrome could be considered in further differential diagnosis.[20]

One of the limitations of our case report was relatively short follow-up length. According to a long-term clinical study on meningioma patients, the recurrence rate was 13% and 38% for 10-year and 25-year follow-ups, respectively for total tumor resection (1-2 Simpson grades).[21] Therefore, the patient should remain under continuous radiological and clinical follow-up. Furthermore, we were not able to present the pictures from the surgical procedure, which would have been valuable for the presentation of our case. Nevertheless, this paper provides an excellent example of effective surgical treatment of large FMM with 2-year recurrence free-survival. Moreover, we did not observe post-operative complications such as vascular damage, neurological deficits, or infections.

Conclusion

Our case demonstrates that the far-lateral approach can be efficient for the resection of anterolateral FMMs. In such cases, Simpson grade 1 can be achieved without complications, providing immediate relief of symptoms and minimizing the risk of recurrence.

Declarations

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Author contributions

Conceptualization: R.R.; Methodology: M.S.; Software: Ł.D.; Investigation: L.S.; Resources: R.R., D.S.; Data Curation: A.D.; Writing – Original Draft: M.S., L.S., Ł.D., J.K.G, Z.H.; Writing – Review & Editing: W.C., R.R. Visualization: A.D.; Supervision: R.R., D.S., K.T.; Project administration: R.R.

Conflicts of interest

The authors declare that they have no competing interests.

Data availability

Not applicable.

Ethics approval

Patient signed informed consent regarding publishing their data and photographs.

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