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Case Report

Pons herniation after skull base chondrosarcoma surgery: A rare complication after transclival endoscopic endonasal approach

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ABSTRACT

Background: Intracranial chondrosarcomas are malignant tumors that most commonly affect the clivus region. For tumors in this location, the extended endoscopic endonasal approach could offer an alternative route. We present a case of pons herniation after this technique.

Case Description: A 55-year-old female presented with a 6-month history of difficulty walking. The neurological evaluation showed asymmetric tetra paresis and involvement of the IX cranial nerve on the right side. Imaging exams showed a lesion at the upper clivus, with a possible diagnosis of chondrosarcoma. An extended transclival approach with partial resection and a multilayer closure were performed. The patient had a slight immediate improvement in muscle strength, and she was discharged home 5 days after surgery. Four weeks later, she evolved with worsening strength on the left side. A new image examination revealed an atypical protrusion of the pontine tissue through the bone defect at the opening of the clivus; a surgical revision was proposed, but the patient chose conservative management.

Conclusion: Pontine herniation is a rare complication with no defined cause. The use of a rigid material for closure could reduce the chances of this complication, but futher studies are necessary to reinforce that hypothesis.

Keywords: Case report, Chondrosarcoma, Complications, Endoscopic endonasal approach, Skull base tumors

INTRODUCTION

Intracranial chondrosarcomas are malignant tumors originating from chondroid cells that generally affect the clivus region and, specifically, the temporo-occipital region.[9] Surgical treatment is the most recommended due to its aggressive nature, although there is still no consensus on the extent of the intended resection. At present, the transsphenoidal endoscopic endonasal approach is considered effective for this type of tumor, especially when the extension is in the anteroposterior direction with a small lateral extension.[7]

The Endonasal endoscopic approach (EEA) for skull base surgeries has advanced with the evolution of the technique and the expansion of anatomical knowledge.[4] EEA offers greater

safety than the transcranial route and adds a low rate of postoperative complications, especially for tumors located in the clivus.[10] However, even with advances, there is still a risk of complications inherent to surgery. Pons herniation is a rare finding and seems to be associated with extensive resections of the dura mater and clivus, although the cause is still not clarified.[5]

In this paper, we present our only case of pons herniation. This complication happened following surgery for chondrosarcoma through a transclival endonasal endoscopic route conducted in a philanthropic hospital in the state of Sergipe, Brazil.

CASE REPORT

We present a 55-year-old female patient with class I obesity, no other comorbidities, no prescribed medication in use, and difficulty walking for approximately 6 months. A neurologist initially consulted her because of tetraparesis symptoms. The patient had a cranial computed tomography (CT) and magnetic resonance imaging (MRI) done. After examinations, the neurologist referred her to the neurosurgery service. In the initial neurological examination, the patient presented with asymmetric tetraparesis. Strength measured grade 3 on the right and grade 4 on the left, associated with global exalted deep reflexes. In addition, she had episodes of dysphagia with liquids showing signs of mild paresis of the IX cranial nerve on the right.

The CT showed a lesion located medially behind the clivus, occupying the middle and lower third of it, with a similar density to the brain parenchyma [Figure 1]. There were signs of involvement of the petrous apex on the right side and bone destruction. The T1-weighted MRI image showed a lesion with hyposignal, and the T2-weighted image showed a heterogeneous image with hypersignal. The contrast-enhanced T1-weighted image showed a lesion with heterogeneous contrast uptake displacing the pons medially and extended from the region of the petrous apex on the right side with the carotid artery displaced laterally and superiorly in its petrous segment [Figure 1]. Furthermore, in the lower images, it was possible to observe signs of contact with the jugular foramen on the right side. Among the differential diagnoses, the main hypothesis was a chondrosarcoma, later confirmed with the anatomopathological study of fragments of the lesion. After discussing the surgical possibilities with the patient, the risks and benefits of an EEA, and a transcranial approach, the patient chose the endonasal option.

After general anesthesia, we positioned the patient in a horizontal supine position with a 3 points-Mayfield fixation and neurophysiological monitoring of cranial nerves and motor and somatosensitive potentials. The position is like that used in pituitary surgery, except for a greater flexion of the head to allow a better view of the clivus region. In addition, we exposed the lateral aspect of the right thigh to remove a free fascia lata graft and fat. After that, the otorhinolaryngology team exposed the entire sphenoid floor and also drilled the superior and middle clivus to allow exposure of the dura mater from the dorsum sellar region to the lower limit of the tumor. Greater right lateral exposure was possible due to the displacement of the para-clival carotid laterally and the petrous carotid on that side being more lateralized and displaced superiorly. We opened the dura mater medially in the craniocaudal direction, followed by central debulking of the lesion.

After resecting the center of the lesion, we performed a circumferential dissection allowing resection of the entire lesion from the petrous apex and the medial and left portions of the tumor. We were able to visualize and preserve all neurovascular structures as the basilar artery and VI nerve bilaterally by this access. However, the most superior portion of the tumor, at the transition between the para-clival carotid artery and cavernous sinus posterior segment, was not well visualized, and we decided not to remove it. We performed the closure of the skull base using the multilayers technique as in the following sequence: a layer of fat inside the cavity; free fascia lata graft internally to the dura mater; right pedicled nasoseptal flap, patches of gel foam, and a gauze pad moistened with antibiotic ointment. We removed the gauze pad 5 days after surgery. The patient presented no complications after surgery and a slight improvement in muscle strength on the right side of the body in the immediate postoperative period. We were able to discharge her after 5 days of surgery and continue to monitor her as an outpatient.

In the postoperative evaluation, 14 days after surgery, the patient began to report worsening strength on the left side in relation to the improvement obtained in the immediate postoperative period. We recommended intensifying physiotherapy sessions and advised that in case of worsening, return for evaluation. Four weeks after surgery, the patient returned to the clinic, presenting grade 3 tetraparesis, unable to walk. She had a new brain MRI done, and it showed an atypical protrusion of the pontine tissue through the bone defect at the opening of the clivus [Figure 2]. At that time, we discussed the possibility of reviewing the reconstruction of the skull base with the patient; however, she opted for conservative management due to risks related to a new surgical procedure. We indicated complementary radiotherapy since the patient did not opt for a new surgical treatment to remove the residual lesion. At her last consultation (2 years after surgery), the patient presented asymmetric hemiparesis (grade 2 strength in the left upper limb and grade 4+ in the left lower limb) with a Barthel Index of 35 points (severe dependence). Despite the maintenance

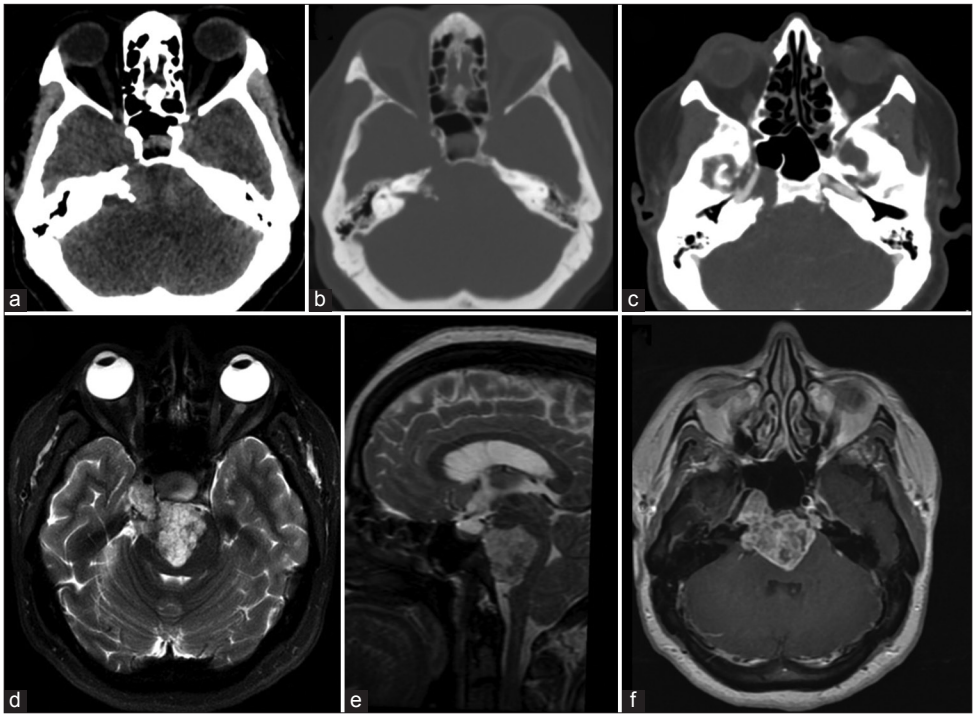

Figure 1: Preoperative images showing in (a) the preoperative axial brain computed tomography (CT) with an isodense prepontine lesion, with (b) indications of extension and destruction of the anterior petrous bone. In (c), a brain angiography CT demonstrates the relationship of the tumor with the right internal carotid, with lateral and superior displacement of the artery in the petrous and para clival segment. In (d and e), an axial and sagittal T2-weighted magnetic resonance imaging (MRI) shows a heterogeneous mass with hypo signal lesion, huge displacement of the pons, and invasion of the petrous apex. In (f), a T1-weighted postgadolinium axial MRI shows a heterogenous contrast enhancement and a possible route for the endoscopic endonasal approach with the displacement of the right internal carotid.

of the protrusion of the pontine tissue, we have been monitoring the patient. She still has difficulty walking but is able to conduct – with some limitations – activities of daily living at home and without signs of growth of the residual lesion.

DISCUSSION

Endoscopic endonasal surgery has been introduced as a treatment option for anterior skull base tumors with favorable results. Sometimes, it is necessary to perform an extensive clival resection to obtain favorable margins for tumor resection and wide brainstem decompression in the EEA treatment for chondrosarcoma, chordomas, and meningiomas.[6] The need for resection of the clival dura mater is inherent to the case and can be extensive in most cases.[1] Although direct duraplasty or primary dural closure with bone skull base reconstruction is not feasible with EEA, in our experience, secondary reconstruction results in decompression and restoration of anterior skull base anatomy in most cases. However, this case presented an anterior displacement of the pons due to the clivus bone defect. It has been the only episode of pons herniation in our series.

Endonasal endoscopic approach closure techniques have improved significantly with the advent of vascularized flaps reducing complication rates.[13] We chose a multilayer method for this case, in which a vascularized nasoseptal flap and fat graft of the fascia lata can be used. In a large retrospective study of multilayer closure using a nasoseptal flap without rigid reconstruction, there were 13.6% anatomical abnormalities of the posterior fossa, including pontine encephaloceles.[5] Closure with a rigid material could reduce the chances of this complication; however, there would be an elevated risk of vascular compression due to a transient increase in intracranial pressure (ICP).[12] Among the rigid closure alternatives described in the literature, there is the gasket seal option, which consists of using autologous fascia lata to create a seal around a bone reinforcement, followed by the application of a dura mater sealant.[8]

Transclival pons herniation is a rare complication and has no defined cause. As in meningoceles or encephaloceles, a

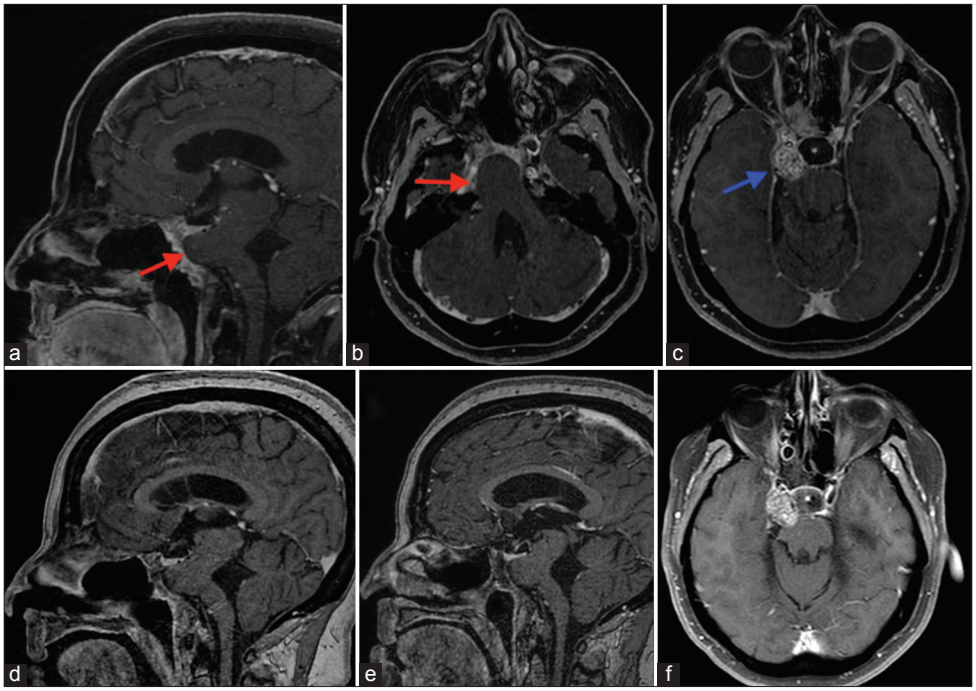

Figure 2: Postoperative images. In (a and b), a T1-weighted postgadolinium sagittal and axial magnetic resonance imaging (MRI) shows the displacement of the pons into the clivus bone defect (red arrow). In (c), a more superior MRI slice shows a residual tumor inside the posterior compartment of the right cavernous sinus (blue arrow). In (d and e), follow-up MRI images of 1 and 2 years, respectively, show the same changes as the first postoperative MRI. In (f), it is possible to see after 2 years no growth of the residual tumor.

transient increase in ICP may be a causal factor. Postsurgical encephaloceles have been associated with decompressive craniectomies and dural openings.[2] In addition to dural and bone defects in these cases, increased ICP is an additional factor that determines the degree of brain herniation. Risk factors have been described in the literature, including extensive clival resection, postoperative meningitis, obesity, nonuse of fat grafting, and extensive clival bone.[5] Our patient has class I obesity, which is one of the probable risk factors described.

As in other specialties, in anterior skull base surgery, there is a clear relationship between the surgeon's level of experience and achieved results, often described as a "learning curve."[3] Complication rates are markers of surgical skills. Postoperative cerebrospinal fluid (CSF) leak is the most frequent complication and is defined as a pertinent marker that reflects the learning curve. Shikary *et al.* reported that 120 procedures are required to reach a plateau of 134 min for average operation duration and one hundred procedures to stabilize CSF leak rates below 5%.[11] The skull base team (neurosurgeon and otorhinolaryngologists) responsible for this surgery has a case series of 166 patients operated through endoscopic endonasal surgery, including 120 pituitary adenomas and 46 patients with skull base pathologies, demonstrating that this complication could be related to with our learning curve.

CONCLUSION

A pontine herniation is a rare complication of transclival endoscopic surgeries and has no defined cause. A rigid material closure could reduce the chances of this complication; nevertheless, it would be associated with other risks. We hope that future innovations in EEA and alternative techniques in endoscopic reconstruction of the anterior skull base will avoid such a complication.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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