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Case Report

Embolization of a vertebral artery encased in a regrowth cervical meningioma before resection

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ABSTRACT

Background: Managing intraoperative bleeding may be challenging when a cervical tumor encases the vertebral artery (VA). Here, a patient with a recurrent cervical meningioma between the C1/2 and C3/4 levels and encasement of the right VA injury developed intraoperative bleeding that was endovascularly embolized postoperatively.

Case Description: A 30-year-old female presented with a progressive quadriparesis, most markedly involving the right upper extremity. Six years ago, she had a cervical meningioma resected at the C2/3 level. The new MR revealed regrowth of intraspinal tumor between the C1/2 to C4/5 levels accompanied by extradural encasement of the right VA within the C2/3 and C3/4 foramina. Before the first surgery, the right VA was embolized (i.e., after a balloon occlusion test proved negative). During the attempted resection of the intradural/extradural tumor, bleeding from the right VA was encountered; it was temporarily controlled. After complete occlusion of the right VA was angiographically confirmed, a second-stage procedure to fully resect the extradural remanent of the tumor was undertaken.

Conclusion: Endovascular embolization of the right VA before the attempted resection of a recurrent intraspinal/extraspinal cervical meningioma failed to occlude the vessel entirely. The VA bleeding encountered intraoperatively was temporarily controlled. Delayed total VA occlusion was angiographically observed before full tumor resection could be completed.

Keywords: Cervical meningioma, Endovascular embolization, Recurrence, Surgical treatment, Vertebral artery

INTRODUCTION

Extradural spinal meningiomas are rare and comprise just 2.5–3.5% of all spinal meningiomas.[1] They can be located at the spinal level.[1,6] Although gross total surgical resection is the gold standard, extradural cervical meningiomas extending into the foramina may encase the vertebral artery (VA), making complete excision more challenging.[2] To avoid injuring the VA during anterior or lateral approaches, preoperative endovascular embolization/occlusion is often recommended.[2,4,6,7] Here, a case of a 30-year-old woman who developed intraoperative bleeding from the still patent VA during the initial attempt at recurrent tumor resection is presented. The first procedure was aborted following temporary VA occlusion. Postoperative additional endovascular right VA embolization was unnecessary as we confirmed that the VA was completely embolized with cerebral digital angiography. The second stage successfully resulted in gross total tumor resection.

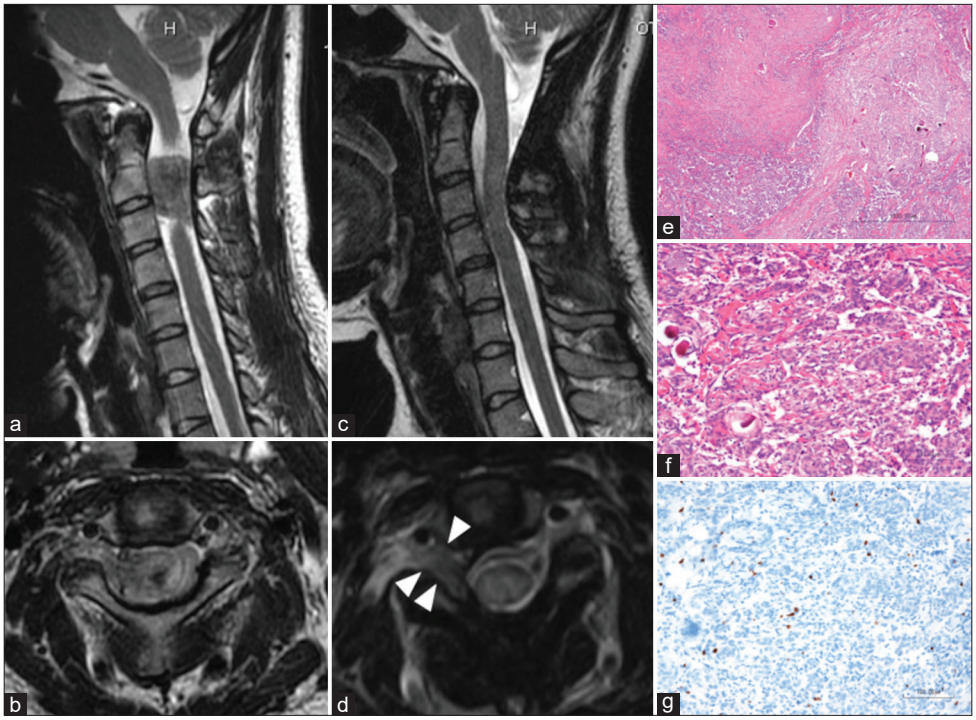

Figure 1: First Surgery: MR and pathological findings. Preoperative T2-weighted MR shows a mass at C2/C3 with cord compression (a: Sagittal and b: Axial). Postoperative T2-weighted MR shows a tumor in the spinal canal that was removed, but there is a residual C2/3 foraminal tumor (white arrow heads) (c: Sagittal and d: Axial). Transitional meningioma (Grade 1) was diagnosed with an aggregation of meningothelial cells with pink cytoplasm, short spindle-shaped cells, and psammoma bodies. Mib-1 index was less than 2% (e-g).

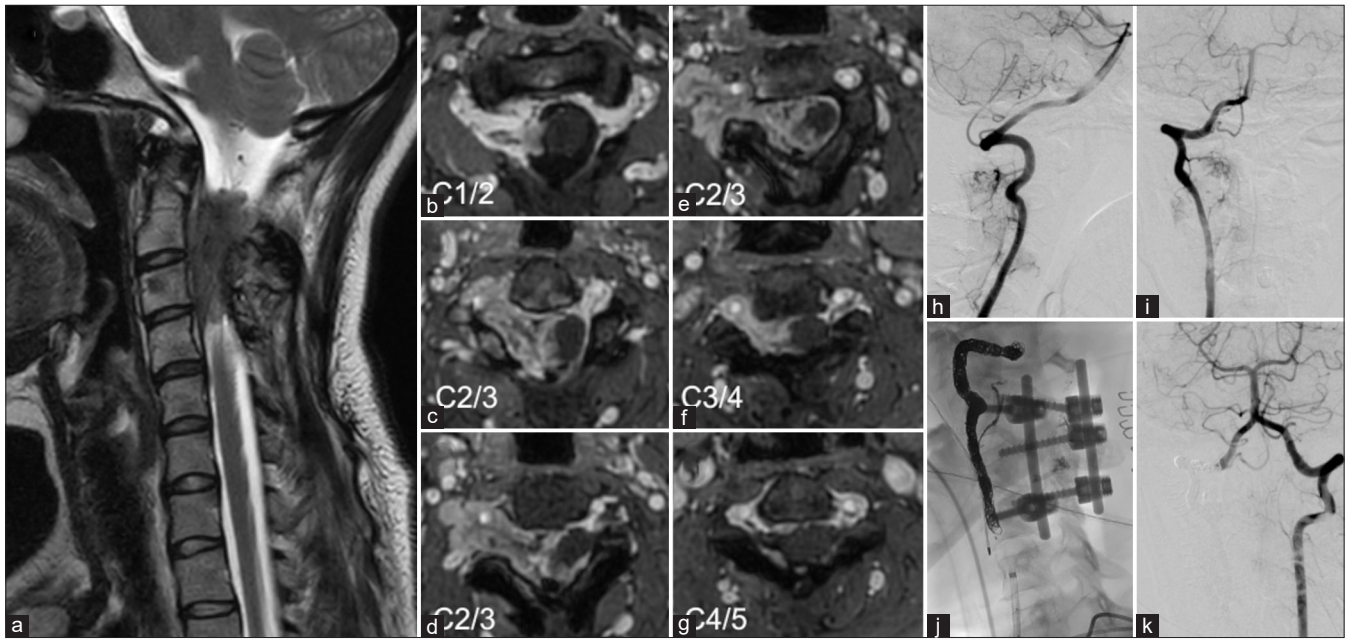

Figure 2: Six years later, preoperative MR and angiography of the recurrent tumor encasing the right VA. A T2-weighted MR shows the recurrent meningioma from C1 to C4 (a). The T1-weighted enhanced MR shows the recurrent tumor in the spinal canal extending through the right-sided foramina of C1/C2 and C3/C4 (b-g). Right vertebral angiography shows the tumor is fed by radicular arteries (h and i). The pedicle screws were placed at the bilateral C2, right C3, and bilateral C4 levels. The right vertebral artery was embolized (j and k).

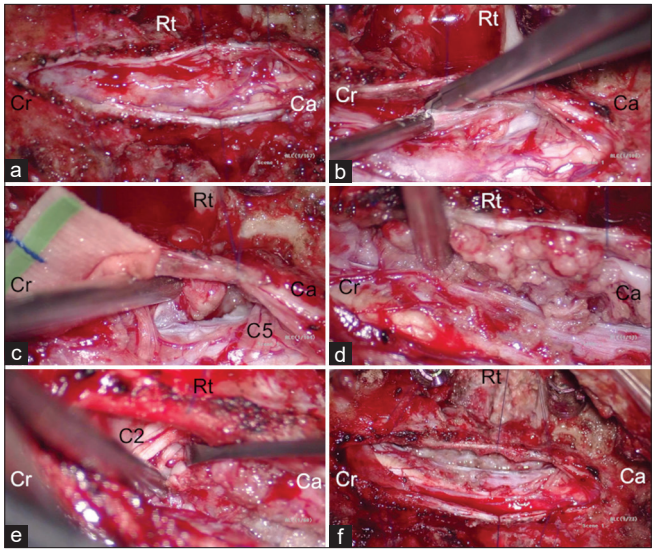

Figure 3: Surgery Part 1: Resection of the intradural recurrent tumor between the C1-C5 levels. The intradural meningioma was laterally detached from the dura (a and b). The caudal margin of the tumor involving the C5 nerve root (c). The tumor was then medially detached from the spinal cord (d). The right C2 nerve root was the cranial margin of the meningioma (e). The intradural meningioma was then removed (f). Ca: Caudal, Cr: Cranial, Rt: Right.

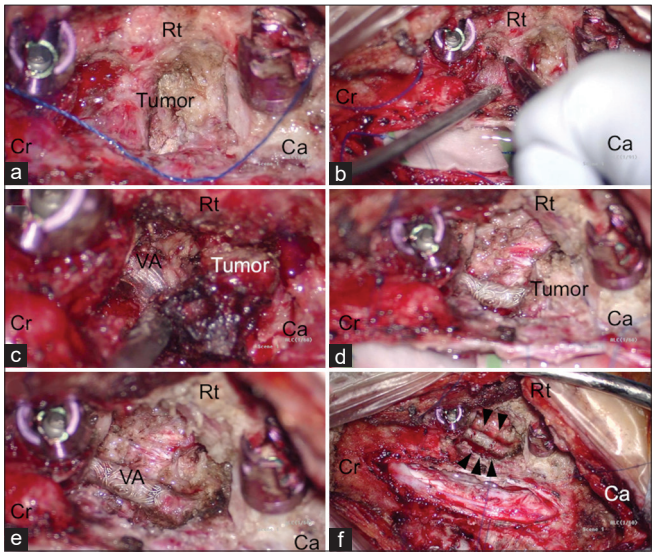

Figure 4: Surgery Part 2: Removal of the extradural recurrent tumor. The lateral masse of C2/C3 and C3/C4 were drilled, allowing for exposure of the extradural meningioma in the C3 nerve sheath (a). Removal of the extradural meningioma was initiated (b). The embolized VA was identified (c). The extradural meningioma lateral to the foramen of C3 was removed along the VA (d and e). However, bleeding occurred around the VA when the extradural tumor was removed at the C4 level (black arrows) (f). Ca, Caudal; Cr, Cranial; Rt, Right; VA, Vertebral artery.

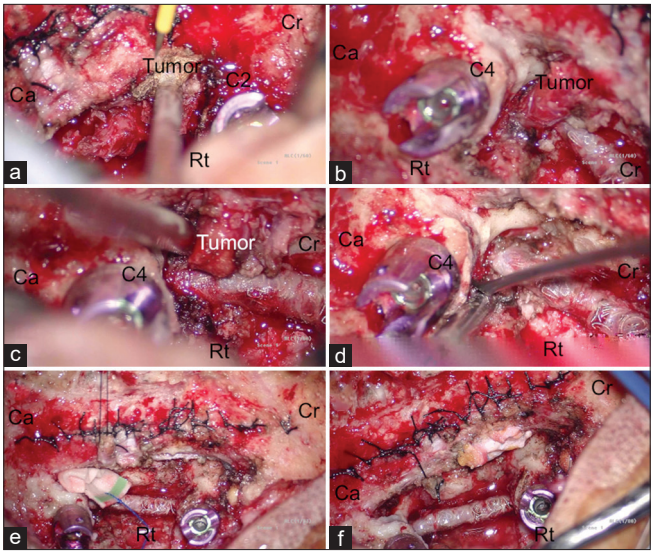

Figure 5: Surgery Part 3; final removal of the extradural recurrent tumor. Residual meningioma at the C2 (a) and C4 levels were removed (b and c). The residual meningioma in the foramen of C4 was curetted (d). The extradural meningioma was then grossly and totally removed, following which a duraplasty was performed (e and f). Ca: Caudal, Cr: Cranial, Rt: Right.

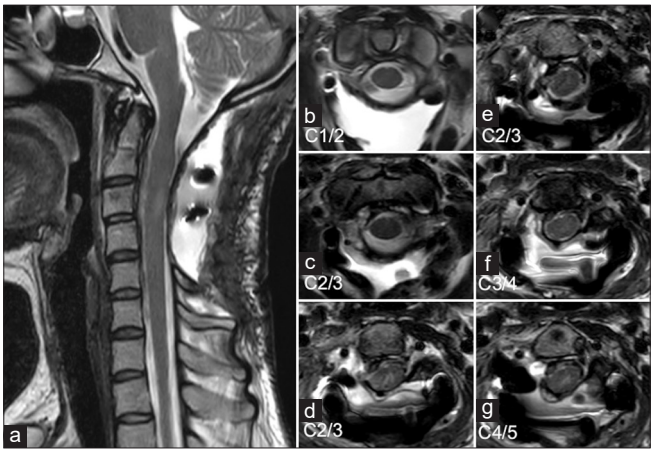

Figure 6: Postoperative MR images. Postoperative T2-weighted magnetic resonance images reveal gross total removal of the regrowth meningioma (a: Sagittal and b-g: Axial).

CASE PRESENTATION

A 30-year-old woman presented with a 2-month history of progressive quadriparesis, most markedly involving the right upper extremity. She had undergone resection of a cervical meningioma 6 years before [Figure 1]. Now, the cervical MR showed a recurrent tumor on the right side between the C1/2 to C4/5 levels, with extradural extension into the

Table 1: Past cases of cervical tumor encasing a vertebral artery.

Author (ref) Journal year	Patients	Symptoms	Location	Tumoral pathology	Surgical strategy
Bettaswamy *et al*.[1] Journal of craniovertebral junction and spine, 2016	50 years, male	Neck pain Paresthesia of the four limbs Spastic quadriparesis Bladder disturbances	C1-C4 (extradural)	Meningothelial meningioma	C2-C4 laminectomy Tumor intentionally unremoved around the VA
Küçük *et al*.[2] World neurosurgery, 2021	6–71 years (mean age: 29.3 years) 13 males and nine females	N.A.	C2 (three cases) C3 (one case) C3-C4 (one case) C4 (two cases) C4-C5 (a case) C5 (four cases) C5-C6 (three cases) C6 (four cases) C7 (two cases) C7-T1 (one case)	Aneurysmal bone cyst (two cases) Cavernous hemangioma (one case) Eosinophilic granuloma (two cases) Giant cell tumor (two cases) Langerhans cell histiocytosis (one case) Meningioma (two cases) Metastasis (four cases)	Anterior approach Anterior approach combined with tumor resection (one case) Anterior approach retracting a vertebral artery, and tumor resection (nine cases) Anterior approach retracting a vertebral artery, autograft, anterior fixation with/without corpectomy, and tumor resection (five cases) Posterior approach Partial hemilaminectomy removing the lateral mass, retraction of a vertebral artery, autograft, and occipitocervical fixation (one case) Circumferential approach (one case) Anterior approach Retracting a vertebral artery, autograft, corpectomy, and tumor resection Posterior approach Partial hemilaminectomy facetectomy, tumor resection, autograft, and lateral mass fixation (C4-C6) (one case) Anterior retropharyngeal approach Retracting a vertebral artery, autograft, and tumor resection Posterior approach Autograft Fixation (C1-C3) (one case) Anterior retropharyngeal approach Autograft and tumor resection Posterior approach retraction of a vertebral artery, tumor resection, costal autograft, and occpitocervical fixation (occipto-C3, C4) (one case) Anterior approach Retracting a vertebral artery, autograft, and tumor resection Posterior approach Tumor resection, costal autograft, and pedicular fixation (C6-T1, T2) (one case) Anterior approach Bilateral retraction of a vertebral artery, autograft, anterior fixation (C4-C7), corpectomy (C5-C6), and tumor resection

(Contd...)

Table 1: (*Continued*)

Author (ref) Journal year	Patients	Symptoms	Location	Tumoral pathology	Surgical strategy
					Posterior approach Lateral mass fixation (C4-C7) (one case) Anterior approach Retracting a vertebral artery, autograft, corpectomy, and tumor resection Posterior approach Facetectomy, pedicular fixation (C5-C7), and tumor resection
Ogungbemi *et al.*[3] Interventional neuroradiology, 2015	19–59 years (mean age: 39.7 years) nine males and nine females	N.A.	Sacrifice of right and left vertebral arteries (4/14 cases)	<Benign tumors>four cases <Malignant tumors> metastases (two cases) Chondrosarcoma (three cases) Chordoma (two cases) Epithelioid fibrosarcoma (two cases) Malignant peripheral nerve sheath tumor (two cases) Osteosarcoma (one case) Spindle cell sarcoma (one case) Synovial sarcoma (one case)	Endovascular occlusion of a vertebral artery with a balloon placed distal to the encased segment Without preceding balloon test occlusion
Tomii *et al.*[6] Acta neurochirurgica, 2013	63 years, female (Representative case)	Numbness in the right hand	C2-C3	N.A.	Posterior approach Bilateral recapping laminoplasty of C2 Intraoperative identification of the VA with Doppler ultrasonography
Wang *et al.*[7] Operative neurosurgery, 2017	(Case 1) 51 years, male (Case 2) 60 y, male (Case 3) 21 years, male (Case 4) 62 years, female	(Case 1) Motor weakness of the right hand (Case 2) Neck pain (Case 3) Dysphagia (Case 4) Numbness of the left arm	(Case 1) C6-T1 (Case 2) C2-C3 (Case 3) C4-C6 (Case 4) C3-C5	Chordoma (all cases)	(Case 1) Posterior approach Laminoplasty (C3-C5), left-side laminectomy (C6-T1), right pedicle removal (C6-T1), and posterior fixation (C4-T3) Anterior approach Intraoperative identification of the VA with Doppler ultrasonography, left-side parasagittal osteotomy (C6-T1), tumor removal, autograft, and anterior fixation (Case 2) Anterior approach Sacrifice of C3 and C4 nerve roots, and a vertebral artery (at the level of C3-C4), and parasagittal osteotomy (C2-C4)

(Contd...)

Table 1: (*Continued*)

Author (ref) Journal year	Patients	Symptoms	Location	Tumoral pathology	Surgical strategy
					Posterior approach Posterior fixation (From occipital bone to C6), tumor removal, expandable cage placement (C1-C4), and autograft (Case 3) Posterior approach Posterior fixation (C2-C7), laminectomy (C3-C6), facetectomy (C2/C3 and C6/C7), sacrifice of C4 and C5 nerve roots and a vertebral artery, and left-side pedicle removal (C3-C6) Anterior approach Anterior cervical discectomy (C4/C5, C5/C6), parasagittal osteotomy (C5), tumor removal, autograft, and anterior fixation with an expandable cage and plate (C4-C6) (Case 4) Posterior approach Posterior fixation (C1-C7), laminectomy and left-side lateral mass removal (C3-C5), and right-side laminectomy (C6) Anterior approach Anterior parasagittal osteotomy (C3-C5), sacrifice of a vertebral artery, tumor removal, discectomy (C2/C3, C5/C6), autograft, and anterior fixation with an expandable cage and plate (C2-C6)

y: Years, N.A.: Not available

right C2/3 and C3/4 foramina where it encased the right VA [Figures 2a-g].

First procedure

Endovascular occlusion of the right VA from C3-C5 was performed before the replacement of pedicle screws at the level of bilateral C2, left C3, and bilateral C4 [Figure 2h-k].

First surgery of tumor resection

The intracanalicular meningioma was circumferentially detached and removed. This required drilling/excision of the right lateral masses of C2, C3, and C4 [Figure 3]. During this dissection, however, bleeding was encountered from the right VA. The bleeding was controlled and not persistent. The procedure was immediately aborted because continuing the removal procedure could result in bleeding complications [Figure 4].

Angiographic findings after first surgery of tumor resection

The digital cerebral angiography, performed 9 days later, newly documented complete embolization/occlusion of the right VA. Therefore, additional endovascular embolization of the right VA was not performed.

Second surgery of tumor resection

During the second surgery, the residual extradural meningioma located between the C2 to C4 levels was removed [Figure 5]. The postoperative course was uneventful and the patient remained neurologically intact. Ten months later, the postoperative MR documented no tumor regrowth [Figure 6].

Pathology

The pathology was consistent with a benign meningioma similar to that removed 6 years earlier; there was no evidence of malignancy.

DISCUSSION

Only 2.5–3.5% of spinal meningiomas are extradural, and in these cases, unilateral encasement of VA must be anticipated.[1] Various preoperative and intraoperative methods for controlling bleeding from the VA compressed/encased by cervical tumors have been proposed, although the

VA can be retracted if necessary. Preoperative embolization of these VA is safer and more effective [Table 1].[1-7] Here, preoperative endovascular embolization of the encased right VA within the recurrent cervical meningioma was first unsuccessful as there was intraoperative bleeding from the still patent right VA. After delayed complete occlusion of the right VA was confirmed angiographically, gross total tumor removal was secondarily achieved.

CONCLUSION

Endovascular embolization of a unilateral encased VA (i.e., after unilateral balloon occlusion produces no deficits) is often considered to prevent intraoperative hemorrhage, particularly during the resection of recurrent cervical meningiomas.

Declaration of patient consent

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

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Nil.

Conflicts of interest

There are no conflicts of interest.

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