



Technical Notes

Intraspinal pilocytic astrocytomas: An overview and 2-D illustrative resection technique video

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Received : 22 December 2021

Accepted : 10 January 2022

Published : 11 February 2022

DOI

10.25259/SNI_1254_2021

Video available on:

www.surgicalneurologyint.com

Quick Response Code:



ABSTRACT

Background: Spinal cord pilocytic astrocytomas (PAs) are rare and typically occur in pediatric patients. While PAs are often well-circumscribed and amenable to gross total resection, they sometimes harbor infiltrative components that can invade normal cord parenchyma.

Methods: Here, we present a 59-year-old female with a progressive right-sided hemi-sensory loss, right-sided hemiparesis, and gait imbalance. The preoperative T2 magnetic resonance imaging revealed a large loculated cystic tumor that focally compressed the dorsal medulla, while the contrast study revealed a 1.3 cm homogeneously enhancing expansile intramedullary mass centered at the C1 level.

Results: The patient underwent a C1-2 laminectomy followed by gross total intramedullary tumor resection utilizing intraoperative dorsal column mapping. There were no operative complications. The patient had preserved motor strength and an expected dorsal column dysfunction, which largely resolved over 9 months postoperatively.

Conclusion: Here, we provide a broad overview of PAs, in addition to a case study/technical note that includes a 2-D intraoperative video detailing the resection technique.

Keywords: Craniovertebral junction tumor, Intradural intramedullary tumor, Neurosurgery spinal oncology, Pilocytic astrocytoma, Technical note surgical video

BACKGROUND AND IMPORTANCE

Pilocytic astrocytomas (PAs), which account for approximately 5% of all primary central nervous system tumors,^[1] are classified by the World Health Organization (WHO) as Grade I astrocytomas. They are also the most common brain tumor found in children and adolescents.^[6] These well-circumscribed, yet potentially infiltrative tumors are most commonly located close to the cerebellar midline in children, while in adults, they are found more laterally within the cerebellum or in the temporal and parietal lobes.^[1,4] Less than 10% of PAs in adults involve the spinal cord.^[5] Early diagnosis and complete resection have been shown to yield good prognosis for most pediatric cases.^[4] However, there is a statistically significant decrease in survival with increasing age; the 60-month survival rate in patients ages 5–19 years of age is 96.5% compared with 52.9% in those 60 years of age and older.^[3] Hence, PA may not be a benign disease in adults and aggressive

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resection is recommended.^[7] Here, we present the technical intramedullary resection of a craniovertebral junction PA in an adult patient, along with the 2-D intraoperative video.

CLINICAL PRESENTATION

Patient presentation

A 59-year-old female presented with a several month history of progressive right-sided hemi-sensory loss, right-sided hemiparesis (4/5), and gait imbalance. The T2 magnetic resonance imaging (MRI) revealed a large cystic, loculated lesion that compressed the dorsal aspect of the medulla along with cord signal from C2 to C5 [Figures 1a-d]. The contrast MRI demonstrated a 1.3 cm homogenously enhancing

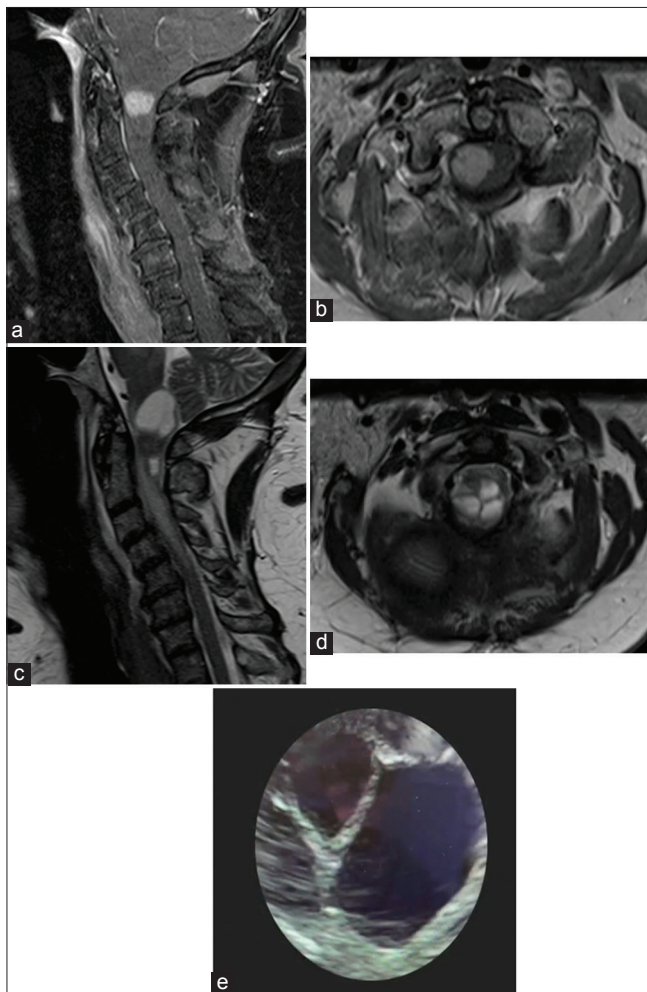


Figure 1: Preoperative (a) sagittal T1 postcontrast magnetic resonance imaging (MRI), (b) axial T1 postcontrast MRI, (c) sagittal T2 MRI, and (d) axial T2 MRI demonstrating a 1.3 cm homogenously enhancing intramedullary mass centered at C1. Spinal cord T2 MRI signal change was present from C2 through C5. (e) Intraoperative ultrasound confirming cystic nature of C1 pilocytic astrocytoma (WHO Grade I).

intramedullary mass centered at C1 and eccentric to the right that expanded the spinal cord. The computed tomography angiography (CTA) demonstrated the course of the vertebral arteries.

Surgery

The patient was positioned prone on a “Jackson table” with intraoperative neurophysiologic monitoring – namely, intraoperative motor evoked potentials, somatosensory evoked potentials (SSEPs), free-running electromyography, and dorsal column mapping – utilized throughout the duration of surgery. The surgeon utilized a surgical microscope and ultrasound to perform a gross total resection (GTR) of the tumor. This required a C1-2 laminectomy, 3 cm suboccipital craniectomy, midline myelotomy (i.e., using the dorsal column mapping) [Figures 1e and 2]. During the myelotomy, the anticipated brief decrease in SSEPs occurred. Once the tumor was exposed and grossly removed [Figure 3],

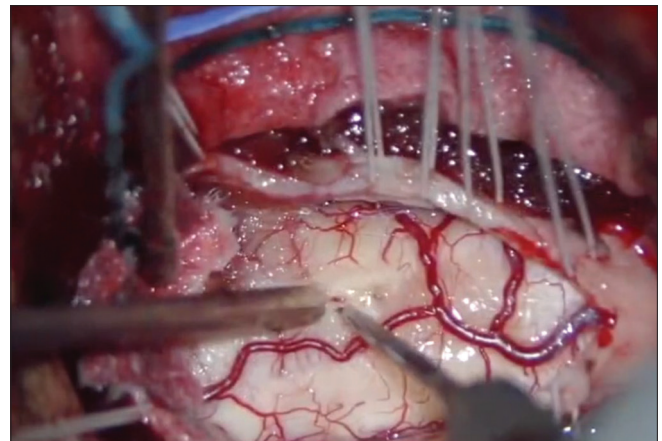


Figure 2: Intraoperative image of dural tack-up sutures and midline myelotomy along C1 pilocytic astrocytoma (WHO Grade I).



Figure 3: Intraoperative image of resection of the superficial component of C1 pilocytic astrocytoma (WHO Grade I) following devascularization and sharp dissection.

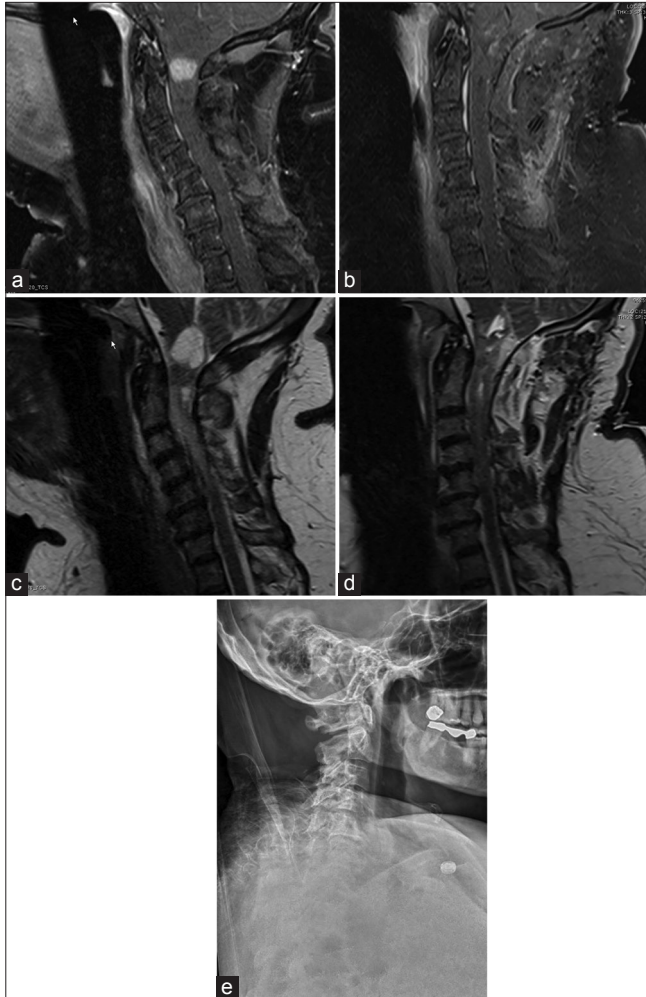
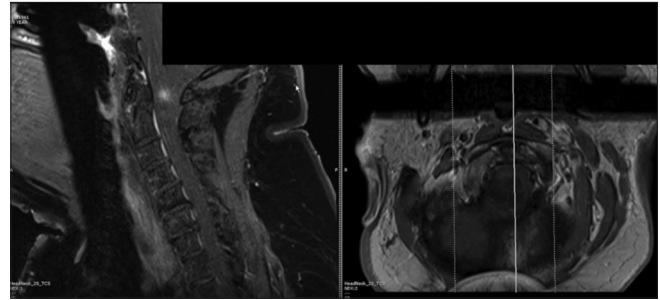


Figure 4: Sagittal T1 postcontrast magnetic resonance imaging (MRI) (a) preoperative and (b) postoperative gross total resection of C1 pilocytic astrocytoma (WHO Grade I). Sagittal T2 MRI (c) preoperative and (d) postoperative resection of C1 pilocytic astrocytoma (WHO Grade I). Subtle postoperative hyperintensities within the tumor bed resulted from a combination of blood products and hemostatic agents. (e) Postoperative upright cervical spine X-ray (lateral view) showing no evidence of atlantoaxial or atlanto-occipital instability following gross total resection of C1 pilocytic astrocytoma (WHO Grade I).

the dura was closed in a watertight fashion using 6-0 Prolene® Sutures.

Clinical outcome and pathology

Postoperatively, the patient had preserved motor strength and the expected dorsal column dysfunction, which markedly resolved within 9 months. The postoperative MRI scans demonstrated GTR of the tumor and dynamic X-rays confirmed no atlantoaxial or atlanto-occipital instability [Figure 4]. The tumor was identified as PA (WHO Grade I), and therefore, no further adjuvant treatment was indicated.^[2,4]



Video Caption: Two-dimensional video of surgical gross total resection of C1 pilocytic astrocytoma (WHO Grade I) in an adult patient.

DISCUSSION

Primary PA of the spine is extremely rare, particularly among adults, and GTR is the standard of care.^[2] In our case, the entire solid tumor mass was resected and resulted in the spontaneous regression of the cyst (i.e., without direct removal of the cyst walls). Accurately locating the midline for the myelotomy helps to circumvent inadvertent dissection through the dorsal columns, which would result in postoperative sensory deficits.^[8] However, if the surgeon does not have access to dorsal column mapping, the midline can be identified anatomically by appreciating the confluence of pial vessels. In addition to the use of intraoperative neurophysiological monitoring during the resection of the tumor, other precautions can be implemented to prevent over-manipulation of the dorsal columns. The tumor can be debulked utilizing microdissection to establish the tumor-spinal cord plane before retracting the dorsal columns.^[8] A brief reduction in SSEPs typically occurs after myelotomies for intramedullary lesions. Hence, patients should be counseled prior to surgery that they may in fact have a new dorsal column dysfunction after surgery. Further, preoperative CTAs are important to identify potentially aberrant courses of the vertebral and posterior inferior cerebellar arteries. In addition, if instrumentation is not applied following the C1-2 laminectomy, careful dynamic X-ray and CT studies should be successively performed to detect the late onset of instability.

CONCLUSION

In this technical note, we presented the surgical approach to resect an intramedullary occiput-C1-C2 PA.

Declaration of patient consent

Patient's consent not required as the patient's identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Ojukwu DI, Hoffman HA, Song R, Galgano MA. Intraspinal pilocytic astrocytomas: An overview and 2-D illustrative resection technique video. *Surg Neurol Int* 2022;13:41.