Anterior approach to cervical intramedullary pilocytic astrocytoma

Case report

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Although there has been considerable experience with anterior approaches to ventral intradural, extramedullary, and pial-based spinal lesions, there is no information in the literature regarding the safety and feasibility of the resection of an intramedullary tumor via an anterior approach. The authors report on the gross-total resection of an intramedullary cervical pilocytic astrocytoma via a C-7 corpectomy and anterior myelotomy. The surgery proceeded without complication, and postoperatively the patient maintained the preoperative deficit of mild unilateral hand weakness but had no sensory deficits. Follow-up MR imaging at 6 months showed gross-total macroscopic resection. Selected intramedullary tumors can be safely removed via an anterior approach. This approach avoids the typical sensory dysfunction associated with posterior midline myelotomy. (DOI: 10.3171/SPI/2008/9/9/253)

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terior spinal cord via anterior cervical16 or anterolateral thoracic approaches22,24 also exist; however, most of these reports describe the removal of purely extramedullary tumors or spinal cord lesions arising from either the ventral pia or spinal cord surface. Here we describe the successful removal of a completely intramedullary ventral spinal astrocytoma via an anterior cervical approach and review the literature regarding anterior approaches to intradural spinal tumors as well as the goals of surgery in the treatment of spinal astrocytomas.

Case Report

History and Examination. This 17-year-old patient presented with a several-months-long deterioration in right hand function. Neurological examination revealed motor deficits confined to the intrinsic muscles in his right hand, mild atrophy of the second dorsal interosseous muscle and thenar eminence, intact sensory function, normal gait, normal reflexes, and down-going toes.

Magnetic resonance imaging showed an enhancing mass within the ventral spinal cord at C-7 capped by a large cyst rostrally and a much smaller cyst caudally (Fig. 1). The preoperative differential diagnoses included hemangioblastoma, astrocytoma, and subependymoma.

Operation. Given the eccentric ventral location of the tumor, an anterior approach was selected. Following routine intubation, a spinal drain was placed and left clamped during surgery. After the placement of intraoperative neurophysiological monitoring leads with somatosensory evoked potentials, motor evoked potentials, and free running electromyography capabilities, the patient was positioned supine with his head slightly extended and the mandible retracted using a Caspar headholder.

The first operative stage involved a standard right-sided anterior cervical approach through a 6-cm incision parallel to the sternocleidomastoid muscle. By using blunt dissection, a corridor between the carotid sheath and the trachea and esophagus was developed down to the anterior spine. Fluoroscopic localization revealed the correct level. Monopolar cautery was used to dissect the prevertebral fascia and longus colli muscles from the C-6, C-7, and T-1 vertebral bodies. After placing a self-retaining Caspar retractor and distraction posts in the C-6 and T-1 vertebral bodies, a C-7 corpectomy with adjacent discectomies was performed. The corpectomy was ~20 mm in width. Resection of the underlying posterior longitudinal ligament exposed the ventral cervical dura (Fig. 2a).

After meticulous hemostasis, a midline anterior durotomY was made and dural edges were retracted using 4-0 silk sutures anchored to the longus colli fascia (Video 1).

Dilated veins were apparent on the ventral spinal cord pial surface, but no radiculomedullary artery was seen in the operative field (Fig. 2b). The pia was intact. The spinal cord was focally expanded and edematous, but no tumor

![Fig. 1. Preoperative sagittal T1-weighted MR images without (A) and with (B) contrast enhancement, and axial T1-weighted contrast-enhanced (C and D) MR images demonstrating a homogenously enhancing lesion at the level of the C-7 vertebral body. The lesion is intramedullary, located eccentrically in the right ventral spinal cord, and is associated with a large rostral cyst and a small caudal cyst.](image-url)
margin reached the spinal cord surface. Identification of the anterior median fissure or the anterior spinal artery was not possible due to spinal cord swelling. A longitudinal myelotomy was performed in the right anterior funiculus, medial to the ventral root exit zone. Abnormal tissue was immediately apparent (Fig. 2c), and after a specimen was sent for pathological examination, the tumor was resected using bipolar cautery, Cavitron aspirator, and suction (Fig. 2d). Frozen sections demonstrated a low-grade glial neoplasm with Rosenthal fibers.

Because no well-defined surgical plane was present between the tumor margin and spinal cord, resection proceeded in an inside-out manner. Prolene (6-0) pial sutures laterally clipped to the dura mater provided gentle lateral eversion of the spinal cord and facilitated tumor resection. Once all of the clearly identifiable tumor was resected, hemostasis was achieved and the retracting sutures were removed (Fig. 2e). The spinal cord assumed a more normal position (Fig. 2f), and the dura was closed with a running 4-0 silk suture. Arthrodesis and stabilization were performed with a fibular strut, local bone graft from the corpectomy, and an anterior plate from C-6 to T-1.

Postoperative Course. Postoperatively the endotracheal tube was removed from the patient, and he was unchanged in terms of neurological function. He was placed in a rigid cervical collar and remained supine with continuous spinal drainage at the level of the shoulder for 2 days. Plain radiographs showed a stable construct (Fig. 3A). A postoperative MR image showed satisfactory resection with minimal enhancement (Fig 3B and 3C). On postoperative Day 3 the patient was mobilized and ultimately discharged on postoperative Day 6. Permanent histology confirmed the initial diagnosis of pilocytic astrocytoma. The rigid collar continued to be worn by the patient for 12 weeks. After 6 months of follow-up he reported significant improvement in hand function. No sensory deficits or subjective sensory symptoms were noted. A 6-month postoperative MR image was negative for recurrence (Fig. 3D).

Discussion

Some anterior approaches to spinal tumors have sought avenues to high, ventrally positioned cervical meningiomas and schwannomas through transoral approaches. Other anterior approaches to middle and lower cervical nerve sheath tumors that were entirely or primarily extradural have been successful as well, allowing removal of the entire tumor in a single approach. Ultimately, surgeons have taken advantage of the relative facility and safety of anterior cervical exposures and high fusion rates that modern instrumentation affords, even across multiple segments, to approach and remove a variety of intradural extramedullary neoplasms.

Prior to this report, however, it was unclear whether a purely intramedullary spinal cord tumor could be approached anteriorly with preservation of motor function. Our case illustrates that an anterior approach can be feasible for selected intramedullary glial tumors, particularly if the lesion is ventrally located in the cervical spinal cord. The anatomical basis for the anterior approach to intramedullary lesions suggests that a paramedian longitudinal myelotomy, in either the right or left hemicord between the anterior median fissure and ventral nerve root exit zone, can be safely performed, as it was in the present case. Whereas the anterior corticospinal and anterior spinothalamic tracts are located in the anterior funiculus, the clinical
importance of these accessory tracts seems limited. It remains to be seen whether the locally crossing fibers of the spinothalamic tract within the anterior commissure are at risk during ependymoma resection because of their location ventral to the central canal. Although the anterior median fissure provides a more anatomically developed surgical plane than the posterior median septum, the presence of the anterior spinal artery and its penetrating end artery branches within the anterior median fissure can preclude a purely ventral exposure through this fissure.

The longitudinal extent of the myelotomy can be unilaterally limited by a radiculomedullary feeding vessel to the anterior spinal artery. Every nerve root has an associated artery on its ventral surface, and these arteries can contribute blood supply to the spinal cord through anastomoses with the anterior spinal artery. The levels at which these contributions occur are few and vary between individuals. These arteries can usually be identified intraoperatively by their size and course, which is perpendicular to the myelotomy. Fortunately in the present case such a vessel was not encountered.

Unlike most common types of spinal tumor for which complete resection is the consensus first choice therapeutically, opinions in the literature regarding the extent of resection for a low-grade astrocytoma range from aggressive debulking to biopsy sampling and radiation. Curiously, no difference in survival has been noted between patients with Grade I and those with Grade II tumors on either side of this debate. Indeed, the published prevalence of Grade I versus II tumors varies so widely among series that, in our opinion, meaningful numbers in children or adults is not reliably known. Thus, based on a literature analysis alone, it is difficult to know how histological diagnosis should inform surgical aggressiveness when a low-grade astrocytoma is encountered and what prognostic difference exists between Grades I and II tumors.

Pointing out the difficulty in distinguishing between ependymoma and astrocytoma on frozen section, we have favored a more practical strategy indicating that the extent of resection should be dictated primarily by the surgeon’s ability to find and maintain clear dissection planes or to identify clearly abnormal tissue. Because a diagnosis of fibrillary astrocytoma on frozen section is a diagnosis of exclusion and often changes with the final pathology, only positive histological features on frozen sections, such as ependymal rosettes or Rosenthal fibers, should exert further influence.

In the current case, although clear dissection planes were often not apparent, the abnormal color of the tumor and the known relationship between the tumor and the cyst provided confidence in our ability to be more aggressive. Given its relevance in the pediatric intracranial literature and the general confusion regarding the role of surgery in the treatment of spinal astrocytomas, the intraoperative diagnosis of pilocytic astrocytoma, based on positive histological phenomena, also contributed to this decision.

Conclusions

Anterior approaches to ventral intramedullary lesions can be technically feasible and can be undertaken with preservation of motor function. To preserve dorsal column function, this surgical strategy may be preferred in selected cases of ventral lesions without dorsal extension.

Disclaimer

The authors do not report any conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References


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