Lateral access to paravertebral tumors

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Traditional transabdominal and retroperitoneal approaches for paravertebral tumors can be associated with injury to the viscera and lumbar plexus. The authors provide a technical description of a known approach with a new application for the resection of paraspinal tumors using both open and minimally invasive transpsoas techniques and report on 2 illustrative cases. In both cases, gross-total resection of the tumor was achieved and the patients experienced resolution of their presenting neurological symptoms, although one of the patients required 2 extra days of hospitalization due to an asymptomatic retroperitoneal hematoma, which was conservatively managed.

The authors conclude that the lateral transpsoas approach is a safe approach for paravertebral tumors and may not require an access surgeon.

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KEY WORDS minimally invasive; transpsoas; retroperitoneal; tumor; technique

ABBREVIATIONS EMG = electromyography; SSEP = somatosensory evoked potential.


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on the lateral aspect of the appropriate disc space. At this point the working tubular retractor is deployed, docking on the surface of the psoas muscle (shallow docking). The light source is introduced and the surface of the muscle is scanned for any neural structures. Under direct vision, the psoas muscle is split bluntly, protecting any visualized nerves down to the tumor. The tumor can then be detected—over the lateral surface of the vertebral body (L-4) deep to the psoas muscle in our Case 1. The tubular retractor is collapsed and carried down to the lateral surface of the body and docked straddling the tumor as the medial blade is rotated to lie anteriorly. In our patient (Case 1 below), we kept the retractors on the surface of the psoas muscle and retracted the muscle manually, as the visualized nerves did not allow docking on the vertebral body without crushing them. “Shallow docking” of the retractor on the psoas is a key concept and step in this procedure as it allows for appropriate mobilization of the genitofemoral nerve and splitting of the psoas under direct vision to identify the tumor, without traumatizing it with the dilators and retractor.

The operating microscope is brought in, and using magnification and microinstruments, the tumor is shelled out intracapsularly, from its pseudocapsule (refer to Fig. 3). Direct stimulation of the neural structures is carried out to ensure that there is no neurological injury. Closure can be performed quickly as blood loss is minimal and drains are unnecessary using this minimally invasive retractor system.

Open Technique

A video clip showing the use of this technique for resection of a paraspinal tumor is provided in Video 2.

VIDEO 2. Case 2. Video clip showing open transpsoas resection of a nerve sheath tumor. Copyright Akwasi Ofori Boah. Published with permission. Click here to view.

A larger tumor requires an expanded incision (approximately 8 cm), which is also made in the flank obliquely (entering the incision on the tumor). The tumor will be immediately visible once the retroperitoneal space is developed, expanding through the psoas muscle (see Fig. 5). The tumor is dissected using loupe magnification, in like fashion through a transpsoas corridor, which is not standard for this approach.

Illustrative Cases

Case 1

This 18-year-old female patient with a history of neurofibromatosis Type 1 presented with radicular pain of the left lower extremity. The radiculopathy demarcated an L-4 root signature and had been present for more than 6 months. The neurological examination findings were normal, but a lumbar spine MRI study demonstrated a 2 × 1–cm expansile lesion of the left L-4 nerve root, lateral to the neuroforamen (Fig. 2 upper). Due to her primary diagnosis, the patient also had multiple neurofibromas throughout her spinal axis. A selective femoral nerve block with local anesthetic provided relief of her symptoms for 24 hours, demonstrating the symptomatic nature of the L-4 nerve root lesion. She therefore underwent an uncompli-
cated gross-total resection of the lesion with the lateral minimally invasive approach (Fig. 2 lower, Fig. 3). The estimated blood loss was 50 ml. The patient was discharged on postoperative Day 2. At the 3- and 12-month follow-up visits, the patient demonstrated full strength and was pain free with some trace numbness of the anterior left thigh.

Case 2
This 43-year-old male patient with neurofibromatosis Type 1 (Fig. 4A) presented with a 6- to 12-month history of left lower-extremity pain/paresthesias shooting into the hip/thigh and down to his shin. A left paravertebral tumor measuring $7.5 \times 8.5$ cm was identified on lumbar spine MRI and CT in his workup (Fig. 4B). This patient underwent an uncomplicated resection (Fig. 4C) of this tumor via a lateral, retroperitoneal transpsoas approach. The tumor was considered too large for the tubular retractor and was resected with open surgery (Fig. 5). Intraoperatively, the tumor was noted to originate from the left L-5 neuroforamen.

The patient did well postoperatively and was discharged on postoperative Day 4. The delayed discharge was due to a retroperitoneal hematoma in the tumor bed, which was managed conservatively, requiring no transfusions. This was felt to have been caused by an iliopsoas intramuscular vein that was incompletely coagulated during the transpsoas dissection.

Discussion
The retroperitoneum is bounded anteriorly by the abdominal and peritoneal structures, posteriorly by the quadratus lumborum and the iliacus muscles, superiorly by the diaphragm, and inferiorly by the pelvic viscera. In this space the ilioinguinal, iliohypogastric, and lateral femoral cutaneous nerves course freely downward to reach the anterior iliac crest.

From this view, visualizing the orientation of the lumbar plexus is challenging. The psoas muscle covers the lateral aspects of the lumbar vertebrae. The components
of the lumbar plexus enter the psoas muscle, divide into branches, pass through the psoas muscle, and leave it at various sites to run obliquely downward to the pelvic area, where they exit the pelvis mainly under the inguinal ligament. The iliohypogastric and ilioinguinal nerves course superficially to reach the anterior iliac crest.

At the L1–2 disc space, the psoas muscle forms a thin layer that is easily dissected, along with the contributors to the lumbar plexus, the ilioinguinal and genitofemoral nerves. At the level of the L2–3 disc space, the genitofemoral nerve is found crossing from posterior to anterior to reach the anterior aspect of the psoas muscle. At the L3–4 disc space, the psoas muscle is larger in diameter, and the majority of neural structures (L-2 division to lumbar plexus, L-3 nerve root, and lateral femoral cutaneous nerve [L-2, L-3]) are found at this level. The genitofemoral nerve is found running obliquely from posterior to anterior. At the L4–5 level the femoral nerve is found running obliquely from posterior to anterior toward the ala of the sacrum.

When spreading the muscle, the intrinsic motor branches are particularly susceptible to injury. These are small nerve fibers compared with the other branches of the plexus, and most of them are arranged in clusters, branching from the femoral nerve around the caudal L-3, L-4, and L-5 vertebral bodies. Direct visualization in our approach allows for identification of these branches and thus minimizes their risk of intraoperative injury.

Taking into account the relevant anatomy, intraoperative neurophysiological monitoring with direct stimulation probes and the detection function of the stimulation of the retractor itself allows for early identification of branches of the lumbar plexus during the docking portion of the procedure. Another safety measure, which we recommend, is the concept of “shallow docking.” Lateral lumbar interbody fusions usually require placement of a retractor device on the lateral aspect of the spine itself in a “safe zone,” which is ideal for either dissection or corpectomy.27 In this particular use of the retractor, we intentionally keep the retractor system more superficial on the surface of the psoas muscle. Blunt dissection of the psoas muscle is performed under direct vision with loupe magnification, protecting the branches of the lumbar plexus from iatrogenic injury. Paravertebral tumors, which involve the neuroforamina,15 will typically be embedded within the psoas fibers or lie just deep to them, which further underscores the importance of blunt dissection.

Once the tumor is identified, resection is performed using an intracapsular enucleation technique. Further circumferential delineation is performed with blunt and sharp dissection using the operating microscope and microinstruments.

Traditional approaches for resection of retroperitoneal nerve sheath tumors are usually multidisciplinary, involving a general or vascular surgeon using an anterior retroperitoneal approach, and entail a greater chance of injury to the lumbar plexus and retroperitoneal structures. The technique described in this paper affords the operating neurosurgeon a minimally invasive approach with direct and full visualization of paravertebral tumors without the morbidity of an open incision and the difficulty of approaching a tumor deep to the psoas muscle microscopically. The operating neurosurgeon can obtain access to this tumor in a relatively short time with minimal blood loss. Resection of slow-growing paravertebral tumors is usually curative and thus avoids the morbidity/latency of radiation1 or radiofrequency ablation.19

In patients with larger tumors (> 5 cm), the same approach can be used with a larger incision and traditional retractors. The patient in our Case 1 was discharged home within 48 hours and was ambulatory on the day of surgery with relief of preoperative symptoms. The patient in Case 2, who had a larger tumor (> 5 cm), also had relief of his preoperative symptoms and was ambulatory on the day of surgery, but he was monitored in the hospital for an additional 48 hours postoperatively due to a retroperitoneal hematoma and was thus discharged on postoperative Day 4.

There were no intraoperative complications in either of our cases, and both patients had stable findings on neurological examinations postoperatively. One year after surgery, neither patient had had any recurrence of symptoms associated with the treated lesions.

Conclusions

Our lateral transpsoas approach can be performed in a minimally invasive or open fashion for resection of retroperitoneal, paravertebral nerve sheath tumors within the psoas muscle. It is a safe novel approach, which may not require an access surgeon. It is particularly useful for extraforaminal tumors deep to the psoas muscle; EMG and SSEP monitoring and the shallow docking technique aid in the avoidance of injury to the lumbar plexus.

References


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Disclosures
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Supplemental Information
Videos

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