*Erratum*

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# Laparoscopic management of a posterior mediastinal tumor mimicking an adrenal neoplasm

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This article was inadvertently designated as a "Case Report" both online and in the printed version of *Surgical Endoscopy;* thus only the abstract of the article appeared in the printed version. The article, however, should have been included in the "Technique" section of the Journal, and the full text should have appeared in both the print as well as the online version. The publisher reprints the article in its entirety here.

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**Abstract**
*Background:* Rarely, a posterior mediastinal mass may mimic an adrenal tumor on preoperative computed tomography scan. The intraoperative discovery that a mass thought to be associated with the adrenal gland actually is above the diaphragm in the posteroinferior mediastinum poses a challenge for the laparoscopic surgeon. Conversion to a thoracotomy or to videothoracoscopy incurs additional morbidity and risk for the patient.
*Materials and Methods:* We describe a technique for the transdiaphragmatic removal of a benign mass from the posterior mediastinum. A posterior mediastinal tumor was detected during a laparoscopic procedure for a suspected right adrenal tumor. Frozen section proved benign, and the mass was resected laparoscopically via transdiaphragmatic access to the posterior mediastinum.
*Results:* No complications were noted during or after surgery. The patient was ready for discharge from the hospital on postoperative day 1.
*Conclusions:* Transdiaphragmatic resection was done successfully instead of conversion to a thoracotomy or thoracoscopic procedure for a benign posterior mediastinal tumor found incidentally during laparoscopic surgery for a presumed adrenal lesion. This transdiaphragmatic approach can be applied to selected benign mediastinal masses.

**Keywords:** Laparoscopic surgery — Mediastinal tumors — Schwannoma — Transdiaphragmatic resection

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Traditionally, the adrenals were approached surgically via an open transabdominal, thoracoabdominal, or posterior flank approach. However, laparoscopic adrenalectomy now has become the procedure of choice for removing benign adrenal tumors [4]. Because computed tomography (CT) scan has a high accuracy in diagnosing and localizing adrenal tumors [7], it often is the only anatomic imaging study obtained before surgery.

The posteroinferior mediastinum is anatomically adjacent to the adrenal bed on CT scan. However, the surgical approach is quite different. The intraoperative discovery that a suspected adrenal tumor actually is superior to the diaphragm poses a challenge for the surgeon prepared for laparoscopic adrenalectomy. Conversion to a thoracotomy or videothoracoscopy will incur additional morbidity for the patient [6]. Transdiaphragmatic laparoscopic resection of such a tumor can be an option in this situation. We report a case of posterior mediastinal schwannoma mimicking a right adrenal lesion on CT scan and describe its laparoscopic transdiaphragmatic resection.

## Case report

In October 1997, a 65-year-old woman presented with recent onset of cough and shortness of breath. The chest x-ray showed a right paracardiac density. Because of this abnormality CT was performed, and a 9 × 7 × 7-cm right heterogeneous mass with a thickened peripheral margin and low-density center was seen (Fig. 1). This mass was interpreted as a right adrenal tumor. Transcutaneous ultrasound demonstrated a mass measuring 9 cm with a large hypoechoic area that also appeared to represent an adrenal neoplasm.

The woman's medical history was unremarkable except for Raynaud's phenomenon, diverticulitis 15 years before, and an appendectomy in the past. Physical examination was unremarkable. Laboratory values revealed a moderate anemia, with a hemoglobin concentration of 10.3 g/dl and a

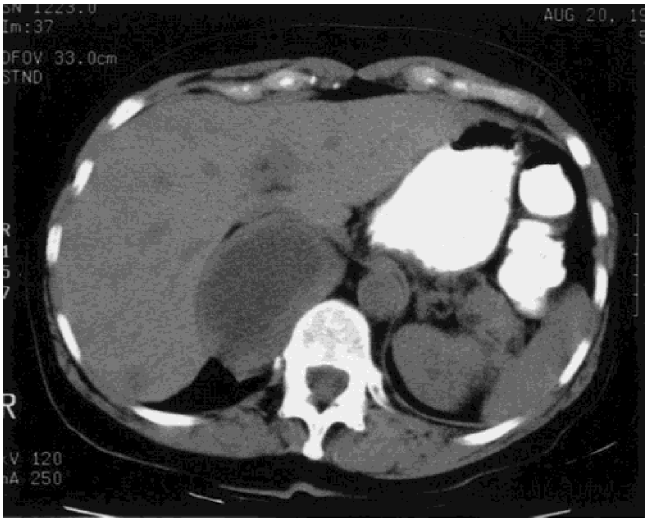


**Fig. 1.** Computed tomography of the abdomen shows a 7-cm right adrenal heterogenous mass with a thickened peripheral margin and low-density center.

hematocrit of 30.3%. A complete endocrinological workup suggested that this tumor was nonsecretory. On the basis of the CT findings, the patient was scheduled for an anterior laparoscopic adrenalectomy.

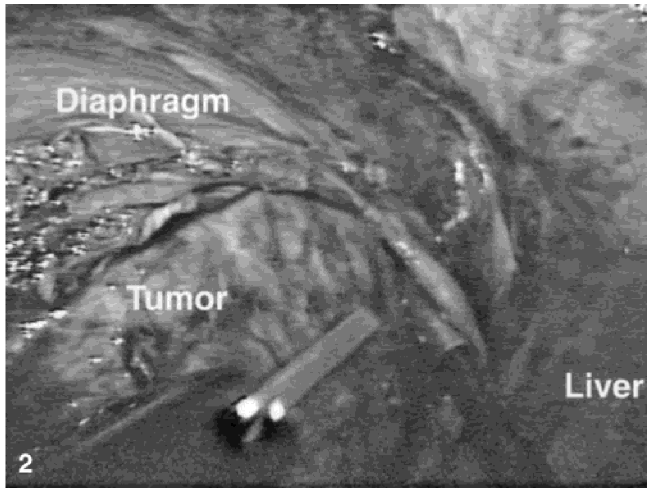
After the induction of general endotracheal anesthesia, the patient was placed into a left lateral decubitus jackknife position. The right chest and abdomen were sterilely prepped and draped. A 1.5-cm incision was made in the right subcostal position, and the abdominal cavity was entered under direct vision using an Optiview trocar. A pneumoperitoneum of 15 mmHg was established. Three additional trocars were placed along the right costal margin.

After dissection of the triangular ligament of the liver, laparoscopic ultrasonography was used to map out the mass and its anatomic relationship to the kidney and the inferior vena cava. The mass again appeared to be adjacent to the upper pole of the kidney, in the region of the right adrenal bed, with a 1- to 2-cm rim of solid tissue and a fluid-filled (hypoechoic) center. The peritoneal layer overlying the mass was incised, revealing that the skeletal muscle of the diaphragm had been displaced inferiorly and was draped over the mass. The right adrenal gland was identified just caudally to the mass along the vena cava and appeared to be entirely normal.

A biopsy was performed to rule out malignancy and to plan the best surgical approach. Three core biopsies were performed in the periphery (solid portion) of the mass under laparoscopic ultrasound guidance. Histologic examination of frozen sections revealed a benign mesenchymal tumor. We decided that a transdiaphragmatic resection would be reasonable in light of the benign histology and easily accomplished without the need for any additional trocars. A 6- to 7-cm incision of the posterior diaphragm was made and the well-encapsulated mass encountered. The tumor was shelled out easily with the Harmonic Scalpel (Ethicon Endo-Surgery, Cincinnati OH, USA) and herniated into the peritoneal cavity (Fig. 2). After further mobilization of the mass, a fan retractor was used to lift the tumor away from the remaining posterior attachment (Fig. 3). Two discrete feeding vessels were identified and divided between clips (Figs. 4 and 5).

The mass was placed into a large specimen retrieval bag and, with morcellation, withdrawn through one of the existing trocar sites (Fig. 6). The pneumoperitoneum was then reestablished, and the tumor bed was irrigated and checked for hemostasis. Two running 2-0 Tycron sutures were started at each end of the diaphragmatic incision and tied in the middle. There was some paradoxical movement of the right diaphragm suggesting a pneumothorax, but no sign of respiratory or cardiovascular compromise. Therefore, no chest tube was placed. The pneumoperitoneum was released, and the laparoscopic trocar sites closed under positive pressure ventilation. After the patient was turned to the supine position, a chest x-ray was performed revealing a clinically insignificant small right apical pneumothorax and no evidence of fluid.

The surgical procedure lasted 245 min. Estimated blood loss was 20 ml. The patient tolerated the procedure well, and there were no postoperative complications. She was discharged on postoperative day 1.



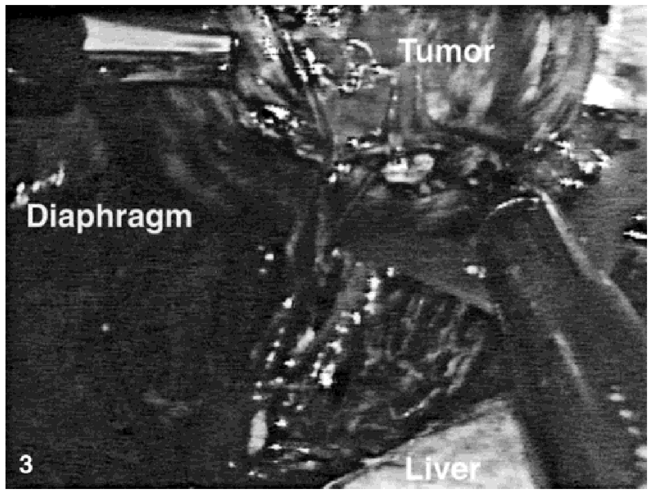



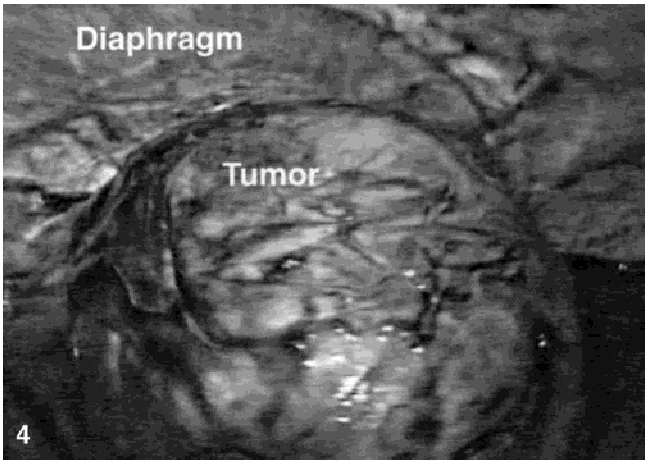

**Fig. 2.** The dissection of the tumor from the diaphragm using the Harmonic Scalpel.
**Fig. 3.** The tumor has been completely dissected from the diaphragm, and the pedicle shows two discrete vessels to be divided between clips.

Final histology showed a benign mesenchymal neoplasm consistent with schwannoma, composed of cellular (Antoni type A) and hypocellular (Antoni type B) areas, and including occasional areas of pallisaded nuclei (Fig. 7). The tumor was positive for S-100 protein, but negative for desmin consistent with origin from Schwann cells of the peripheral nerve sheath. At this writing, the patient has been followed up for 6 months with no recurrence or symptoms.

## Discussion

Neurogenic tumors are the most common cause of a posterior mediastinal mass. They constitute 23% of all mediastinal masses in adults and generally are asymptomatic [10]. In the adult, 97% of posterior mediastinal neurogenic tumors are found to be benign. Tumors of nerve sheath origin, (schwannomas), which represent 40% to 60% of all neurogenic tumors, are seen in adults in the third to fifth decades of life [5]. They are almost all benign. Video-assisted thoracoscopic surgery has been recommended as the standard procedure for posterior mediastinal benign neurogenic tumors because of their well-encapsulated nature [2, 3].

Currently, CT scan provides the most useful preopera-



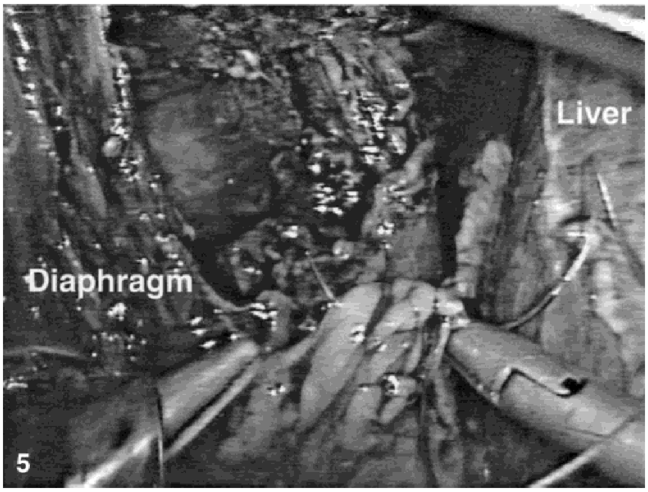
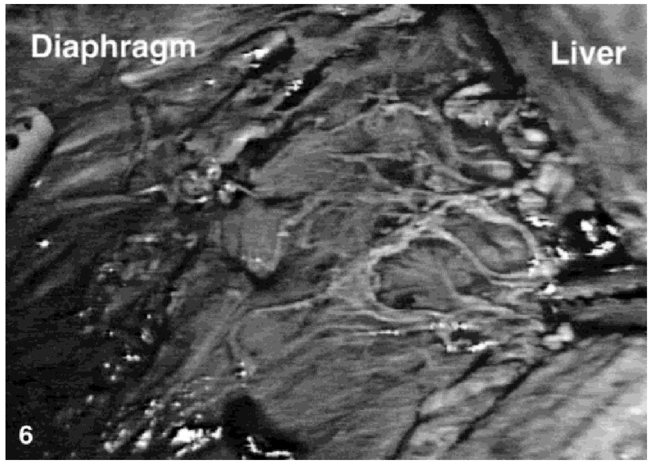




Fig. 4. The resection of the tumor has been completed, and the specimen is ready for removal.
Fig. 5. The opening in the diaphragm is closed with a running 2-0 Tycron suture.



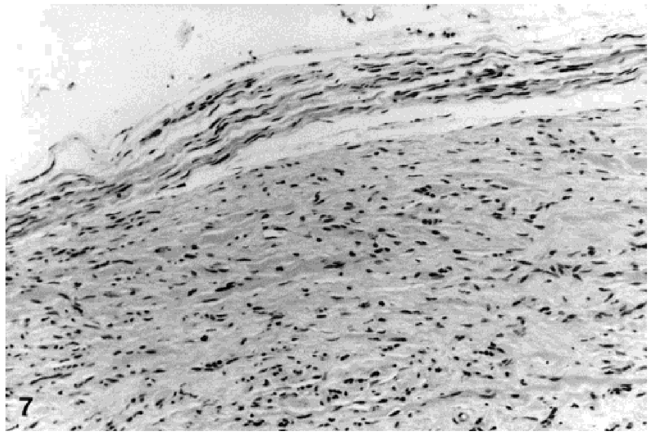




Fig. 6. The diaphragmatic defect has been closed, and there is no communication between the abdominal and thoracic cavities.
Fig. 7. Histology shows normal peripheral nerve fiber adjacent to tumor, suggesting origin of tumor from peripheral nerve sheath (original magnification ×200).

tive information for the diagnosis and treatment of mediastinal lesions [9]. However, a posterior mediastinal mass rarely may mimic an adrenal tumor on CT scan, and the patient may be prepared for adrenal surgery with the real diagnosis made intraoperatively. To our knowledge, the appropriate management of mediastinal tumors diagnosed during attempted adrenal surgery has not been addressed in the laparoscopic era.

We have managed one such patient successfully laparoscopically without converting to another procedure by approaching the posterior mediastinum transdiaphragmatically. Despite the use of multiple imaging methods in this patient preoperatively, we were unable to differentiate between the inferoposterior mediastinum and the right adrenal bed, perhaps because of anatomic distortion given the large size of the tumor, or simply because the areas are immediately adjacent to each other.

Malignant mediastinal lesions currently are considered a contraindication for endoscopic removal [2, 9]. However, with confirmed benign histology, we believed that continuing with the minimally invasive approach was a reasonable option. The availability of advanced laparoscopic instruments greatly facilitated this approach. The 45° scope and laparoscopic ultrasound were helpful in locating the tumor, guiding the biopsy, and establishing the anatomic relationship to vital structures. This information reassured us that the transdiaphragmatic approach would be safe. The Harmonic Scalpel facilitated dissection and maintained a clear field with minimal blood loss because of its excellent hemostatic capacity. Our operative time of 245 min compares favorably with the reported operative time of 40 to 270 min for thoracoscopic removal of mediastinal neurogenic tumors [1, 8].

Careful dissection in the posterior mediastinum, with particular precaution not to violate the pleural cavity, is important in this approach to prevent the need for a chest tube. Our patient did have a small pneumothorax that did not require a chest tube. Despite a fresh suture line on the diaphragm, she was breathing comfortably and ready for discharge within 24 h of surgery.

This approach may be an option for a selected group patients with tumors preoperatively known to be in the posteroinferior mediastinum. With this approach, placement of a double-lumen endotracheal tube and induction of single-lung ventilation can be avoided. A postoperative chest tube would be required only in selected cases wherein the pleura is violated. The reported average length of hospital stay after thoracoscopic resection of mediastinal neurogenic tumors ranges from 2.6 to 6 days [1, 8]. The reported patient was ready for discharge on postoperative day 1. She was clinically indistinguishable from any other patient undergoing laparoscopy in terms of postoperative pain.

In conclusion, we successfully resected a posterior mediastinal benign schwannoma using a laparoscopic transdiaphragmatic approach. In this special clinical situation, the approach decreased the morbidity and postoperative recovery compared with conversion to a more conventional thoracic or thoracoscopic procedure. Although the choice of approach was based on a presumed diagnosis of right adrenal tumor, it potentially could be applied safely to a selected group of patients with benign tumors of the posterioinferior mediastinum.

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