



Techniques and Procedures

First Rib Resection Using Videothoracoscopy for the Treatment of Thoracic Outlet Syndrome

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ABSTRACT

Objective: Thoracic outlet syndrome is a condition caused by compression of the subclavian artery, subclavian vein and/or the brachial plexus. Scalene muscle section and first rib removal is the most effective treatment. The objective of this article is to demonstrate first rib resection using videothoracoscopy.

Technique: We describe first rib removal by videothoracoscopy using three 12 mm entrance ports (although one is widened to 3 cm to introduce periosteotomy cutters and rib shears). We have performed this operation on three cases of thoracic outlet syndrome with very good results.

Conclusions: Removal of the first rib by videothoracoscopy is a viable and very aesthetic technique with a low morbidity. It is a very good option for the majority of patients affected by this syndrome, particularly in obese patients or those with Paget-Schroetter syndrome.

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Extirpación de la primera costilla por videotoracosopia para el tratamiento del síndrome del estrecho torácico

RESUMEN

Introducción: El síndrome del estrecho torácico es una patología provocada por la compresión de la arteria subclavia, vena subclavia y/o el plexo braquial. Su tratamiento más efectivo es la sección de la musculatura escalena y la extirpación de la primera costilla. El objetivo de este trabajo es mostrar la técnica de la extirpación de la primera costilla por videotoracosopia.

Técnica: Describimos la técnica de extirpación costal por videotoracosopia a través de tres puertas de entrada de 12 mm (si bien una se amplía 3 cm para la introducción de periostotomos y costotomos). Hemos realizado esta intervención a tres casos de síndrome del estrecho torácico con resultados muy buenos.

Conclusiones: La extirpación de la primera costilla por videotoracosopia es una técnica factible, muy estética y de escasa morbilidad. Es una opción muy buena para la mayoría de pacientes afectados de este síndrome, especialmente en pacientes obesos o con síndrome de Paget-Schroetter.

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Palabras clave:

Síndrome del estrecho torácico
Videotoracosopia
Exéresis de primera costilla
Síndrome Paget-Schroetter
Cirugía

Introduction

Thoracic outlet syndrome (TOS) is made up of a complex of symptoms originated by the compression of the artery, the subclavian vein or the brachial plexus at the upper thoracic aperture between the neck and the shoulder.

Its incidence is between 5 and 10% of the population.¹ Clinical manifestations can be vascular, neurological or both, depending on the predominant component that is compressed. The symptoms that

these patients present include pain in the upper limb and shoulder, paresthesia, muscle weakness, claudication or pseudoangina phenomena, Paget-Schroetter syndrome or thrombosis of the subclavian vein, Raynaud's syndrome and occasionally dermal trophic disorders, ischemia and gangrene.²

Several causes are known to originate this syndrome, such as the presence of cervical ribs, alterations of the costoclavicular ligament, anomalies of the scalene muscle or the insertion of the *pectoralis minor* muscle.³

Examination of the patient can be normal, although on occasion the distal pulse can be reduced or absent and accompanied by cyanosis or digital ischemia. The diagnosis is confirmed with the reproduction of the symptoms with arm-raising maneuvers,

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the Adson maneuver and angiographic and neurophysiological studies.

Although the treatment is initially rehabilitative,⁴ the persistence of the symptoms should be an indication for surgical intervention.

Surgical treatment by means of the excision of the first rib and scalenotomy achieve the decompression of the subclavian bundle. There are different effective methods of approach, such as transaxillar,⁵ supraclavicular,⁶ posterior or even infraclavicular with clavicular resection.⁷ For more than a decade though, with the development of video-assisted thoracoscopic surgery, there have been sporadic reports of successful resection of the first rib and scalenotomy by thoracoscopy.⁸ We present three patients who underwent video-assisted thoracoscopic resection of the first rib due to TOS.

Description of the Technique

The surgical technique of the extirpation of the first rib by video-assisted thoracoscopy is as follows: the patient is positioned in lateral decubitus with the arm in abduction and held in an arch. The upper limb is monitored neurophysiologically in order to have constant control of the brachial plexus during the entire intervention. Three ports of entry are made for video-assisted thoracotomy access: one in the 7th intercostal space at the mid-axillary line for entry of the optical device (Karl Storz, 10 mm and 0°), another in the third intercostal space at the mid-axillary line that is widened to 3-4 cm for the later introduction of the surgical material for costotomy and periostotomy, and the last is a 12-mm access in the sixth space of the posterior axillary line or under the tip of the scapula (fig. 1).

The intervention begins with the identification of the first rib, which is sometimes hidden in the posterior segment due to its apical situation. The parietal pleura is opened over this rib completely from the front to the back, using either endo-scissors with electrocoagulation or ultrasonic scalpel for this maneuver (fig. 2). At this point, care must be taken not to damage the internal mammary vessels at the anterior margin; these should be observed and respected.

Once the internal side of the first rib is uncovered, the dissection of the lower edge is begun with Maurer, Doyen and Semb rib shears (fig. 3). As the first rib is very flat, we can quickly see the internal side of it, and using traction towards the middle line (downwards) of the rib, the dissection of the external side progresses until we approach the upper edge. That is the hotspot of the intervention and it is fundamental to identify, both above and below the rib, the subclavian vessels and the brachial plexus (fig. 4). If they are adhered to the upper rib edge, it is preferable to cut them away from the rib with a dissector before continuing the dissection of the upper edge of the rib with the shears, and this way avoid a possible vascular or nerve

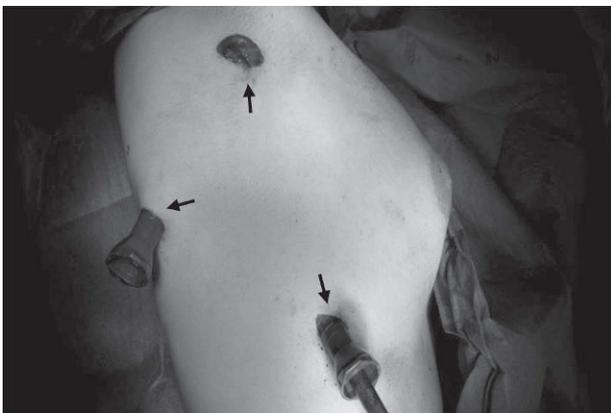


Figure 1. Position of the patient in lateral decubitus. The arrows indicate the locations for the placement of the ports of entry.

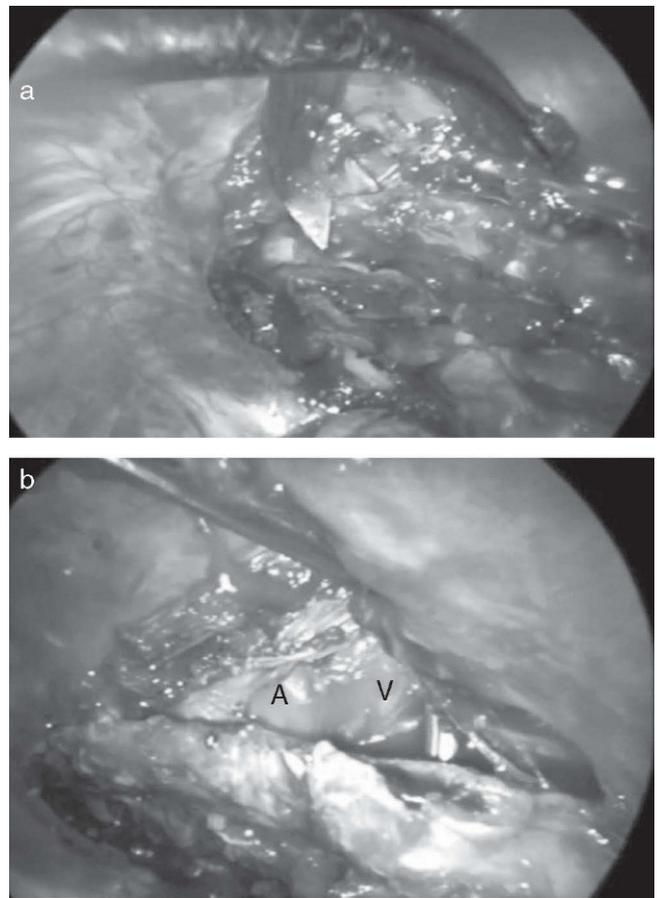


Figure 2. a) Dissection of the lower rib edge with periostotomy; b) the dissector passes along the upper edge of the rib, separating the subclavian vessels (A: Artery; V: Vein).

lesion. At this point, the rib, with enough traction, descends a few centimeters and allows for perfect visualization of the subclavian vein and artery, although it is still strongly anchored by the scalene muscles.

As the subclavian vein is under control, the anterior edge of the first rib is resected at its union with the sternum. For this maneuver, we use the Kerrington and dissectomy pliers, trying to cut the rib in its chondral portion, which makes this movement easier. In addition to cutting the costal cartilage, we must dissect and section the strong ligament that keeps the rib joined to the clavicle.

Once the anterior edge of the first rib and the costoclavicular ligament are cut, the rib descends much more easily with traction from the anterior entry and the dissection of the upper edge of the rib may be continued.

The following step is the section of the scalene, which, thanks to the traction, should be well exposed between the subclavian vein and artery. For this section, we prefer to use the ultrasonic scalpel to avoid damaging the vessels due to extension of the electric cauterization. Once the anterior scalene muscle is sectioned, the rib is much freer and the dissection is much simpler. The rib continues to be liberated towards the spinal column, while the neurophysiologist reports on the behavior of the brachial plexus. On one occasion, we continued the costal dissection until it was released from the transverse apophysis and from the first dorsal vertebra; the rib was thus completely excised without having to use costotomy. Usually, however, in order to avoid damaging the plexus, it is first necessary to section the rib as posterior as possible by means of first-rib costotomy (which is difficult to get through the port of entry), later extirpating the costal head with gouge pliers between the roots of

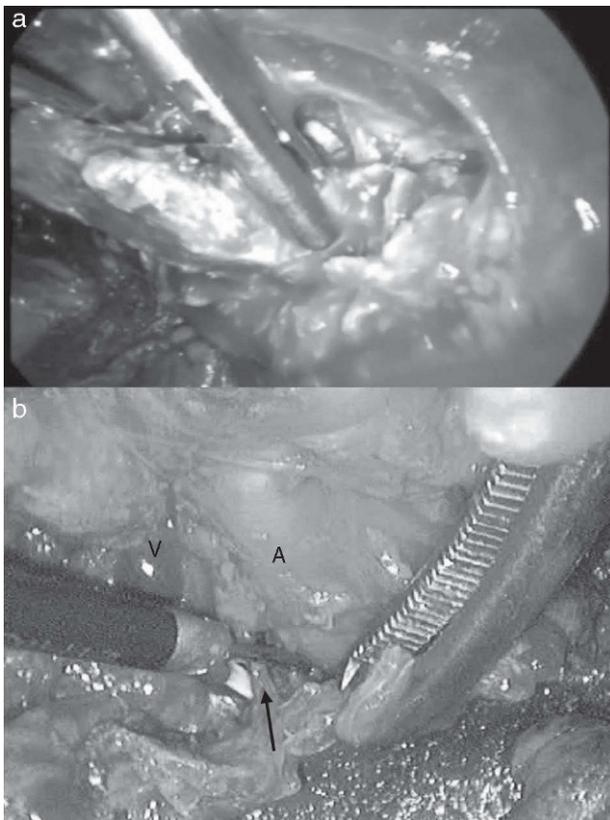


Figure 3. a) Resection of the anterior end costal cartilage of the right first rib; b) Resection of the anterior scalene muscle with ultrasound scalpel in a case on the left side. The arrow indicates the scalene muscle with the subclavian vein (V) in front and the subclavian artery (A) behind.

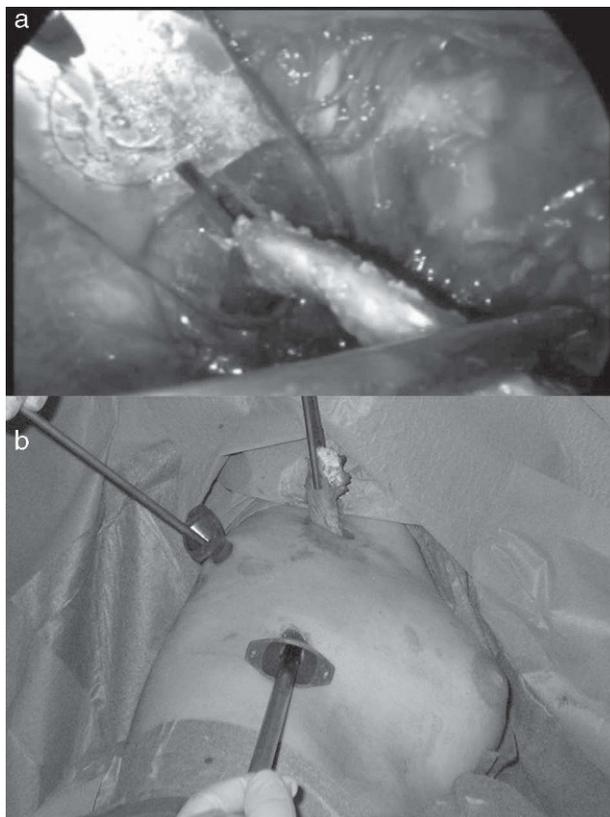


Figure 4. a) Resection of the posterior end of the first rib; b) Extraction of the first rib by minithoracotomy.

the brachial plexus. For this maneuver, we should have good vision and the information that the neurophysiologist provides us is essential.

Once the entire rib is excised, it is removed through the port of entry at the mid-line and the hemostasia is meticulously examined. We leave a posteroinferior pleural drain for at least 24 hours, due to the apical dissection that was performed, and the ports are closed by suturing only the skin.

Procedures

From December 2009 to April 2010, our department has surgically treated three cases of thoracic outlet syndrome using video-assisted thoracoscopy, performing extirpation of the first rib with this method. The patients were two men and a woman, with a mean age of 37 (range 15-56 years), one with Paget-Schroetter syndrome. All the patients who underwent this technique have had very good results, with complete symptom relief. Pleural drains were removed after 24 hours, and the mean debit was 43 cc. Mean post-op was 32 hours, with no complications. The good recuperation after the operation is remarkable; the three patients were able to raise and abduct their arms with no difficulty after the intervention as they experienced less pain than patients who had undergone other surgical approaches. Complications of the surgical wound are also avoided with this method, such as blood or serous collections, which are frequent in the axillary approach.

At the follow-up office visits, we have found these three patients to be asymptomatic, with angiographic and neurophysiological studies within the limits of normal.

Indications

This technique is indicated in practically all patients affected with thoracic outlet syndrome, whatever the etiology, as their symptoms are demonstrated to improve with the excision of the first rib and scalenotomy. It is especially useful in cases of Paget-Schroetter syndrome, as the thrombosis of the subclavian vein produces peripheral accessory circulation that makes the axillary or supraclavicular approach difficult, but this is avoided with video-assisted thoracoscopy. It is also very useful in obese patients, those with vascular aneurisms, and in all those who want a better esthetic effect (young girls, for example) and better functional recovery with the same morbidity and final surgical results.

Limitations

There are few limitations, but it is necessary to dominate advanced techniques in video-assisted thoracoscopic surgery, as well as to have the adequate material for costal resection by minithoracotomy.

Contraindications

This technique is contraindicated if the patient has undergone previous subclavian vascular surgery or if he/she has pleural adherences that cannot be freed by video-assisted thoracoscopy. Likewise, due to the lack of visibility, it is contraindicated if for any reason the subject cannot tolerate one-lung ventilation.

Comments

Video-assisted thoracoscopic surgery (VATS) of thoracic outlet syndrome provides, unlike the classical approaches, an excellent view of all the bone, vascular and nerve structures in the area. It allows for the identification of the first rib along its entire extension by simply performing the aperture of the parietal pleura. The technique allows for the removal of the first rib in its entirety from

the chondrocostal union in the anterior area to the withdrawal of the costovertebral joint. It also facilitates the section of the anterior and middle scalene muscle with perfect visualization of the artery, vein and brachial plexus, resulting in greater safety, as well as also improving control and preventing lesions on the sympathetic chain and the stellate ganglion. Other observed advantages in our study are short post-operative stay and a quick return to daily life, although these facts should be confirmed in future randomized studies. The results obtained in the follow-up of our study are comparable with those reported by other series.⁹⁻¹¹

This technique is radically different from that communicated by other authors¹² who use the trans-axillary approach with endoscopic vision through the axillary thoracotomy. Our technique is completely thoracoscopic, without the use of a rib spreader and using mainly endoscopic material for the dissection and costal periosteum section.

Although some authors¹³ limit the indication of this technique in obese or very muscular patients in whom the resection of the first rib with the transaxillary approach is difficult, our group considers that video-assisted transthoracic surgery can be the first-choice approach in most patients with TOS in reference centers for video-assisted thoracoscopic surgery.

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