Surgical Techniques: Operative Decompression Using the Infraclavicular Approach for VTOS

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Abstract

The infraclavicular approach provides direct access to the costoclavicular space for focused treatment of VTOS. Using this approach complete first rib resection and subclavian venolysis can be performed without unnecessary exposure or manipulation of the brachial plexus or subclavian artery. Sacrifice of collateral veins that usually exist in the supraclavicular and axillary areas is also easily avoided with the infraclavicular approach. Residual venous stenoses may be directly addressed with patch angioplasty through the same exposure or by percutaneous angioplasty. Excellent results for the treatment of effort thrombosis and VTOS using the infraclavicular approach have been reported.

Introduction

The transaxillary, supraclavicular, and paraclavicular approaches are commonly used for thoracic outlet decompression and provide excellent access to the neurovascular structures within the interscalene space for treatment of neurogenic and arterial thoracic outlet syndromes. Many surgeons utilize the aforementioned techniques in the treatment of venous thoracic outlet syndrome as well, likely due to familiarity with these approaches. In the case of VTOS, however, the relevant anatomy and pathology (i.e., the subclavian vein) is found within the more anterior costoclavicular space. The costoclavicular space, first rib, and subclavian vein may be directly accessed via an infraclavicular approach and this has become our preferred approach for treatment of VTOS.

First described by Gol in the neurosurgical literature in 1968 for treatment of NTOS, the infraclavicular approach is best suited to treatment of VTOS by providing direct access to the subclavian vein and first rib within the costoclavicular space [1]. Potential advantages of the infraclavicular approach include minimal manipulation of the brachial plexus, phrenic nerve, and subclavian artery, which are not involved in VTOS.

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Collateral veins, which generally course through the supraclavicular space to enter the jugular veins or through the axilla to enter the chest wall, and may be interrupted by other surgical approaches, are avoided by the infraclavicular approach. Most importantly, the central portion of the subclavian vein can be directly visualized during the critical venolysis step of the procedure and, if needed, proximal exposure of the central veins can be gained by transmanubrial extension of the infraclavicular incision. For these reasons, we have found the infraclavicular approach to venous thoracic outlet syndrome to be an excellent choice. Limited utilization of the infraclavicular approach is most likely due to lack of familiarity with the technique, which is actually quite straightforward.

Technique

General endotracheal anesthesia is provided. The patient is positioned supine with the affected arm prepped into the field. The extremity is encircled with a sterile sling permitting mobility which facilitates exposure during the procedure, particularly during dissection along the posterior aspect of the first rib.

A transverse incision is made below the clavicle, overlying the first rib (Fig. 62.1). The incision extends from the lateral border of the munubrium to the deltopectoral groove. A plane is developed between fibers of the pectoralis major using a muscle-sparing approach and the more lateral pectoralis minor muscle is not divided. The anterior surface of the first rib is identified deep to the pectoralis major muscle (Fig. 62.2). The subclavius muscle is divided from its insertion onto the first rib. Working directly on the superior aspect of the first rib the attachments of the anterior and middle scalene muscles are divided with electrocautery; and along the inferior aspect of the rib the intercostal muscles are divided. A hand-held renal vein retractor is placed alongside the first rib to facilitate exposure and to protect the neurovascular structures. Superior and anterior movement of the shoulder is extremely useful to facilitate exposure while the first rib is freed. Using a periosteal elevator, the pleura is cleared

Fig. 62.1 A transverse incision is made overlying the first rib

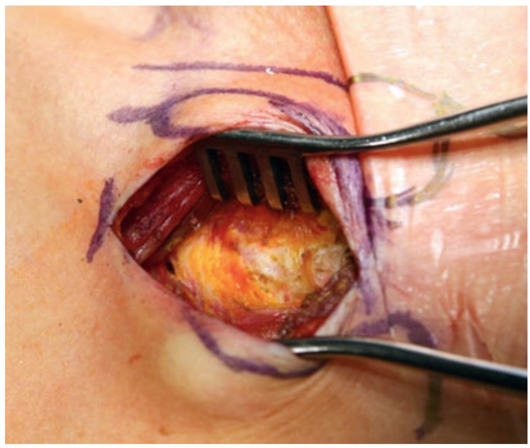

Fig. 62.2 After muscle-sparing division of the pectoralis fibers, the anterior surface of the first rib is encountered

from the deep surface of the rib. Cleared of it attachments, with the neurovascular structures protected, the first rib is then divided using either Kerison rongeurs or a rib cutter at the costomanubrial junction and close to the vertebral transverse process to facilitate complete removal. Residual fragments of the posterior rib can be removed using rongeurs.

A circumferential subclavian venolysis is then performed to remove fibrous tissue using sharp scissors dissection. Careful attention is paid to freeing the vein anteriorly as it courses behind costoclavicular ligament and the head of the clavicle and the manubrium (Fig. 62.3). Although others have reported routine patch angioplasty to address venous stenoses, our preferred method is to perform intraoperative venography following wound closure. Residual subclavian vein stenoses (>50 %) are treated with angioplasty using balloon diameters of 10–14 mm with inflation pressures up to 20 atm, when necessary (Fig. 62.4). Should more proximal exposure for surgical vein patch angioplasty prove necessary, the transmanubrial extension of the incision may be performed to expose the innominate veins; claviculectomy is unnecessary. The resection is done extrapleurally, and while it is not uncommon to create a rent in the pleura a thoracostomy tube is generally not needed. A drain is routinely placed in the bed of the resected first rib.

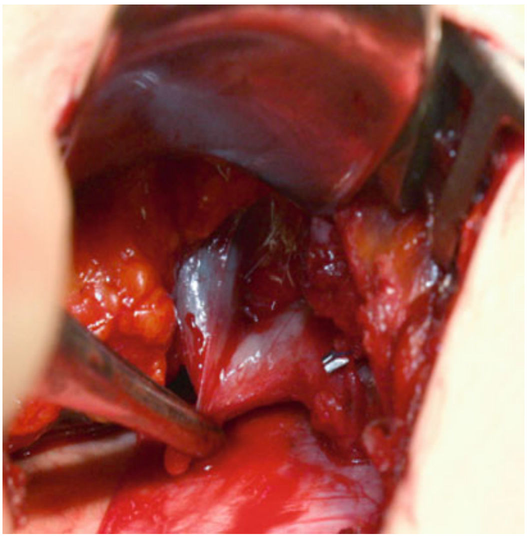

Fig. 62.3 Exposure facilitates an extensive subclavian venolysis

Postoperative Management

Intravenous ketorolac and narcotics are used for postoperative analgesia. Immobilization is unnecessary and gradual return to normal use of the upper extremity is encouraged. The drain is removed after output is less than 30 ml over a 24 h period. Postoperative anticoagulation is selectively used only for patients with residual non-occlusive chronic thrombus observed by intraoperative venography or duplex ultrasound after surgical decompression and angioplasty. Surveillance duplex ultrasonography is performed prior to hospital discharge and at 3, 6, and 12 months postoperatively.

Outcomes

Molina was the first describe an infraclavicular approach to venous thoracic outlet decompression [2]. Using an approach that consisted of immediate thrombolysis and urgent decompression via the infraclavicular technique, 100 %

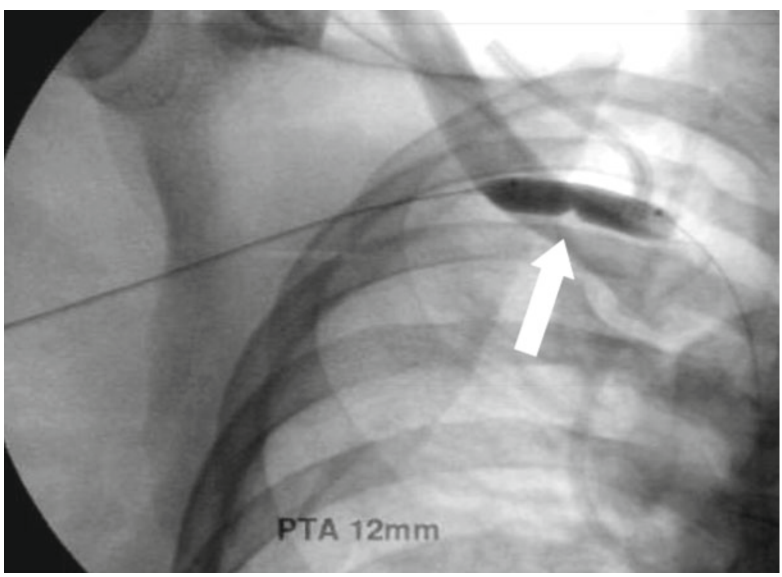

Fig. 62.4 Residual stenosis (*arrow*) is treated with balloon angioplasty

procedural success was achieved. Of 97 patients treated for VTOS and acute subclavian vein thrombosis, there was only one bleeding complication and two pneumothoraces that required tube thoracostomy. At short-term and long term follow-up (mean = 5.2 years, range 2–21 years) duplex assessed subclavian vein patency was 100 %. Arm function was noted to be normal in all patients.

Johnston et al. reported a 94 % primary patency and 100 % secondary patency in 21 patients treated for VTOS and acute subclavian vein thrombosis using the infraclavicular approach for rib resection and venolysis followed by intraoperative subclavian vein angioplasty to treat residual stenosis [3]. It should be noted that poorer results are typical for patients with chronic subclavian thrombosis, especially when surgical reconstruction or replacement of the subclavian vein is needed, emphasizing the need for early identification and treatment of patients with effort thrombosis with catheter-directed thrombolysis.

References

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