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Surgical approach to anterior scalenectomy

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Thoracic outlet is clearly a difficult syndrome to diagnose and a difficult entity to treat surgically. Neurogenic thoracic outlet syndrome has been treated by multiple different procedures over the years [1]. Transaxillary first rib resection was initially the treatment of choice. Subsequently anterior scalenotomy, then anterior scalenectomy, and combinations of first rib resection and anterior scalenectomy were performed [2,3]. Symptomatic improvement remained at approximately 70% at best. More recently, brachial plexus neurolysis has been performed. In the author's experience, the combination of anterior scalenectomy and brachial plexus neurolysis has yielded improved results. In this article the surgical approach and technique to anterior scalenectomy are described.

Surgical technique of anterior scalenectomy

After general anesthesia and endotracheal intubation are administered, the patient's head is positioned by turning it to the contralateral side and slightly hyperextending the head and neck. This position provides a wide exposure to the supraclavicular fossa. The operating table is then placed in a moderate degree of reverse Trendelenburg, thus leveling the neck and supraclavicular fossa.

The skin incision is made approximately 2 cm above and parallel to the clavicle in the supraclavicular fossa. It extends for approximately 5 cm in length. The incision is then carried down through the subcutaneous tissue, and the platysma is divided in the direction of the skin incision using cautery. Sensory nerves can be identified in the area below the platysma and should be preserved. If transected, permanent paresthesias may result in the area of the incision.

After transection of the platysma, the clavicular head of the sternocleidomastoid muscle comes into view. The clavicular head of the sternocleidomastoid muscle routinely is transected. This has not been a problem in the author's experience and it affords wide exposure of the anatomic area where most of the dissection takes place. It is reapproximated at time of closure and has not been a cosmetic problem. Some surgeons choose to mobilize and retract the clavicular head of the sternocleidomastoid muscle. The sternal head of the sternocleidomastoid muscle is not in the surgical field and thus does not present a problem.

The scalene fat pad is encountered next. At this time, the omohyoid muscle also comes into view; it is easily retracted laterally and does not require transection. To optimize exposure at this point, two self-retaining retractors are used: the first opens the wound in the superior–inferior direction, and the other opens the wound in the medial–lateral direction. With these two self-retaining retractors positioned properly, no further retraction is needed for the remainder of the procedure. The internal jugular vein is noted immediately in the operative field and this represents the medial boundary of the surgical dissection. The omohyoid muscle represents the lateral boundary of the dissection.

The scalene fat pad is then completely removed by sharp dissection. In doing this, it is best to start from the lateral border and progress toward the

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medial border. When one approaches the medial aspect of the field, careful sharp dissection must take place to identify the anterior scalene muscle and the phrenic nerve. Often the phrenic nerve is lifted when mobilizing the scalene fat pad. If one is not cautious, the phrenic nerve can be injured at this point. Once the anterior scalene muscle is partially identified and the phrenic nerve is noted to be in its usual position on the anteromedial aspect of the scalene muscle, then one can proceed with further removal of the scalene fat pad. Some surgeons do not remove the scalene fat pad completely, but simply partially dissect and retract it superiorly or laterally. In the author's experience, complete removal of the scalene fat pad causes no deleterious effect and provides wider exposure to the surgical field. When removing the scalene fat pad, the transverse cervical artery and vein and branches thereof are encountered. These structures are ligated proximally and distally, transected, and removed with the scalene fat pad.

The thoracic duct

When performing the procedure on the left side, one often encounters the thoracic duct. The thoracic duct is at the base of the neck on the left side and forms an arch that rises approximately 3 cm above the level of the clavicle. The thoracic duct passes posterior to the subclavian artery and posterior to the medial border of the anterior scalene muscle. It enters the venous system at the junction of the left internal jugular vein and left subclavian vein. Occasionally there are branches that extend laterally into the area of the scalene fat pad. The main body of the thoracic duct lies on the medial border of the surgical dissection and often can be identified easily. Because of variable anatomy, in some instances the thoracic duct is not readily identifiable. If one is aware of its usual position on the most medial aspect of the field of dissection it can be avoided safely. Branches of the thoracic duct entering the area of the scalene fat pad should be ligated on removal of the scalene fat pad. If a lymphatic leak is encountered, careful ligation of the leaking branch must be done to avoid continuous leakage into the wound. Sometimes it is necessary to ligate the thoracic duct for control.

Complications caused by thoracic duct ligation exist but are uncommon [4]. These would consist of incomplete thoracic duct ligation with a persistent lymphatic leak and thoracic duct obstruction with a back-up of chyle into the mediastinum and subsequent chylothorax. Persistent lymphatic leak often resolves and most often does not require surgical intervention. If a drain is left in place and the drainage is significant, one would continue to observe the drainage and as it decreased, one would remove the drain and most often the lymphatic leak resolves. If a lymphocele develops postoperatively, it is appropriate to aspirate the lymphatic fluid percutaneously, and after a few times the lymphatic leak usually resolves. In the unlikely circumstance in which it persists, one would need to surgically explore the wound to ligate the point of lymphatic leak. Rarely coverage with the sternocleidomastoid muscle is necessary.

Chylothorax is an extremely rare complication and may require chest tube drainage to resolve. It is extremely unusual to require a thoracotomy to deal with chylothorax.

The anterior scalene muscle

After complete removal of the scalene fat pad, the anterior scalene muscle is well visualized. The phrenic nerve usually lies on the anteromedial aspect of the anterior scalene muscle; however, at times it can lie laterally. Also, the phrenic nerve may not be a single trunk. At times the phrenic nerve consists of two branches on the anterior surface of the anterior scalene muscle. This must be recognized and care taken to avoid injury to both branches. The phrenic nerve is then carefully mobilized from the anterior scalene muscle so that it can be moved gently medially or laterally to facilitate anterior scalenectomy. It should be emphasized that the nerve, when moved, should be gently displaced medially or laterally and should not be grasped by forceps at any time. This can cause temporary diaphragmatic palsy.

Anterior scalene muscle dissection

The anterior scalene muscle is then carefully mobilized by sharp and careful blunt dissection medially and laterally and then a right angle clamp is placed beneath the anterior scalene muscle. The anterior scalene muscle is then lifted and transected as close as possible to its insertion on the first rib. The anterior scalene muscle at the first rib is divided sharply and hemostasis is achieved with the use of bipolar cautery. Because of the proximity of the phrenic nerve and also because of the proximity of the brachial plexus, it is necessary to deliver cautery precisely to the bleeding points. By using bipolar cautery, electrical dissipation to the brachial

plexus, phrenic nerve, or other surrounding structures is avoided. After complete transection of the anterior scalene muscle at its insertion on the first rib, the subclavian artery and its branches are visualized. They lie in the inferior aspect of the field and present no problem with further dissection. The anterior scalene muscle is then dissected proximally toward its origin on the transverse processes. Small venous bleeding points often are encountered. These are easily controlled with bipolar cautery or compression. At this stage of the procedure, the trunks of the brachial plexus are encountered.

When proceeding with the anterior scalene muscle dissection, one must carefully dissect the muscle fibers off the trunks of the brachial plexus without causing injury to these trunks or to proximal branches, such as the suprascapular nerve or the subclavian nerve. Injuries to these nerves would cause paresthesias to the shoulder and back areas. The anterior scalene muscle is taken as close to the transverse processes as possible. With sharp transection, the muscle fibers are divided and again hemostasis is achieved with bipolar cautery. Most often the muscle is removed intact; however, sometimes there are fragments left behind and these should be removed carefully after the bulk of the muscle has been removed.

Middle scalene muscle

At times the middle scalene muscle is prominent, causing compression of the brachial plexus. If this is encountered, the middle scalene muscle should be removed [5]. This is accomplished by carefully mobilizing the C5–6 trunk of the brachial plexus. Care must be taken to protect the suprascapular nerve, which is usually in the inferior portion of this field. The middle scalene muscle fibers are variable but are usually found posterior to the brachial plexus. This could be somewhat lateral or medial. It is not necessary to remove this muscle in its entirety in the author's experience; simply removing a 2–3-cm section in the area of the superior trunk of the brachial plexus is satisfactory. Sometimes a cervical rib or remnant is noted in or near the middle scalene muscle and this also is removed at this time.

Wound closure

After completion of the anterior scalenectomy, brachial plexus neurolysis is performed. Wound closure then begins. Approximately 4–5 ml of a corticosteroid solution is placed over the brachial plexus before closure. The author believes this may play a role in reduction of scar tissue and recurrence of symptoms. A closed suction drainage system is then inserted and taken out through a separate stab wound to prevent any significant hematoma formation. The clavicular head of the sternocleidomastoid muscle is then reapproximated with interrupted figure eight absorbable sutures. The platysma is then closed with a running absorbable suture and the skin is approximated with a subcuticular absorbable suture or with interrupted nonabsorbable sutures. The closed drainage system usually is removed in less than 24 hours if there is not considerable drainage in the reservoir. Postoperative recovery is generally uneventful and most patients are discharged from the hospital within 24 hours.

Complications

The incidence of complications is less than 2%. The most common complications consist of seroma, lymphocele, lymphatic leak, phrenic paralysis, pneumothorax, hemothorax, and chylothorax. Brachial plexus injury, arterial injury, and venous injury have not occurred in the author's experience but have been reported in the literature.

Seromas and lymphoceles are handled with aspiration and most often this is all that is needed. Rarely re-exploration of the wound is necessary. Lymphatic leak, if persistent, is treated with re-exploration of the wound. If a drain is placed, one can continue to observe the leakage. When the volume decreases, the drain is removed and most often the leak resolves. Phrenic paralysis in the author's experience has been temporary and has resolved in a short time period. To avoid this, one must be extremely careful when handling the phrenic nerve during the resection and removal of the anterior scalene muscle. Pneumothorax is handled in the usual manner with a chest tube and usually resolves within 24 hours. It has not been the author's experience to have a persistent air leak. Pleural effusion or chylothorax is handled with thoracocentesis. Rarely chest tube placement is needed. Generally, with the supraclavicular approach, few thoracic complications are encountered.

Summary

Anterior scalenectomy can be accomplished with a low complication rate following the steps in

the surgical technique described. In the author's experience, when using this technique in addition to brachial plexus neurolysis, patient satisfaction and improvement rate are extremely high. The incidence of complications is low and the vast majority of patients are discharged within 24 hours of the procedure.

References

[1] Kelly TR. Thoracic outlet syndrome: current concepts of treatment. Ann Surg 1979;190:657.

[2] Qvarfordt PG, Ehrenfeld WK, Stoney RJ. Supraclavicular radical scalenectomy and transaxillary first rib resection for the thoracic outlet syndrome—a combined approach. Ann J Surg 1984;148:111.

[3] Roos DB. The place for scalenectomy and first rib resection in thoracic outlet syndrome. Surgery 1982;92:1077.

[4] Sanders RJ. Thoracic outlet syndrome: a common sequela of neck injuries. Lippincott. 1991.

[5] Urschel HC Jr, Razzuk MA. Current concepts: management of thoracic outlet syndromes. N Engl J Med 1972;286:1140.