Thoracic duct injury during anterior cervical discectomy: a rare complication

Case report

ANNA KRISTINA E. HART, M.D., JOHN H. GREINWALD, JR., M.D., CHRISTOPHER I. SHAFFREY, M.D., AND GREGORY N. POSTMA, M.D.

Department of Otolaryngology—Head and Neck Surgery, Naval Medical Center, Portsmouth, Virginia; Department of Otolaryngology—Head and Neck Surgery, University of Iowa Health Center, Iowa City, Iowa; Departments of Neurological and Orthopaedic Surgery, Henry Ford Hospital, Detroit, Michigan; and Department of Otolaryngology, Center for Voice Disorders of Wake Forest University, Bowman Gray School of Medicine, Winston-Salem, North Carolina

Chylous fistula resulting from intraoperative injury to the cervical thoracic duct is well described as a complication of neck dissection. However, injury to the thoracic duct during spinal surgery is rarely reported. The authors present the first case of thoracic duct injury occurring during cervical discectomy and fusion via an anterior approach. The anomalous location of the terminal arch of the thoracic duct in this patient contributed to the complication. The morbidity of chyle leakage is minimized by its early recognition, a thorough understanding of lymphatic system anatomy, and aggressive management of the thoracic duct injury.

KEY WORDS • thoracic duct • cervical spine • operative complication • discectomy

Rabinson and Smith22 initially described the anterior approach for cervical discectomy and fusion in 1955. Anterior exposure of the thoracolumbar spine for fusion procedures was first described by Hodgson and Stock13 for the treatment of Pott’s disease in 1956. Since then, these anterior approaches have commonly been used in the treatment of a variety of spinal deformities. Despite the widespread popularity of anterior spine procedures, a review of the literature disclosed only nine cases of chylorrhea following anterior arthrodesis, all of which were performed in the thoracolumbar spine. This report documents the first case of thoracic duct injury occurring during cervical discectomy and fusion via an anterior approach. The terminal arch of the thoracic duct in this patient was more superiorly positioned than is typical, which contributed to the complication.

Case Report

History. Conservative treatment had failed in this 37-year-old man with left C-7 radiculopathy secondary to C6–7 herniated nucleus pulposis and uncovertebral joint osteophyte formation, and the decision was made to pursue surgical treatment.

Operation. A standard left anterior cervical approach was used to perform an anterior cervical discectomy and fusion of C6–7 by means of iliac crest grafting. A transverse left anterior cervical incision was centered over the carotid tubercle. The platysma was undermined after it had been divided in the same direction as the skin incision. Dissection was continued medial to the sternocleidomas- toid muscle and carotid sheath until the prevertebral space was encountered. The operative field then became flood- ed with a large volume of milky fluid we believed to be chyle. As the fluid was suctioned away it appeared to orig- inate around the jugular vein at the level of the C-6 vertebral body. The otolaryngology service was consulted in- traoperatively and the leak was found to be emanating from a thoracic duct located in an unusually cephalic position. The discectomy and fusion were completed prior to repairing the thoracic duct, which was protected in the interim. Subsequently, the thoracic duct was clearly identified medial to the carotid artery. It was approximately 6 mm in width and ascended as far as the superior cornu of the thyroid cartilage, 7 to 8 cm above the clavicle (Figs. 1 and 2). The lacerated duct was ligated on each side with a No. 3-0 silk suture. The patient was placed in Trendelen- burg’s position and tested for leakage with positive pressure ventilation performed by the anesthesiologist. No fur- ther leakage was noted, and Surgicel and fibrin glue were packed around the site. The sternocleidomastoid and strap muscles were sutured over the repair, a passive drain was placed, and a pressure dressing was applied.
Postoperative Course. The patient received intravenous-ly administered fluids for 72 hours while the head of his bed was elevated and he was monitored with daily chest x-ray studies for a possible chylothorax. On the 3rd postoperative day the drain was removed; the pressure dressing was removed on postoperative Day 4. The patient had an otherwise uneventful postoperative course. Fusion was seen at C6–7 on radiographic studies obtained at 3 months postsurgery, and the patient experienced nearly complete resolution of radicular symptoms and neck pain at his 1-year follow-up examination.

Discussion

Anatomical Features

The thoracic duct is the conduit for the return of lymph to the bloodstream from all of the lymphatic vessels except those on the right side of the head, neck, thorax, right upper limb, right lung, right side of the heart, and the diaphragmatic surface of the liver. It varies in length from 36 to 45 cm in adults and extends to the root of the neck from its origin in the cisterna chyli, which is situated on the anterior surface of the first and second lumbar vertebral bodies. The thoracic duct enters the thorax through the aortic hiatus to the right of midline. Greenfield and Gottlieb in their dissections of 75 cadavers, identified one instance of the thoracic duct remaining on the right side and emptying into the right internal jugular vein (IJV) as did Davis in his study of 22 cadavers. After ascending dorsal to the aortic arch between the left side of the esophagus and pleura, it progresses into the root of the neck dorsal to the left subclavian artery. The thoracic duct then curves laterally to lie anterior to the scalenus anterior muscle and the phrenic nerve. At the upper level of the clavicle the thoracic duct is bordered anteriorly by the left common carotid artery, the vagus nerve, and the IJV. It is bordered laterally by the omohyoid muscle, posteriorly by the anterior scalene fascia, and medially by the esophagus. The thoracic duct has been described as invariably being anterior to the thyrocervical trunk and the vertebral artery and vein. Van Pernis found it anterior to the subclavian artery in 92% of specimens. Greenfield and Gottlieb noted that the thoracic duct passed anterior to the IJV toward its termination in 25 of 75 dissections. The height of the terminal arch of the thoracic duct in the neck varies; it may be situated inferior to, at, or as much as 5.5 cm superior to the clavicle (Fig. 2). The thoracic duct measures 3 to 5 mm in diameter at both its origin and its termination, although it dwindles considerably in size in the midthorax. The terminal arch in our patient was 7 to 8 cm superior to the clavicle at the upper portion of the thyroid cartilage and measured 6 mm in diameter.

Van Pernis determined that the thoracic duct’s termination into the venous system consistently occurred within 1 cm of the angle formed by the junction of the left subclavian vein and the IJV, whereas Kinnnaert inconsistently found it within 2 cm of this angle. The vessel in which the thoracic duct terminates and the number of terminations are more variable. Greenfield and Gottlieb noted that 48 of 75 thoracic ducts terminated in the left IJV; in 45 of these cases, the union took place as a single termination with the left IJV. There were three instances involving a communication by multiple terminations in the IJV. Eighteen of 75 thoracic duct terminations were identified in the left subclavian vein, seven in the left external jugular vein, and one each in the left innominate vein and right IJV. Overall, in their study, 89.4% of thoracic ducts had one termination, 6.6% had two, and 4% had three. Davis also noted a majority of single terminations and reported one case in which the lymphovenous junction occurred within the vertebral vein. Kinnnaert obtained anatomical data from 49 patients. In addition to noting thoracic duct terminations in the aforementioned veins, one case was reported in which the lymphovenous junction occurred within the transverse cervical vein. Kinnnaert determined that 12.8% of these thoracic ducts were single ducts with a single venous terminus, 65.9% had multiple channels reuniting in a common terminus, and 21.3% had multiple channels that opened separately into veins. Although the data on the thoracic ducts with multiple terminations was consistent with that of other studies, Kinnnaert believed...
Physiological Considerations

Chyle has a variably milky appearance attributable to its fat content, which depends on dietary consumption; 60 to 70% of ingested fat is conveyed to the bloodstream by way of the thoracic duct. The main lipid component is triglyceride (> 200 mg/dl). Chyle has a pH of 7.4 to 7.8, with electrolyte concentrations and glucose levels similar to those of plasma. The protein content, predominantly albumin, is generally 40 to 80% of plasma values and varies according to the relative contributions of the hepatic and intestinal lymphatic vessels. Chyle’s characteristic appearance and greasy consistency assist in recognizing chylorrhea. The flow rate of chyle in the thoracic duct, which may be as high as 2 to 4 L per day, is maintained by intestinal peristalsis, movements of the upper extremities and torso, coughing and respiratory movements, thoracic duct wall contractions, and pulsation of adjacent arteries. The flow rate is maximum after a fatty meal. Over half of the total flow in the thoracic duct under resting conditions is represented by intestinal lymph, but the extent to which ingested water and nutrients influence this flow is disputed by some authors.

Chyle Leak, Neck Dissection, and Anterior Spinal Procedures

Robinson and Smith described the surgical technique for stabilization of a pathological cervical spine segment with a bone graft in 1955. Since then the number of anterior cervical spine procedures has been increasing. Davis reported that there were 48,000 hospitalizations for cervical fusion procedures in the United States each year in the period from 1988 to 1990.

In 1907, Stuart compiled the first series of surgically induced thoracic duct injuries in the neck. The potential for the thoracic duct to be injured during surgical procedures in the lower part of the neck because of its variable terminal course is well supported by the reports of others as well. One to 2% of all radical neck dissections are thought to be complicated by chylous fistula.

Its small size, inconstant location, and proximity to the vertebral bodies also render the thoracic duct susceptible to injury during surgical procedures in the lower part of the neck because of its variable terminal course.

Recognition and Treatment of Chyle Leakage

Chronic loss of chyle can result in serious metabolic derangements secondary to depletion of fluid, electrolytes, and protein, as well as decreased immunocompetence caused by peripheral lymphocytopenia. Untreated, the clinical course is one of progressive weakness, dehydration, peripheral edema, and emaciation. Typically, chylorrhea is most easily identified immediately after transection of the thoracic duct. A prompt search for the source must be made if watery, creamy, “greasy” fluid or whitish clotted material is seen at any time during neck surgery. The application of prolonged positive pressure by the anesthesiologist while the patient is in Trendelenburg’s posi-
tion expedites location of a leak, as does the use of an operating microscope. The thoracic duct should be carefully ligated with a No. 3-0 or 4-0 nonabsorbable suture when the site of the leakage is identified. Because other contributions to the duct or multiple terminations may be responsible for continued chylorrhea, repeated application of positive pressure while the patient is in Trendelenburg’s position is advisable prior to skin closure.

Postoperatively, skin flap erythema and edema may be the first indication of a chylous fistula. The rapid flap elevation, due to chyle accumulation in amounts that can exceed 500 ml in 24 hours, may be mistaken for a seroma or hematoma. Analysis of fluid from an operative drain or aspiration of the site will reveal a variably cloudy fluid depending on the fat content of the patient’s diet. Oral feedings should be discontinued, intravenous fluids initiated and, if present, drains should be converted from suction to gravity. A pressure dressing is recommended and the patient should be restricted to bed rest in the semi-Fowler position. The suspect fluid should be sent for triglyceride analysis. Daily monitoring of the patient’s electrolytes and the amount of chyle lost allows for maintenance of an appropriate electrolyte balance with intravenous fluids. The management of a persistent chylous fistula or chylothorax, which has also been reported as a complication of neck dissection, is beyond the scope of this discussion and is well described elsewhere.

Conclusions

Chylorrhea resulting from intraoperative injury to the cervical thoracic duct is well described as a complication of neck dissection. However, injury to the thoracic duct during cervical discectomy and fusion via an anterior approach has not, to our knowledge, been previously described. The structure of thoracic duct branches and the amount of chyle lost allows for maintenance of an appropriate electrolyte balance with intravenous fluids. The management of a persistent chylous fistula or chylothorax, which has also been reported as a complication of neck dissection, is beyond the scope of this discussion and is well described elsewhere.

References


Acknowledgment

The authors thank Ms. Jean L. Bonnette for her assistance with the hand-drawn figures.