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Surgical Management of Lymphatic Leakage

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Lymphatics are found in almost every organ in the body, and they produce a variety of waste products that must be eliminated. lymphatic leakage is a typical occurrence. It can cause immunodeficiency as well as nutritional issues. Furthermore, it has a significant morbidity and death rate, depending on the existence of an underlying illness. Lymphatic leakage can be

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congenital, traumatic, or cancerous, and occurs when the lymphatic system is disrupted. It might take the following forms: Chylothorax, Lymphatic Fistula, Chylous Ascites. treatment of lymph leaks includes: reduction of lymphatic flow through physiological or pharmacological manipulation; replacement of fluid and electrolytes, as well as interventional procedure and/or direct surgical closure. In this review we'll be discussing lymphatic system anatomy, its leakage and its management.

Keywords: lymph ascites; lymphocele; chyloperitoneum.

1. INTRODUCTION

Lymphatic leakage can be congenital, traumatic, or cancerous, and occurs when the lymphatic system is disrupted. It might take the following forms: Chylothorax, Lymphatic Fistula, Chylous Ascites Lymphatic fistulas are epithelialized pathways that form between the lymphatic system and the epidermis as a result of lymphatic damage during retroperitoneal, femoral, or other lymphadenectomy surgeries, infrainguinal reconstruction, or aortic aneurysm repairs. They can affect the lymphatic channels and their surrounding tissues, including the bladder, GI tract, uterine cavity, and skin. [1,2,3,4].

Proteins and excess interstitial fluid can be drained back into the systemic circulation, immunological responses can be regulated by both cellular and humoral pathways, and lipids can be absorbed from the gut through lymphatic circulation. Low quantities of fluid regularly filter into the interstitial tissues, where they are collected by blind-ended lymphatic capillaries and returned to the blood stream. This fluid enters the cisterna chyli and the thoracic duct before exiting through the subclavian veins. [5] Despite their rarity in the past, the frequency of chylothorax, chylous ascites, and lymphocele is on the rise, owing to cancer patients' extended life times and the possibility of invasive treatment. Lymphoceles complicate between 0.6–32 percent of renal transplants, urologic lymphadenectomies, and gynecologic lymphadenectomies, while chylous ascites complicates between 0.3–11 percent of major abdominal surgeries. Asymptomatic tiny lymphoceles observed on follow-up imaging to a resistant high volume and severe chylous ascites are all possible manifestations. Conservative treatment for lymphatic injuries has traditionally included dietary changes, such as a low-fat diet or complete parenteral nutrition, drainage of the afflicted region, and supportive care. [6,7-12].

As a saccular aneurysm, the Cisterna chyli marks the end of the retroperitoneal lymphatic channels and the start of the thoracic duct. According to anatomical data, the cisterna chyli is absent in half of the cases, and is replaced by a variable lymphatic plexus. During the embryonic development of the thoracic duct, it appears in paired form, right and left thoracic ducts, but only one section will develop into an adult thoracic duct. As a result, the thoracic duct might split into right and left branches in rare situations. The right branch connects to the right subclavian vein, also known as the internal jugular vein. According to a radiological research, a visible right-sided duct occurs in 4% of people. Another appearance type is a single right-sided thoracic duct with three independent terminal branches draining into the right internal jugular vein. [5] Chylous ascites is an accumulation of fluid in the abdomen or retroperitoneum caused by a thoracic duct or para-aortic or mesenteric lymphatics damage (eg, the cisterna chyli). The development of chylous ascites following abdominal aortic repair has been described in many case reports and considerably smaller clinical series dating back to 1970. [1].

The trauma to the lymphatic system during surgery causes postoperative lymphatic fluid leaking. Lymphatic ascites (lymph ascites), lymphocele, lymphorrhea, lymphatic fistula, and other unique types of lymphatic leakage, such as chylous ascites (chyloperitoneum), chylorrhea, chyloretroperitoneum, and chylothorax, have all been recorded as postoperative lymphatic leakage. [5] Lymphatic intervention has been a new frontier in interventional radiology over the last two decades, with Constantin Cope bringing it to the forefront in 1999 with a prospective study of thoracic duct embolization for chylothorax. Cope's initial discovery spawned a slew of follow-up techniques and applications, including the effective treatment of chylous ascites, lymphoceles, plastic bronchitis, and protein-losing enteropathy. [6].

After numerous abdominal procedures, lymphatic leakage is a typical occurrence. It can cause immunodeficiency as well as nutritional issues. Furthermore, it has a significant morbidity and death rate, ranging from 40% to 70% depending on the existence of an underlying illness. There have been a few examples of lymphatic leakage following bariatric surgery recorded in the literature. [13] Surgery–primary muscle flaps, lymphatic ligation, and suction drain placement– as well as nonoperative–bed rest, elevation, compression, prophylactic antibiotics, vacuum aided closure treatment, and glue embolization– are presently used as first-line therapies for lymphatic leak. Although there is evidence to support each of these techniques, there is no consensus on how to address lymphatic problems quickly. [14].

1.1 Anatomy Overview

The lymphatic system's anatomy is quite similar to that of the peripheral vascular system. It works by restoring lymphatic fluid to the circulatory system, where it is removed unilaterally. Lymphatics are found in almost every organ in the body, and they produce a variety of waste products that must be eliminated. Lymph nodes are responsible for monitoring the composition of lymphatic fluid/blood, engulfing any pathogens, boosting the immune system, and eradicating illness. In response to an inflammatory event, an immunological response, or a cancer, the thymus matures and produces T cells. [15] When we utilise our muscles, the lymphatic fluid is squeezed through the vessels rather than pumped like blood. The lymph channel walls and valves have features that assist regulate lymph flow. Lymphatic vessels, like veins, contain valves inside them to prevent fluid from flowing back in the opposite way. Lymph is poured into bigger vessels until it reaches the two major channels in our trunk, the lymphatic ducts. The filtered lymph fluid is then returned to the blood in the veins. Lymph nodes are junctions where the veins branch out. They're called glands, but they're not actual glands because they're not part of the endocrine system. Immune cells in the lymph nodes look for foreign material such as bacteria, viruses, or fungus [16].

The arteriovenous-capillary junction is where lymphatic flow begins. At this juncture, there is a declining but net positive filtration pressure, with an estimated 8 to 12 L of fluid extravasated into the surrounding interstitium daily. The lymphatic system is in charge of the bulk of the body's fluid resorption activities. This lost fluid is reabsorbed by small, blind-ended lymphatic vessels in the surrounding tissue known as "initial lymphatic vessels" or "lymphatic capillaries." These first lymphatic vessels are microscopically structured in a leaf-like arrangement and serve as a one-way valvular structure. A single layer of endothelial cells is structured on a discontinuous basement membrane to produce them. "Lymph" refers to the fluid that has entered the lymphatic system. [17] Local tissue stresses must be conveyed to the lymphatic channel lumen and turned into intraluminar pressure waves in order for tissue displacements to create pressure gradients that promote lymph generation and advancement. The mechanical qualities of the vessel wall, in turn, impact force transmission, with stiff structures being more effective than distensible ones [18].

The right lymphatic duct and the thoracic duct are the two primary lymphatic ducts in the body. The right duct drains the upper right quadrant, whereas the thoracic duct drains the lower body, including the limbs and abdomen. All lymphatic vessels feature one-way valves to prevent fluid from flowing backward. The pressure gradient caused by muscular contractions and respiratory motions causes lymph to flow forward. Lymphatic vessels are distinguished by their thin endothelial walls and overlapping configuration. Any fluid from the tissues can enter the cells because of this shape. The lymphatic capillaries eventually join together to form a much larger network of veins deep within the body. The right lymphatic duct and the thoracic duct are formed by these lymphatic veins. [15] The content of early lymph varies greatly across the body and is influenced by the organ or tissue from which it drains. Lymph has a similar basic composition to plasma, comprising largely of water, as well as nutrients, plasma proteins, antigens, humoral factors, and a variety of other substances. Chyle is a kind of lymph formed from the intestines and liver that has a greater concentration of proteins and chylomicrons—between 0.02 and 0.06 g/mL of proteins and > 0.01 g/mL of chylomicrons. In contrast to lymph, which appears clear or mildly transparent, chyle has a more opaque and milky white appearance [17-20].

1.2 Management and Surgical Intervention

For the surgical treatment of lymphatic fistulas, chylous ascites, and chylothorax, standard preoperative care should be used. Prior to

operational intervention, it is critical to pay close attention to the patient's dietary and metabolic state. Standard blood tests, electrocardiography (ECG), chest radiography, and cardiac risk assessment should all be conducted.

The following principles apply to the treatment of lymph leaks: reduction of lymphatic flow through physiological or pharmacological manipulation; replacement of fluid and electrolytes, as well as nutrition maintenance; tissue sealant-related agent or devices, as well as interventional procedure and/or direct surgical closure. Nutritional replacement and supplementation is considered a critical aspect of patient care in practically every series. The majority of reports of effective lymph leak treatment employing novel therapy are based on small anecdotal examples with a wide range of case types and represent institutional practis [20].

1.3 Low Production Chylothorax

The objective of treatment is to drain the fluid in symptomatic individuals while also controlling their diet and addressing the underlying cause. Octreotide is frequently used to prevent surgery and limit the amount of leaks [21].

1.3.1 Chylothorax with a high output

Most typically found after surgery. Although conservative care is attempted at first, many patients eventually require a procedure such as thoracic duct ligation or embolization.

For patients awaiting surgery, ancillary measures include total bowel rest, the start of parenteral nutrition, and octreotide/somatostatin and etilefrine treatment. The time of surgery is debatable, with some urging surgery the same day after surgery and others recommending five days of conservative care before surgery in unsuccessful situations [21].

1.3.2 Lymphatic fistula

With an interdigital injection of 5 mL of isosulfan blue into the first and second web spaces of the foot, infrainguinal, intra-abdominal, and intrathoracic lymphatic damage can be better characterised. Blue fluid droplets are released from the site of lymphatic damage during infrainguinal reexploration. Infrainguinal lymphatic damage sites should subsequently be suture-ligated if visible, then painstakingly closed in many layers. Lymphatics can be closed by clips, sutures, or adhesive. It's possible to leave a Jackson-Pratt drain at the lymphatic damage site. It should be kept indoors until the leakage slows down. When medicinal and interventional therapy fail, suture closure of the damaged lymphatic (infrainguinal, lumbar, mesenteric, or para-aortic) is the treatment of choice. Suture ligation may be replaced with fibrin glue for wounded infrainguinal lymphatic vessels that are not visible. A lateral closure with a 6-0 to 8-0 polypropylene suture should be used to treat injuries to the cisterna chyli or thoracic duct. If this does not work, the cisterna chyli and thoracic duct may be ligated with proximal sutures [1].

A retrograde transvenous technique or even a direct ultrasound-guided puncture in the neck followed by embolization are two further options for accessing the thoracic duct. The supply channel is closed with N-butyl cyanoacrylate that is thoroughly combined with lipiodol in the percutaneous transabdominal technique for thoracic duct embolization. Thoracic duct embolization has a success rate of around 70%. Chronic diarrhoea, lower extremities edoema, and abdominal ascites are among postoperative consequences of this treatment [21].

1.3.3 Ascites chylous

A celiotomy or a retroperitoneal approach might be used depending on the location of the lymphatic leaking. Following identification using the isosulfan blue procedure, lymphatic vessels in the lumbar, mesenteric, and para-aortic regions may be suture-ligated or oversewn. Injury to the cisterna chyli, on the other hand, should be sutured laterally using a 6-0 to 8-0 polypropylene suture. A Jackson-Pratt drain placed intra-abdominally near the injury site may be used [1].

1.3.4 Pleurodesis

For individuals who are not surgical candidates, pleurodesis is a procedure that involves inserting talc or drugs such as bleomycin and tetracycline into the chest drainage system via a catheter. Pleurectomy can be performed during thoracotomy or thoracoscopically in surgical pleurodesis with abrasion, depending on the patient's fitness. Surgical pleurodesis has been found to be more successful than medicinal pleurodesis [21].

The most common treatment for thoracic duct damage is lateral closure with 6-0 to 8-0 polypropylene. If this is ineffective, the thoracic

duct may be completely ligated. For any future drainage, a chest tube should be retained in place.

The right lung is selectively intubated and ventilated, and general anaesthesia is administered. The patient is positioned in the lateral decubitus posture on the right side. At the sixth or seventh intercostal gap, a left posterolateral thoracotomy is done (ICS). The procedure of parietal pleurectomy can assist to promote symphysis and halt the leak. The consumption of 40-50 mL of cream or milk aids in the detection of the leak. Extensive dissection is avoided if the leak is not easily found; such dissection might result in significant harm to important tissue [1].

For post-pneumonectomy patients with chylothorax. If there is no sign of a mediastinal shift, the leak is handled without chest tube drainage . If there is a contralateral mediastinal shift, a drain may be required, and additional examination for thoracic duct ligation or embolization should be performed [21].

in a study the effects of post-operative lymph leak treated with TPN were examined. Patients who developed chylothorax after oesophagectomy had a 30% mortality rate. The majority of lymph leak patients (67 percent) chose TPN alone. The overall rate of re-intervention was 20%. In all patients receiving oesophageal surgery, the re-intervention rate is 60%. In conclusion, the prognosis of post-operative lymph leak is mostly determined by the body zone in which it occurs. Most lymph leaks after head and neck surgery, as well as abdominal surgery, react favourably to TPN alone. Re-operative intervention appears to be more prevalent in individuals who have had oesophageal surgery [20].

While early surgical intervention has a faster time to resolution than nonsurgical therapy, nonsurgical management shows to be helpful in the management of lymphatic leak, and some patients do not require a second surgery to recover. Reoperation on a repaired groyne is not without danger and morbidity, therefore this is an essential issue. There are no studies in the literature that provide unambiguous predictors of conservative treatment failure. Surgical and demographic risk factors, on the other hand, predispose individuals to lymphatic leak [14].

2. CONCLUSION

Lymphatic system is one the most critical systems in the body and they are prone to leakage whether the reason is post-operational or other traumatic/congenital reason. Management of the leakage depends on the area and nature of the leakage. Although some other management techniques, surgical treatment can be the fastest and most efficient. However, it's not easy and mortality rate after surgery is high, with that being said we hoping for better improvement in surgical techniques for both avoiding leakage occurrences and having lower mortality and better lymphatic leakage surgery outcomes.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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