

Research Article

The Study on Lymphatic Cysts Caused by Lymphadenectomy

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Abstract

Background: Traumatic lymphatic cyst, also known as cystic lymphangioma, is a multidisciplinary disease, with congenital lymphatic cysts being more common. Lymphatic cysts lack specific clinical manifestations, and the vast majority of cases are incidentally discovered during auxiliary examinations or surgeries, making diagnosis challenging. Surgery is the most effective treatment for this condition, with a favorable prognosis. Lymphatic cysts caused by lymphatic injury are clinically rare. This study theoretically analyzes the clinical characteristics of lymphatic cysts resulting from lymphatic injury. **Objective:** To explore the mechanisms by which lymphatic injury leads to lymphatic cyst formation and provide guidance for clinical treatment measures. **Methods:** The study involves analyzing the principles of lymphatic injury and examining the process of lymphatic cystic transformation and cyst formation. **Results:** The causes of lymphatic injury include mechanical cutting, thermal energy conduction from electrocautery, needle puncture, and trauma. **Conclusion:** There are various mechanisms and causes of lymphatic injury, and lymphatic injury is common during surgery. When lymphatic vessels are identified during surgery, they should be managed similarly to blood vessel ligation and disconnection. Lymphatic cysts are prone to recurrence, and complete resection is an effective treatment for this condition. Puncture and subtotal resection have a high recurrence rate.

Keywords

Lymphatic Injury, Lymphatic Cyst, Cystic Lymphangioma, Principles, Mechanisms, Cyst Recurrence

1. Introduction

Lymphatic cysts are congenital benign hamartomas. During the embryonic period, mesodermal clefts within the venous plexus fuse to form large primitive lymph sacs, which drain into the central venous system. Over time, these lymph sacs either regress or develop into a lymphatic system parallel to the venous system. If the primitive lymph sac does not connect with the venous system, a lymphatic cyst forms. Additionally, intraoperative lymphatic injury is another cause of lymphatic cyst formation [1, 2]. Clinically, this disease is rare and can occur at any age, although it is more common in children. It can be

found in the neck, axilla, mediastinum, and subphrenic regions [3], and in rare locations such as the greater omentum, retroperitoneum, mesentery, lumbar region, lesser omentum, and abdominal aorta. Clinically, the disease often presents without obvious symptoms or signs [4]. However, tumor enlargement may cause compression symptoms or discomfort. Most patients seek medical attention after inadvertently detecting a mass, or it is incidentally discovered during surgery or imaging examinations, while a small number of patients present with discomfort such as pain. Preoperative diagnosis mainly relies on color

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Doppler ultrasound, CT, and MRI examinations [2, 5, 6]. CT typically shows a round or oval cystic mass with well-defined borders, though some cases may have unclear boundaries. The cyst usually has a uniform density with a CT value close to that of water. After contrast enhancement, there is no enhancement of the cyst fluid, and the cyst wall may show slight linear enhancement. Color Doppler ultrasound shows a cystic mass with no internal echoes or blood flow signals, but blood flow signals may be observed on the cyst wall and septa. High-frequency color Doppler ultrasound is highly sensitive and can determine the size, location, and adjacent relationships of the cyst. MRI typically reveals a round or oval cystic lesion with clear borders, a thin cyst wall, and uniform internal density, appearing as a long T1 and long T2 signal. Han et al. [7] reported that lymphatic cysts could be well visualized using lymphatic SPECT/CT imaging, although this examination is relatively expensive. Due to the atypical clinical presentation and low incidence of lymphatic cysts, preoperative diagnosis is challenging and may be easily mistaken for other diseases. Preoperative imaging examinations are helpful for diagnosis, and fine-needle aspiration biopsy can improve diagnostic accuracy [8], but the final diagnosis still depends on postoperative pathological examination and/or immunohistochemical analysis. The primary treatment for this disease is surgical excision, to prevent progressive tumor enlargement that could cause compression symptoms or infection due to cyst rupture [9]. Karcaaltincaba et al. [1] suggested that percutaneous therapy combined with a sclerosing agent is simple, effective, and has few complications, making it a first-line treatment for lymphatic cysts, particularly those with infection. Choudhrie et al. [10] proposed that the first step in treating a lymphatic cyst is percutaneous aspiration and drainage, and laparoscopic treatment has good outcomes with a low recurrence rate. Todokoro et al. [11] reported that lymphaticovenous anastomosis, which is minimally invasive and restores lymphatic circulation, should be considered an effective treatment for lymphatic cysts. However, these treatment methods require further research and practice.

2. Methods

This study collected all relevant studies from public databases, including CNKI, CrossRef, PubMed, WorldCat, Wanfang, and VIP. The studies include original research articles, reviews, case reports, and other research papers. We discussed and summarized the causes of lymphatic cyst formation, its treatment measures, and future interventions to provide clinicians with valuable insights and lessons.

3. Results

3.1. Congenital Lymphatic Cyst Formation Due to Developmental Abnormalities

During embryonic development, abnormalities in the for-

mation and connection of lymphatic vessels may occur, leading to cyst formation [12]. The developmental abnormalities of lymphatic vessel cysts primarily stem from anomalies in the lymphatic system during the embryonic stage. The lymphatic system forms during the early stages of embryonic development and needs to establish the correct duct structure and function in the normal course of development [13]. If abnormalities occur during this process, lymph fluid may accumulate within the lumen, forming a cyst. Developmental abnormalities can be classified into several types: Lymphatic Vessel Dysplasia: During the embryonic period, the development of lymphatic vessels is regulated by genes, vascular growth factors, and cell interactions. If these regulatory mechanisms fail, it may result in incomplete development or abnormal connections of the lymphatic vessels, leading to cyst formation. Lumen Narrowing or Obstruction: The lumen of the lymphatic vessels may become narrowed or obstructed during development, preventing the normal drainage of lymph fluid, eventually leading to cyst formation [14]. This is usually caused by abnormal proliferation or fibrosis of the vessel walls. Lymphatic Vessel Fusion Abnormalities: Normally, lymphatic vessels should fuse at appropriate locations to form a functional lymphatic system. If fusion abnormalities occur, it may lead to cyst formation, such as multiple small lymphatic vessels failing to connect properly, forming a localized cystic cavity. These developmental abnormalities may not only lead to localized lymphatic cysts but may also trigger a series of clinical symptoms, such as localized masses and compression symptoms. Understanding the mechanisms of these developmental abnormalities is crucial for the early diagnosis and treatment of lymphatic cysts and also provides a foundation for future research and clinical interventions.

3.2. Acquired Lymphatic Cyst Formation Due to Trauma

Local trauma or surgery may cause the rupture of lymphatic vessels, leading to cyst formation (acquired lymphatic cysts). Direct Trauma: Physical injuries such as tearing, compression, or impact may directly affect the integrity of the lymphatic vessels. This trauma can cause the lymphatic vessel walls to rupture, allowing lymph fluid to leak into the surrounding tissues, gradually forming a cystic cavity. This is commonly seen in sports injuries or traffic accidents. Surgical Trauma: During surgical procedures, especially those involving the lymphatic system, such as lymph node removal or certain cancer surgeries, the lymphatic vessels may be damaged. This trauma can not only cause the direct rupture of lymphatic vessels but also lead to the accumulation of local lymph fluid, eventually forming a cyst [15]. Postoperative scar tissue may also affect the normal flow of lymph fluid, promoting cyst formation. Infection-Induced Inflammation: Trauma may lead to skin or soft tissue infections, and the inflammatory response to the infection may also affect the lymphatic vessels. Infections or inflammation can cause damage to the local lymphatic vessels,

leading to abnormal accumulation of lymph fluid and cyst formation. Chronic Trauma: Long-term repetitive external forces, such as occupational injuries or prolonged compression, may cause chronic lymphatic vessel damage. This long-term damage may lead to gradual dilation of the lymphatic vessels and the accumulation of local lymph fluid, ultimately forming a cyst [16]. When dealing with lymphatic cysts caused by trauma, treatment usually depends on the severity of the injury, such as conservative treatment, aspiration drainage, or surgical intervention when necessary. Early diagnosis and appropriate intervention are crucial to preventing further cyst development and alleviating symptoms.

3.3. Infection (Acquired Lymphatic Cysts)

Certain infections (such as tuberculous lymphadenitis) may lead to the formation of lymphatic cysts. Lymphatic cysts caused by infections are mainly related to the impact of local infections and inflammation on the lymphatic system. Infections can lead to lymphatic cyst formation through the following mechanisms: Local Infection: Bacterial, viral, or fungal infections can cause inflammation of the lymphatic vessels, leading to damage to the function and structure of the lymphatic vessels. For example, skin infections (such as cellulitis) or deep tissue infections (such as deep abscesses) may spread through the lymphatic system, affecting the health of the lymphatic vessels [7, 8]. The inflammatory response induced by infection may lead to damage to the lymphatic vessel walls or impairment of local lymphatic fluid drainage, resulting in cyst formation. Lymphatic Vessel Obstruction Caused by Infection: Inflammation caused by infection may lead to swelling or fibrosis of the surrounding tissues of the lymphatic vessels, resulting in narrowing or obstruction of the lymphatic vessels. Lymph fluid cannot flow normally and accumulates within the lymphatic vessels, forming a cyst. This is commonly seen in tuberculous lymphadenitis or other chronic infections that cause damage to the lymphatic vessels. Immune Response and Tissue Damage: The immune response induced by infection may cause acute or chronic damage to the lymphatic vessels. The immune system's response to infection may sometimes lead to inflammation, exudation, and tissue destruction of the lymphatic vessels, processes that can result in cyst formation [14]. In addition, chronic infections or prolonged low-level infection states may lead to chronic inflammation of the lymphatic vessels and cyst formation. Post-Infection Complications: Certain infectious diseases, such as tuberculosis or lymphatic filariasis, may cause severe damage to the lymphatic vessels, resulting in persistent lymphatic cysts [17]. These diseases usually cause lasting pathological changes within the lymphatic system, making it difficult for lymph fluid to flow normally and leading to cyst formation. For lymphatic cysts caused by infections, treatment typically includes anti-infection therapy to control pathogens, along with addressing local lymphatic vessel damage caused by the infection, such as necessary surgical drainage or supportive treatment.

Early diagnosis and comprehensive treatment are crucial for improving prognosis and preventing complications [18].

3.4. Genetic Factors (Congenital Lymphatic Cysts)

Certain familial diseases (such as Turner syndrome) are associated with the occurrence of lymphatic cysts. Genetic factors play an important role in the occurrence of lymphatic cysts, particularly in certain hereditary diseases and syndromes that may increase the risk of lymphatic cysts. These genetic factors usually lead to cyst formation by affecting the development or function of lymphatic vessels. The specific mechanisms include: Gene Mutations and Genetic Syndromes: Some specific hereditary syndromes are closely related to lymphatic cysts. For example, Turner syndrome (a disease caused by sex chromosome abnormalities) is often accompanied by underdevelopment of lymphatic vessels and cyst formation. These genetic diseases often lead to abnormal development of the lymphatic system, preventing the lymphatic vessels from properly draining lymph fluid, ultimately forming cysts. Familial Tendency: Multiple cases of lymphatic cysts may appear in some families, suggesting a possible genetic susceptibility [6]. These familial cases indicate that family members may share certain genetic variations that could affect the normal development and function of lymphatic vessels, leading to the occurrence of cysts. Gene-Environment Interaction: The interaction between genetic factors and environmental factors may further complicate the formation of lymphatic cysts. For example, although certain gene mutations may increase the risk of developing lymphatic cysts, environmental factors such as infections or trauma may also act as triggers. Genes Affecting Lymphatic Vessel Development: Specific gene mutations may directly affect the development and structure of lymphatic vessels [13]. These genes may be related to the proliferation of endothelial cells of lymphatic vessels, lumen formation, and regulation of lymph fluid flow. Developmental abnormalities caused by gene mutations may prevent lymphatic vessels from developing normally during the embryonic stage or after birth, increasing the risk of cyst formation. In conclusion, genetic factors influence the development and function of lymphatic vessels through various mechanisms, leading to the occurrence of lymphatic cysts. In-depth research on genetic factors can help identify high-risk individuals, develop early screening strategies, and provide a theoretical basis for future treatments.

4. Discussion

Clinical Presentation of Post-Traumatic Lymphatic Cysts: The symptoms of post-traumatic lymphatic cysts vary depending on their location and size [19]. Common clinical manifestations include: Painless Mass: Often presents as a painless mass that gradually enlarges. Compression Symptoms: When the cyst compresses adjacent structures, compression symptoms may occur, such as difficulty breathing

or swallowing. Signs of Infection: In a few cases, signs of infection may appear, such as fever, redness, and swelling. Diagnostic Methods for Lymphatic Cysts: Physical Examination: A physician can make an initial assessment of the cyst's location and size through a physical examination. Ultrasound Examination: Used to evaluate the size, contents, and relationship of the cyst with surrounding tissues. CT Scan and MRI: Help to determine the extent of the cyst and whether there are any complications. Needle Biopsy: Under ultrasound guidance, a needle aspiration can be performed to obtain cyst fluid for cytological examination or culture to aid in diagnosis. Treatment Strategies for Lymphatic Cysts: The treatment methods for lymphatic cysts include: Observation: For small cysts that are asymptomatic, an observation and wait strategy with regular follow-ups may be adopted. Medication: For cysts caused by infection or inflammation, antibiotics or other medications may be needed. Aspiration and Drainage: For larger cysts, aspiration and drainage may be performed to relieve symptoms. Surgical Removal: For cysts that continue to grow or cause significant symptoms, surgical removal may be necessary [20].

5. Conclusion

Traumatic lymphatic cysts are usually benign and have a good prognosis. However, if not treated promptly or if complications such as infection or bleeding occur, they can lead to serious clinical problems. Long-term follow-up can effectively monitor changes in the cyst and prevent potential complications. Traumatic lymphatic cysts are relatively common benign cystic lesions, and while most cases have a good prognosis, timely and accurate diagnosis and appropriate treatment are crucial for patients with significant symptoms or complications. Future research needs to focus on the pathogenesis, improvements in early diagnostic techniques, and optimization of treatment methods. After lymph node removal surgery, lymphatic cysts may form due to surgical trauma leading to the rupture of lymphatic vessels or obstruction of lymph fluid flow. During surgery, the lymphatic vessels may be cut or damaged, causing lymph fluid to accumulate postoperatively, forming a cyst. Postoperative scar tissue or inflammatory reactions may also further obstruct lymphatic circulation, leading to cyst formation. Preventive measures include postoperative monitoring and, if necessary, interventions such as drainage or reoperation to alleviate lymph fluid accumulation.

Abbreviations

CNKI China National Knowledge Infrastructure
VIP China Science and Technology Journal Database

Author Contributions

Zhang Wei wrote the manuscript. Liu Chao managed the

research program. Yang Zhe statistics. Wang Chun and Gu Yupei conducted statistical analyses.

Data Sources

All data were sourced from Renshou Yunchang Hospital.

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Conflicts of Interest

All authors of this paper declare that they have no conflicts of interest.

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