

Original paper

Application of ultrasound-guided intranodal lymphangiography in the diagnosis and treatment of chylous ascites after abdominal surgery

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Abstract

Purpose: Chylous leakage is a serious and challenging postoperative complication. The purpose of this study was to explore the application of ultrasound-guided intranodal lymphangiography in the diagnosis and treatment of chylous ascites following abdominal surgery.

Material and methods: Ten patients with chylous ascites after abdominal surgery after ineffective conservative treatment such as low-fat diet, parenteral nutrition, and negative pressure drainage were included in this single-center retrospective study. Of these 10 patients, 9 developed chylous ascites after liver surgery, and 1 after a radical gastrectomy.

Results: Lymphangiography was successfully performed in all 10 patients. The average dosage of lipiodol used was 4.5 ml (range 3.5-7.0 ml). No procedure-related complications were observed after excluding unrelated factors. During lymphangiography, lipiodol leakage was directly observed in 3 cases, and in the other 5 cases, it was detected through abdominal computed tomography post-lymphangiography. Chylous ascites resolved solely through lymphangiography in 6 patients without requiring additional surgical intervention.

Conclusions: Lymphangiography may help identify leakage sites in patients with chylous ascites unresponsive to conservative treatment and could potentially be effective in treating chylous ascites following abdominal surgery.

Key words: chylous ascites, abdominal surgery, lymphatic vessel, angiography.

Introduction

Chylous ascites is a rare condition resulting from leakage of intestinal lymph from the lymphatic system. Iatrogenic chylous ascites caused by surgery is uncommon but difficult to treat in cases with unsuccessful conservative treatment [1]. Although conservative treatment has a high cure rate for mild chylous ascites, conservative treatment is often ineffective for chylous ascites with a higher drain-

age volume. Furthermore, the subsequent loss of protein, vitamins, and immunoglobulins may lead to cachexia, an impaired immune system, and sepsis, which may lead to higher perioperative mortality and poor prognosis [2]. Therefore, identifying an appropriate diagnostic and treatment approach for chylous ascites is crucial. This study explores the clinical value of intranodal lymphangiography in diagnosing and treating chylous ascites after abdominal surgery by reviewing patients with refractory chylous ascites after abdominal surgery.

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Authors' contribution:

A Study design · B Data collection · C Statistical analysis · D Data interpretation · E Manuscript preparation · F Literature search · G Funds collection

Material and methods

Data collection

We collected clinical data from patients who were diagnosed with chylous ascites after undergoing surgery at Zhongshan Hospital, Fudan University, between January 2022 and November 2023, and who did not respond to conservative treatments such as a medium-chain triglyceride diet, total parenteral nutrition, and negative pressure drainage. The group consisted of 8 males and 2 females, aged 42-71 years, with an average age of 52. All were diagnosed with chylous ascites, with the following breakdown: 6 cases were due to partial hepatectomy, 3 cases from liver transplantation, and 1 from radical gastrectomy for gastric cancer. The primary lesions included intrahepatic cholangiocarcinoma (5 cases), hepatocellular carcinoma (3 cases), hepatic neuroendocrine carcinoma (1 case), and gastric adenocarcinoma (1 case). Prior to lymphangiography, chylous ascites persisted for a duration ranging from 7 to 118 days, during which all patients had abdominal drainage tubes inserted. The average daily drainage volume, as depicted in Table 1, ranged from 386 to 1802 ml. Inclusion criteria for patients were: 1) diagnosed with chylous ascites; 2) have undergone abdominal surgery; 3) ineffectiveness of conservative treatment. Exclusion criteria were: 1) allergy to iodized oil; 2) chylous ascites caused by non-surgical factors.

Lymphangiography

Percutaneous lymphangiography was performed after obtaining informed consent from each patient. Bilateral inguinal lymph nodes were detected by ultrasound, and the puncture site was determined according to its size. Under ultrasound guidance, a 22 G puncture needle (YAKO Sangyo Co., Ltd. Japan) was used to puncture the central lymphatic vessels of inguinal lymph nodes. Depending on the patient's condition, one side or both sides of the groin were injected with poppy iodinated oil injection (Jiangsu Hengrui Pharmaceuticals Co., Ltd.), with a total volume of no more than 10 ml. The upward flow of lipiodol was observed during the lymphangiography, and the location of lipiodol leakage was identified by lymphangiography or by post-lymphangiographic computed tomography.

Post-lymphangiographic follow-up

The basic situation of the patients, the amount of lipiodol used during the lymphangiography, the detection rate of lymphatic leakage on abdominal computed tomography (CT) images after lymphangiography, the time from the day of lymphangiography to the disappearance of chylous ascites, whether other surgical methods were performed after lymphangiography and the volume of chylous

ascites per day after lymphangiography were followed up regularly. Intraoperative complications, such as allergic reactions to contrast agents and lipiodol, were recorded. Serious complications, such as alveolar hemorrhage, pulmonary vascular lipiodol embolism, cerebral infarction and other adverse reactions, were closely monitored. After discharge, patients were regularly checked for chylous ascites recurrence and the need for retreatment, as well as the effectiveness of such treatments.

Results

A total of 12 lymphangiographies were performed on 10 patients, one of whom experienced surgical treatment failure before lymphangiography. Among them, 2 patients (cases 6 and 8) underwent 2 lymphangiographies. Of the 12 lymphangiographies, 11 were technically successful. One attempt failed because the inguinal lymph nodes could not be detected again under ultrasound for puncture. Among the 11 successful procedures, in 10 cases it passed through the right inguinal lymph vessels, and in 1 case it passed through the bilateral inguinal lymph vessels.

One patient (case 10) had cardiac arrest about 2 days after surgery, and another (case 6) suffered a cerebral infarction 7 days after surgery. However, after careful discussion by an expert panel of neurologists, cardiologists, surgeons, interventional radiologists, and radiologists, these symptoms of the two patients were considered unrelated to lymphangiography. The average amount of iodized oil used was 4.5 ml, with individual doses in the range 3.5-7.0 ml.

In three patients (cases 2, 5, and 9), the site of leakage was successfully identified during the lymphangiography. The remaining five patients (cases 3, 4, 6, 7 and 8) were not sought to find the leakage site during lymphangiography; however, after the completion of lymphangiography, they underwent abdominal CT scans, which successfully identified the leakage site. In another two patients, the site of leakage was not found through either lymphangiography or abdominal CT scans. Figure 1 shows the lymphangiography image of case 9, and Figure 2 shows the computed tomography image of case 5.

Six of the 10 patients (cases 1, 2, 4, 5, 6 and 9) had a significant reduction in daily drainage volume, and in 4 cases (cases 1, 2, 5 and 9) the chylous ascites resolved within 2 weeks. The drainage volume of the remaining 4 cases (cases 3, 7, 8, 10) did not change significantly. Eventually, cases 2 and 7 stopped having chylous ascites, and case 10 showed a temporary decrease in drainage volume but suffered respiratory and cardiac arrest two days after the procedure. Although resuscitated successfully, the patient developed septic shock, and relevant drainage data were lost. In case 8 chylous ascites has not stopped so far and relevant data were also lost because an attempt to clamp the drainage tube was made after lymphangiography failed to provide therapeutic benefit.

Table 1. Characteristics of each patient in whom lymphangiography was performed and the course of chylous leakage after lymphangiography

Age	Gender	High Weight	Cause of chylous leakage	Underlying disease	Amount of drainage before lymphangiography (ml day ⁻¹)	Time between diagnosis and lymphangiography	Preoperative treatment	Usage of iodized oil	Leakage site	Follow-up treatment	Amount of drainage the day after lymphangiography (ml day ⁻¹)	Time between lymphangiography and cure (days)
1	71	M	171	67	Liver surgery	Hepatocellular carcinoma	653	15			395	10
2	53	M	183	70	Liver transplantation	Intrahepatic cholangiocarcinoma	1100	50			575	3
3	57	M	174	74	Liver surgery	Intrahepatic cholangiocarcinoma	1550	41	Surgery		1550	33
4	63	M	160	54	Liver surgery	Intrahepatic cholangiocarcinoma	2000	16			696	27
5	67	M	170	64	Liver surgery	Intrahepatic cholangiocarcinoma	386	38			90	13
6	52	M	166	60	Liver surgery	Hepatic neuroendocrine carcinoma	1802	24	Lymphangiography		100	24
7	42	F	173	66	Liver transplantation	Hepatocellular carcinoma	1602	38			1148	103
8	68	F	155	38	Radical gastrectomy	Gastric adenocarcinoma	542	118			NA	NA
9	66	M	170	54	Liver surgery	Intrahepatic cholangiocarcinoma	204	7			40	4
10	54	M	172	72	Liver transplantation	Hepatocellular carcinoma	1100	19			NA	NA



Figure 1. Image of case 9 during lymphangiography

Discussion

Although the phenomenon of spontaneous healing of chylous ascites after lymphangiography was discovered in 2005 [3], it was previously carried out by pedal lymphangiography. With ultrasound-guided intranodal lymphangiography first proposed in 2011 [4], the limitations of previous pedal lymphangiography techniques were technically addressed, making lymphangiography more convenient and efficient [5]. In previous studies, the overall success rate of therapeutic lymphangiography in patients with failed conservative treatment was 51% [6]. The reason for the relief of chylous ascites after lymphangiogra-

phy may be related to the hydrolysis and saponification of fat, the accumulation of lipiodol, the inflammatory reaction of lipiodol, and the high viscosity of lipiodol [6-9].

There are many reasons for development of chylous ascites. The underlying etiologies for chylous ascites have been classified as traumatic, congenital, infectious, neoplastic, postoperative, cirrhotic, or cardiogenic. Although malignancy and cirrhosis account for about two-thirds of all cases of CA in Western countries [10], lymphatic vessel damage and infection after abdominal surgery are also among the main causes in adults [11]. Patients with ascites caused by postoperative chylous leakage are often in a state of high energy expenditure and protein requirements due to traumatic stress (Figure 3). Chylous ascites may lead to decreased blood volume, malnutrition, and a compromised immune system, severely affecting postoperative recovery, prolonging the length of stay, and even increasing mortality [12]. It has been reported that the incidence of chylous ascites after liver transplantation is 0.6-4.7% [13] and the incidence of chylous ascites after oncological abdominal surgery is 7.4% [14]. Unlike many previous studies on chylous ascites, 10 patients in this study underwent abdominal surgery, and 90% of them underwent liver-related surgery. The reported therapeutic efficacy of lymphangiography for postoperative lymphatic leakage is 46-89% [6,7,15-18] according to relevant reports in the literature, which corresponds well to our 60% therapeutic success rate of observation following lymphangiography. However, a lower success

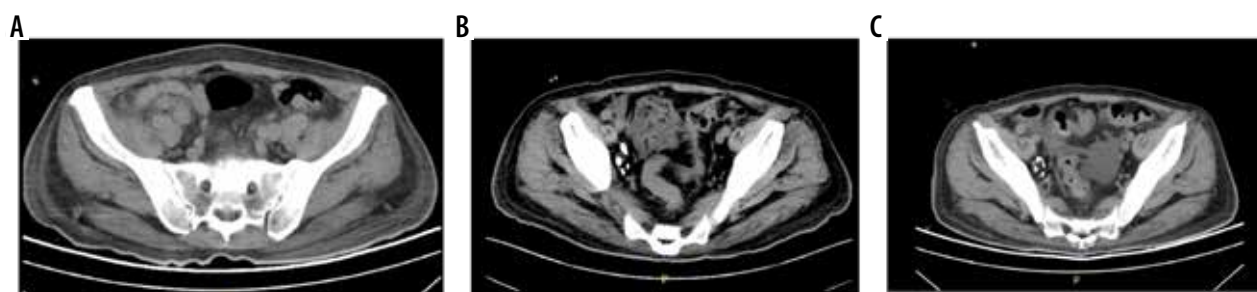


Figure 2. A) Computed tomography image of case 5 before lymphangiography. B) Computed tomography image of case 5 three days after angiography. C) Computed tomography image of case 5 eleven days after angiography



Figure 3. Image of chylous ascites drainage



Figure 4. Lipiodol remaining in lymph nodes for up to 17 months

rate was observed in liver transplantation, possibly due to higher rates of leakage and the complexity of surgical procedures. Therefore, we need to consider other treatment methods, such as platelet-rich plasma (PRP) and fibrin glue (FG) [19].

After the review by the expert panel, none of the 10 patients experienced lymphangiography-related complications. Although one patient had cardiac arrest two days after lymphangiography, this individual had low blood pressure beforehand and relevant bacteria were detected in the pleural effusion. At the same time, the relevant bacteria were detected in the pleural effusion before the lymphangiography. Therefore, after the discussion of the expert panel, they determined that the cardiac arrest was unrelated to lymphangiography. In another case, a second lymphangiography was performed 11 days after the first, with a new cerebral infarct appearing five days later. We did not find any signs of lipiodol-related cerebral infarction in the brain by careful comparison with previous head CT scans. Therefore, although two patients had unexpected symptoms during the perioperative period, we believe that lymphangiography is relatively safe. However, the number of lymphangiographies carried out globally is relatively small compared with other interventional procedures, so it is still necessary to be alert for the occurrence of related complications.

We also noted interesting phenomena such as the slow metabolism of lipiodol in lymphatic vessels, with residues remaining in lymph nodes for up to 17 months (Figure 4). Lipiodol not only ascends from the inguinal lymph nodes but also descends to the scrotum in some cases (Figure 5). Although our elderly patients no longer require fertility, the potential impact on reproductive function due to lipiodol deposition in scrotal lymph nodes remains unclear. This requires further study to understand the long-term effects of lipiodol residues in lymphangiography. In one case, a second lymphangiography was performed after the therapeutic failure of the first lymphangiography. The drainage volume was significantly reduced after the second lymphangiography, which proved that if the first lymphangiography failed therapeutically, the second lymphangiography could still be effective.



Figure 5. Lipiodol descending to the scrotum

This single-center retrospective study had a limited sample size, underscoring the need for further systematic research to confirm the therapeutic efficacy of lymphangiography for postoperative chylous ascites.

Conclusions

Our study suggests that ultrasound-guided intranodal lymphangiography may aid in both the diagnosis and potential treatment of chylous ascites following abdominal surgery. For patients with chylous ascites unresponsive to conservative treatment, this procedure appears to be safe and has shown promise in clinical practice.

Disclosures

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2. Assistance with the article: None.
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4. Conflicts of interest: None.

References

1. Hamaguchi S, Michigami Y, Inoue M, Tsukamoto K, Wada S, Ogawa Y. Successful treatment of chylous ascites by superselective embolization of the inflowing lymphatic vessels using a steerable microcatheter: a case study. *Radiol Case Rep* 2022; 17: 3205-3208.
2. Toliyat M, Singh K, Sibley RC, Chamarthy M, Kalva SP, Pillai AK. Interventional radiology in the management of thoracic duct injuries: anatomy, techniques and results. *Clin Imaging* 2017; 42: 183-192.
3. Yamagami T, Masunami T, Kato T, Tanaka O, Hirota T, Nomoto T, et al. Spontaneous healing of chyle leakage after lymphangiography. *Br J Radiol* 2005; 78: 854-857.
4. Rajebi MR, Chaudry G, Padua HM, Dillon B, Yilmaz S, Arnold RW, et al. Intranodal lymphangiography: feasibility and preliminary experience in children. *J Vasc Interv Radiol* 2011; 22: 1300-1305.
5. Nadolski GJ, Itkin M. Feasibility of ultrasound-guided intranodal lymphangiogram for thoracic duct embolization. *J Vasc Interv Radiol* 2012; 23: 613-616.

6. Alejandre-Lafont E, Krompiec C, Rau WS, Krombach GA. Effectiveness of therapeutic lymphography on lymphatic leakage. *Acta Radiol* 2011; 52: 305-311.
7. Matsumoto T, Yamagami T, Kato T, Hirota T, Yoshimatsu R, Masunami T, et al. The effectiveness of lymphangiography as a treatment method for various chyle leakages. *Br J Radiol* 2009; 82: 286-290.
8. Bazancir LA, Jensen RJ, Frevert SC, Ryom P, Achiam MP. Embolization of the thoracic duct in patients with iatrogenic chylothorax. *Dis Esophagus* 2021; 34: doab001. DOI: 10.1093/dote/doab001
9. Ikomi F, Kawai Y, Ohhashi T. Recent advance in lymph dynamic analysis in lymphatics and lymph nodes. *Ann Vasc Dis* 2012; 5: 258-268.
10. Bhardwaj R, Vaziri H, Gautam A, Ballesteros E, Karimedini D, Wu GY. Chylous ascites: a review of pathogenesis, diagnosis and treatment. *J Clin Transl Hepatol* 2018; 6: 105-113.
11. Lizaola B, Bonder A, Trivedi HD, Tapper EB, Cardenas A. Review article: the diagnostic approach and current management of chylous ascites. *Aliment Pharmacol Ther* 2017; 46: 816-824.
12. Wang K, Xiao J, Li L, Li X, Yang Y, Liu Z, et al. The application of a medium-chain fatty diet and enteral nutrition in post-operative chylous leakage: analysis of 63 patients. *Front Nutr* 2023; 10: 1128864. DOI: 10.3389/fnut.2023.1128864.
13. Matsuura T, Yanagi Y, Hayashida M, Takahashi Y, Yoshimaru K, Taguchi T. The incidence of chylous ascites after liver transplantation and the proposal of a diagnostic and management protocol. *J Pediatr Surg* 2018; 53: 671-675.
14. Kaas R, Rustman LD, Zoetmulder FA. Chylous ascites after oncological abdominal surgery: incidence and treatment. *Eur J Surg Oncol* 2001; 27: 187-189.
15. Kortés N, Radeleff B, Sommer CM, Bellemann N, Ott K, Richter GM, et al. Therapeutic lymphangiography and CT-guided sclerotherapy for the treatment of refractory lymphatic leakage. *J Vasc Interv Radiol* 2014; 25: 127-132.
16. Kos S, Haueisen H, Lachmund U, Roeren T. Lymphangiography: forgotten tool or rising star in the diagnosis and therapy of postoperative lymphatic vessel leakage. *Cardiovasc Intervent Radiol* 2007; 30: 968-973.
17. Gruber-Rouh T, Naguib NNN, Lehnert T, Harth M, Thalhammer A, Beeres M, et al. Direct lymphangiography as treatment option of lymphatic leakage: indications, outcomes and role in patient's management. *Eur J Radiol* 2014; 83: 2167-2171.
18. Hur S, Shin JH, Lee IJ, Min SK, Min SI, Ahn S, et al. Early experience in the management of postoperative lymphatic leakage using lipiodol lymphangiography and adjunctive glue embolization. *J Vasc Interv Radiol* 2016; 27: 1177-1186.e1. DOI: 10.1016/j.jvir.2016.05.011.
19. Hamidi Alamdari D, Amini E, Arianpoor A, Ziaemehr A, Aliakbarian M. A novel approach to recalcitrant postoperative chylous ascites in liver re-transplantation: a case report. *Int J Organ Transplant Med* 2021; 12: 38-41.