



Glue Embolization of Lymphopseudoaneurysm for Chylous Ascites after Retroperitoneal Surgery

Lyo Min Kwon, MD^{1*}, Saebeom Hur, MD¹, Chang Wook Jeong, MD²,
Hwan Jun Jae, MD, PhD¹, Jin Wook Chung, MD, PhD¹

Departments of ¹Radiology and ²Urology, Seoul National University College of Medicine, Seoul, Korea

Objective: To assess the safety and efficacy of lymphopseudoaneurysm (LPA) glue (n-butyl cyanoacrylate [NBCA]) embolization in the management of chylous ascites after retroperitoneal surgery.

Materials and Methods: A retrospective analysis from January 2014 to October 2018 was performed in six patients (4 females and 2 males; mean age, 45.3 ± 14.2 years; range, 26–61 years) who underwent LPA embolization for chylous ascites developing after retroperitoneal surgery involving the perirenal space (four donor nephrectomies, one partial nephrectomy, and one retroperitoneal lymphadenectomy). After placing a percutaneous drainage catheter into the LPA or adjacent lymphocele, embolization was performed by filling the LPA itself with a mixture of glue and Lipiodol (Guerbet).

Results: Daily drainage from percutaneously placed drains exceeded 300 mL/day despite medical and surgical treatment (volume: mean, 1173 ± 1098 mL; range, 305–2800 mL). Intranodal lymphangiography was performed in four of the six patients and revealed leakage in 2 patients. Percutaneous embolization of the LPA was successful in all patients using an NBCA and Lipiodol mixture in a ratio of 1:1–1:2 (volume: mean, 4.3 ± 1.1 mL; range, 3–6 mL). Chylous ascites was resolved and the drainage catheter was removed in all patients within 4 days after the procedure (mean, 2.0 ± 1.8 days; range, 0–4 days). No procedure-related complications or recurrence of chylous ascites occurred during a mean follow-up period of 37.3 months (range, 21.1–48.4 months).

Conclusion: Glue embolization of LPA has the potential to be a feasible and effective treatment method for the management of chylous ascites after retroperitoneal surgery.

Keywords: Embolization; Chylous ascites; Nephrectomy; Lymphatic vessels; Cyanoacrylate

INTRODUCTION

Chylous ascites is a possible post-operative complication following retroperitoneal surgery with an incidence rate

of up to 11% (1). This condition may result from damage during surgery to the para-aortic lymph node (LN) or the lymphatic vessels close to the cisterna chyli, which hold a large volume of flowing chylous lymphatic fluid. Chylous ascites may lead to a severe loss of plasma protein, fat, and immunomodulatory lymphocytes (2).

Due to advances in the field of lymphatic intervention, many post-operative lymphatic leakages are currently treated with minimally invasive procedures, such as thoracic duct embolization, or intranodal LN embolization (3-7). However, chylous ascites remains a difficult condition to diagnose and treat by inguinal intranodal lymphangiography because chylous and non-chylous lymphatic fluids follow different pathways (8-10).

Recently, the concept of a lymphopseudoaneurysm (LPA) was introduced (3). An LPA is defined as a small cavity of lymph collection that is directly extravasated from lymphatic vessels or LNs. It is contained by surrounding

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Corresponding author: Saebeom Hur, MD, Department of Radiology, Seoul National University College of Medicine, 101 Daehak-ro, Jongno-gu, Seoul 03080, Korea.

• E-mail: saebeom.hur@snu.ac.kr

*Current affiliation: Department of Radiology, Hallym University Kangnam Sacred Heart Hospital, Seoul, Korea.

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tissue before draining into larger spaces, such as the peritoneal cavity, or into lymphoceles (3). Several studies have reported the application of LPA embolization to treat chylous ascites, chylothorax, and lymphoceles (3, 8, 10).

Glue (n-butyl cyanoacrylate [NBCA]) embolization of LPA is presented here as a treatment method for chylous ascites after retroperitoneal surgery.

MATERIALS AND METHODS

The Institutional Review Board of the author's institution approved this study and waived the requirement for patient consent.

From January 2014 to October 2018, patients who had previously undergone lymphatic intervention for chylous ascites were retrospectively reviewed based on hospital electronic medical charts. Six patients underwent LPA embolization for chylous ascites after the following retroperitoneal surgeries: hand-assisted laparoscopic (HAL) nephrectomy as living donors for kidney transplantation (n = 4), HAL retroperitoneal LN dissection due to testicular cancer (n = 1), and open partial nephrectomy due to renal cell carcinoma (n = 1). One of the six patients had previously been included in a study (3). Chylous ascites was initially detected as a white fluid flowing from the surgical drainage tube, and was confirmed by a triglyceride level test value exceeding 200 mg/dL (11). The leak was refractory to conservative management (fasting, low-fat or fat-free diet, and sandostatin), percutaneous catheter drainage (PCD), or surgical ligation. The mean daily drainage volume was 1173 ± 1098 mL (range, 305–2800 mL), and the mean triglyceride level was 790.3 ± 407.3 mg/dL (range, 203–

1461 mg/dL). On average, chylous ascites occurred 2.3 days (range, 0–5 days) after surgery, and patients were referred to intervention radiology 21.7 days after the development of symptoms (range, 7–72 days). Patient demographic data and clinical information are shown in Table 1.

Lymphangiography and Closest Upstream LN Embolization

Intranodal lymphangiography was performed via the inguinal LNs with a 26-gauge needle (Kovax-Needle, Korea Vaccine Co.) under ultrasound guidance. Ethiodized oil (Lipiodol, Guerbet) was injected until it outlined the more central lymphatics in the abdomen. In cases with leakage, the closest upstream LN (i.e., the most closely located LN that may provide afferent lymphatic flow to the leakage sites) was punctured and embolized with a glue mixture of NBCA (Histoacryl, B. Braun Surgical) and ethiodized oil in a ratio of 1:1–1:3.

PCD of the LPA or Lymphocele

Under ultrasonography or cone-beam computed tomography (CT) guidance, an 8.5- or 10.2-Fr Dawson–Mueller Drainage Catheter (Cook Medical Inc.) was placed directly into the LPA (Figs. 1A, B, 2A). A small fluid collection in the retroperitoneum adjacent to the surgical bed was considered an LPA. In cases where two fluid collections occurred, the smaller one was considered an LPA and the larger one a lymphocele (Fig. 1A). In cases where direct catheter drainage of the LPA was not feasible due to small size or location, the adjacent lymphocele was drained instead. The drainage volume was monitored for 1–2 days, and if it consistently exceeded 200 mL per day further LPA

Table 1. Patient Demographic Data, and Details of Chylous Leakage and Prior Treatments

Pt. No./ Age (Y)/Sex	Underlying State	Surgery	Type of Leakage/ Duration (Days)	Amount of Daily Drainage (mL)	Medical Treatment	Other Treatment
1/57/F	TPL donor	Left HAL nephrectomy	Chylous ascites/19	2650	Sandostatin, NPO, FFD, LFD NPO, sandostatin followed by Avil and meckool combination (due to sandostatin allergy)	Lymphatic ligation, sclerotherapy
2/55/F	TPL donor	Left HAL nephrectomy	Chylous ascites/7	470		Open dressing
3/61/F	Renal cell carcinoma	Left partial nephrectomy	Chylous ascites/11	400	Sandostatin, NPO and TPN, FFD	-
4/26/M	Testicular cancer	Orchiectomy, retroperitoneal LN dissection	Chylous ascites/72	2800	Sandostatin, NPO, FFD	Sclerotherapy
5/38/F	TPL donor	Left HAL nephrectomy	Lymphocele/7	860	Sandostatin	-
6/35/M	TPL donor	Left HAL nephrectomy	Lymphocele/2	305	NPO, FFD	-

FFD = fat-free diet, HAL = hand-assisted laparoscopic, LFD = low-fat diet, LN = lymph node, NPO = nil per os diet, Pt. No. = patient number, TPL = transplantation, TPN = total parenteral nutrition

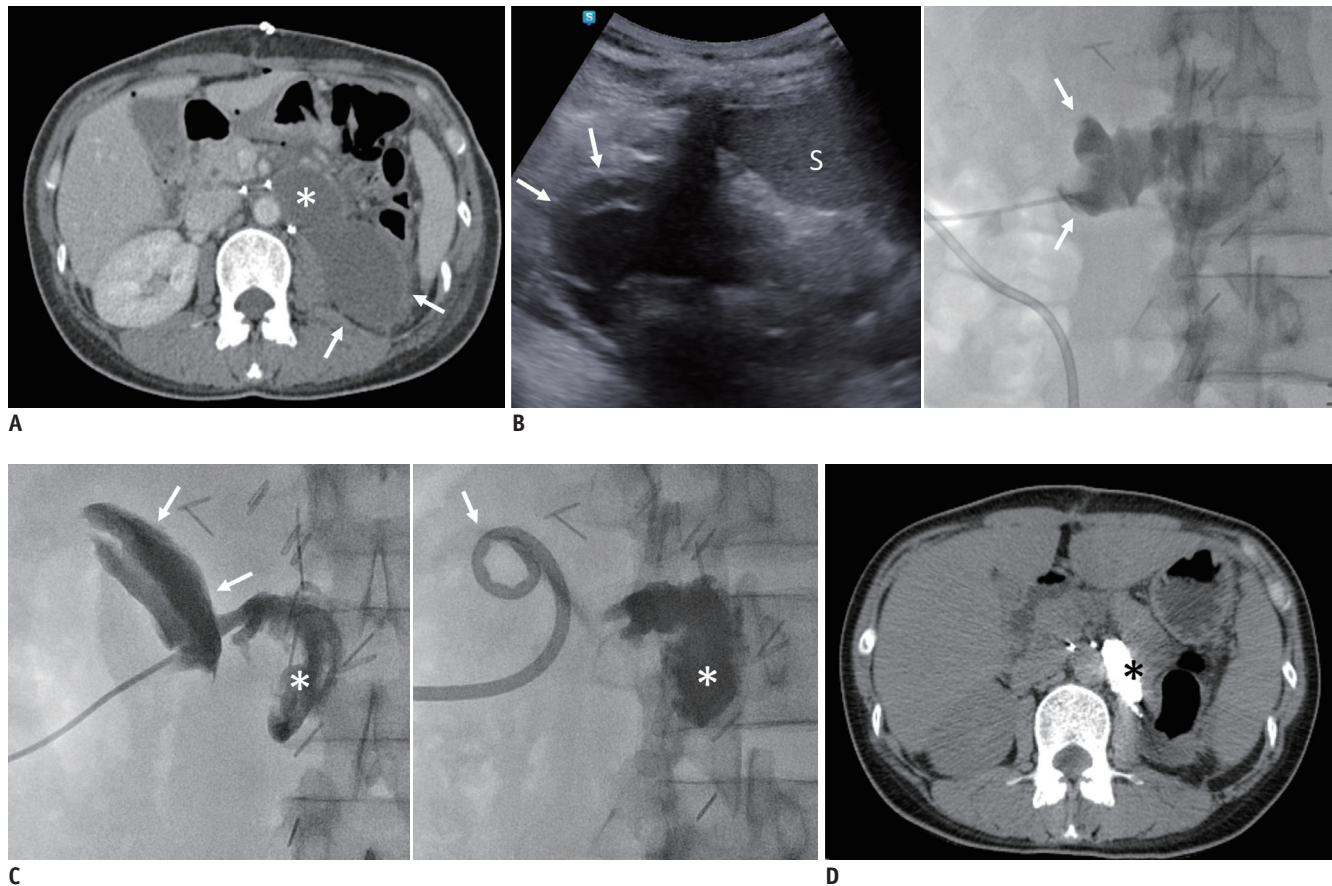


Fig. 1. Images from a 38-year-old female kidney donor patient (patient 5) who underwent PCD insertion for a lymphocele that developed after donor nephrectomy.

A. CT scan obtained 6 days after operation shows an hourglass-shaped fluid collection in the left nephrectomy site. In the hourglass-shaped fluid collection, para-aortic, relatively deep fluid collection is presumed to be a LPA (asterisk), and superficial fluid collection is presumed to be a lymphocele (arrows). **B.** The day after the CT scan, ultrasonography-guided PCD insertion was performed. In the ultrasound image, a lymphocele (arrows) is observed beside the spleen (S). The lymphocele (arrows) is punctured and PCD insertion is performed. **C.** After drainage, embolization of the LPA was performed. In the contrast study via drainage tube, the lymphocele (arrows) and LPA (asterisk) are visualized to be connected by a narrow neck-like portion. The LPA (asterisk) is embolized by filling it with a glue mixture (NBCA:ethiodized oil, 1:2). The drainage catheter is repositioned to locate inside the lymphocele (arrow). **D.** Non-contrast CT scan obtained 2 weeks after embolization. A compact casting status of the LPA (asterisk) by the glue mixture was noted, without washout or lymphocele recurrence. LPA = lymphopseudoaneurysm, NBCA = n-butyl cyanoacrylate, PCD = percutaneous catheter drainage

embolization was scheduled (12).

Embolization of the LPA

Before the embolization procedure, the drainage catheter was exchanged with a 5–7-Fr 10 cm length vascular sheath for the introduction of a guiding catheter. The LPA was evaluated by injecting a water-soluble contrast agent via a 5-Fr angio-catheter such as a Kumpe Catheter (Cook Medical Inc.) (Figs. 1C, 2A). If the contrast leaked into the adjacent larger lymphocele or peritoneal cavity, the outflow tract was occluded with endovascular coils and a 1:2 glue mixture to confine the LPA (Fig. 2A). If an injured inflow lymphatic vessel connected to the LPA was observed during subsequent contrast injection into the confined

LPA (Fig. 2B, C), catheterization and embolization of the lymphatic vessel was pursued. If catheterization was not possible, a dense glue mixture (1:1–1:2 ratio) was injected with a microcatheter to fill the LPA (Fig. 1C, D). After embolization, the microcatheter was removed from the 5-Fr angio-catheter and discarded. The drainage catheter was peripherally placed to the embolized LPA or lymphocele through the same access route (Figs. 1C, 2C). The drainage catheter was removed when the output decreased to less than 10 mL per day in five of six patients. Patients were clinically followed-up at 2 weeks, 1 month, 3 months, and 6 months after discharge, and interviews were conducted to monitor for symptoms such as abdominal bloating, which is a possible symptom of chylous ascites. Complications

were analyzed and graded by the Society of Interventional Radiology adverse event classification system proposed in 2017 (13). Routine follow-up imaging was not performed, excepting cancer patients.

RESULTS

Lymphangiography was performed in four of the six patients. In two of the four (50%), a lymphatic duct with a possible lymphatic leakage point was identified.

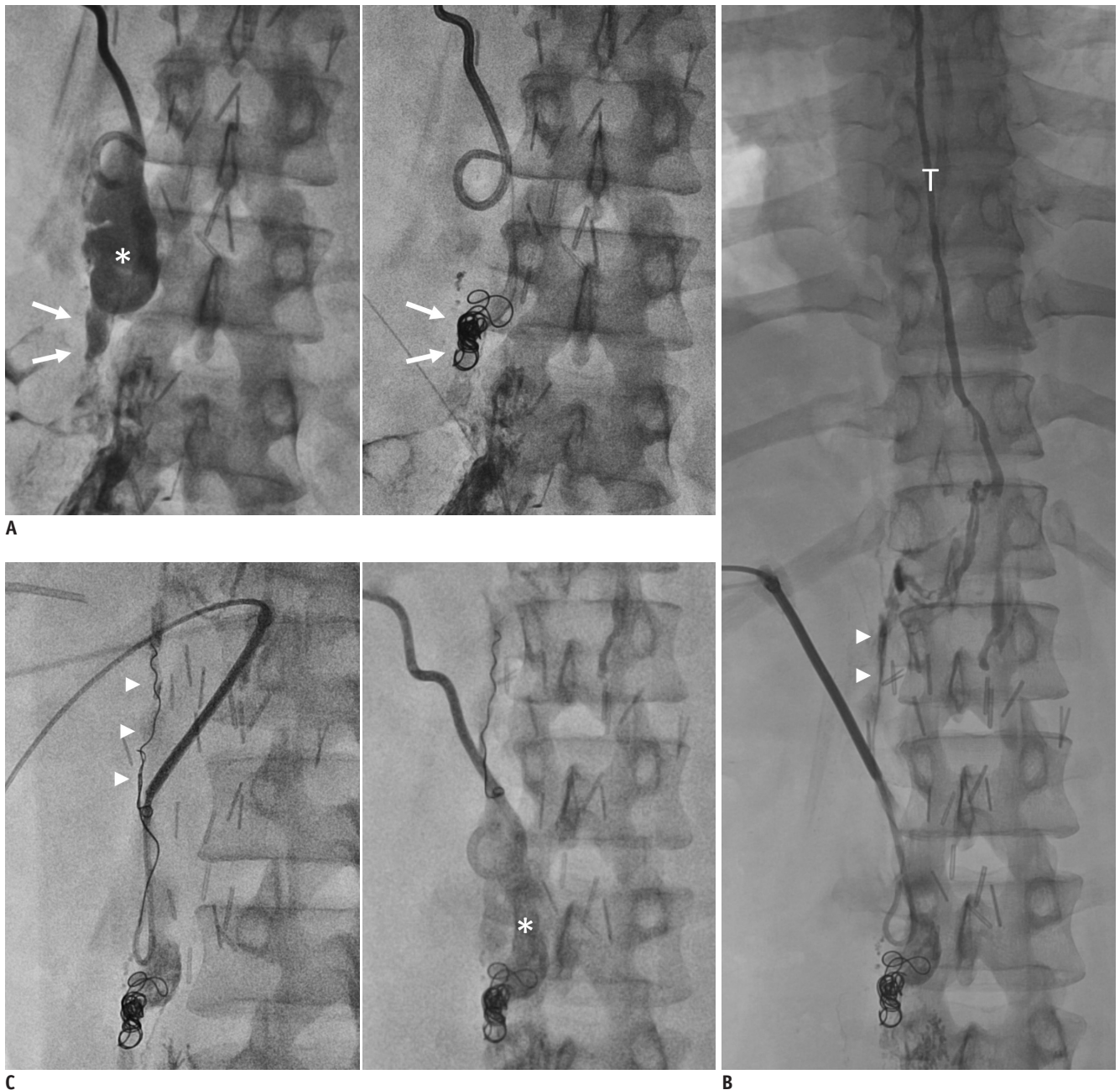


Fig. 2. Images from a 26-year-old male patient (patient 4) who underwent PCD insertion for a LPA in the left perinephric space for chylous ascites caused by retroperitoneal LN dissection for testicular cancer.

A. A drainage catheter is inserted into the LPA (asterisk) in the left perinephric space. A contrast study via drainage catheter shows an outflow tract (arrows) of the LPA into the peritoneal space. A microcatheter is inserted throughout the drainage catheter and coil embolization is performed for the outflow tract (arrows). **B.** After outflow tract embolization, a subsequent contrast study shows reflux into the inflow tract (arrowheads), which is connected to the thoracic duct (T). **C.** Coil embolization is also performed for the inflow tract (arrowheads) and the LPA (asterisk) itself is embolized by filling it with a glue mixture (NBCA:ethiodized oil, 1:2). The drainage catheter is reinserted into the distal portion of the LPA. LN = lymph node

Embolization with glue was performed in the adjacent retroperitoneal LN near the leakage point in both patients, but chylous ascites symptoms did not improve in either patient.

A drainage catheter was inserted into the LPA in two of the patients, and inserted into the lymphocele in the other four patients. In three of the four patients with inserted lymphocele drainage catheters, contrast injection revealed a connection between the lymphocele and the LPA, which was successfully cannulated with a 5-Fr angio-catheter and microcatheter. In the fourth patient with an inserted lymphocele drainage catheter, an additional percutaneous puncture for the LPA was performed. The percutaneous approach to the LPA was successful in all patients. The outflow tract was observed in four patients and embolized in two patients with 2.5 microcoils on average. A damaged inflow lymphatic vessel was observed in three patients, and superselection with embolization was performed in one of the three (Fig. 2). Superselection failed in the remaining two patients, however during LPA embolization the glue was refluxed into the inflow lymphatic duct and successfully embolized in both patients. In all patients, embolization of the LPA only (n = 3), or the LPA with connected injured

lymphatic vessel (n = 3), was successfully achieved with the glue mixture (volume: mean, 4.3 ± 1.1 mL; range, 3–6 mL) (Table 2). Patients 1 and 4 underwent three and two sessions of embolization, respectively. Patient 1 was the first patient to undergo LPA embolization with applied embolic materials of 100% alcohol, thrombin, and glue for three sessions, and treatment was successful following the last glue embolization. In Patient 4, upstream lymphatic duct embolization and LPA embolization were performed at different stages. After embolization, the drainage volume gradually decreased and the drain was removed within four days (mean, 2.0 ± 1.8 days; range, 0–4 days). All patients were discharged within 8 days after treatment (mean, 2.5 ± 3.9 days; range, 0–8 days). After removal of the drainage catheter, no symptoms recurred, and no additional procedures were required in any of the patients.

No serious adverse events occurred in any patient. One patient complained of mild pitting edema, Grade 1+ in a bilateral lower extremity, which spontaneously resolved without treatment after a year. Chylous ascites did not recur during a follow-up period of approximately one and a half years (amount: mean, 37.3 ± 10.4 months; range, 21.1–48.4 months).

Table 2. Patient Procedures, Including Lymphangiography and Embolization, and Outcomes

Pt. No./ Age (Y)/ Sex	Lymphangiography	LN Embolization	PCD Location	Tubography	Embolization	Immediate Outcomes			Final Outcomes	
						No. of Sessions	Final Drainage (mL)	Interval between LE and PCD Removal (Days)	F/U (Months)	Symptom
1/57/F	Y	N	LPA	LPA only	LPA	3	420	0	42	Self-limiting leg edema [†]
2/55/F	Y	N	Lymphocele	LPA, outflow tract to lymphocele, inflow lymphatic duct	LPA, inflow lymphatic duct (nonselective)	1	5	2	40	No
3/61/F	Y*	Y [†]	Lymphocele	Lymphocele only	LPA	1	10	4	36	No
4/26/M	Y	Y [†]	LPA	LPA, outflow tract to peritoneal cavity, inflow lymphatic duct	LPA, outflow tract, inflow lymphatic duct (selective)	2	3	3	35	No
5/38/F	N	-	Lymphocele	LPA, outflow tract to lymphocele	LPA	1	5	4	19	No
6/35/M	N	-	Lymphocele	LPA, outflow tract to lymphocele	LPA, outflow tract	1	10	2	15	No

*Incomplete due to lymphatic ligation, [†]Retroperitoneal LN embolization was performed due to a suspected lesion from lymphangiography, but no improvement of chylous ascites was observed, [‡]Showed spontaneous resolution in 12 months. F/U = follow-up, LE = last embolization, LPA = lymphopseudoaneurysm, N = no, PCD = percutaneous catheter drainage, Y = yes

DISCUSSION

Anatomically, chylous ascites is difficult to diagnose via lymphangiography due to the following physiological issue (9). As the contrast agent injected at the inguinal LN joins the cisterna chyli via the lumbar trunk, and chylous lymphatic fluids join the cisterna chyli via the mesenteric trunk, the damaged lymphatics causing chylous ascites may occur outside of the contrast pathway from the cisterna chyli to the intraperitoneal cavity. In this study, inguinal intranodal lymphangiography identified the leak in 50% of patients, but the chylous ascites persisted after subsequent LN embolization. In a study by Majdalany et al. (8), lymphangiography for chylous ascites identified the leak in 55% of patients, resulting in a 50% clinical success rate for LN glue embolization. In another study by Nadolski et al. (7) including 10 patients with chylous ascites after nephrectomy or retroperitoneal LN dissection due to testicular cancer, lymphangiography revealed the leak in (70%) of the patients. LN embolization was subsequently performed in 3 of those patients, and chylous ascites was

resolved in 2 of the 3 (66%) (9).

Even though intranodal lymphography and LN embolization have demonstrated favorable clinical outcomes in some cases, a new approach is needed to assess chylous ascites considering the inherent physiological obstacles mentioned above. Some novel lymphangiography methods have been introduced such as intraoperative mesenteric lymphangiography, and balloon-occluded retrograde abdominal lymphangiography and embolization (BORALE), but the former is invasive and the latter requires dedicated devices (e.g., micro-balloons), and can be technically demanding (10, 14, 15).

The concept of LPA embolization has been introduced in several case reports and case series (3, 4, 6). Although the terminologies differed in each paper, the LPA embolization method using glue and a percutaneous approach was the same. However, not all papers reported successful results. In a study by Hur et al. (3), eight cases of LPA embolization were performed with a 50% success rate. Given this result, LPA embolization may not be applicable to all chylous ascites cases. One hypothesis for the promising technical

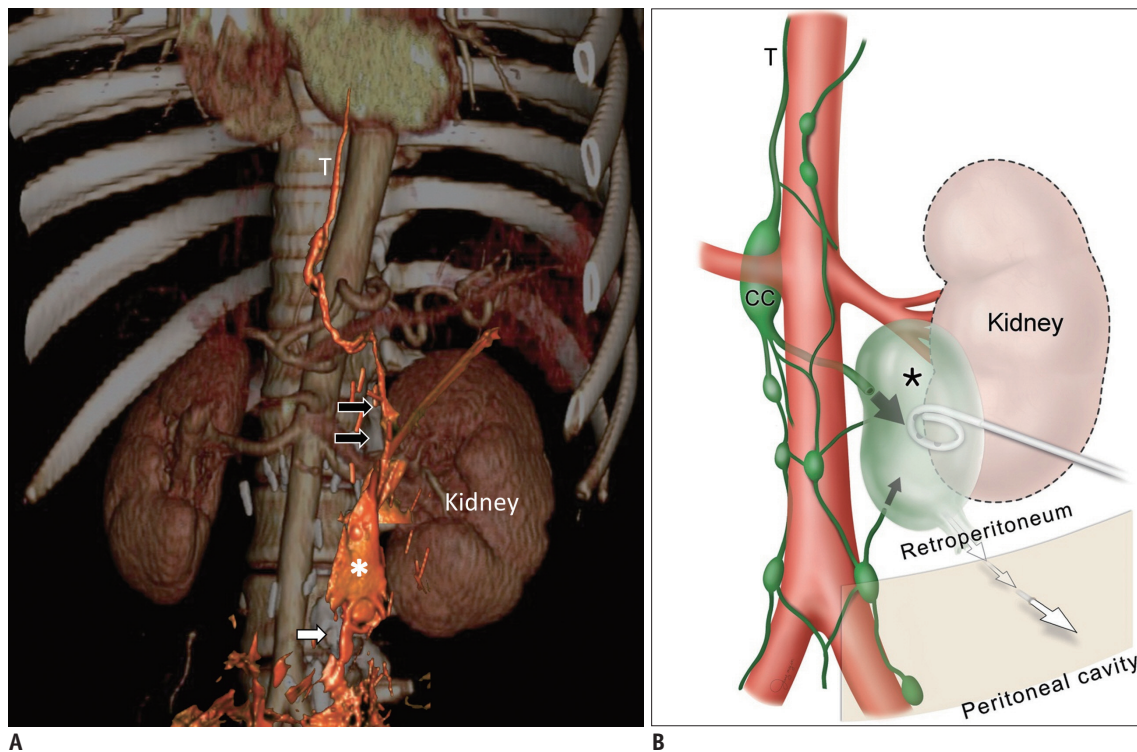


Fig. 3. Schematic 3D representation of the lymphatic pathway after nephrectomy.

A. Overlay of two reconstructed 3D images: contrast injection via PCD and a volume rendering image from conventional CT, left anterior oblique view in patient 4. The PCD tube is inserted in the LPA (asterisk). The inflow tracts (black arrows), outflow tract (white arrow), and thoracic duct (T) are clearly represented in the overlay image. **B.** Schematic representation of the lymphatic fluid pathways in (A). The cut retroperitoneal lymphatics (black arrows) around the nephrectomy site which lymphatic fluids leak from the thoracic duct (T) and cisternal chyli (CC), form a LPA (asterisk). Fluid accumulates in the LPA and drains into the peritoneal cavity (white arrows). 3D = three-dimensional

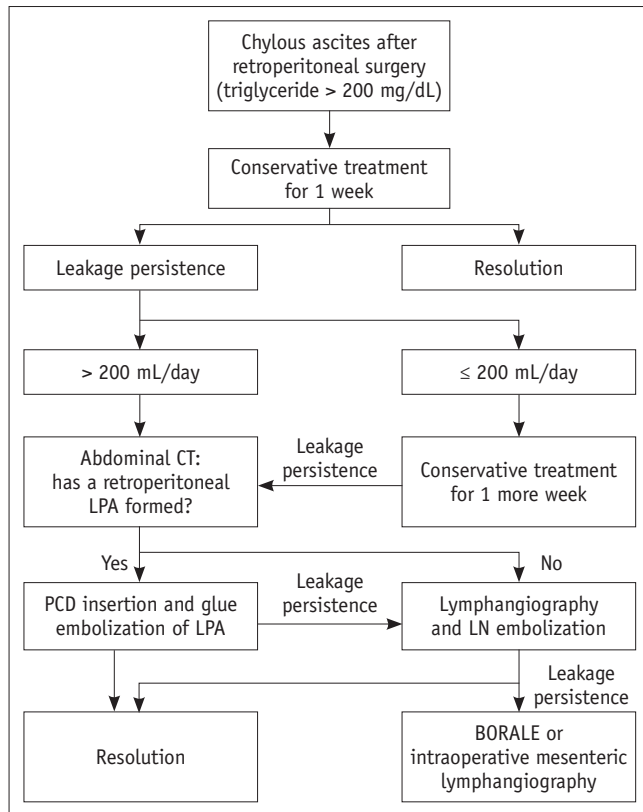


Fig. 4. Flow chart for the management of chylous ascites after retroperitoneal surgery. BORALE = balloon-occluded retrograde abdominal lymphangiography and embolization

and clinical success of the present study is that the LPA locations were suitable for glue embolization. The surrounding retroperitoneal tissue may create a fibrotic wall-like structure allowing the LPA to withstand glue embolization, and also facilitating an easy percutaneous approach. Another possible reason is that the thoracic duct and cisterna chyli, which are the main lymphatic pathways, are not usually damaged during nephrectomy or retroperitoneal LN dissection (Fig. 3).

Based on the results of this study, a recommended treatment flow for chylous ascites after retroperitoneal surgery is introduced in Figure 4. If CT reveals a retroperitoneal LPA in a case generating more than 200 mL/day of chylous ascites drainage with no response to conservative treatment, then PCD insertion and LPA embolization may be attempted prior to lymphangiography. Subsequently, if a response is still not observed, then lymphangiography, BORALE, or intraoperative mesenteric lymphangiography may be attempted.

There are several limitations to this study. The sample size was small, and both the disease entity and embolization technique were heterogeneous. Future studies should

combine a larger and less heterogeneous patient cohort with application of a standardized technique. Moreover, it should be noted that LPA embolization might not be effective in the following circumstances. First, an LPA may not form in the immediate post-surgery state, or in cases following an extensive resection of retroperitoneal tissue. Second, it may also not be feasible in patients with blocked drainage through the thoracic duct. In addition, a large amount of glue in the LPA can be a potential source of infection due to the inherent properties of the percutaneous approach (16).

In conclusion, LPA embolization with glue has the potential to be a feasible and effective treatment method for chylous ascites after nephrectomy or retroperitoneal surgery involving the perirenal space.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

ORCID iDs

Lyo Min Kwon

<https://orcid.org/0000-0001-5611-2480>

Saebeom Hur

<https://orcid.org/0000-0003-0787-5101>

Chang Wook Jeong

<https://orcid.org/0000-0002-2200-5019>

Hwan Jun Jae

<https://orcid.org/0000-0002-0328-3400>

Jin Wook Chung

<https://orcid.org/0000-0002-1090-6872>

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