Case Report

Endolymphatic exclusion for the treatment of pediatric chylous ascites secondary to neuroblastoma resection: report of two cases ☆,☆☆,★,★★,†,††

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ABSTRACT

Chylous ascites is a rare, but highly morbid complication of oncologic resection, often associated with retroperitoneal lymphadenectomy. Conservative measures with total parenteral nutrition or lipid-reduced formulas constitute the initial mainstay therapy, but not without risks and failures. This report describes 2 endolymphatic treatment strategies for iatrogenic chylous ascites following neuroblastoma resection. Lymphatic leaks were identified using intranodal lymphangiography, targeted with cone-beam computed tomographic guidance, and embolized with n-butyl cyanoacrylate. There were no adverse outcomes, with complete resolution of chylous ascites and a mean follow-up of 26 months.

dissection. Incidence of chylous ascites in this setting ranges from 2% to 11% [1–3].

Despite its overall low incidence, chylous ascites results in significant morbidity. The loss of chyle, which is rich in proteins, lipids, immunoglobulins, electrolytes, and vitamins, depletes many elements that are vital to normal physiology [4]. Nutritional and electrolyte deficiencies require total parenteral nutrition and fluid replenishment. Loss of lymphocytes and immunoglobulins contributes to immunosuppression [5]. There are also reports of diminished bioavailability of certain drugs with chyle losses [6–8]. These complications may extend hospital stays, increase postoperative mortality, and delay or preclude adjuvant chemotherapy [9].

Conservative treatment measures, including enteral feeding, total parenteral nutrition, and somatostatin analogs, constitute the initial medical management. Reported success rates of these conservative methods range from 60% to 100% over 2-6 weeks of treatment [9,10]. Major drawbacks to these approaches include complications of long-term central venous access, malnutrition, neurological developmental deficits from fatty acid deficient diet, and extended hospitalizations [9,11–13].

Various endolymphatic interventions offer a less invasive approach for definitive management of refractory chylous ascites [14–16]. These described interventions have, however, been largely reported in adults. This report describes 2 pediatric patients with persistent iatrogenic chylous ascites that were successfully managed with endolymphatic embolization.

Case report

Patient 1

A 5-year-old male patient presented with 1 month of periorbital ecchymosis. Diagnostic evaluation revealed a 7.6 × 7.1 × 9.5 cm right adrenal mass, pancytopenia, sphenoid and occipital bone lesions, and bone marrow infiltration consistent with high-risk neuroblastoma. After his fourth cycle of chemotherapy per ANBL0532, he underwent right adrenalectomy, retroperitoneal lymphadenectomy, and nonsegmental liver resection. Large volume chylous ascites developed 2 weeks after surgery upon resolution of ileus and initiation of total parenteral nutrition. Paracentesis was performed 1 month post resection with removal of 2 L of fluid, notable for triglyceride level of 310 mg/dL (normal reference range <110 mg/dL). The ascites rapidly reaccumulated despite initiation and escalation of octreotide infusion (up to 8 mcg/kg/hr), medium chain triglyceride formula and, later, *nil per os* status. A second paracentesis was performed 2 weeks later with removal of 3.6 L of fluid. The patient was referred for lymphatic imaging and intervention.

Under general anesthesia, a paracentesis was performed with removal of 3 L of fluid. Conventional bilateral inguinal node lymphangiography was performed with ethiodized oil, revealing bilateral foci of retroperitoneal extravasation at L3-L4 (Fig. 1). The patient was repositioned prone. Foci of extravasation were targeted percutaneously with 22-gauge needles

using cone beam computed tomography (CBCT) with navigational overlay (XperGuide, Philips). Each site was embolized with 1.5 mL of a 1:1 mixture of n-butyl cyanoacrylate (n-BCA) to ethiodized oil until retrograde filling of the supplying retroperitoneal lymphatic channels was observed.

The patient underwent a subsequent paracentesis 3 days later with removal of 3 L fluid. He was weaned from octreotide and transitioned from parenteral nutrition to an unrestricted diet over the subsequent 6 weeks. A final paracentesis, 1 month after the lymphatic embolization, was performed with removal of 1.9 L fluid. Ascites has not recurred since. With subsequent therapies including tandem autologous stem cell transplantation, radiation, and immunotherapy the patient achieved complete disease remission 15 months postpresentation, and remains disease free at 45 months postpresentation. Patient follow-up from time of intervention is currently 40 months.

Patient 2

A 1-year-old boy was presented with pathologic wrist and shoulder fractures and was found to have a 12.2 × 8.5 × 8.5 cm left adrenal mass and diffuse osseous involvement. Operative biopsy confirmed favorable histology, N-Myc-amplified neuroblastoma. After his fifth cycle of chemotherapy per ANBL1531 Arm A, he underwent resection of the left adrenal mass with extensive lymphadenectomy around the aorta, superior mesenteric artery, celiac axis, and left renal artery and vein at 17 months of age. Large volume ascites accumulated 3 weeks postoperatively with the advancement of diet. Paracentesis yielded 0.6 L of grossly chylous fluid (triglycerides 6785 mg/dL). Ascites recurred despite the patient being made *nil per os*, and he received a second paracentesis with removal of 1 L of fluid. Five weeks postresection, he was referred for lymphatic imaging and intervention.

Under general anesthesia, a paracentesis was performed with removal of 1 L of fluid. Conventional bilateral inguinal node lymphangiography was performed with ethiodized oil, revealing unilateral focus of retroperitoneal extravasation at L2 (Fig. 2). CBCT of the pelvis was performed, characterizing a left lateral external iliac chain lymph node with efferent drainage to the site of extravasation. The node was targeted percutaneously with a 25-gauge needle using CBCT with navigational overlay. After efferent drainage to the site of extravasation was again confirmed, embolization was performed into and across the extravasation using 0.5 mL of a 1:3 mixture of n-BCA to ethiodized oil. He remained on total parenteral nutrition for 1 additional week and subsequently was advanced to an unrestricted diet over 1 week without recurrence of ascites.

The patient went on to receive hematopoietic stem cell transplant. At the time of this report, he has undergone his fifth cycle of immunotherapy. Patient follow-up from time of intervention is currently 12 months.

Discussion

This description of 2 successful endolymphatic interventions for chylous ascites following neuroblastoma resection high-
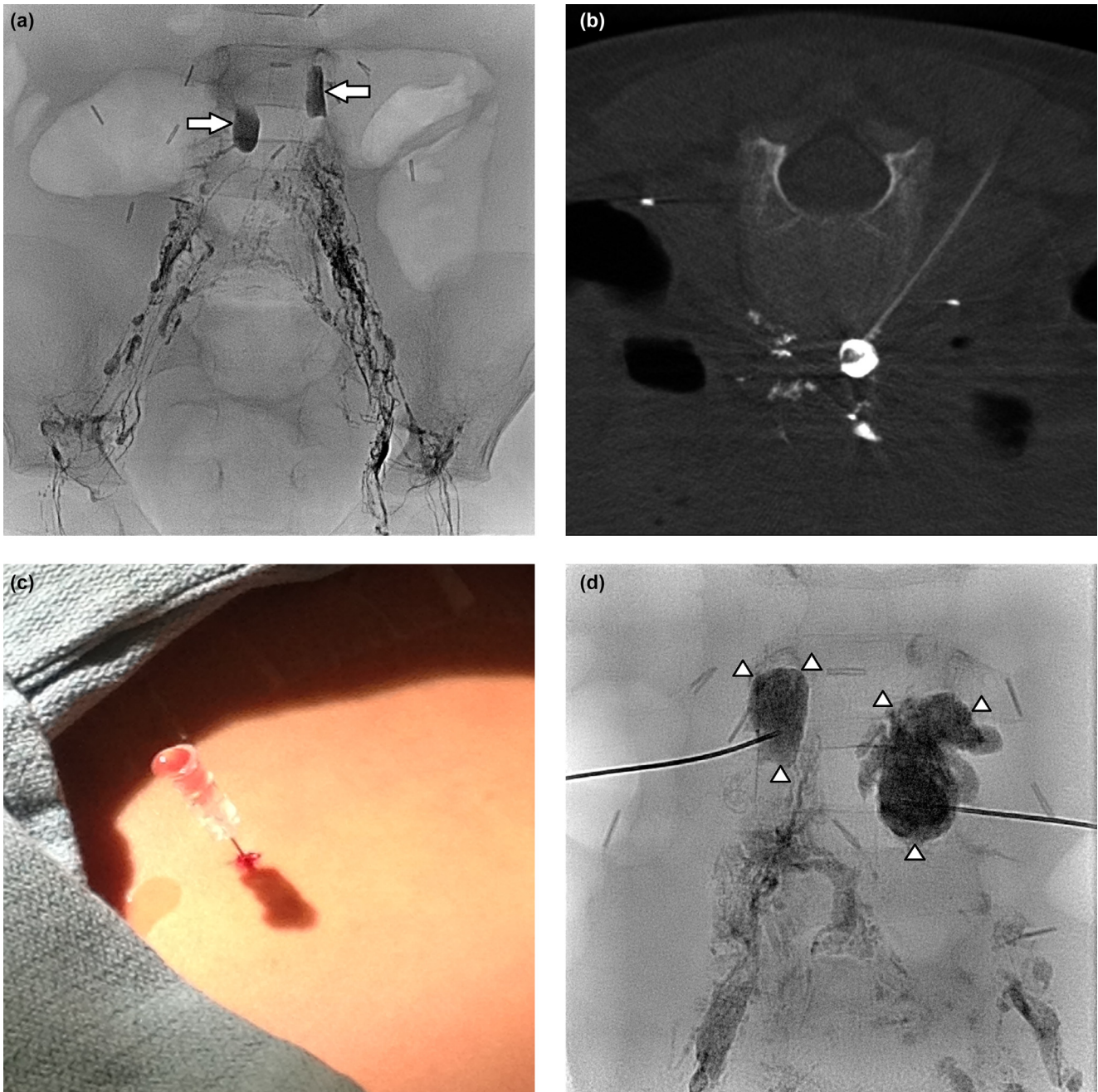
Fig. 1 – Frontal fluoroscopic image following bilateral inguinal access and lymphangiography using ethiodized oil (A) demonstrated two foci of lymphatic extravasation in the retroperitoneum (arrows). Following prone positioning, foci of extravasation were targeted using cone beam CT guidance (B). Lymphatic fluid draining from the access needles was noted (C). Each site was embolized using cyanoacrylate (D) (arrowheads).

lights a minimally invasive treatment option for this morbid condition. Each case demonstrated complete resolution of ascites for a mean follow-up of 26 months. No procedure-related complications were seen.

In both cases, a lymphatic leak was identified prior to targeted embolization. In larger case series, lymphatic leaks were identified in 55%-75% of patients [16,17]. Comparatively, prior reports on surgical intervention demonstrated identification in 80% of patients [18,19]. The use of ethiodized oil during lym-

phangiography has been shown to have a therapeutic effect, likely due to an inflammatory or embolic effect [17,20]. With this in mind, overall clinical success rates of these less invasive modalities can approach 90% [16,17].

Multiple previous reports demonstrate the feasibility and safety of embolizing lymph nodes or lymphatic networks with embolics such as n-BCA glue [14,21–25]. The n-BCA is mixed with ethiodized oil at various ratios to control the rate of polymerization and downstream propagation. Excessive down-
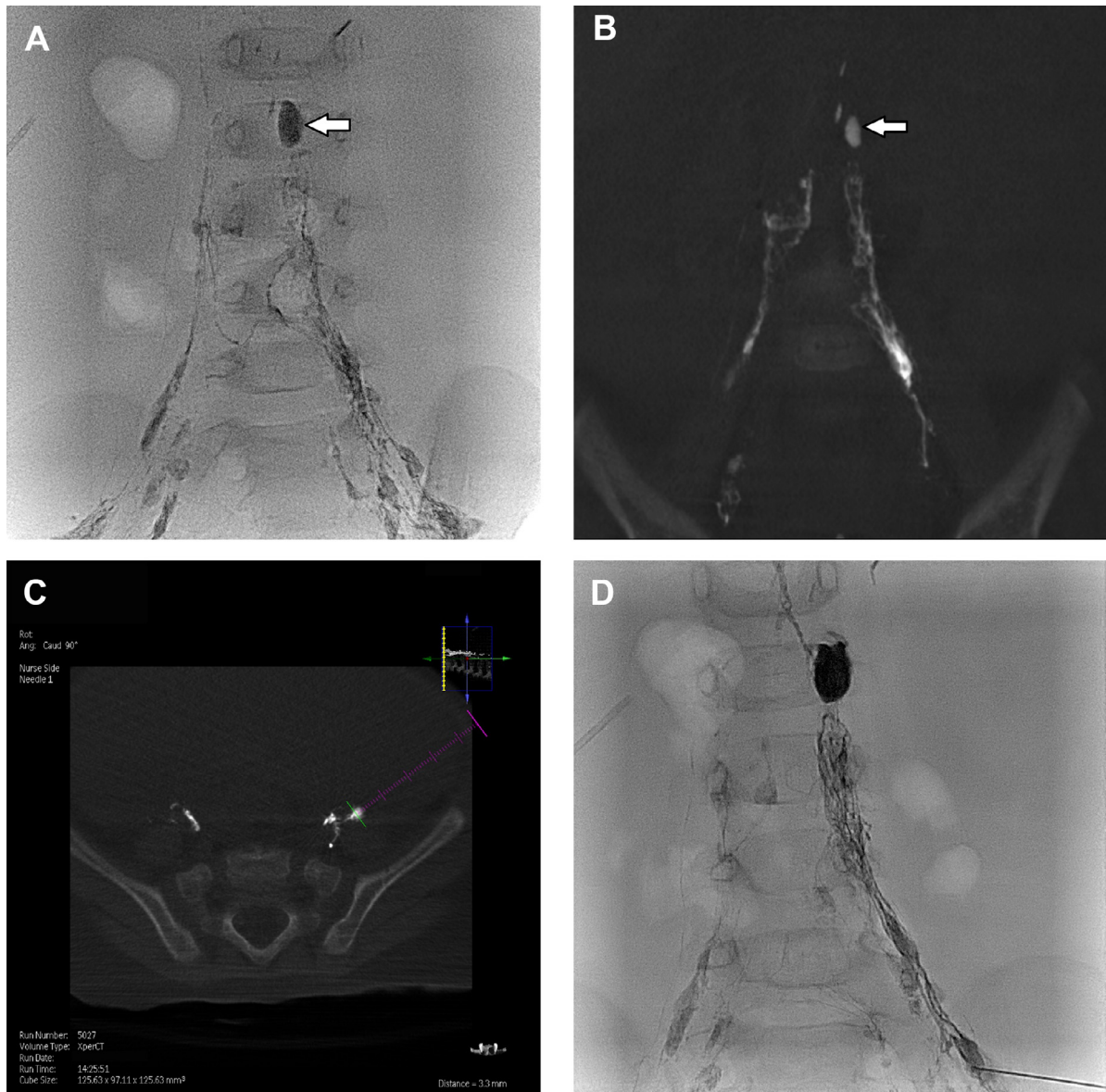
Fig. 2 – Frontal fluoroscopic image following bilateral inguinal access and lymphangiography using ethiodized oil (A) demonstrated a single focus of lymphatic extravasation in the left retroperitoneum (arrow). Cone beam CT was performed (C), confirming the focus of extravasation (arrow) and further characterizing retroperitoneal lymphatic anatomy. A left lateral external iliac chain node was identified and targeted using cone beam CT guidance with navigational overlay (XperGuide, Philips) (C). Following contrast confirmation of inline drainage to the focus of extravasation, embolization was performed using cyanoacrylate (D) with preservation of the right-ided lymphatics.

stream embolization must be avoided to prevent obstruction of normal central conducting channels such as cisterna chyli and thoracic duct. Targeting lymph nodes or channels in close proximity to the injury minimizes excessive embolization of upstream structures and theoretical risk of lymphedema. Additionally, administration of ethiodized oil should be limited to 0.25 mL/kg in children to avoid possible adverse outcomes such as pulmonary oil embolism [26,27].

Compared to thoracic duct embolization, embolization of retroperitoneal and mesenteric lymphatic injuries creates several technical challenges. Relative to the typical access channel in these interventions, the cisterna chyli, the involved ducts may be very small caliber, particularly in a pediatric patient. Accessing cisterna chyli with sufficiently caudal angulation for retrograde wire advancement introduced morbidity associated with transthoracic approaches. A technique of inferior thoracic duct embolization followed by retrograde reflux of sclerosant has been reported [28]. Percutaneous hepatic lymphatic access, transcervical thoracic duct arch access and endovascular entry through the venolym-

phatic junction may afford the retrograde access trajectory needed for infradiaphragmatic lymphatic interventions [29]. In this report, we described both direct access to the injury itself with refluxing embolization as well as upstream node access with downstream embolization with CBCT guidance to address the chylous ascites while minimizing nontarget lymphatic embolization, including preservation of the thoracic duct.

These cases exemplify the feasibility and efficacy of endolymphatic interventions in iatrogenic pediatric chylous ascites. More studies are warranted to establish standardized techniques and long-term safety.

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