



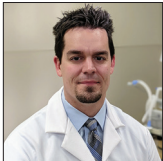
## Case Report

# Using aneurysm clips for repair of cisterna chyli injury during posterior spinal fusion

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## ABSTRACT

**Background:** Injury to the cisterna chyli (CC) is a rare surgical complication with a lack of literature describing its repair. Aneurysm clips have been successfully used to repair durotomies. Its usage in lymphatic injury has never been described. We sought to demonstrate the use of aneurysm clips for the repair of lymphatic vessels.

**Case Description:** A 60-year-old male retired physician with Parkinson's disease underwent a lumbosacral instrumented fusion with pelvic fixation (L1-pelvis) in 2011. He returned 5 months postoperatively after a fall and was ambulatory with a cane upon admission. CT demonstrated worsening kyphosis with pedicular and superior endplate fracture at the fusion apex. MRI revealed spinal cord compression at the failed level. Extension thoracolumbar fusion was performed (T3-L1) with intraoperative violation of the anterior longitudinal ligament (ALL) during T12/L1 discectomy. CC laceration was suspected. The ALL was dissected from the CC and aorta, allowing visualization of the injury. Three curved aneurysm clips were applied to the lacerated CC, which was visually inspected to ensure a patent lumen. The disk space was filled with poly-methyl-methacrylate cement in place of an interbody cage, preventing migration of the clips. The patient underwent rehabilitation in an inpatient facility with improved ambulation. He has had regular clinic follow-up and was last seen in 2020 with no evidence of lymphedema noted.

**Conclusion:** CC injury is rare, and usage of aneurysm clips in its repair has never been described. We demonstrate the safe use of aneurysm clips to repair CC injury with long-term favorable clinical outcomes.

**Keywords:** Cisterna chyli, Lacerations, Ligation

## INTRODUCTION

Maintenance of lymphatic flow is crucial for wound healing, immunity, and nutrient uptake, all of which are essential for postoperative recovery.<sup>[28]</sup> Chylous ascites may result from an untreated lymphatic vessel injury, including injury to the cisterna chyli (CC).<sup>[15]</sup> The CC is a lymphatic sac located anterior to the L1-L2 vertebra just underneath the aorta [Figure 1]. It is primarily responsible for directing lymphatic flow from the intestines and lower extremities to the thoracic duct.<sup>[14]</sup> The thoracic duct receives lymph from the CC and ultimately terminates in the left subclavian vein.<sup>[18]</sup> Injury to the CC is a rare surgical complication, and its repair has been seldom described. Surgical intervention is necessary in select cases. However, no standardized technique

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is currently recognized. Current literature supports the repair of lymphatic vessels with direct repair using sutures or muscle flap techniques. However, the use of aneurysm clips to repair lymphatic injury has never been described.<sup>[7,13]</sup> Aneurysm clips have been successfully used to repair durotomies during spinal surgery.<sup>[8]</sup> We demonstrated the use of aneurysm clips in the repair of a CC injury during thoracolumbar fusion.

## CASE DESCRIPTION

A 60-year-old male retired physician with a history of Parkinson's disease underwent a lumbosacral instrumented fusion with pelvic fixation (L1-pelvis). He required admission to an extended-care facility due to his Parkinson's disease with medication noncompliance. He was discharged with a walker and reported that his ambulation had improved since surgery. Subsequently, the patient had a fall, noting increased back pain and leg pain, and presented to us 5 months postoperatively.

The patient was ambulatory with a cane on admission. However, he had severe back pain and bilateral lower extremity weakness, requiring assistance to stand up. CT thoracic and lumbar spine showed worsening of his kyphosis with pedicular fracture and superior endplate fracture at the apex of his fusion. MRI revealed spinal cord compression at the level of failure. Due to his adjacent segment failure with spinal cord compression, revision and extension of thoracolumbar fusion with instrumentation were performed (T3-L1). Intraoperatively, the anterior longitudinal ligament (ALL) was violated during the T12/L1 discectomy, with fluid noted to be leaking into the disk space.

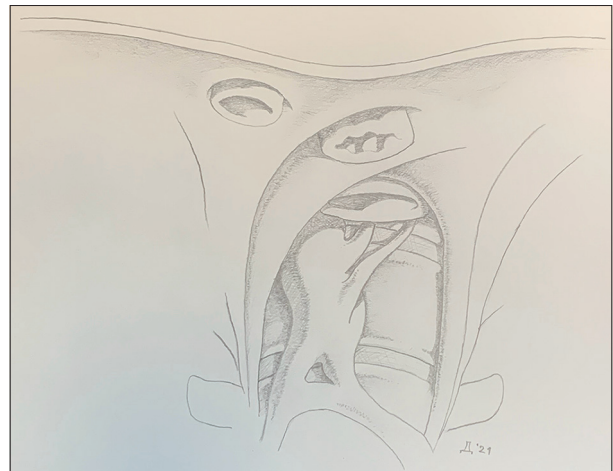
Due to the proximity of the CC to the thoracolumbar junction, laceration was suspected. Direct visualization was the primary diagnosis method, with a milky fluid noted to be leaking from the CC. Lymphangiography is an imaging technique that may be used to assess the patency of the lymphatic vessels. However, this was not feasible as an intraoperative investigation.<sup>[17,26]</sup> A differential diagnosis of infection/abscess was considered, and intraoperative cultures and Gram stains were sent for evaluation.

The ALL was dissected from the lacerated CC and descending aorta, allowing clear visualization of the injury. The CC was noted to be adherent to the ALL of the spine and immobile. Curved aneurysm clips [Figure 2] were applied to the lacerated opening of the CC, which caused a cessation in the flow of lymphatic fluid into the disk space. A total of three aneurysm clips were placed, and the CC was then visually inspected to ensure that the aneurysm clips did not occlude the lumen. The disk space was then filled with poly-methyl-methacrylate cement, preventing migration of the clips by anchoring the aneurysm clips in place and providing intervertebral support in place of an interbody cage [Figure 3].

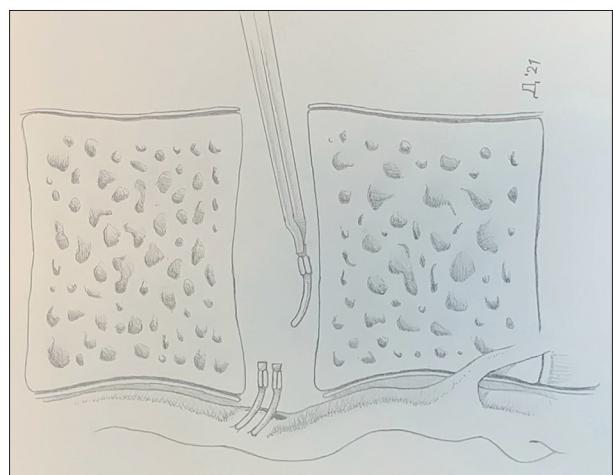
The patient underwent extensive rehabilitation in an inpatient facility, and his ambulation improved. His balance was significantly compromised due to his Parkinson's disease, requiring a cane for ambulation. He was regularly followed up in the clinic, and he was last seen in 2020. As a physician, the patient diligently monitored his symptoms and was aware of performing self-evaluations for lymphedema and abdominal ascites. As a result, a lymphangiogram and abdominal X-ray were not performed to evaluate the integrity of the CC. No evidence of lymphedema in the lower extremities has been noted in all subsequent visits [Figure 4].

## LITERATURE REVIEW AND DISCUSSION

Untreated lymphatic injury can lead to persistent leaking of chyle and lymph. Long-chain fatty acids (LCFAs) are absorbed through lacteals in the small intestine, then transported to the venous system exclusively through the lymphatic vessels.<sup>[14,20,28]</sup>



**Figure 1 :** Anatomic representation of cisterna chyli.



**Figure 2:** Illustration of curved aneurysm clips as applied intraoperatively.

**Table 1:** Literature review of CC repair.

Author	Year	Patient population	Injury mechanism	Location of injury	Intervention	Outcome (short term)	Outcome (long term)
Barakat et al. <sup>[6]</sup>	2012	76 y/o male	AAA repair	CC	Peritovenous shunt followed by ligation	Persistent ascites	Resolution
Dogan* et al. <sup>[15]</sup>	2020	51 y/o female	Laparoscopic para-aortic lymphadenectomy	CC	Sealed and surgically repaired	Unreported	Unreported
Calkins et al. <sup>[11]</sup>	2000	8 y/o male	Motor vehicle accident	CC	Ligation with 3-0 Silk	POD # 3 tolerating a regular diet	1 month regular die no ascites
Brown et al. <sup>[10]</sup>	2019	74 y/o male	Nissen fundoplication	CC	Fractionated radiation (1 Gy×10)	No chylous ascites	8–18 months no chylous ascites
Su and Chen* <sup>[29]</sup>	2007	36 y/o female 46 y/o female 26 y/o male	Anterior lumbar interbody fusion	CC	Direct repair (unspecified)	No chylous ascites	Unreported
Propst-Proctor et al. <sup>[24]</sup>	1983	19 y/o female	Anterior lumbar interbody fusion for deformity	CC	Ligation with 2-0 Silk and placement of chest tube	POD # 9 chest tube removed no residual leaking	Unreported
		14 y/o female	Anterior lumbar interbody fusion for deformity	CC	Ligation with 6-0 Nylon and placement of chest tube	POD # 3 chest tube removed	Unreported
Baldrige and Lewis <sup>[5]</sup>	1948	41 y/o female	Thoracic sympathectomy	CC	Ligation (unspecified) with sutured mediastinal pleural flap	Mild transitory edema of the lower extremities while inpatient	6 months postoperative no evidence of fluid in chest or abdomen and no peripheral edema
Allison et al. <sup>[3]</sup>	2013	23 y/o male	GSW	CC	Endovascular ligation using glue and coils	POD # 2 tolerating regular diet	3 months postoperative no chylous effusion
Akpinar et al. <sup>[2]</sup>	2014	22 y/o male	Fall	Unspecified lymphatic injury	Thoracostomy drain	16 days of thoracostomy tube, tube removed, tolerating regular diet	Unreported

\*No specific information regarding surgical repair provided. CC: Cisterna chyli, AAA: Abdominal aortic aneurysm, POD: Postoperative day. PubMed search: (Cisterna chyli OR thoracic duct) AND (injury OR laceration) AND repair. Accessed January 2021; filter: "English"

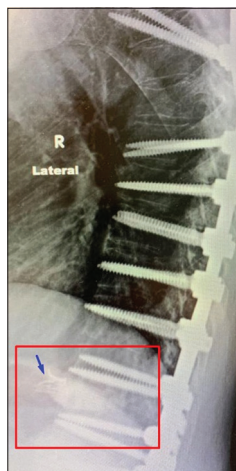
Disruption in this pathway leads to deficiency in processing the LCFA, leading to malnutrition and the possible need for significant dietary restrictions or total parenteral nutrition (TPN), decreased immunity and persistent lymphedema.<sup>[4,12]</sup> Medium-chain triglycerides and TPN bypass the lymphatic system entirely, allowing adequate utilization of nutrients.<sup>[14,20]</sup>

At present, there is no standard of care regarding the diagnosis and treatment of these injuries.<sup>[2,3,5,11,24]</sup> Diagnostic techniques include clinical evaluation for lymphedema, abdominal ascites, abdominal X-ray, and lymphangiography. Lymphangiography is performed through injection of ethiodized oil into a superficial lymph node using ultrasound guidance. Ethiodized oil is hand injected (1 mL/5 min) into the lymph node with intermittent fluoroscopic visualization.

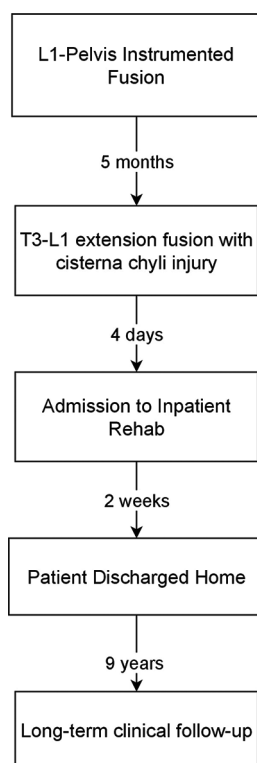
Consecutive images are taken as the contrast courses cranially. The procedure is continued until the lymphatic structure of interest is opacified.<sup>[17,18,22,26]</sup>

Conservative management remains a common practice for the treatment of lymphatic leaks. Dietary modifications including TPN with close observation commonly result in the cessation of leaks. Persistent leaks require surgical intervention.<sup>[6,9,16,27]</sup> However, methods of surgical repair with CC injuries have been seldom reported.

Techniques for repair include direct surgical repair with absorbable or nonabsorbable sutures and utilization of muscle flaps. These techniques, along with thoracic duct ligation, have been successfully utilized in thoracic duct injuries during lower neck surgery.<sup>[14,16,20,21]</sup> Thoracic



**Figure 3:** Postoperative sagittal X-ray demonstrating PMMA (red box) anchoring aneurysm clips in place (blue arrow).



**Figure 4:** Timeline of clinical events.

duct ligation has been extensively described in persistent lymphatic leak following neck surgery with thoracic duct injury.<sup>[1,22]</sup> Ligation of the thoracic duct was performed using cauterization, absorbable and nonabsorbable sutures, and in rare instances, a Ligasure device.<sup>[19]</sup> In addition, persistent chylothorax due to thoracic duct injury has been successfully treated with lymphatic-venous anastomosis. This treatment bypasses the damaged thoracic duct and allows the physiological lymphatic flow to proceed through

alternate venous drainage.<sup>[22,25]</sup> More recently, endovascular embolization has successfully been utilized in the treatment of chylothorax secondary to CC laceration.<sup>[30]</sup>

Our literature search resulted in nine articles regarding CC repair [Table 1]. In addition to the previously described treatment methods, Brown *et al.* described successful utilization of radiation therapy to treat CC injury with persistent postoperative chylous leaking. A total of 10 Gy were given to the patient in 10 fractions of 1 Gy per treatment. The patient recovered well with no leaking noted postradiation.<sup>[10]</sup>

## CONCLUSION

CC injury is rare. The use of aneurysm clips in its repair has never been described. We have demonstrated that aneurysm clips can safely repair CC injury with long-term favorable clinical outcomes.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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