Case Report

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

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Received : 17 February 2021
Accepted : 06 August 2021
Published : 30 August 2021

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." Chylous ascites may result from an untreated lymphatic vessel injury, including injury to the cisterna chyli (CC).[15] 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.[14] The thoracic duct receives lymph from the CC and ultimately terminates in the left subclavian vein.[18] 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
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.\cite{7,13} Aneurysm clips have been successfully used to repair durotomies during spinal surgery.\cite{8} 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.\cite{17,26} 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.\cite{14,20,28}
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.\cite{4,12} Medium-chain triglycerides and TPN bypass the lymphatic system entirely, allowing adequate utilization of nutrients.\cite{14,20}

At present, there is no standard of care regarding the diagnosis and treatment of these injuries.\cite{2,3,5,11,24} 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.\cite{17,18,22,26}

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.\cite{6,9,16,27} 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.\cite{14,16,20,21} Thoracic

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**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.\cite{6} | 2012 | 76 y/o male        | AAA repair             | CC                 | Peritovenous shunt followed by ligation                                       | Persistent ascites                                      | Resolution                           |
| Dogan et al.\cite{15} | 2020 | 51 y/o female      | Laparoscopic para-aortic lymphadenectomy | CC | Sealed and surgically repaired                                               | Unreported                                             | Unreported                           |
| Calkins et al.\cite{11} | 2000 | 8 y/o male         | Motor vehicle accident | CC                 | Ligation with 3-0 Silk                                                       | POD # 3 tolerating a regular diet                       | 1 month regular diet, no ascites     |
| Brown et al.\cite{10} | 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\cite{29} | 2007 | 36 y/o female      | Anterior lumbar interbody fusion | CC | Direct repair (unspecified)                                                 | No chylous ascites                                      | Unreported                           |
| Propst-Proctor et al.\cite{24} | 1983 | 14 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                           |
|                        |      |                    |                        |                    | Ligation with 6-0 Nylon and placement of chest tube                          | POD # 3 chest tube removed                              | Unreported                           |
| Baldridge and Lewis\cite{5} | 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 | 3 months postoperative no chylous effusion |
| Allison et al.\cite{3} | 2013 | 23 y/o male        | GSW                    | CC                 | Endovascular ligation using glue and coils                                    | POD # 2 tolerating regular diet                         | Unreported                           |
| Akpinar et al.\cite{2} | 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"
duct ligation has been extensively described in persistent lymphatic leak following neck surgery with thoracic duct injury \cite{1,22}. Ligation of the thoracic duct was performed using cauterization, absorbable and nonabsorbable sutures, and in rare instances, a Ligasure device \cite{19}. 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 \cite{22,25}. More recently, endovascular embolization has successfully been utilized in the treatment of chylothorax secondary to CC laceration \cite{30}.

Our literature search resulted in nine articles regarding CC repair \cite{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 \cite{10}.

**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.

**REFERENCES**

1. Ahmed U, Davakis S, Syllaos A, Sdralis E, Lorenzi B, Mastoraki A, et al. Prone position thoracoscopic management of neck chyle leak following major head and neck surgery: A case series. Ann Ital Chir 2020;91:265-72.
2. Akpinar V, Duran FY, Duman E, Özkalkanli MY, Duran Ö, Horsanali B. Bilateral chylhotorax after Falling from Height. Case Rep Surg 2014;2014:e618708.
3. Allison S, Rainey M, Aarabi S, Padia SA. Traumatic laceration of the cisterna chyli treated by lymphangiography and percutaneous embolization. Cardiovasc Intervent Radiol 2014;37:267-70.
4. Andreou Z, Trinidad A, Shakeel M, Argiris K, Panesar J, Kothari P. Severe hypo-osmotic hyponatraemia due to chylous leak following radical neck dissection. J Coll Physicians Surg Pak 2013;23:221-3.
5. Baldrige RR, Lewis RV. Traumatic chylothorax. Ann Surg 1948;128:1056-78.
6. Barakat HM, Shahin Y, McCollum P. Chylous ascites complicating elective abdominal aortic aneurysm repair: Case report and review of treatment options. Vasc Endovascular Surg 2012;46:682-5.
7. Baumeister RG, Seifert J, Wiebecke B. Behavior of resorbable...
and nonresorbable suture material in lymph vessel suture.
Handchir Mikrochir Plast Chir 1982;14:87-91.
8. Beier AD, Barrett RJ, Soo TM. Aneurysm clips for durotomy repair: Technical note. Oper Neurosurg (Hagerstown) 2010;66:ons-E124-5.
9. Börm W, Hübner F, Haffke T, Richter HP, Kast E, Rath SA. Approach-related complications of transthoracic spinal reconstruction procedures. Zentralbl Neurochir 2004;65:1-6.
10. Brown S, Abana CO, Hammad H, Brown A, Mhlanga J, Binder C, et al. Low-dose radiation therapy is an effective treatment for refractory postoperative chylous ascites: A case report. Pract Radiat Oncol 2019;9:153-7.
11. Calkins CM, Moore EE, Huerd S, Patten R. Isolated rupture of the cisterna chyli after blunt trauma. J Pediatr Surg 2000;35:638-40.
12. Campisi CC, Boccardo F, Piazza C, Campisi C. Evolution of chylous fistula management after neck dissection. Curr Opin Otolaryngol Head Neck Surg 2013;21:150-6.
13. Chang F, Cheng D, Qian M, Lu W, Li H, Tang H, et al. Thoracic duct chylous fistula following severe electric injury combined with sulfuric acid burns: A case report. Am J Case Rep 2016;17:730-3.
14. Doerr CH, Miller DL, Ryu JH. Chylothorax. Semin Respir Crit Care Med 2001;22:617-26.
15. Dogan NU, Dogan S, Erol M, Uzun BT. Cisterna chyli: An important landmark in laparoscopic paraaortic lymphadenectomy. Gynecol Oncol 2020;156:511.
16. Hsu YJ, Chen PR, Lin YS, Fang HY, Chen CK. Chylothorax following endovascular aortic repair with subclavian revascularization—a case report. J Cardiothorac Surg 2014;9:165.
17. Ito H, Usui A, Uchida W, Mutsuga M. Usefulness of lymphography and computed tomography for detecting the site of chyle leakage. Indian J Thorac Cardiovasc Surg 2019;35:104-7.
18. Johnson OW, Chick JF, Chauhan NR, Fairchild AH, Fan CM, Stecker MS, et al. The thoracic duct: Clinical importance, anatomic variation, imaging, and embolization. Eur Radiol 2016;26:2482-93.
19. Khelil K, Maassarani F, Dassonville M, Laet MH. Thoracoscopic thoracic duct sealing with LigaSure in two children with refractory postoperative chylothorax. J Laparoendosc Adv Surg Tech A 2007;17:137-9.
20. Lucente FE, Diktaban T, Lawson W, Biller HF. Chyle fistula management. Otolaryngol Head Neck Surg 1981;89:575-8.
21. Marsac J, Frija G, Bismuth V. Chylothorax and the pathology of the lymphatic pleura. Rev Fr Mal Respir 1982;10:227-41.
22. Parmeggiani D, Gualtieri G, Terracciano G, Gambardella C, Parisi S, Brusciano L, et al. Prolonged iatrogenic thoracic duct chylous fistula in neck surgery: Conservative management or surgery? A literature review. Scand J Surg 2021;157:4962987078.
23. Paul S, Altorki NK, Port JL, Stiles BM, Lee PC. Surgical management of chylothorax. Thorac Cardiovasc Surg 2009;57:226-8.
24. Propst-Proctor SL, Rinsky LA, Bleck EE. The cisterna chyli in orthopaedic surgery. Spine (Phila Pa 1976) 1983;8:787-92.
25. Rodi T, Nguyen BT, Fritsche E, Rajan G, Scaglioni MF. Direct repair of iatrogenic thoracic duct injury through lymphovenous anastomosis (LVA): A case report. J Surg Oncol 2020;121:224-7.
26. Sachs PB, Zelch MG, Rice TW, Geisinger MA, Rissius B, Lammert GK. Diagnosis and localization of laceration of the thoracic duct: Usefulness of lymphangiography and CT. AJR Am J Roentgenol 1991;157:703-5.
27. Scorza LB, Goldstein BJ, Mahraj RP. Modern management of chylous leak following head and neck surgery: A discussion of percutaneous lymphangiography-guided cannulation and embolization of the thoracic duct. Otolaryngol Clin North Am 2008;41:1231-40.
28. Sriram K, Meguid RA, Meguid MM. Nutritional support in adults with chyle leaks. Nutrition 2016;32:281-6.
29. Su IC, Chen CM. Spontaneous healing of retroperitoneal chylous leakage following anterior lumbar spinal surgery: A case report and literature review. Eur Spine J 2007;16 Suppl 3:332-7.
30. 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;42:183-92.

How to cite this article: McCabe R, Tong D, Hanson C, Slavnic D, Soo TM. Using aneurysm clips for repair of cisterna chyli injury during posterior spinal fusion. Surg Neurol Int 2021;12:428.