

ACR Appropriateness Criteria[®]

Management of Chylothorax

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Abstract

Chylothorax, the accumulation of lymphatic fluid within the pleural cavity, results from disruption or obstruction of the thoracic duct or its tributaries, or from transdiaphragmatic chylous ascites. When severe, this condition may impair respiratory function and induce metabolic complications because of chronic loss of protein and lipids. Management strategies ranging from dietary modifications, medical therapy, surgical ligation, pleurodesis, and lymphatic embolization, generally follow a tiered approach. Special considerations apply to chylothorax associated with central venous obstruction or concurrent chylous ascites, sometimes requiring unique management strategies. The various approaches to the management of chylothorax and their appropriateness in a variety of clinical circumstances are discussed.

The American College of Radiology Appropriateness Criteria are evidence-based guidelines for specific clinical conditions that are reviewed annually by a multidisciplinary expert panel. The guideline development and revision process support the systematic analysis of the medical literature from peer reviewed journals. Established methodology principles such as Grading of Recommendations Assessment, Development, and Evaluation or GRADE are adapted to evaluate the evidence. The RAND/UCLA Appropriateness Method User Manual provides the methodology to determine the appropriateness of imaging and treatment procedures for specific clinical scenarios. In those instances where peer reviewed literature is lacking or equivocal, experts may be the primary evidentiary source available to formulate a recommendation.

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Disclaimer: The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Key Words: Appropriateness Criteria, appropriate use criteria, AUC, chylothorax, effusion, embolization, lymphangiography, pleurodesis, thoracic duct

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ACR Appropriateness Criteria® Management of Chylothorax. [Variants 1 to 4](#) and [Table 1](#).

Variant 1. Adult. Chylothorax of any etiology. Initial therapy.

Procedure	Appropriateness Category
Medical therapy and dietary modification	Usually Appropriate
Thoracic duct embolization	May Be Appropriate
Surgery	May Be Appropriate
Pleurodesis	Usually Not Appropriate

Variant 2. Adult. Chylothorax refractory to medical and dietary management. Next therapy.

Procedure	Appropriateness Category
Thoracic duct embolization	Usually Appropriate
Pleurodesis	Usually Appropriate
Surgery	May Be Appropriate

Variant 3. Adult. Spontaneous chylothorax with concurrent central venous obstruction. Initial therapy.

Procedure	Appropriateness Category
Thoracic duct embolization	May Be Appropriate
Catheter directed mechanical thrombectomy thoracic central vein	May Be Appropriate
Intraabdominal lymphatic embolization	May Be Appropriate
Medical therapy and dietary modification	May Be Appropriate (Disagreement)
Thoracic central vein recanalization	May Be Appropriate
Pleurodesis	May Be Appropriate
Surgery	May Be Appropriate
Surgical thrombectomy thoracic central vein	May Be Appropriate

Variant 4. Adult. Chylothorax with concurrent chylous ascites. Initial therapy.

Procedure	Appropriateness Category
Medical therapy and dietary modification	May Be Appropriate (Disagreement)
Portal vein recanalization	May Be Appropriate
TIPS	May Be Appropriate
Surgery	May Be Appropriate
Pleurodesis	Usually Not Appropriate
Thoracic duct embolization	Usually Not Appropriate

Table 1. Appropriateness category names and definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

SUMMARY OF LITERATURE REVIEW

Introduction/Background

The network of the lower extremity and pelvis carrying interstitial fluid coalesces and ascends in the retro-peritoneum, meets with protein-rich hepatic and triglyceride-rich enteric lymphatics, and subsequently ascends through the posterior mediastinum as the thoracic duct(s) before draining to the central venous vasculature through the venolymphatic junction(s) [1,2]. The system accommodates 1 to 2 L of flow daily under normal circumstance and contributes an essential mechanism of fluid and nutritional balance [1,2].

Extravasation (lymphorrhea) from the thoracic duct or its thoracic tributaries, or transdiaphragmatic flow of chylous ascites, may overwhelm the resorption capacity of the pleural space resulting in chylothorax. Progressive accumulation provokes respiratory decompensation, whereas chronic losses via drainage induce malnutrition.

Thoracic chyle leakages most commonly occur as a result of iatrogenic injury, specifically following pulmonary resection or mediastinal instrumentation such as esophagectomy [3-6]. Nontraumatic or spontaneous etiologies include malignant (particularly lymphomatous) obstruction, congenital lymphatic anomalies, venous outflow obstruction, and others [7]. Suspected chylothorax is confirmed via pleural aspirate demonstrating the presence of chylomicrons and elevated triglyceride levels (>110 mg/dL) [1,7]. Confirmation, combined with suspected etiology, prompts medical and/or interventional management to avert significant patient morbidity and/or mortality.

Initial Therapy Definition

Initial therapy is defined as a first-line treatment option for the medical condition defined by the variant. More than one option can be considered usually appropriate as the initial therapy when:

- There are equivalent alternatives (i.e., only one option will be planned to effectively manage the patient's care).

OR

- There are complementary therapies (i.e., more than one treatment option is planned to be performed simultaneously or in sequence during the same setting, wherein the therapies provide synergistic or complementary benefits to effectively manage the patient's care).

DISCUSSION OF PROCEDURES BY VARIANT

Variant 1: Adult. Chylothorax of any etiology. Initial therapy

The goal of therapy is to manage chylothorax occurring in patients of any etiology, and to resolve or alleviate morbidity associated with chylothorax.

Medical Therapy and Dietary Modification. In a typical fed state, the intestinal and hepatic lymphatic compartments combine to contribute the vast majority of the fluid volume handled by the lymphatic system. Institutional approaches vary widely, but medical and dietary measures generally aim to reduce enteric contributions to global lymphatic transit, thereby promoting healing of the site(s) of extravasation.

Chylous flow rises dramatically following high-fat meals and can be mitigated by nonfat enteral nutrition with lessened deleterious nutritional effects compared to with a completely fasting state [8,9]. Unlike long-chain triglycerides that transit directly via the enteric lymphatics to the thoracic duct, medium-chain triglycerides (MCTs) are absorbed by intestinal cells for subsequent portal venous transit, and diets containing MCTs as the only lipid content aim to achieve the same efficacy for chylothorax as completely nonfat enteral nutrition [10]. Although increased most dramatically by high-fat content meals, any enteric content potentially spurs lymphatic flow and total parenteral nutrition is advocated as a primary intervention or in a stepwise fashion for failure after initial modifications of enteric nutrition [10]. Following the triglyceride content of chest tube output in addition to volume of output may serve as a prognostic indicator of efficacy when employing fat controlled nutrition [8].

The somatostatin analog octreotide diminishes splanchnic perfusion and secondarily gastrointestinal secretions. Alpha-adrenergic agents work via similar mechanisms but with comparatively sparse evidence for chylothorax [10]. Rather than a standalone treatment, use of octreotide is typically complementary to aforementioned dietary modification strategies where in which it has been shown to more commonly improve outcomes relative to the primary medical/dietary strategy alone [10-15].

Greater success rates are generally observed when initial rates of extravasation are <1 L per day. Although often less definitive than direct interruption of lymphatic extravasation by surgical interruption or endolymphatic obstruction, medical and dietary interventions reduce the risk of additional morbidity from invasive interventions and are, therefore, typically used as a first-line treatment in the management of chylothorax. The reported success rates of various combinations of medical and dietary interventions in the treatment chylothorax from of all iatrogenic and traumatic causes range between 30% and 100% [8-23].

Thoracic Duct Embolization. Access to the central lymphatics is achieved by transabdominal access of the cisterna chyli, percutaneous retrograde access of the thoracic duct arch in the neck, or transvascular retrograde cannulation through the venolymphatic junction. Following central lymphatic access, lymphangiography confirms or characterizes pathology. Embolization is typically performed with mechanical and/or liquid embolic agents. In cases of attempted but unsuccessful transabdominal access, disruption of the cisterna chyli and surrounding lymphatics may result in sufficient diversion away from the lymphatic extravasation to allow healing and resolution of chylothorax. Similarly, ethiodized oil used for planning stages of the procedure itself has enough of an embolic effect to resolve lymphatic extravasation alone in 30% to 70% of cases [10].

Individual experiences suggest technical success rates ranging between 48% and 90% and clinical success rates ranging between 60% and 90% [10,17,18,20,24-26], with the ability or inability to successfully access the cisterna chyli being a predictor of both technical and clinical success. A recent systematic review and meta-analysis demonstrated a pooled clinical success rates of combined lymphangiography and thoracic duct embolization of 94% [18].

Similar to surgical ligation, interruption of the central lymphatics may lead to development of ascites and/or lymphedema. Risks unique to thoracic duct embolization include those derived from the method of lymphatic access as well as nontarget embolization [25].

Surgery. Surgical management of thoracic chyle leaks broadly includes ligation of the thoracic duct or the leaking tributary, ligation and re-anastomosis of the injured segment, and reconstruction of the venolymphatic junction. Direct visualization of leaks is performed thoroscopically or less commonly via thoracotomy, and may be augmented by the administration of a fatty meal or subcutaneous or intranodal injection of lipophilic dyes, or indocyanine green. Aforementioned techniques may be supplemented by placement of fibrin sealants and/or tissue flaps over the site of ligation. Surgical methods may be combined with pleurodesis and are typically employed in combination with dietary and medical measures [10,17,18,20,23,27-29].

When no leak is identified, empiric supradiaphragmatic ligation to interrupt the expected course of the caudal thoracic duct may be performed. Through a heterogeneous in approach and in combination with other treatments, surgical intervention for iatrogenic chylothorax is effective in more than 90% of cases [10]. For cases of spontaneous chylothorax surgical planning, MR lymphangiogram may assist in the characterization of pathophysiology and thus direct surgical approaches. Due to interruption of flow, thoracic duct ligation may be complicated by lymphedema and/or ascites with many such occurrences resolving over months as the lymphatic system collateralizes around the obstruction.

Pleurodesis. Chemical pleurodesis involves irritation of the pleural space by introducing chemical irritants into the thoracic cavity, either via chest tube or intraoperatively, to induce adhesions/symphysis and reduce or obliterate the potential space for the accumulation of fluid including chylothorax. Commonly used agents include talc, doxycycline, hypertonic glucose, and OK-342. Existing literature predominately surrounds treatment after failure of medical and dietary measures for iatrogenic/traumatic chylothorax, where in which high clinical success rates of pleurodesis have been reported [16,18,30]. The use of pleurodesis as a first-line treatment, prior to before any medical or dietary measures, is sparsely reported, and is typically employed secondarily due to comparative invasiveness and rare risks of serious complications such as acute respiratory distress syndrome from the inflammatory agents used. Mechanical pleurodesis alone has been reported to have high success rates between 80% and 100%, albeit with evidence limited to small series [10].

Variant 2: Adult. Chylothorax refractory to medical and dietary management. Next therapy

The goal is to manage chylothorax that persists despite medical and dietary measures, and to resolve or alleviate morbidity associated with refractory chylothorax.

Thoracic Duct Embolization. Access to the central lymphatics is achieved by transabdominal access of the cisterna chyli, percutaneous retrograde access of the thoracic duct arch in the neck, or transvascular retrograde cannulation through the venolymphatic junction. Following central lymphatic access, lymphangiography confirms or characterizes pathology. Embolization is typically performed with mechanical and/or liquid embolic agents. In cases of attempted but unsuccessful transabdominal access, disruption of the cisterna chyli and surrounding lymphatics may result in sufficient diversion away from the lymphatic

extravasation to allow healing and resolution of chylothorax. Similarly, ethiodized oil used for planning stages of the procedure itself has enough of an embolic effect to resolve lymphatic extravasation alone in 30% to 70% of cases [10].

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Similar to surgical ligation, interruption of the central lymphatics may lead to development of ascites and/or lymphedema. Risks unique to thoracic duct embolization include those derived from the method of lymphatic access as well as nontarget embolization [25].

Pleurodesis. Pleurodesis involves chemical irritation of the pleural space to induce adhesions/symphysis and reduce or obliterate the potential space for the accumulation of fluid including chylothorax. Commonly used agents include talc, doxycycline, hypertonic glucose, and OK-342. Existing literature predominately surrounds treatment after failure of medical and dietary measures for iatrogenic/traumatic chylothorax, where in which high clinical success rates of pleurodesis are reported [16,18,30]. The use of pleurodesis as a first-line treatment, prior to before any medical or dietary measures, is sparsely reported, and is typically employed secondarily due to comparative invasiveness and rare risks of serious complications such as acute respiratory distress syndrome from the inflammatory agents used. Mechanical pleurodesis alone has been reported to have high success rates between 80% and 100%, albeit with evidence limited to small series [10]. With robust evidence regarding the efficacy of pleurodesis nontraumatic chylothorax, this method often applied as initial management [7,10,18,31,32].

Surgery. Surgical management of thoracic chyle leaks broadly includes ligation of the thoracic duct or the leaking tributary, ligation and re-anastomosis of the injured segment, and reconstruction of the venolymphatic junction. Direct visualization of leaks is performed thoroscopically or less commonly via thoracotomy, and may be augmented by administration of a fatty meal or subcutaneous or intranodal injection of lipophilic dyes, or indocyanine green.

Aforementioned techniques may be supplemented by placed with fibrin sealants and/or tissue flaps over the site of ligation. Surgical methods may be combined with pleurodesis and are typically employed in combination with dietary and medical measures [10,17,18,20,23,27-29].

Through a heterogeneous in approach and in combination with other treatments, surgical intervention for iatrogenic chylothorax is effective in more than 90% of cases [10]. When no leak is identified, empiric supradiaphragmatic ligation to interrupt the expected course of the caudal thoracic duct may be performed. For cases of spontaneous chylothorax planning, MR lymphangiogram may assist in the characterization of anatomy and thus direct surgical approaches.

Variant 3: Adult. Spontaneous chylothorax with concurrent central venous obstruction. Initial therapy

The goal of therapy is to manage chylothorax occurring in patients occurring with concurrent central venous obstruction.

Thoracic Duct Embolization. Access to the central lymphatics is achieved by transabdominal access of the cisterna chyli, percutaneous retrograde access of the thoracic duct arch in the neck, or transvascular retrograde cannulation through the venolymphatic junction. Following central lymphatic access, lymphangiography confirms or characterizes pathology. Embolization is typically performed with mechanical and/or liquid embolic agents. In cases of attempted but unsuccessful transabdominal access, disruption of the cisterna chyli and surrounding lymphatics may result in sufficient diversion away from the lymphatic extravasation to allow healing and resolution of chylothorax. Similarly, ethiodized oil used for planning stages of the procedure itself has enough of an embolic effect to resolve lymphatic extravasation alone in 30% to 70% of cases [10].

Individual experiences suggest technical success rates ranging between 48% and 90% and clinical success rates ranging between 60% and 90% [10,17,18,20,24-26], with the ability or inability to successfully access the cisterna chyli being a predictor of both technical and clinical success. A recent systematic review and meta-analysis demonstrated a pooled clinical success rates of combined lymphangiography and thoracic duct embolization of 94% [18]. Outcomes specific to nontraumatic/noniatrogenic origins of chylothorax are lacking.

Similar to surgical ligation, interruption of the central lymphatics may lead to development of ascites and/or lymphedema. Risks unique to thoracic duct embolization include those derived from the method of lymphatic access as well as nontarget embolization [25].

Catheter Directed Mechanical Thrombectomy Thoracic Central Vein. Central venous obstruction due to thrombosis or malignancy may compromise lymphatic

outflow through venolymphatic junction and result in various sequelae of lymphatic congestion, including chylothorax. Restoring central venous patency and thus normal venolymphatic outflow may be performed with the aim of resolving chylothorax without instrumentation of the lymphatic system. Literature surrounding this approach; however, is limited.

Intraabdominal Lymphatic Embolization. Ascending passage of liquid embolics from an abdominal lymphatic access site may be performed to address sites of lymphatic extravasation in the upper abdomen and chest that are otherwise difficult to address by standard thoracic duct embolization techniques. Evidence for this approach is limited to case reports.

Medical Therapy and Dietary Modification. In a typical fed state, the intestinal and hepatic lymphatic compartments combine to contribute the vast majority of the fluid volume handled by the lymphatic system. Institutional approaches vary widely, but medical and dietary measures generally aim to reduce enteric contributions to global lymphatic transit, thereby promoting healing of the site(s) of extravasation.

Chylous flow rises dramatically following high-fat meals and can be mitigated by nonfat enteral nutrition with lessened deleterious nutritional effects compared to with a completely fasting state [8,9]. Unlike long-chain triglycerides that transit directly via the enteric lymphatics to the thoracic duct, MCTs are absorbed by intestinal cells for subsequent portal venous transit, and diets containing MCTs as the only lipid content aim to achieve the same efficacy for chylothorax as completely nonfat enteric nutrition [10]. Although increased most dramatically by high-fat content meals, any enteric content potentially spurs lymphatic flow and total parenteral nutrition is advocated as a primary intervention or in a stepwise fashion for failure after initial modifications of enteric nutrition [10]. Following the triglyceride content of chest tube output in addition to volume of output may serve as a prognostic indicator of efficacy when employing fat controlled nutrition [8].

The somatostatin analog octreotide diminishes splanchnic perfusion and secondarily gastrointestinal secretions. Alpha-adrenergic agents work via similar mechanisms but with comparatively sparse evidence for chylothorax [10]. Rather than a standalone treatment, use of octreotide is typically complementary to aforementioned dietary modification strategies whereby it has been shown to more commonly improve outcomes relative to the primary medical/dietary strategy alone [10-15].

Greater success rates are generally observed when initial rates of extravasation are <1 L per day. Although often less definitive than direct interruption of lymphatic

extravasation by surgical interruption or endolymphatic obstruction, medical and dietary interventions reduce the risk of additional morbidity from invasive interventions and are, therefore, typically used as a first line-line treatment in the management of chylothorax. The reported success rates of various combinations of medical and dietary interventions in the treatment chylothorax from of all iatrogenic and traumatic causes range between 30% and 100% [8-23].

Thoracic Central Vein Recanalization. Central venous obstruction due to thrombosis or malignancy may compromise lymphatic outflow through venolymphatic junction and result in various sequela of lymphatic congestion, including chylothorax.

Percutaneous recanalization and/or thrombolysis of occluded central vein(s) and thus normal venolymphatic outflow may be performed with the aim of resolving chylothorax without instrumentation of the lymphatic system. Literature surrounding this approach; however, is limited.

Pleurodesis. Pleurodesis involves chemical irritation of the pleural space to induce adhesions/symphysis and reduce or obliterate the potential space for the accumulation of fluid including chylothorax. Commonly used agents include talc, doxycycline, hypertonic glucose, and OK-342. Existing literature predominately surrounds treatment after failure of medical and dietary measures for iatrogenic/traumatic chylothorax, where in which high clinical success rates of pleurodesis have reported [16,18,30]. The use of pleurodesis as a first-line treatment, prior to any medical or dietary measures, is sparsely reported, and is typically employed secondarily due to comparative invasiveness and rare risks of serious complications such as acute respiratory distress syndrome from the inflammatory agents used. Mechanical pleurodesis alone has been reported to have high success rates between 80% and 100%, albeit with evidence limited to small series [10]. Literature surrounding its use in central venous obstruction is limited.

Surgery. Surgical management of thoracic chyle leaks broadly includes ligation of the thoracic duct or the leaking tributary, ligation and re-anastomosis of the injured segment, and reconstruction of the venolymphatic junction. Direct visualization of leaks is performed thoroscopically or less commonly via thoracotomy, and may be augmented by administration of a fatty meal or subcutaneous or intranodal injection of lipophilic dyes. Aforementioned techniques may be supplemented by placed with fibrin sealants and/or tissue flaps over the site of ligation.

Surgical methods may be combined with pleurodesis and are typically employed in combination with dietary and medical measures [10,17,18,20,23,27-29]. Through a

heterogenous in approach and in combination with other treatments, surgical intervention for iatrogenic chylothorax is effective in more than 90% of cases [10].

When no leak is identified, empiric supradiaphragmatic ligation to interrupt the expected course of the caudal thoracic duct may be performed. For cases of spontaneous chylothorax planning, MR lymphangiogram may assist in the characterization of anatomy and thus direct surgical approaches.

Surgical Thrombectomy Thoracic Central Vein. Central venous obstruction due to thrombosis or malignancy may compromise lymphatic outflow through venolymphatic junction and result in various sequela of lymphatic congestion, including chylothorax. Surgical thrombectomy aimed at restoration of venous patency and thus normal venolymphatic outflow may be performed with the aim of resolving chylothorax without instrumentation of the lymphatic system. Literature surrounding this approach; however, is limited.

Variant 4: Adult. Chylothorax with concurrent chylous ascites. Initial therapy

The goal of therapy is to manage chylothorax accompanying chylous ascites and to resolve or alleviate morbidity associated with chylothorax and chylous ascites.

Medical Therapy and Dietary Modification. In a typical fed state, the intestinal and hepatic lymphatic compartments combine to contribute the vast majority of the fluid volume handled by the lymphatic system. Institutional approaches vary widely, but medical and dietary measures generally aim to reduce enteric contributions to global lymphatic transit, thereby promoting healing of the site(s) of extravasation.

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Greater success rates are generally observed when initial rates of extravasation are <1 L per day. Although often less definitive than direct interruption of lymphatic extravasation by surgical interruption or endolymphatic obstruction, medical and dietary interventions reduce the risk of additional morbidity from invasive interventions and are, therefore, typically used as a first-line treatment in the management of chylothorax. The reported success rates of various combinations of medical and dietary interventions in the treatment of chylothorax from all iatrogenic and traumatic causes range between 30% and 100% [8-23]. Literature regarding the use of dietary modification and medical treatments in the setting of lymphorrhea and central venous obstruction is limited.

Portal Vein Recanalization. Cirrhotic portal hypertension translates excess pressures to the lymphatic system occasionally resulting in chylous ascites and/or chylous pleural effusion. Similar to central venous obstruction, portal venous obstruction may result in the translation of high mesenteric venous pressures to the abdominal lymphatic compartment with ensuing lymphorrhea. Portal decompression by way of portal venous recanalization or bypass (Rex shunt) has been shown to alleviate or resolve chylous leaks. Literature, however, is sparse [33,34].

TIPS. Cirrhotic portal hypertension translates excess pressures to the lymphatic system occasionally resulting in chylous ascites and/or chylous pleural effusion. Similar to central venous obstruction, portal venous obstruction may result in the translation of high mesenteric venous pressures to the abdominal lymphatic compartment with ensuing lymphorrhea. Portal decompression by way of bypass (transjugular intrahepatic portosystemic (TIPS) shunt) has been shown to alleviate or resolve chylous leaks. Literature, however, is sparse [33-35].

Surgery. For suspected abdominal sources of lymphatic extravasation, ligation of the thoracic duct may be expected to exacerbate lymphorrhea. Oversewing suspected retroperitoneal sites of extravasation, however, may be effective. Literature surrounding this approach is limited. Diverting lymphatic accumulation in the abdomen to the vasculature by way of a peritoneovenous shunt may also be considered [36-38].

Pleurodesis. Pleurodesis involves chemical irritation of the pleural space to induce adhesions/symphysis and reduce or obliterate the potential space for the accumulation of fluid including chylothorax. Commonly used agents include talc, doxycycline, hypertonic glucose, and OK-342. Existing literature predominately surrounds treatment after failure of medical and dietary measures for iatrogenic/traumatic chylothorax, where in which high clinical success rates of pleurodesis are reported [16,18,30]. The use of pleurodesis as a first-line treatment, prior to any medical or dietary measures, is sparsely reported, and is typically employed secondarily due to comparative invasiveness and rare risks of serious complications such as acute respiratory distress syndrome from the inflammatory agents used. Mechanical pleurodesis alone has been reported to have high success rates between 80% and 100%, albeit with evidence limited to small series [10]. With robust evidence regarding the efficacy of pleurodesis in nontraumatic chylothorax, this method is often applied as initial management [7,10,18,31,32].

Literature surrounding its use in chylothorax following abdominal surgery is limited to a small case series [39].

Thoracic Duct Embolization. In cases of chylothorax resulting from transdiaphragmatic flow of abdominal lymphorrhea, thoracic duct embolization may be expected to worsen chyle losses by compromising the normal lymphatic outflow.

SUMMARY OF HIGHLIGHTS

This is a summary of the key recommendations from the variant tables. Refer to the complete narrative document for more information.

- **Variant 1:** Chylothorax of any etiology may be first approached with conservative measures including nonfat enteral nutrition (or MCTs as the only lipid) and somatostatin analogs, which will promote resolution of chylorrhea in a large portion of patients without the morbidity of procedural intervention. In the situation of brisk chylous losses (eg, >1 L/d) and/or when a distinct location of chylous injury is known, the condition may be reasonably first approached with surgical or interventional approaches, because noninvasive measures are less likely to resolve large or otherwise rapid chylous leaks.
- **Variant 2:** For patients who refractory to medical and dietary measures, management appropriately escalates to surgical ligation or lymphatic embolization of the thoracic duct. Pleurodesis may be considered as an alternative, particularly if patient factors limit candidacy for surgical or interventional approaches.
- **Variant 3:** Uncommonly, chylous effusions can occur as a result of downstream obstructions at or central to the

venolymphatic junction. Surgical, and interventional treatments on the lymphatic system can resolve the lymphatic extravasation and thus may be appropriate but do not address the inciting condition. In such situations, particularly if there are other clinical sequela of the venous obstruction, central venous recanalization via thrombolysis, thrombectomy, angioplasty or stent may be appropriate.

■ **Variant 4:** Altered lymphatic dynamics stemming from elevations in portal pressures and resulting in chylous accumulation in the chest and/or abdomen may require unique management approaches. Medical/dietary therapies to slow lymphatic flow globally may be appropriate. Surgical or interventional disruptions of the thoracic duct when extravasations are occurring in abdominal or retroperitoneal sites of extravasation will likely worsen the condition, and thus these types of intervention should focus on interruption of lymphatic flow below and across sites of extravasation. Portal decompression via recanalization or diversion (eg, TIPS) may secondarily reduce lymphatic pressures and allow sites of chylous leakage to heal.

SUPPORTING DOCUMENTS

The evidence table, literature search, and appendix for this topic are available at <https://acsearch.acr.org/list>. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at <https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria>.

GENDER EQUALITY AND INCLUSIVITY CLAUSE

The ACR acknowledges the limitations in applying inclusive language when citing research studies that predates the use of the current understanding of language inclusive of diversity in sex, intersex, gender, and gender-diverse people. The data variables regarding sex and gender used in the cited literature will not be changed. However, this guideline will use the terminology and definitions as proposed by the National Institutes of Health [40].

REFERENCES

- Zurcher KS, Huynh KN, Khurana A, et al. Interventional management of acquired lymphatic disorders. *Radiographics* 2022;42:1621-37.
- Hur S, Kim J, Ratnam L, Itkin M. Lymphatic intervention, the frontline of modern lymphatic medicine: part II. Classification and treatment of the lymphatic disorders. *Korean J Radiol* 2023;24:109-32.
- Bryant AS, Minnich DJ, Wei B, Cerfolio RJ. The incidence and management of postoperative chylothorax after pulmonary resection and thoracic mediastinal lymph node dissection. *Ann Thorac Surg* 2014;98:232-5; discussion 35-7.
- Bender B, Murthy V, Chamberlain RS. The changing management of chylothorax in the modern era. *Eur J Cardiothorac Surg* 2016;49:18-24.
- Pillay TG, Singh B. A review of traumatic chylothorax. *Injury* 2016;47:545-50.
- Chen C, Wang Z, Hao J, et al. Chylothorax after lung cancer surgery: a key factor influencing prognosis and quality of life. *Ann Thorac Cardiovasc Surg* 2020;26:303-10.
- Nadolski G. Nontraumatic chylothorax: diagnostic algorithm and treatment options. *Tech Vasc Interv Radiol* 2016;19:286-90.
- Takuwa T, Yoshida J, Ono S, et al. Low-fat diet management strategy for chylothorax after pulmonary resection and lymph node dissection for primary lung cancer. *J Thorac Cardiovasc Surg* 2013;146:571-4.
- Ji H, Wang Z, Xu C, Yu X, Huang H. Prognostic significance of pleural fluid triglyceride levels based on a low-fat diet management strategy in patients with chylothorax following pulmonary resection. *J Cardiothorac Surg* 2024;19:337.
- Agrawal A, Chaddha U, Kaul V, Desai A, Gillaspie E, Maldonado F. Multidisciplinary management of chylothorax. *Chest* 2022;162:1402-12.
- Ismail NA, Gordon J, Dunning J. The use of octreotide in the treatment of chylothorax following cardiothoracic surgery. *Interact Cardiovasc Thorac Surg* 2015;20:848-54.
- Chan JY, Wong EW, Ng SK, van Hasselt CA, Vlantis AC. Conservative management of postoperative chylous fistula with octreotide and peripheral total parenteral nutrition. *Ear Nose Throat J* 2017;96:264-7.
- Jacob S, Meneses A, Landolfo K, et al. Incidence, management, and outcomes of chylothorax after lung transplantation: a single-center experience. *Cureus* 2019;11:e5190.
- Power R, Smyth P, Donlon NE, Nugent T, Donohoe CL, Reynolds JV. Management of chyle leaks following esophageal resection: a systematic review. *Dis Esophagus* 2021;34.
- Deboever N, Feldman H, Eisenberg M, et al. Octreotide's role in the management of post-esophagectomy chylothorax. *Dis Esophagus* 2024;37.
- Cho HJ, Kim DK, Lee GD, et al. Chylothorax complicating pulmonary resection for lung cancer: effective management and pleurodesis. *Ann Thorac Surg* 2014;97:408-13.
- Reisenauer JS, Puig CA, Reisenauer CJ, et al. Treatment of post-surgical chylothorax. *Ann Thorac Surg* 2018;105:254-62.
- Kim PH, Tsao J, Shin JH. Lymphatic interventions for chylothorax: a systematic review and meta-analysis. *J Vasc Interv Radiol* 2018;29:194-202.e4.
- Zheng J, Chen YY, Zhang CY, Zhang WQ, Rao ZY. The retrospective research of enteral nutrition with medium-chain triglyceride and total parenteral nutrition support of postoperative chylothorax in adults. *SAGE Open Med* 2020;8:2050312120938221.
- Gilyard SN, Khaja MS, Goswami AK, Kokabi N, Saad WE, Majdalany BS. Traumatic chylothorax: approach and outcomes. *Semin Intervent Radiol* 2020;37:263-8.
- Zhang K, Li C, Zhang M, Li Y. Treatment of chylothorax complicating pulmonary resection with hypertonic glucose pleurodesis. *J Cardiothorac Surg* 2021;16:149.
- Yasuura Y, Konno H, Hayakawa T, et al. Chylothorax after pulmonary resection and lymph node dissection for primary lung cancer; retrospective observational study. *J Cardiothorac Surg* 2022;17:11.
- Zhu X, Feng X, Huang Z, et al. Analysis of related factors and treatment effect of chylothorax after lung surgery. *J Thorac Dis* 2024;16:3291-305.
- Kariya S, Nakatani M, Ueno Y, et al. Transvenous retrograde thoracic ductography: initial experience with 13 consecutive cases. *Cardiovasc Intervent Radiol* 2018;41:406-14.
- Majdalany BS, Sanogo ML, Pabon-Ramos WM, et al. Complications during lymphangiography and lymphatic interventions. *Semin Intervent Radiol* 2020;37:309-17.

26. Moon S, Park J, Kim GM, et al. Thoracic duct embolization for treatment of chyle leakage after thyroidectomy and neck dissection. *Korean J Radiol* 2024;25:55-61.
27. Uchida S, Suzuki K, Hattori A, Takamochi K, Oh S. Surgical intervention strategy for postoperative chylothorax after lung resection. *Surg Today* 2016;46:197-202.
28. Cuong NN, Hoan L, Tra My TT, et al. Minimally invasive treatment of chyle leak after thyroidectomy and cervical lymph node dissection in patients with thyroid carcinoma: results of a study involving 36 patients. *Ther Clin Risk Manag* 2024;20:75-82.
29. Tsuchitani Y, Ozawa Y, Taniyama Y, et al. Risk factors and treatment of chylothorax after minimally invasive esophagectomy for esophageal cancer. *Cureus* 2024;16:e65606.
30. Papatheodorou P, Taliadoros A, Thrasyvoulou C, Tsironis G. Sclerosing angiomatoid nodular transformation of the spleen: a case report. *BMJ Case Rep* 2021;14.
31. Goity LD, Itkin M, Nadolski G. An algorithmic approach to minimally invasive management of nontraumatic chylothorax. *Semin Intervent Radiol* 2020;37:269-73.
32. Fukumoto A, Terao T, Kuzume A, et al. Management of lymphoma-associated chylothorax by interventional radiology and chemotherapy: a report of five cases. *Int J Hematol* 2022;116:579-85.
33. Lutz P, Strunk H, Schild HH, Sauerbruch T. Transjugular intrahepatic portosystemic shunt in refractory chylothorax due to liver cirrhosis. *World J Gastroenterol* 2013;19:1140-2.
34. Lv Y, Han G, Fan D. Hepatic hydrothorax. *Ann Hepatol* 2018;17:33-46.
35. Yang Z, Li Y, Chen H, et al. Comparison of the effectiveness of inguinal lymphangiography and transjugular intrahepatic portosystemic shunt creation in cirrhosis-related chylous ascites. *J Vasc Interv Radiol* 2025;36:1341-6.
36. Kim J, Won JH. Percutaneous treatment of chylous ascites. *Tech Vasc Interv Radiol* 2016;19:291-8.
37. Yarmohammadi H, Schilsky J, Durack JC, et al. Treatment of chylous ascites with peritoneovenous shunt (Denver shunt) following retroperitoneal lymph node dissection in patients with urological malignancies: update of efficacy and predictors of complications. *J Urol* 2020;204:818-23.
38. Aly AK, Santos E, Fung J, et al. Intranodal lymphangiography and embolization for management of iatrogenic chylous ascites after oncological surgery. *J Vasc Interv Radiol* 2024;35:883-9.
39. Griffo S, De Luca G, Stassano P. Chylothorax after abdominal surgery. *Gen Thorac Cardiovasc Surg* 2010;58:159-62.
40. National Academies of Sciences, Engineering, and Medicine; Division of Behavioral and Social Sciences and Education; Committee on National Statistics; Committee on Measuring Sex, Gender Identity, and Sexual Orientation. Measuring sex, gender identity, and sexual orientation. In: Becker T, Chin M, Bates N, eds. *Measuring sex, gender identity, and sexual orientation*. Washington, DC: National Academies Press; 2022.