THE DIAGNOSIS AND MANAGEMENT OF POSTOPERATIVE CHYLOUS ASCITES

ILAN LEIBOVITCH, YORAM MOR, JACOB GOLOMB AND JACOB RAMON

From the Department of Urology, Chaim Sheba Medical Center, Tel Hashomer and Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

ABSTRACT

Purpose: Postoperative chylous ascites is a rare complication of retroperitoneal and mediastinal surgery that represents a difficult management problem due to the serious mechanical, nutritional and immunological consequences of the constant loss of protein and lymphocytes. We reviewed the topic of postoperative chylous ascites with special emphasis on the relevant diagnostic and imaging modalities. We propose a novel management algorithm.

Materials and Methods: We performed a MEDLINE search of the literature on chylous ascites using chyloperitoneum as the subject heading and chylous ascites as an additional key word. The search yielded 651 articles. We focused on 102 series, collective reviews and mainly case reports related to the issue of postoperative chylous ascites.

Results: We propose a novel algorithm based on a step-up approach aimed at promoting decreased lymph production and flow as well as maintaining nutritional balance. The management algorithm integrates repeat palliative paracentesis, dietary measures, total parenteral nutrition therapy, peritoneovenous shunting and surgical closure of the lymphoperitoneal fistula. Due to the remarkable effectiveness of somatostatin therapy for the closure of lymphatic fistula somatostatin therapy should be attempted with or without total parenteral nutrition early in the course of treatment of chylous ascites before any invasive steps are taken.

Conclusions: Various management modalities may be used successfully to treat chylous ascites. Therefore, treatment should be individualized and adjusted to the severity of lymphatic leakage and its consequences. The outcome mostly depends on the underlying pathological condition. Thus, in the absence of malignant or congenital underlying pathology the prognosis in cases of postoperative chylous ascites is good with the majority responding to conservative measures.

Key Words: kidney, testis, chyloperitoneum, postoperative complications, somatostatin

Chylous ascites, that is the accumulation of chyle in the peritoneal cavity, is a rare condition mostly caused by diseases that interfere with the abdominal or retroperitoneal lymphatic glands.1, 2 Postoperative chylous ascites is a rare complication of retroperitoneal and mediastinal surgery that is caused by the unrecognized interruption of the major retroperitoneal lymphatic channels and lymphoperitoneal fistula formation. Postoperative chylous ascites always represents a difficult problem in patient treatment. Patients with low performance status due to the primary operation are further debilitated by the serious mechanical, nutritional and immunological consequences of the constant loss of protein and lymphocytes.3–5 Moreover, due to the rarity of postoperative chylous ascites diagnosis and treatment are not well established. The literature that proposes multiple possible management regimens and uncontrolled therapeutic measures just adds to the complexity of this challenging condition.

The retroperitoneal lymphatic system has special interest for urologists. The retroperitoneal lymphatic glands are the regional lymph node drainage of the kidneys and testicles, and the secondary drainage site for the external genitalia, perineum and pelvic organs. In addition, common urological surgical procedures, such as radical nephrectomy, adrenal-
formed by the coalescence of the common iliac lymph vessels, which derive from the lymphatic glands of the lower extremities, genitalia and pelvic organs. The ascending vertical lumbar lymphatic trunks follow the aorta and inferior vena cava upward into the retroperitoneum, where they are joined by the lymphatic glands of the abdominal and retroperitoneal viscera. Classically the ascending vertical lumbar lymphatic trunks merge posterior and medial to the aorta behind the left crus of the diaphragm, and in front of the first and second lumbar vertebra to form the cisterna chyli (fig. 1). The cisterna chyli, which is a saccular dilatation of the ascending vertical lumbar lymphatic glands, marks the termination of the retroperitoneal lymphatic pathways and the beginning of the thoracic duct, which emerges from its upper end. The thoracic duct traverses the aortic hiatus into the right posterior mediastinum, where it courses left at the level of the 4th thoracic vertebra to join the venous system at the angle of the junction of the left jugular and subclavian veins. Due to the inconsistent anatomy of the abdominal lymphatic glands a distinct cisterna chyli is present in only approximately half of the cases, while in other half it is replaced by a variable lymphatic plexus.

The cisterna chyli and thoracic duct transport the lymph from the whole body except the right upper hemi-trunk. Of this lymph flow 50% to 90% derives from the intestine and liver, and contains absorbed dietary fat in the form of chylomicrons. Consequently fat absorption from the diet significantly increases the lymphatic flow in the cisterna chyli from a fasting baseline of less than 1 ml. per minute to more than 200 ml. per minute after the ingestion of a fatty meal. Conversely bowel rest as well as low fat elementary diets decrease the lymph flow.

**Fig. 1. Anatomy of retroperitoneal and thoracic lymphatic trunks.**

**ETIOLOGY OF CHYLOUS ASCITES**

Chylous ascites may be the result of many pathological conditions, including congenital defects of the lymphatic system, nonspecific bacterial, parasitic and tuberculous peritoneal infection, liver cirrhosis, malignant neoplasm, blunt abdominal trauma and surgical injury. These etiologies may be categorized into distinct mechanism based groups. The most common etiological factors are abdominal malignancy and congenital lymphatic abnormalities in adults and children, respectively. Postoperative chylous ascites is a rare condition that usually develops as a result of operative trauma to the thoracic duct, cisterna chyli or their major tributaries in combination with increased chyle production and obstruction of lymphatic drainage from the abdomen.

Various vascular surgical procedures, including aortofemoral bypass, resection and replacement of the inferior vena cava as part of surgery to remove malignant tumors, a Warren shunt and mesocaval shunt procedures may cause chylous complications. Nevertheless, abdominal aortic surgery is the most common etiology of postoperative chylous ascites, causing 81% of all chylous complications due to surgical injury to the retroperitoneal lymphatic glands or cisterna chyli. Regardless, chylous ascites comprises less than 1% of all complications after vascular surgery of the abdominal aorta and it is relatively rare in view of the large numbers of aortic reconstructions performed worldwide. Pabst et al summarized 22 cases of chylous ascites after abdominal aortic surgery reported up to 1991 and added their own experience with an additional 5. Only a few other cases have been described more recently. Patients who underwent surgery for abdominal aortic aneurysms via the retroperitoneal approach. The accumulation of chylous ascites was reported sporadically after pelvic surgery for advanced gynecologic malignancy. Anterior spinal surgery is another rare cause of chylous ascites with only 7 reported cases. An additional case of lymphatic leak after lumbar surgery presented as postoperative wound drainage. The overall incidence of chylous complications after anterior spinal surgery is not clear. Chylous ascites was also reported in 0.5% of patients after laparoscopic presacral neurectomy for pelvic pain. Heart and liver transplantation causes chylous complications only rarely. These transitory chyle collections are attributed to retroperitoneal dissection and usually resolve rapidly. Surgical procedures on the upper gastrointestinal tract are another reported cause of chylous ascites. They include vagotomy and pyloroplasty performed for a chronic duodenal ulcer as well as esophagectomy.

Retroperitoneal urological surgery, mainly lymphadenectomy performed for testis and renal cancer, involves extensive dissection that may lead to disruption of the major retroperitoneal lymphatic channels and result in chylous collections. More than 42 cases of chylous ascites were reported after retroperitoneal lymph node dissection for testis cancer, while an additional 5 were reported after nephrectomy and lymphadenectomy for renal cancer. Chylous ascites is much more common after post-chemotherapy retroperitoneal lymph node dissection than after primary retroperitoneal lymph node dissection performed for clinical stage...
I testis cancer. This finding probably reflects the extensive nature and complexity of these major procedures rather than the effect of chemotherapy. Resection of the inferior vena cava during retroperitoneal dissection is another risk factor associated with an increased prevalence of postoperative chylous ascites. Lymphatic leakage in these cases is likely to result from disruption of the lymphatic tracts during extended dissection. The accumulation of chyle is presumably augmented by the interruption of the inferior vena cava, causing a sudden increase in venous pressure, which is back to the lymphatic system. To our knowledge the incidence of chylous ascites after retroperitoneal lymph node dissection is not defined. Baniel et al reported a 1.2% incidence in a series of 1,520 patients who underwent retroperitoneal lymph node dissection for testis cancer. However, this high rate was probably biased by the complexity of their cases. Similarly Janetschek et al reported an unexpectedly high incidence of chylous ascites in 5 of 24 patients who underwent post-chemotherapy laparoscopic retroperitoneal lymph node dissection for testicular carcinoma. However, this phenomenon may be explained by the type of lymphatic leakage and the movement of the diaphragm or due to chylothorax. Chylous ascites may rarely present as postoperative wound drainage or excessive prolonged drainage from the operative site. The appearance of the fluid is usually described as milky or chylous. It is odorless, alkaline and sterile. Typically the fluid has a high triglyceride content that is 2 to 8-fold that of serum and protein content greater than 3 gm./dl. This fluid usually contains fat globules and leukocytes with a lymphocytic predominance. Microscopic examination of fluid smears stained with Sudan III shows fat globules and leukocytes with a lymphocytic predominance. The appearance of the fluid is usually described as milky or chylous. Patients may complain of an uncomfortable sensation of abdominal fullness and dyspnea, which may be related to a large amount of ascites restricting the movement of the diaphragm or due to chylothorax. Other nonspecific symptoms include abdominal pain, nausea and vomiting, malnutrition and hypoproteinemia. Chylous ascites may present as postoperative wound drainage or excessive prolonged drainage from the operative site. In several cases chylous ascites was unsuspected clinically and the diagnosis was made only during exploratory laparotomy. The time frame of postoperative ascites development varies from several days to several months after surgery.

**Diagnosis**

**Presentation.** The clinical diagnosis of chylous ascites may be suspected from physical signs and symptoms of fluid accumulation in the peritoneal space after a retroperitoneal surgical procedure. Abdominal distention, enlarging girth and disproportionate weight gain are probably the most common signs of chylous ascites. Patients may complain of an uncomfortable sensation of abdominal fullness and dyspnea, which may be related to a large amount of ascites restricting the movement of the diaphragm or due to chylothorax. Other nonspecific symptoms include abdominal pain, nausea and vomiting, malnutrition and hypoproteinemia. Chylous ascites may present as postoperative wound drainage or excessive prolonged drainage from the operative site. In several cases chylous ascites was unsuspected clinically and the diagnosis was made only during exploratory laparotomy. The time frame of postoperative ascites development varies from several days to several months after surgery.

**Diagnostic paracentesis.** The diagnosis of chylous ascites is confirmed by analyzing the ascitic fluid obtained by paracentesis. The appearance of the fluid is usually described as milky or chylous. It is odorless, alkaline and sterile. Typically it has a high triglyceride content that is 2 to 8-fold that of plasma (range 0.4 to 4 gm./dl.), specific gravity greater than that of serum and protein content greater than 3 gm./dl. Microscopic examination of fluid smears stained with Sudan III shows fat globules and leukocytes with a lymphocytic predominance.

**Imaging.** Imaging the lymphatic system has an important role in the investigation of chylous ascites. Various imaging techniques have been used to diagnose, estimate the extent and localize the exact site of lymphatic leakage to predict its outcome and facilitate therapy. Although the lymphatic fistula may occasionally be visible during exploratory laparotomy, visualization may be facilitated by intraoperative imaging that involve injection of dye directly into the lymphatic ducts or esophagus. Since these techniques are time-consuming and stain the operative field, they should be abandoned in favor of more feasible preoperative imaging, which appears to be the preferred approach.

Computerized Tomography (CT): CT findings are not specific to chylous ascites. Although the diagnosis of cisterna chyli rupture may be indicated on CT by the concomitant extraperitoneal and intraperitoneal collections, the CT density of chylous ascites usually resembles that of water with identical attenuation coefficients and it is indistinguishable from bowel secretions, urine, bile or simple ascites. Occasionally CT may reveal the gradual development of the fat-fluid level in the peritoneal collection when the patient remains horizontal for a sufficient period. This rare but pathognomonic presentation of chylous ascites is termed the fat-fluid level sign. CT may be performed concurrently with standard lymphangiography. However, this approach did not add significantly to the information obtained from serial plain x-ray done during lymphangiography. Another CT technique involves direct opacification of the thoracic duct with oral fat emulsions consisting of 50% ethiodized oil. Nevertheless, this technique is not commonly used due to the superior results obtained with lymphangiography and the difficulty of ingesting high fat content emulsions postoperatively by patients who are candidates for these studies.

**Bipedal Lymphangiography:** Bipedal lymphangiography using ethiodized oil injected into cannulated lymphatic vessels on the dorsum of the foot has traditionally been the standard imaging modality for evaluating chylous ascites and other lymphatic disorders. Lymphangiography is useful for diagnosis and should be performed early in the course of evaluation when the diagnosis is in doubt. It enables localization of the exact site of lacerations in the lymphatic channels and, hence, simplifies definitive surgical repair. Kohnoe et al described a combined method of preoperative lymphangiography using iodized oil and intraoperative lymphangiography using Evans blue to identify additional sites of chyle leakage not evident on preoperative lymphangiography and facilitate successful surgical repair of the fistula.

Experience with a novel method was recently reported by Cope. He used standard pedal lymphography to opacify the cisterna chyli and retroperitoneal lymph ducts to allow their visualization on radiographs. Subsequently these catheters were used to perform direct transabdominal lymphangiography with aqueous contrast medium. In 5 cases of lymphatic leakage transabdominal lymphangiography localized 3 fistulas that were not visualized on standard lymphography, demonstrating its superior sensitivity compared with oil based dye pedal lymphangiography.

Standard lymphangiography has several other substantial disadvantages. Cannulation of foot lymphatic glands is difficult and painful, and results may be not reproducible. Oil based contrast material may cause severe local and systemic adverse effects, including tissue necrosis, hypersensitivity reactions and the exacerbation of lymphedema.

Lymphoscintigraphy: Because lymphoscintigraphy is non-invasive and more physiological than traditional oil dye based radiological studies, it was advocated by several groups for evaluating chylous ascites. It may be particularly useful when radiological lymphography is contraindicated. Andrews and Binder reported accurate lymphoscintigraphy localization that facilitated surgical repair of lymphatic leakage after abdominal hysterectomy and pelvic node dissection for cervical cancer. In addition, they used lymphoscintigraphy for followup to document the marked decrease in leakage postoperatively.

More recently, Pui and Yueh reviewed experience with technetium (Tc)-antimony sulfide colloid, human albumin or dextran lymphoscintigraphy for evaluating chylous complications. They emphasized the safety and simplicity of these studies compared with standard lymphangiography and concluded that lymphoscintigraphy can accurately reveal abnormal lymphatic drainage and, thus, is useful for patient selection for surgery and assessment of treatment outcome. The safety and efficacy of lymphoscintigraphy imaging was also shown in infants and children with chylous ascites.

Another isotopic study that may indirectly add to the diagnosis of chylous collections is a simple diaminodimethine-
pentaacetic acid (DTPA) renal scan. Accumulation of 99mTc-DTPA outside of the urinary system does not occur regularly but it may be observed in various pathological conditions involving the transudation of plasma components into fluid collections, excluding uncomplicated ascites. Therefore, the detection of 99mTc-DTPA in the peritoneal cavity after renal scan is a sign suggestive of chylous ascites.75

In addition to the diagnostic value of lymphangiography or lymphangioscintigraphy, others emphasized the prognostic significance of an abnormal radiological study.1, 62, 70, 76 The radiological evidence of a chylous fistula documented on lymphangioscintigraphy or conventional oil contrast lymphangiography usually implies a nonremitting chylous complication associated with large leaks that does not respond to conservative measures and requires surgical repair. On the other hand, normal lymphangiography is usually associated with self-limited chylous ascites that ultimately resolve nonoperatively. Nevertheless, spontaneous remission with conservative therapy in an abused child was reported by Boysen despite abnormal lymphangiography showing the area of leakage into the peritoneal cavity.77

Oral Contrast Medium: Imaging studies with oral contrast medium may also have a role in the evaluation of lymphatic leaks causing chylous collections, especially when they originate from sites in the intestinal lymphatic glands and not from the major lymphatic channels. Wang et al proposed the use of oral 13C-carbon-palmitic acid for detecting such enteric lesions of intestinal sources.78 Palmitic acid is a long chain fatty acid that is absorbed directly into the intestinal lymphatic glands. Hence, its detection in the fluid outside of the intestines implies leakage from the intestinal lymph trunk. In addition, Bauwens et al reported localization of lymphatic leakage by oral iodine marked fatty acids, such as 131Iodine-pentadecanoic acid, which showed increased uptake at the site of leakage.37 The role of oral ethiodized oil emulsions for direct opacification of the thoracic duct for CT was also performed early in the evaluation of chylous ascites.83

MANAGEMENT

Various management modalities may be successful for treating chylous ascites. Aalami et al performed a retrospective collective review of case reports of 156 patients with chylous ascites due to various causes.79 Of these cases 33% were managed successfully by surgery, while 67% resolved after conservative treatment. The treatment of postoperative chylous ascites is primarily conservative,16 intended to decrease the flow of lymph in the mesenteric lymphatic glands that join together in the disrupted major retroperitoneal and thoracic ducts, and consequently limit the leakage of lymph into the peritoneum. Additional treatment goals are the alleviation of mechanical symptoms related to the distended abdomen and replacement of significant nutritional losses. Common conservative treatment consists of repeat therapeutic paracentesis, high protein, low fat, medium chain triglyceride diet, salt restriction, diuretics, total parenteral nutrition7, 9, 10 and more recently the administration of somatostatin.2, 80–82 Persistent active lymphatic leakage and continued formation of chylous ascites after several weeks of maximal conservative treatment warrants a more aggressive approach, including insertion of a peritoneovenous shunt or surgical direct lymphostasis by suture ligation of the disrupted lymphatic channel.3, 5, 18

Paracentesis. Diagnostic and palliative paracentesis is usually performed early in the evaluation of chylous ascites.83 Despite several definite drawbacks repeat paracentesis is commonly included in the nonoperative treatment regimens for chylous ascites due to the immediate palliative effect achieved by decreasing abdominal distention. In addition, intermittent paracentesis is often performed with various combinations of dietary intervention and total parenteral nutrition.5, 7, 19, 20, 23, 25, 33–35, 41 Usually paracentesis is not successful as a solitary measure since it has only a transitory palliative effect.7, 9 although 7% of the patients in the review of Aalami et al achieved resolution by paracentesis only.79 More commonly repeat drainage of the ascitic fluid by multiple abdominal taps or a permanent catheter may prolong leakage,26 increase nutritional and immunological depletion,7, 19, 26 and add to the risk of infection.9 Intravenous re-infusion of ascitic fluid can decrease the nutritional losses associated with repeat paracentesis84 but it may trigger other complications, such as fat emboli and infection.85

Dietary intervention. Lymph flow in the thoracic duct is significantly influenced by the fat content of the diet. After a fatty meal flow may increase by 200–fold and reach 200 ml/kg per hour. While long chain triglycerides enter the venous system through the lymphatic glands of the bowel and significantly affect lymph flow, medium chain triglycerides bypass the lymphatic glands and are absorbed directly into the portal venous system, hence, not increasing the amount of lymph flow.10 Dietary intervention, which is the mainstay of nonoperative therapy for chylous ascites, involves a high protein, low fat, medium chain triglyceride diet to accomplish decreased lymph flow in the major lymphatic tracts and facilitate the closure of chylous fistulas.86 Nutritional manipulations alone or combined with diuretics and paracentesis may be effective for mild to moderate cases of chylous ascites, resulting in a successful outcome in up to 50%.7, 9, 33–35, 41, 47, 50, 79 Although not all cases of postoperative chylous ascites respond to an elemental high protein, low fat, medium chain triglyceride diet only,12 such a nutritional regimen should be part of any conservative therapeutic protocol. In addition, continuing the medium chain triglyceride diet is suggested as maintenance therapy for several months after the successful resolution of chyloperitoneum.9 Total parenteral nutrition is an essential part of nonoperative management of chylous ascites. It is especially crucial in patients who cannot tolerate adequate oral intake or those with refractory chylous ascites unresponsive to dietary intervention.10 It effectively further decreases the production and flow of lymph by allowing the bowel to rest. Furthermore, total parenteral nutrition restores nutritional deficits and balances metabolic impairments imposed by long-standing chylous ascites and repeat sessions of paracentesis. The success rate of total parenteral nutrition therapy for postoperative chylous ascites varies. After 2 to 6 weeks of therapy 60% to 100% of cases resolved that were managed by total parenteral nutrition only or combined with a medium chain triglyceride diet and paracentesis.5, 7, 9, 18, 20, 21, 25 Total parenteral nutrition is usually recommended as second line treatment when enteral dietary manipulation fails.9, 10 Nevertheless, Pabst et al presented an algorithm for treatment of chylous ascites after abdominal aortic surgery and suggested that total parenteral nutrition should be included as first line therapy immediately after the diagnosis of chylous ascites.7 Total parenteral nutrition may also be successful as the last remedy in cases of refractory chylous ascites that recur or persist after a failed surgical attempt to ligate the lymphatic fistula.16, 19

Somatostatin. Initial experience with continuous intravenous high dose somatostatin for the closure of postoperative lymphorrhagia was reported in 1990 by Ulibarri et al.83 Satisfactory results were also achieved by others.80, 82, 87–89 Typically the response to continuous intravenous administration of somatostatin is characterized by a drastic decrease in the output of the lymphatic fistula after 24 to 72 hours of therapy. Drainage from the lymphatic fistula further tapers to an insignificant volume within an additional few days.80, 82 Shapiro et al reported rapid resolution of chylous ascites after liver transplantation within 2 days after subcutaneous administration of the somatostatin analogue octreotide at a dose of 100 μg, 3 times daily combined with total parenteral nutrition.2 On the other
hand, Stefanidis et al noted disappointing results with an identical approach in a case of high output chylothorax.80 Our experience with subcutaneous administration of somatostatin in a case of protracted chylous ascites after radical nephrectomy and inferior vena cava thrombectomy showed an excellent response within 36 hours after the initiation of therapy (unpublished data).

The exact mechanisms involved in the drying effect of somatostatin on lymphatic fistulas are not completely understood. Somatostatin, which is a peptide hormone consisting of 14 to 28 amino acids, is present in the central nervous system, gastrointestinal tract and pancreas. Its inhibitory functions affect the release of growth hormone, insulin, glucagon, gastrin, thyroid-stimulating hormone, adrenocorticotropic hormone, secretin, pancreozymin, cholecystokinin, pepsin and renin. It was previously shown to decrease the intestinal absorption of fats, decrease triglyceride concentration in the thoracic duct and attenuate lymph flow in the major lymphatic channels.82 In addition, it also decreases gastric, pancreatic and intestinal secretions, inhibits motor activity of the intestine, slows the process of intestinal absorption and decreases splanchnic blood flow, which may further contribute to decreased lymph production.80 In view of these data somatostatin therapy with or without total parenteral nutrient should be attempted early in the course of chylous ascites treatment before any invasive steps are taken. The currently available somatostatin analogs octreotide and lanreotide are octapeptides with a much longer half-life than the naturally occurring somatostatin. Hence, somatostatin therapy may be started with low dose subcutaneous injections of 100 μg 3 times daily and escalated up to 12 mg as continuous intravenous administration according to the desired response. Since somatostatin interferes with blood glucose regulation, close monitoring of blood glucose and gradual diminution of somatostatin dose is recommended to prevent unbalanced glucose fluctuations.82

Direct surgical repair. The first successful surgical repair by direct ligation of a leaking lymphatic channel was reported in 1977 in a child with intractable chylous ascites.91 In a review Aalami et al reported that 41% of 51 patients were treated successfully with direct surgical ligation of the leaking lymphatic glands.79 Nevertheless, the role and timing of surgical repair remain controversial. The proponents of early reoperation argue that the site of lymphatic fistula can be identified intraoperatively by direct visualization, facilitated by a heavy fatty meal preoperatively or injection of lipophilic dye intraoperatively.9,62 After localization the leakage site is identified intraoperatively by direct visualization, facilitated by a heavy fatty meal preoperatively or injection of lipophilic dye intraoperatively.9,62 Alternatively fibrin glue may be used to occlude rapidly and permanently the ruptured lymphatic glands.92 Meinke et al93 and more recently Williams et al94 advocated early surgical intervention to avoid the metabolic complications and protracted hospital course associated with conservative approaches. The most suitable candidates for early intervention are patients with good performance status and a well visualized lymphatic fistula.93 Conversely the opponents of operative therapy stress the hazards of reoperation in malnourished and immunocompromised patients at poor risk who have barely recovered from previous major surgery and formidable complications.21 Despite available and potentially helpful adjunctive measures intraoperative localization of the fistula or its surgical repair may be challenging and possibly morbid.56,92 For this reason unsuccessful reoperation and recurrence of chylous ascites are not uncommon.16,19,94,95 Although early surgery is rarely indicated due to the effectiveness of conservative measures,22 surgical repair of a chylous fistula remains a valid and effective therapeutic option that should probably be reserved for refractory long-standing cases of chylous ascites after unsuccessful conservactive management.11,18,24,37,51,95 The duration of attempted nonoperative therapy before the surgical option is raised is not defined. Li et al suggested using T-cell immunocompetence as a measure of determining whether treatment should be conservative or operative.56 Nevertheless, since some protracted cases may be resolved only after weeks or months of conservative treatment,19,92 a nonoperative attempt for at least 4 to 8 weeks is probably warranted before surgical exploration.5,11

The role of laparoscopy for managing chylous ascites is currently limited to evaluation purposes only and it is considered an invaluable and efficient diagnostic tool for determining the causes of ascites formation. Nevertheless, with the increasing use of laparoscopy in urological and general surgery the role of therapeutic laparoscopy for managing chylous ascites is secured.97

**Peritoneovenous shunts.** Peritoneovenous shunting with a LeVeen or Denver shunt is a more aggressive palliative measure used mainly as a secondary mode of therapy in patients in whom conservative dietary intervention fails.4,7,9,21,42,52,98 Peritoneovenous shunts may be also a reasonable alternative to surgical exploration21 in patients with rapid accumulation of ascitic fluid that may cause an average loss of 1.5 l daily,59 and especially in those who require more rapid alleviation of the consequent severe mechanical, metabolic and immunological complications.10 Unlike repeat paracentesis this approach does not cause nutritional depletion since ascitic fluid is recirculated.15 Peritoneovenous shunts are also associated with fewer infectious complications than repeat abdominal taps or reinfusion. Nevertheless, disseminated intravascular coagulation,50 fat emboli, severe infections and death from sepsis were reported after the insertion of such shunts.7,94,98 Although the reported overall patency rate of the LeVeen shunt is 90%,93 malfunction of a shunt requiring its removal or replacement may occur due to obliterating or compartmentalization of the peritoneal space by adhesions, which tend to form due to the interaction between serosal surfaces and the fluctuations of protein rich fluid.9,10,102 An alternative shunting method was described by Rector and Whittlesey.102 This technique establishes an extracorporeal circuit that effectively re-circulates ascitic fluid from the peritoneal cavity to the superior vena cava through a hemofilter that removes water and electrolytes, while returning protein, fat and white cells. Overall peritoneovenous shunts remain a satisfactory therapeutic and palliative option for managing severe refractory chylous ascites, mainly in patients with poor performance status who cannot undergo surgical exploration.4,7,9,10,15,21,42,52,98,99,103

**Miscellaneous measures.** Etilefrine: Guillem et al reported the resolution of lymphatic leakage within a few days without any side effects after intravenous administration of etilefrine in 3 patients with chylothorax and chylourineum after esophagectomy.104 Etilefrine, a sympathomimetic drug used to treat orthostatic hypotension, decreases chyle flow in the thoracic duct by causing contraction of the smooth muscle in its wall. Hence, it may be considered an alternative measure for managing postoperative chylous complications.

**Embolization:** Cope described a procedure involving percutaneous transabdominal puncture, and catheterization of the cisterna chyli and major retroperitoneal lymphatic ducts in patients with postoperative chylous ascites.69 This technique was used to identify and successfully embolize the chylous fistula in 4 of 5 patients. Percutaneous embolization seems to be a feasible and safe procedure that may obviate operative repair of chylous fistulas but it necessitates further evaluation before it can be recommended to be used routinely for managing chylous ascites.

**Iodinated Dye:** Daniel et al suggested a method based on personal experience that involves exchange of the chylous ascites fluid with intraperitoneal injection of an iodinated dye with sclerosing effect on the retroperitoneal lymphatic glands.9 This method requires additional investigation.
Prospective Prevention of Chylous Complications: It is apparent that the best treatment is the prevention of chylous ascites during the initial surgical procedure. The retroperitoneal lymphatic channels should be prospectively identified during surgery and divided between ligatures or hemoclips. If lymphatic extravasation is recognized intraoperatively, the source of leakage should be carefully controlled by suture ligation or hemoclips. Hence, with meticulous dissection and control of the major lymphatic glands during surgery around the proximal aorta many cases of chylous complications can be avoided.7, 10, 45

Management algorithm. Several management algorithms were devised for postoperative chylous ascites.7, 9, 10, 79 We propose a novel algorithm based on a step-up approach that integrates somatostatin therapy and imaging (fig. 2). Prospective prevention of lymphatic leaks during the initial surgery is the primary goal. If the postoperative clinical course is suspicious for chylous leakage or the accumulation of chylous ascites, diagnostic and palliative paracentesis is usually indicated. Repeat paracentesis may be required for the palliation of dyspnea and abdominal distention. After the diagnosis of chylous ascites is established most patients are placed on an elementary low fat, medium chain triglyceride diet and the response is assessed. An inadequate response to dietary manipulation indicates the initiation of total parenteral nutrition therapy to promote decreased lymph production and flow as well as maintain nutritional balance. Early total parenteral nutrition therapy concomitant with a medium chain triglyceride diet is indicated in infants or in patients with complicated disease, and in those with a high output fistula, intolerance of oral intake or severe nutritional deficiencies that justify primarily a more aggressive approach. If chylous ascites does not resolve after a period of combined dietary intervention and total parenteral nutrition, fistula closure should be attempted with subcutaneous somatostatin. Somatostatin therapy can be stepped up to high dose, continuous intravenous administration if subcutaneous or even low dose intravenous somatostatin fail to achieve the anticipated response. Surgical exploration and direct ligation of the leaking lymphatic glands is probably the next reasonable step when somatostatin and total parenteral nutrition fail to stop the leakage. Since many patients treated conservatively require several weeks and up to 2 months until adequate closure of the lymphatic fistula, approximately 6 to 8 weeks should be allowed for assessing the outcome of conservative therapy before it is judged to have failed. Bipedal lymphangiography or lymphoscintigraphy may contribute valuable information before surgical intervention. Surgical

---

**fig. 2. Algorithm for managing chylous ascites. MCT**, medium chain triglycerides. **TPN**, total parenteral nutrition. **Tx**, therapy
exploration may be considered earlier when imaging identifies the lymphatic fistula site and the patient is a good surgical candidate. During the 1970s and 1980s a peritoneovenous shunt was the principal alternative for unsuccessful conservative treatment but currently its popularity is decreased due to reported potentially fatal complications and a definite rate of shunt malfunction. Currently shunts are used only infrequently and probably should be reserved for patients with severe refractory chylous ascites and poor performance status who cannot undergo surgical exploration. Nonetheless, this algorithm was devised as general guiding principles, whereas the final choice of treatment is specific in each individual and should be adjusted to the severity of lymphatic leakage and its consequences.

CHYLOUS ASCITES IN CHILDREN

Postoperative chylous ascites is extremely rare in the pediatric population. Allen et al reported chylous ascites in an infant after retroperitoneal lymph node dissection was done for granulosa cell tumor of the testis. Eberl et al reported chylous ascites in a 2-year-old girl after tumor nephrectomy with lymphadenectomy for nephroblastoma. Co-occurrence of chylous ascites and chylothorax is reported in approximately a third of all pediatric patients with chylous ascites after abdominal surgery due to the rupture of congenital diaphragmatic defects or surgical intervention that enable the movement of peritoneal fluid into the pleural cavity. Etiologically traumatic chylous ascites is closely related to the postoperative type of chylous ascites. This rare and often unrecognized etiology of chylous ascites in the pediatric population is usually attributed to the shearing of tethered lymphatic glands during hyperextension injury to the spine or the sudden compression of congested abdominal lymph vessels. Occasionally chylous ascites may be the presenting manifestation of the battered child syndrome. Overall including nonsurgical causes of chylous collections approximately 100 cases have been reported in the pediatric age group. The analysis of 58 published pediatric cases by Unger and Chandler revealed that nonsurgical therapy was effective in about two-thirds of pediatric cases, including half within month 1 of therapy. The mainstay of nonoperative therapy for chylous ascites is total parenteral nutrition. Its feasibility for managing chylous ascites in infants and children is well established despite limited published experience. Surgical treatment, including direct repair of leaking lymphatic glands and peritoneovenous shunt placement, should be reserved for patients in whom conservative management with total parenteral nutrition fails. Although conservative management is usually successful in children, the diagnosis of chylous ascites is often made only by exploratory laparotomy.

PROGNOSIS

The outcome of chylous ascites mostly depends on the underlying pathological condition causing lymphatic leakage. The most common causes of nonpostoperative chylous ascites are intra-abdominal malignancy in adults and congenital lymphatic malformations in children. Accordingly the prognosis in most cases of chylous ascites is poor and mortality is reported to be as high as 43% to 83% due to the combined ill effects of the underlying disease augmented by the mechanical, nutritional and immunological consequences of the chylous complication. Nevertheless, postoperative chylous ascites carries a much favorable prognosis with significantly lower mortality rate. Pabst et al analyzed pooled data from 17 previously published reports of chylous ascites that developed after aortic surgery and noted that overall chylous ascites resolved in all except 7.7% of patients. The cause specific mortality rate in that analysis was 11.1% (3 of 27 patients). A single patient who was not treated with total parenteral nutrition died of nutritional deterioration, while 2 died of septic complications related to repeat paracentesis and an infected peritoneovenous shunt, respectively. An additional 2 deaths were not related to the chylous complication and occurred after chylous ascites resolved. In another large series of chylous ascites that developed after retroperitoneal lymph node dissection resolution was reported in all 18 patients without mortality. A similar excellent outcome was noted in multiple additional cases of postoperative chylous ascites. Overall when there is no dismal underlying pathological condition, the prognosis of postoperative chylous ascites is good with the majority of cases responding to conservative measures.

CONCLUSIONS

Postoperative chylous ascites is a rare complication of retroperitoneal and mediastinal surgery caused by the unrecognized interruption of major retroperitoneal lymphatic channels and establishment of a lymphoperitoneal fistula. Postoperative chylous ascites is always a difficult management problem due to the consequences of the primary operation and the constant loss of lymph. Various management modalities may be successful for chylous ascites. Management should be individualized and adjusted to the severity of lymphatic leakage and its consequences. Principally management is based on a step-up approach aimed at promoting decreased lymph production and flow as well as maintaining nutritional balance. The management algorithm integrates repeat palliative paracentesis, dietary measures, total parenteral nutrition therapy, peritoneovenous shunting and surgical closure of the lymphoperitoneal fistula.

Because of the remarkable effectiveness of somatostatin therapy for lymphatic fistula closure, somatostatin therapy with or without total parenteral nutrition should be attempted early in the course of treatment of chylous ascites before any invasive steps are taken. Somatostatin therapy may be started with low dose subcutaneous injections and escalated 40-fold to a high dose as continuous intravenous administration according to the desired response. The outcome of chylous ascites mostly depends on the underlying pathological condition causing lymphatic leakage. Thus, when there is no malignant or congenital underlying pathological condition, the prognosis in cases of postoperative chylous ascites is good with the majority responding to conservative measures.

REFERENCES

tion, 61: 1410, 1996