

# Chylous complications of various severity and manifestations within diverse compartments in reconstructive vascular surgery

Barth Udo<sup>1</sup>, Albrecht Roland<sup>1</sup>, Wasseroth Klaus<sup>1</sup>, Rahms Volker<sup>1</sup>, Meyer Frank<sup>2</sup>

<sup>1</sup>Dept. of General, Abdominal and Vascular Surgery, HELIOS Klinikum, Aue;

<sup>2</sup>Dept. of General, Abdominal and Vascular Surgery, University Hospital at Magdeburg, Magdeburg; Germany

Article history: Received: 09.06.2017 Accepted: 21.01.2018 Published: 30.06.2018

**ABSTRACT:** **Introduction:** Chylous complications, which also occur in the profile of vascular surgical interventions with considerable frequency, are challenging with regard to their adequate management.

**Aim & method:** Short compact overview on epidemiological, classifying, symptomatic, diagnostics and therapeutic aspects of chylous complications in vascular surgery, based on

- own clinical experiences,
- current selection of relevant scientific references, and
- representative case reports from clinical practice.

**Results (complex patient- & clinical finding-associated aspects):**

- Basic treatment of lymphedema / postreconstructive edema comprises a complex physical therapy to improve edematous swelling, which needs to be usually performed over years.
- In case of lymphocele, a wait-and-see strategy can be initially pursued to observe spontaneous clinical course. If the lymphocele and its clinical complaints persist, puncture, placement of drainage or temporary instillation of doxycyclin or ethanol can be attempted.
- In case of lymphatic fistula, vacuum-assisted closure dressing, radiation and selective ligation of lymphatic vessels after previous application of methylene blue dye can be used.
- Chylascites and chylothorax should be primarily treated – as has been widely established in the meantime – with a consequently conservative approach initially comprising paracentesis / thoracocentesis, protein-enriched and low-fat diet containing middle-chain triglycerides (MCT) or total parenteral nutrition combined with the application of a somatostatin analogue (surgical approach as ultima ratio only aiming at ligation of the lesioned lymphatic vessel – if necessary, including preoperative consumption of cream).

**Summary:** Chylous complications can be primarily treated with conservative measures, which should be exploited using a step-wise approach prior to surgical intervention as ultima ratio.

**Conclusion:** The experienced vascular surgeon should be acquainted with a sufficient, finding-adapted management of chylous complications. This requires a well-experienced clinician and surgeon with great expertise regarding the interdisciplinary setting comprising of interventional radiology, vascular (abdominal) surgery and partially surgical intensive care.

**KEYWORDS:** Vascular surgery, chylous complications, lymphatic edema, lymphocele, lymphatic fistula, chylothorax, chylascites, chylascos, chyloperitoneum

## INTRODUCTION

Lymphatic alterations are serious complications in clinical practice in general but also in the profile of vascular surgical interventions, which are themselves – due to the increasing number of interventions – raising slightly and which can lead to a relevant prolongation of patients' treatment. Frequency after arterial reconstructions ranges from 0.3 to 12 % [1]. Only after peripheral arterial vascular reconstructive interventions at the calf, there is a frequency of postoperative swelling / lymphedema of 15-30 % [1]. The risk is substantially increased in repeated surgical interventions. The spectrum of lymphatic complications is characterized by lymphedema or postreconstructive edema, lymphocele, lymphatic fistula, chylothorax or chylascites naturally depending on the surgical site. In general, treatment is considerably influenced by personal experiences including an already established algorithm

and recommendations, in particular, with regard to chylothorax / chylascites [2] but less with regard to a guideline-oriented therapeutic path with underlying evidence. The aim of the following summarizing and systematizing short compact overview is to illustrate the current aspects of frequency, occurrence, causes, intervention-dependent manifestation profile and sites, diagnostics and therapy of lymphatic complications in vascular surgery based on own clinical experiences, a relevant selection of topic-related references from scientific literature and representative case reports from clinical practice.

## METHOD

Narrative overview based on a search of relevant scientific references in PubMed® using the key words “vascular surgery – chylous

complications – lymphatic edema – lymphocele – lymphatic fistula – chylothorax – chylascites – chylascos – chyloperitoneum“.

## CORNER POINTS

### Occurrence, pathophysiology, classification

#### *Physiology of the lymphatic system*

The lymphatic system transports water, plasma proteins, cells, fatty acids and “foreign substances“ from the interstitial space to blood circulation, which cannot be absorbed into the capillaries, as well as electrolytes and vitamins. Lymphatic volume amounts approximately 2 L within 24 hours [3]. Lymphatic capillaries originate blindly as endothelial cannula within the periphery and finally unify to lymphatic vessels, which mouth themselves into the thoracic duct and left lymphatic duct, and finally, into the venous system [3]. Along the lymphatic vessels, lymph nodes are positioned, which have specific drainage areas within the periphery according to the anatomy of the lymphatic system. Lymph nodes associated to a specific drainage area are called regional lymph nodes [4].

#### *Epidemiology and definition of lymphatic complications*

There are varying data in the literature on the frequency of lymphatic complications in reconstructive vascular surgery. Postreconstructive lymphatic edema occurs in 70 to 100 % of cases, in 85 % of cases after femoro-popliteal and in 15 % after aorto-iliac bypass operations [5]. The occurrence of lymphatic fistulas in case of inguinal access site ranges from 0.8 to 18 % [6].

The most frequent lymphatic complications in peripheral reconstructive vascular surgery are lymphatic edema, lymphocele and lymphatic fistula. Chylascites can be considered a rare complication in aortic surgery (in addition to abdominal surgery), which is numbered in the scientific literature with an occurrence of less than 1 % [7].

#### *Lymphatic edema and postreconstructive edema*

Lymphatic edema after vascular surgical interventions has to be considered a secondary phenomenon. In contrast to primary lymphatic edema, which is based on an abnormal development of the lymphatic vessels and nodes, in secondary lymphatic edema, there is rather a damage of the lymphatic transport or an obstruction or barrier of the lymphatic flow.

According to Campell et al., the genesis of a postoperative lymphedema can be explained by leakage of intravascular albumin and subsequent edema (storage of water) into the interstitium according to the hydrostatic pressure. The basic cause for it might be a dysfunction at the vascular endothelium by free radicals within the ischemic area [8].

However, Esato et al. could not detect a distinct protein shift from the intra- to the extravascular space. The lack of an appropriate capillary hydrostatic pressure and the postoperative destructions of lymphatic vessels were assumed to be the real cause of a lymphedema [9].

The primary and secondary lymphedema are classified into a resting stage (latency) and the stages I-III: During:

- the resting stage, reduction of the lymphatic transport can be detected with lymphoscintigraphy but no clinical finding;
- stage I, there is a spontaneously reversible edema with no secondary tissue alterations;
- stage II, changes are irreversible – there is an increasing rate of fibrosis with secondary alteration of the skin;
- the final stage (stage III), there is a lymphostatic elephantiasis [10].

Postreconstructive or postischemic edema can develop after arterial interventions mostly at lower extremities. Usually, there is a multifactorial pathogenesis by reperfusion which leads to the release of:

- H<sup>2</sup>O<sub>2</sub>,
- free oxygen radicals (and)
- proteolytic enzymes including the damage of endothelial cells.

This, subsequently, leads to an increase of permeability at the vascular wall and an effusion of protein-rich exudate into the interstitium. The pre-damaged lymphatic vessels are then not able to manage the volume of lymphatic load [11].

#### *Lymphocele*

Lymphocele is defined as abnormal collection of lymphatic fluid within the subcutaneous tissue by traumatic or iatrogenic damage of lymphatic vessels in closed wounds [2]. Clinically, there is an elastic swelling at the skin surface, which can appear shiny. An associated infection can impose with an erythema.

#### *Lymphatic fistula*

If the collection of lymphatic fluid is connected with the skin surface (“lymphoatmospheric“), the term lymphatic fistula is used. The absence of a spontaneous closure within a short time interval can lead to a prolonged treatment and increased risk of infection up to 42 % (!) [12].

#### *Chylascites*

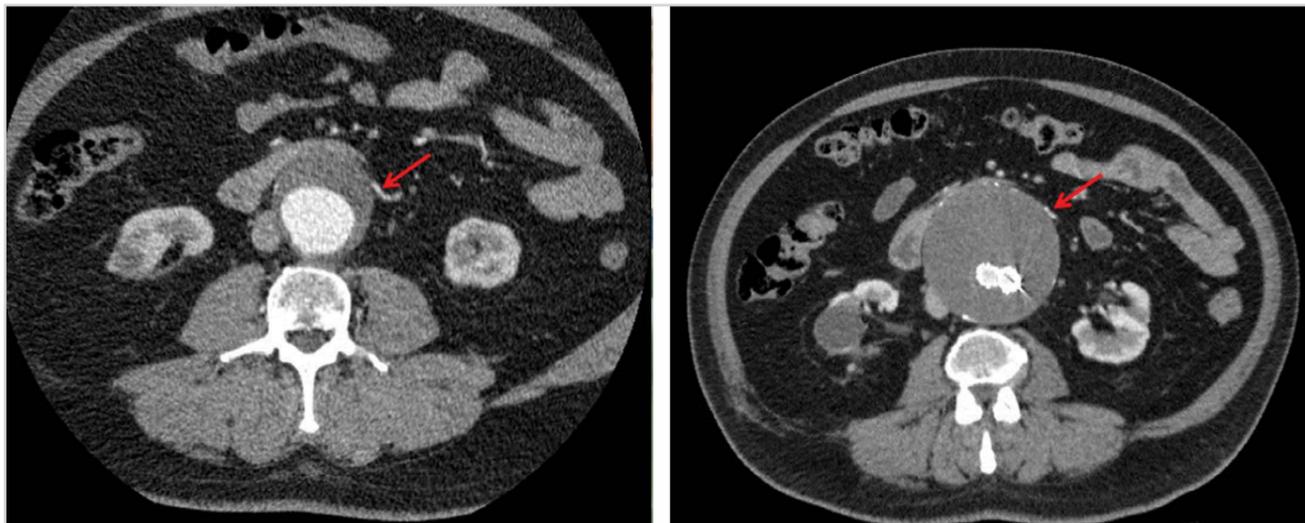
Chylascites (syn.: chylascos, chyloperitoneum) are a collection of chylomicron-enriched lymphatic fluid within the abdominal cavity [13]. Causes of chylascites in reconstructive vascular surgery are direct injuries of the periaortic, interaortocaval, pericaval, pelvic and retroperitoneal lymphatic vessels (flowing into the cisterna chyli), which occur in aortic interventions in up to 81 % of cases [14]. In persisting chylascites, there is an ongoing loss of protein- and fat-enriched fluid as well as a loss of immunocompetent cells, vitamins and electrolytes. As a result of this, there is a threatening metabolic and immunosuppressive malfunction which can lead to a possibly fatal outcome [2].

#### *Chylothorax*

It is a collection of chylous fluid within the pleural cavity mostly characterized by a typical phenotype (see below). Based on the anatomic crossing of the thoracic duct at the 6th thoracic vertebral body, a collection of chylous fluid is located within the right or left pleural cavity depending on the lesion site. The causes are



**Fig. 1.** Case 1: Secondary lymphedema with dermatitis of the thigh and disturbance of wound healing with lymphatic fistula at the venous access and removal site after implantation of an iliac (prosthetic)-popliteal P3-reversed venous bypass as well as surgically treated gangrene of the instep: A. Wound defect with vacuum-assisted closure therapy at the venous access and removal site and instep; B. Secondary wound closure at the venous access and removal and accrued skin graft at the instep.



**Fig. 2.** Imaging – case 2: Transversal scan of an abdominal computed tomography at the central parts of both kidney:  
A. Detection of an infrarenal aortic aneurysm in preparation of an endovascular repair – red arrow: branching off – contrasted inferior mesenteric artery;  
B. Increasing aneurysmatic sac (10 cm in diameter) due to a persisting endoleak type II with contrasted inferior mesenteric artery (red arrow) to plan open implantation of a bifurcational prosthesis – after previous infrarenal EVAR 13 years ago.

– in addition to a spontaneous occurrence – associated with tumor manifestations [15], in particular, lesions due to surgical preparation as part of thoracic surgery measures (among others such as pulmonary, aortic and esophageal surgery) or vascular surgical interventions with a thoracic extent of the intervention.

### Diagnostic (measures)

Diagnostic measures in secondary lymphedema and postreconstructive edema comprise mainly clinical examination. The difference between primary lymphedema, cardiac edema or lipedema can be found in a pronounced manifestation on one side, since secondary lymphedemas are usually limited only to one extremity. Leading symptoms are immersion of natural skin folds and the “Kaposi-Stemmer sign”. It is characterized by a swollen dorsal side of the toes. Initially, lymphedema is elastic and later not impressible any more [16]. In postreconstructive edema, there is a soft swelling with inflammatory erythema and hyperthermia. The skin

is often glassy, tense and touch-sensitive [11].

Apparative diagnostic imaging of lymphedema includes:

- Ultrasound (assessment of the alterations of cutis and subcutis, manifestation of the content of interstitial fluid and fibrosis of the connective tissue),
- Isotope-based lymphography (assessment of the functional disturbance within the lymphatic system),
- Magnet resonance lymphangiography (morphological imaging of the lymphatic vessels with subcutaneously injected contrast media),
- indirect lymphography (imaging of the morphological changes at a specific segment of a lymphatic vessel) (and)
- fluorescence microlymphography (morphology of the lymphatic capillaries).

Today, the classical oily lymphography is obsolete [17].

Lymphocele can be well-imaged using ultrasound – it imposes as cystic and echoless structure within the subcutaneous tissue. Further investigations such as computed tomography (CT) or magnet resonance imaging (MRI) are reserved only for specific questions (e.g., manifestations within the abdominal cavity).

Imaging of a lymphatic fistula by means of methylene blue is controversially discussed due to possible color-based damages or allergic reactions – it should only be performed in exceptional cases [1]. In contrast, Del Frari et al. have described intraoperative imaging by intracutaneous injection of methylene blue as a simple, easily executable, cost-preserving, fast and free of complications method for the precise intraoperative localization [12].

Persisting chylascites can be assumed by a painless and distended abdomen - in addition, unspecific abdominal discomfort, nausea, edemas or enlarged lymph nodes can occur. The release of chylous fluid out of drainages in situ can be considered indicative [2], which appears typically ocherous and similar in appearance to milky coffee. The minimal volume of daily chyle amounts to 200 mL/24 h according to the generally accepted definition. Laboratory analysis reveals chylomicrones-enriched fluid out of the drainages with an associated triglyceride (TG) concentration of more than 1.2 mmol/L (or 110 mg/dL). The microscopic detection of chylomicrones and/or a TG level of this fluid > serum level is appropriate evidence. In a normal white blood cell count and negative microbiological finding(s) (obligatory analysis), an infection can be sufficiently excluded [18]. From a technical point of view, to determine the extent and manifestation site of the leakage ultrasound, CT scan, lymphangiography and lymphoscintigraphy are very helpful and sufficient [2].

### Treatment

#### Lymphedema and postreconstructive edema

The basic treatment measure of lymphatic edema / postreconstructive edema is “Complex physical ‘decongestion’ therapy” (CPDT) according to the approach by Földi and Kubik. This treatment comprises 4 therapeutic components:

1. Manual lymphatic drainage,
2. Compression therapy with specific compressing exchangeable bandages and/or medical compressing stockings,
3. Decongesting physical exercise (and)
4. Skin care [17].

CPDT can be subdivided into two treatment phases. Phase I induces mobilization of congested protein-enriched fluid out of the edema and initiates the reduction of the connective tissue proliferation. Phase II serves to optimize and keep the treatment successful [17]. During the decongesting phase I, the above-mentioned components need to be used minimally once a day, 5 times a week. Lymphological compressing dressings are used for treatment-free weekends [19]. Depending on the specific finding, phase I needs 12 treatment days in average. In addition, even at

the beginning of phase I, flat-knitted compressing stockings should be prescribed and measured up, as well as the measurements should be applied for approval by the insurance company. At the end of phase I, compressing stockings with optimized measurements should be ordered [19]. During phase II, specific measures are used according to the degree of severity of the disease. Thus, within stage II and III of lymphedema, manual lymph drainage should be performed according to individual needs 1-3 times a week. Furthermore, compressing stockings and bandages should be carried, decongesting physical exercises continued and if necessary, phase I should be repeated [17].

In postreconstructive edema, arterial outflow and surgically achieved peripheral arterial pressure are of primary interest. Compression therapy should be performed with almost no pressure by applying a timely limited and a padded bandage, which includes the acra [11]. In fitting compression stockings during phase II of CPDT, flat-knitted compression stockings of class I should be prescribed that have the best adaptation to the deformation of the limbs [17]. The pressure of class I at the ankles amounts to 18-21 mmHg (2.4-2.8 kPa) according to “RAL GZG 387 (2000)” [20]. In a prospective randomized controlled study, te Slaa et al. detected the advantage of compression stockings of class I, which were carried after reconstruction (autologous femoropopliteal bypass surgery) and during the hospital stay at the surgically treated limb day and night, as well as over daytime for further 8 weeks after discharge, versus intermittent pneumatic compression related to postoperative edema [21]. From the author’s own perspective, compression stockings of class I appear a reasonable compromise, since the value of the arterial pressure at the ankle is not clear. In each case, arterial pressure at the ankles (in mmHg) should be higher than the pressure declared for various compression classes. No further conclusions can be derived from the number of the open vessels at the calf [22].

Depending on the various accompanying diseases, modification of the single physical measures is required. Usage needs to be adapted to the individual needs of the specific patient. Accompanying diseases, which require such adaptation, are:

- Arterial hypertension with coronary heart disease and / or heart insufficiency,
- Diabetes mellitus with diabetic neuropathy as well as micro- and macroangiopathy,
- Chronic venous insufficiency of stage III according to Widmer’s classification,
- Malignant tumor diseases,
- Rheumatological diseases (and)
- Inflammatory bowel disease [17].

Contraindications for CPDT are:

- Acute inflammation or erysipelas ,
- Acute thrombophlebitis / phlebothrombosis,
- Decompensated heart insufficiency (and / or)
- Cardiac edema in chronic ischemic heart disease [11].

Manual lymph drainage is a circular stretching and relocating technique, which, in particular, affects the cutis and subcutis [23]. By stretching the wall of the lymphatic vessels, lymphangiopul-sation is increased and, subsequently, a consecutive increase of

chyle production and flow can be achieved [17]. Usually, it starts centrally with stimulation of the regional lymph nodes, drainage propulsion is directed proximally and is associated with breathing exercise for the creation of a central lymphatic suction effect [11].

At a lower extremity, it starts usually from the lateral side because of frequently used vascular surgical/-interventional access sites at the groin. In addition, it is reasonable to plan the flank as a drainage area prior to the actual treatment. Furthermore, wound and scar sites have to be taken into account [24].

Decongesting physical exercises support physical lymphatic transport. Training of the excursion, stretching exercises and isometric muscular exercises should be adapted to the patient's specific needs [25].

Cautious skincare with pH-neutral creams is also recommendable to cushion the drying and mechanically incriminating effect of the compression materials.

### Lymphocele

Lymphoceles can regress within a few weeks. Lymphatic fluid can get connection to draining lymphatic vessels or they can occlude by scar formation. Therefore, it appears reasonable to observe the spontaneous course in the mid-term run. In case of displacement, a sterile puncture can become necessary. A temporary instillation of ethanol or doxycyclin has been described in literature [26]. The own institutional approach comprises – in case of a displacing lymphocele within the subcutis – puncture of it and insertion of a catheter as it is used for urinary catheters via the suprapubic access site, since this type of catheter can be easily implanted using the implantation set after former ultrasound-guided detection of the lymphocele, following ultrasound-guided implantation. To obtain a sample for microbiological analysis is mandatory. The catheter is fixed at the skin surface and connected with a bag to collect the fluid. Afterwards, the area is compressed with a sand bag and bedrest is recommended. In case of reduced chylous volume, the catheter can be removed after former ultrasound-based control investigation followed by a compressing local dressing at the puncture site. This type of treatment is usually successful according to the own experiences.

### Lymphatic fistula

The treatment of lymphatic fistulas can be prolonged and flamboyant. First, rest and mild compression are recommended [27]. A drainage in situ should be kept and used with no further suction [6].

Del Frari et al. favor the intraoperative detection of lymphatic fistulas by intracutaneous methylene blue injections and their subsequent ligation. For that reason, soft tissue is radically debrided at the fistula area. Subsequently, a 0.8 % methylene-blue solution is injected intracutaneously into the interdigital space of the 1st and 2nd toe. After discharge of the dye out of the lesioned lymphatic vessel, it can be identified and ligated with a 3/0 suture (Vicryl) [12].

Local application of doxycyclin can be considered an alternative or additive therapeutic measure in the treatment of lymphatic fistulas. Cnotliwy et al. administered 100 mg of doxycycline hydrochloride once a day via a drainage in situ or using a cannule intro-

duced into the former drainage channel resulting in a significantly shorter treatment period [28].

A further option to treat lymphatic fistulas is the usage of vacuum-assisted closure (V.A.C.). For that reason, Hamed et al. used a normal black polyurethane sponge with a continuous suction of 125 mmHg. The sponge was exchanged three times a week. The treatment was finished if the drainage volume was substantially lower over 2-3 days and if there was a distinctly granulating wound area. It turned out that V.A.C. is an effective and easily available (but also cost-intensive) treatment option [29].

From the own point of view and experiences, a cutaneous V.A.C. can be attempted. The skin around the wound should be covered with a foam dressing (e.g., Mepilex lite® or Allevyn Thin®) before a polyurethane sponge is used. In case of a distinct wound dehiscence or necrosis at the wound margin, surgical debridement and subcutaneous placement of a V.A.C. cannot be avoided.

A further treatment option for persisting lymphatic fistulas is radiation using a dosage of 3x3 Gy, also on 3 subsequent days. In a study by Dietl et al., indication for radiation was seen by the surgeon and a radiologist if there was a postoperative release of chylous fluid of more than 50 mL/24 h. Prior to the radiation, each patient underwent ultrasound-based assessment of length, width and depth to finally determine the volume. Overall, the method was effective and at a reasonable price, as well as, in addition, there were no side effects. After an average of 10.5 days post radiation, drainages could be removed [30].

“Packing” of healed and open lymphatic fistulas and lymphoceles has been described by Sansone et al. It comprises external compression using Prolene® or silk sutures with plastic swabs, which comprises the lymph node-encompassing soft tissue. The treatment lasted 10 to 20 days. This therapeutic approach was assessed as an economic option to treat chronic lymphatic fistulas with a low risk of complications [31].

However, an appropriate soft-tissue preparation to get access to the vessels at the groin is the best prophylaxis for a lymphocele. It is recommended to place a longitudinal skin incision 2 fingers from the femoral artery to the lateral side below the inguinal ligament. Hereafter, preparation goes down to the fascia continuing to the vascular vagina medializing lymphatic vessels and nodes. Injured lymphatic vessels and nodes need to be consequently and carefully ligated or sutured since coagulation only cannot be considered reliable in preventing lymphatic fistula(s) [27,32]. Prophylactic insertion of a closed suction drainage does not provide an advantage to definite avoidance of a lymphocele [33].

### Chylascites – Chylothorax (Fig. 1)

There is a step-wise and consequently conservative therapeutic approach at an initial stage. At the beginning, paracentesis can be performed once or a few times, which serves to relieve pressure on the abdominal cavity (or pleural cavity – in case of thoracocentesis) and subsequently to optimize gastrointestinal peristalsis (breathing excursion). In addition, a protein-enriched and fat-poor diet with MCT (“middle chain [fatty acid-containing] triglycerides”)–fat is recommended, which cannot be absorbed via (peri-)intestinal lymphatic vessels but via portal vein branches. As a result of this, there

is a lower chyle production due to the reduced need for fat transport indicated by a clearing of the chylous fluid with a subsequent spontaneous closure of the fistula [2]. Conservative management and observation should be focused on this effect. In “non-responders”, treatment can be extended by or combined with “n.p.o.” and total parenteral nutrition (“TPN”). To consequently maintain and pursue this type of treatment is recommendable for a time period of 4-6 weeks [2]. The combination of an MCT-based diet or TPN with the application of octreotide (synthetic analogue of somatostatin) leads in approximately 100 % of cases to a successful outcome (final cessation indicated by a clearing of the chylous fluid and reduction of the drainage volume) of chylascites [18]. Karaca et al. used a protocol with 3.5 µg/kg/h of the somatostatin analogue as continuous infusion on the 1st day of treatment. The dosage was increased by 0.5 µg/kg/h after 24 h if no side effects had occurred. This was continued until the ascites volume via drainage was lower than 100 mL/d. Twenty-four hours prior to the removal of the drainage, somatostatin application was stopped [13].

Conservative measures are closely associated with repeated controls of laboratory parameters within short time intervals and indicated supplementation of electrolytes, trace minerals and vitamins etc. ad libitum.

Benedix et al. have used a flow chart (Fig. 1) [34] for their therapeutic planning in case of chylothorax. It starts with paracentesis- / thoracocentesis-associated supportive therapeutic measures such as administration of fluids, electrolytes, vitamins and trace elements, microbiological investigation of the drainage fluid, sandostatin application and TPN. If there is no adequate improvement in chylascites, treatment is extended by continuous intravenous administration of the sympathomimetic drug etilefrin and MCT-based oral nutrition. In case of further persistence, a surgical approach comprising ligation of the damaged lymphatic vessel or thoracic duct needs to be considered. In chylothorax, further treatment after failure of the first therapeutic step depends on the drainage volume. In a drainage volume of more than 1,000 mL, treatment is extended by chemical pleurodesis or an attempt to embolize the thoracic duct / cysterna chyli by image-guided radiological intervention. Surgical intervention is considered the ultimate choice [34].

Basically, if conservative (non-operative) measures fail after a time period of 6-8 weeks, a surgical approach should be considered. This comprises direct ligation of the lesioned lymphatic vessel or creation of a peritoneovenous shunt [35,38]. The problem of such ligation is the doubtless identification of the damaged lymphatic vessel wherefore uptake of fat-enriched nutrition or even cream cake is recommended.

In case of a surgical indication to treat chylothorax after utilization of all conservative measures, epiphrenic ligation of the thoracic duct has to be pursued.

These surgical measures are considered the last choice since the creation of a peritoneovenous shunt is associated with a surgical revision rate of 80 % (because of shunt insufficiency/leakage/occlusion) and mortality of up to 20 % [18].

### Microsurgical therapy of lymphatic edema

After failure of conservative measures over a time period of ap-

proximately 6 months, indication for lymphatic vessel transplantation can be proved. Prediction for this is the necessary detection of disturbed natural drainage of lymphatic fluid within the specific limb by lymphoscintigraphy or lymphatic MRI. In addition, a non-altered leg is required to remove the lymphatic graft [36]. Then, lympho-lymphatic, lymphonodular or lymphovenous anastomoses are created. At the upper extremities, Ingianni described that a reduction of the edematous volume by approximately 30 % can be achieved by means of microsurgical lympho-venous end-to-end anastomoses with an invagination technique [37].

## REPRESENTATIVE CASE REPORTS

Case 1: A 59-year old male patient was admitted to the hospital due to an increasing necrosis at the left forefoot (approximately 20 x 20 cm) with hyperthermia and erythema indicating an infection. One year prior to that, the patient had undergone transperitoneal implantation of an infrarenal aorto-bifemoral Dacron-Y-prosthesis and an additional thrombendarterectomy of the common and profound femoral arteries. The patient was treated according to the “IRA concept”.

For diagnostic purposes and because of claustrophobia, the patient underwent CT-angiography, which revealed an occlusion of the superficial femoral artery and high-grade stenosis at the P2-segment of the popliteal artery prompting to the implantation of an iliac(prosthetic)-popliteal P3-“reversed” venous bypass including saphenous vein removal from the ipsilateral limb.

Intra- and postoperative courses were uneventful. Despite of lack of problems at the wound, there was an early postreconstructive edema which was approached with slight compression. The further course was uneventful, therefore, the patient was transferred to the Dept. of Plastic Surgery for plastic reconstruction of the forefoot. Because of a disturbance of wound healing at the vein-removal site at the left thigh with massive chylous release and a distinct swelling of the left limb with dermatitis, the patient was re-transferred to the first (reporting) hospital. The forefoot was necrosectomized and further treated with V.A.C. closure.

Hereafter, wound dehiscence at the left thigh was debrided and further treated with V.A.C. closure. Both V.A.C. closures were changed a couple of times achieving clean wound conditions. In addition, the left leg was mildly compressed with short tractive bandages, as well as a manual lymphatic drainage initiated at the central lymphatic nodes. There was a slow reduction of the lymphedema while there was also an edema of the right leg, ascites and a scrotal edema. A laboratory analysis confirmed the clinical suspicion of a distinct hypalbuminemia and hypoproteinemia most likely by the release of protein-rich secretion via V.A.C. closure.

Since protein-rich nutrition can only achieve a long-lasting effect, 20 % human albumin was administered intravenously (therapeutic cycle over 3 days). This led to a distinct reduction of scrotal edema and the edema of both legs, which managed to close the wound at the left thigh secondarily. The wound at the left forefoot was further treated with skin graft after removal from the contralateral thigh (Fig. 2).

Case 2: A 70-year old male patient was admitted for an open im-

plantation of a bifurcational prosthesis (18x9 Silvergraft, B. Braun, Melsungen, Germany) because of an enlargement of a persisting endoleak of type II up to 10 cm after former endovascular repair (EVAR) for an aortic aneurysm (Ø: 6 cm) in 2003. After 24 h of cardiopulmonary monitoring at the surgical ICU, the patient was transferred to the normal ward of the Division of Vascular Surgery despite a drainage fluid colored similar to milky coffee with a 24-h-volume of 400-450 mL via a drainage positioned with the tip at the mesenteric root (retroperitoneal space was closed at the end of the vascularsurgical intervention). The detection of chylo-micrones was considered evidence for the postoperative, preparation-induced chylascites, which prompted to the initiation of a 2-week TPN cycle under adequately accompanying laboratory control and adapted supplementation of electrolytes, trace elements and vitamins as well as additional care by a nutritional nurse. Already on the 3rd day after initiation of TPN, drainage fluid cleared up. From the 14th (18th postoperative) day on, a MCT-based diet (see above) was initiated for 3 weeks. The patient was subsequently transferred for further care to the outpatient clinic (wound conditions with no problems). Further controls showed regular perfusion with adequate AB indices (right: 1.28; left: 1.4) and regular proximal and distal bifurcational anastomoses (Fig. 3).

## SUMMARY

There are manifold treatment options of lymphatic complications in vascular surgery, which have been under steady development. Mostly, step-wise and combined conservative procedures (among others, “wait and see”, para[thoraco]centesis, MCT-enriched diet, TPN, supplementation in chylascites/chylothorax) are appropriate in the majority of lymphatic complications, however, they require

## REFERENCES:

- Hanzlick J.: Lymphatische Komplikationen nach peripheren arteriellen Gefäßrekonstruktionen. In: Hepp W., Brunner U.V., Gussmann A. (Hrsg). Lymphologische Gesichtspunkte in der Gefäßchirurgie. Steinkopff Verlag; Darmstadt, 2006.
- Benedix F., Lippert H., Meyer F.: Lymphokutane Fisteln, Chylasites sowie Chylothorax im Komplikationsspektrum chirurgischer Eingriffe: Ursachen, Diagnostik und Therapie. Zentralbl. Chir. 2007; 132: 529–538.
- Schmidt R.F., Thews G. (Hrsg.): Physiologie des Menschen. 24. Auflage, Springer-Verlag; Berlin Heidelberg New York, ISBN 3-540-52643-9.
- Waldeyer A., Mayet A. (Hrsg.): Anatomie des Menschen. 15. Auflage, Walter de Gruyter & Co; Berlin New York, ISBN 3-11-011162-4.
- Krössin T., Rückert R.L.: Einfluss von arteriellen Bypassrekonstruktionen auf die Lymphdrainage bei Patienten mit peripherer arterieller Verschlusskrankheit. In: Hepp W., Brunner U.V., Gussmann A. (Hrsg). Lymphologische Gesichtspunkte in der Gefäßchirurgie. Steinkopff Verlag; Darmstadt, 2006.
- Diener H., Larena-Avellaneda A., Debus E.S.: Postoperative Komplikationen in der Gefäßchirurgie. Chirurg. 2009; 80: 814–826.
- Halloul Z., Meyer F., Bürger T. et al.: Chylasites, eine seltene Komplikation in der Aorten Chirurgie. Vasa. 1995; 24: 377–381.
- Campbell H., Harris P.L.: Albumin kinetics and oedema following reconstructive arterial surgery of the lower limb. J. Cardiovasc. Surg. 1985; 26: 110–115.
- Esato K., Ohara M., Seyama A., Akimoto F. et al.: <sup>99m</sup>Tc-HSA lymphoscintigraphy and leg edema following arterial reconstruction. J. Cardiovasc. Surg. 1991; 32: 741–746.
- Schuchhardt C.: Differenzialdiagnose des Lymphödems. Gefäßchirurgie. 2012; 17: 173–178.
- Heinig B., Florek H.J.: Physiotherapeutische Möglichkeiten bei postoperativen Ödemen nach arterieller Gefäßrekonstruktion. In: Hepp W., Brunner U.V., Gussmann A. (Hrsg): Lymphologische Gesichtspunkte in der Gefäßchirurgie.

the experienced vascular surgeon / clinician of a vascular medical center who needs the interdisciplinary cooperation and development of adequate measures provided by abdominal and thoracic surgeons. Surgical interventions are considered the last choice (“ultima ratio”) in case of failure of conservative therapy and are reserved to specialized centers experienced in reconstructive lymphatic surgery. The first choice is prevention of such complications by selected access sites and knowledge of the anatomic course of the lymphatic vessels including subtitle tissue preparation with consequent ligation of the lymphatic vessels instead of rather lax and exclusive coagulation.

Chylous complications can primarily be approached by a considerable spectrum of conservative measures, which need to be exploited with a step-wise approach ultimately with a surgical intervention.

The vascular surgeon should be familiar with a sufficient finding-specific management of chylous complications, which needs an experienced clinician and surgeon in the interdisciplinary setting comprising interventional radiology, abdominal surgery and partially intensive care.

## ACKNOWLEDGEMENT

The authors are grateful to the clinical partners who are involved in vascular medicine because of their expertise and contributions in the management of interdisciplinary cases, in particular, to the colleagues of the Dept. of Radiology and Nuclear Medicine and the Institute of Neuroradiology at the University Hospital of Magdeburg for providing selective and representative imaging for the purposes of scientific case descriptions.

- Steinkopff Verlag; Darmstadt, 2006.
- Del Frari B., Piza-Katzer H., Schoeller T. et al.: Lymphfisteln an der unteren Extremität. Phlebologie. 2007; 36: 267–271.
- Karaca S., Gemayel G., Kalangos A.: Somatostatin treatment of a persistent chyloperitoneum following abdominal aortic surgery. J. Vasc. Surg. 2012; 56: 1409–1412.
- Leibovitch I., Mor Y., Golomb J. et al.: The diagnosis and management of postoperative chylous ascites. J. Urol. 2002; 167: 449–457.
- Meyer F., Heinrich P., Falkenberg B.: Lymphangiomyomatose Ursache für rezidivierenden Chylothorax mit abdomineller Ausbreitung. Zschr. Herz Thor. Gefäßchir. 1996; 10: 4146.
- Czaika V.A., Gussmann A.: Primäres Lymphödem – Differentialdiagnosen, Diagnostik und Therapie. In: Hepp W., Brunner U.V., Gussmann A. (Hrsg): Lymphologische Gesichtspunkte in der Gefäßchirurgie. Steinkopff Verlag; Darmstadt, 2006.
- Diagnostik und Therapie der Lymphödeme, Leitlinien der Gesellschaft Deutschsprachiger Lymphologen, AMWF-Leitlinien-Register Nr. 058/001 ([http://www.dglymp.de/fileadmin/global/pdfs/Leitlinien\\_Lymphologie1.PDF](http://www.dglymp.de/fileadmin/global/pdfs/Leitlinien_Lymphologie1.PDF)), Zugriff: 31.03.2016.
- Weniger M., D`Haese J.G., Angele M.K. et al.: Treatment options for chylous ascites after major abdominal surgery: a systematic review. Am. J. Surg. 2016; 211: 206–213.
- Gültig O.: Die Erfolgsgeschichte der Lymphologie und der komplexen physikalischen Entlastungstherapie (KPE) – aktuelle Bedeutung. Gefäßchirurgie 2012; 17: 187–193.
- Wienert V., Gerlach H., Gallenkemper G. et al.: Leitlinie Medizinischer Kompressionsstrumpf (MKS). Phlebologie. 2006; 35: 315–320.
- te Slaa A., Dolmans D.E., Ho G.H. et al.: Prospective Randomized Controlled

- Trial to Analyze the Effects of Intermittent Pneumatic Compression on Edema Following Autologous Femoropopliteal Bypass Surgery. World J. Surg. 2011; 35 (2): 446–454.
- Pourhassan S., Kröger K.: Postoperatives Lymphödem nach femoropoplitealem Bypass. Gefäßchirurgie. 2011; 16: 127–129.
- Bringezu G., Schreiner O.: Die Therapieform Manuelle Lymphdrainage. In: Bringezu G., Schreiner O. (Hrsg): Lehrbuch der Entlastungstherapie. 4. Auflage, Springer Verlag; Berlin Heidelberg New York, ISBN 3642549225, 9783642549229.
- Schreiner O.: Manuelle Lymphdrainage zur Behandlung der chronischen peripheren arteriellen Verschlusskrankheit (pAVK). In: Bringezu G., Schreiner O. (Hrsg): Lehrbuch der Entlastungstherapie. 4. Auflage, Springer Verlag; Berlin Heidelberg New York, ISBN 3642549225, 9783642549229.
- Debus E.S., Winkler M., Tató F.: Erkrankungen der Lymphgefäße. In: Debus ES, Gross-Fengels W (Hrsg). Operative und interventionelle Gefäßmedizin. Springer-Verlag; Berlin Heidelberg, 2012.
- Herpertz U.: Ödeme und Lymphdrainage, Diagnose und Therapie von Ödemkrankheiten. 4., überarbeitete und erweiterte Auflage, Schattauer GmbH; 2010 (ISBN 978-3-7945-2703-8).
- Wenk H.: Die Leiste. Gefäßchirurgie. 2013; 18: 153–162.
- Cnotliwy M., Gutowski P., Petriczko W. et al.: Doxycycline Treatment of Groin Lymphatic Fistulae Following Arterial Reconstruction Procedures. Eur. J. Vasc. Endovasc. Surg. 2001; 21: 469–470.
- Hamed O., Muck P.E., Smith J.M. et al.: Use of vacuum-assisted closure (VAC) therapy in treating lymphatic complications after vascular procedures: new

- approach for lymphoceles. J. Vasc. Surg. 2008; 48 (6): 1520–1523, 1523. e1–4.
- Dietl B., Pfister K., Aufschläger C. et al.: Die Strahlentherapie inguinaler Lymphfisteln nach gefäßchirurgischen Eingriffen. Strahlenther. Onkol. 2005; 181 (6): 396–400.
- Sansone F., del Ponte S., Zingarelli E. et al.: The „packing of the groin“ technique: an innovative approach for groin lymphocele. Interactive Cardio Vasc. Thorac. Surg. 2011; 13 (4): 367–369.
- Debus E.S., Diener H., Kölbl T. et al.: Operative Zugangswege in der rekonstruktiven Gefäßchirurgie der Arterien. Chirurg. 2013; 84: 153–168.
- Niedergethmann M., Bludau F., Dusch N. et al.: Stellenwert von Drainagen in der Chirurgie. Chirurg. 2011; 82: 1079–1084.
- Benedix F., Lippert H., Meyer F.: Etiology, diagnosis and treatment of lymphocutaneous fistulas, chylascites and chylothorax as infrequent but serious complications following surgical procedures. Zentralbl. Chir. 2012; 137 (6): 580–586.
- Alam S.E., Kar S.M., Kar P.M.: Successful management of chylous ascites: A report of two cases. Saudi J. Kidney Dis. Transpl. 2016; 27: 386–390.
- Wallmichrath J., Baumeister R.G.H., Giunta R. et al.: Lymphgefäßtransplantation mit Anastomosierung der Transplantate an regionale Lymphknoten zur Therapie von Lymphödem. Lymph. Forsch. 2011; 15 (2): 68–71.
- Ingianni G.: Mikrochirurgische lympho-venöse Anastomose beim sekundären Lymphödem der oberen Extremitäten. Handchir. Mikrochir. Plast. Chir. 2003; 35 (4): 216–220.
- Ha G.W., Lee M.R.: Surgical repair of intractable chylous ascites following laparoscopic anterior resection. World J. Gastroenterol. 2015; 21 (19): 6077–6081.

Word count: 4580 Page count: 9 Tables: – Figures: 2 References: 38

DOI: 10.5604/01.3001.0011.8172 Table of content: <https://ppch.pl/issue/11207>

Copyright: Copyright © 2018 Fundacja Polski Przegląd Chirurgiczny. Published by Index Copernicus Sp. z o. o. All rights reserved.

Competing interests: The authors declare that they have no competing interests.



The content of the journal „Polish Journal of Surgery” is circulated on the basis of the Open Access which means free and limitless access to scientific data.



This material is available under the Creative Commons - Attribution 4.0 GB. The full terms of this license are available on: <http://creativecommons.org/licenses/by-nc-sa/4.0/legalcode>

Corresponding author: Prof. dr. med. F. Meyer, Wydział Chirurgii Ogólnej, Jamy Brzuszej i Naczyniowej Szpitala Uniwersyteckiego, Leipziger Strasse 44, 39120 Magdeburg, Niemcy, tel.: +49 391-67 15500, fax: +48 391 67 15570, e-mail: [frank.meyer@med.ovgu.de](mailto:frank.meyer@med.ovgu.de)

Cite this article as: Barth U., Albrecht R., Wasserth K., Rahms V., Meyer F.; Chylous complications of various severity and manifestations with in diverse compartments in reconstructive vascular surgery; Pol Przegl Chir 2018; 90 (3): 44-52

