Lymphatic Intervention: Basic to Advanced

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Disclosures

None
Macrocystic lymphatic malformation
LM Agents

- **Doxycycline**
  - 20mg / kg
  - Up to 1000 mg
  - 100 mg + 10 ml water

OR:

- 5ml contrast
- 5m lignocaine

- **Bleomycin**

- **Alcohol**

- **Polidocanol** ?
Needle
Empty lymph
Replace with Doxycycline
Large macro cystic lymphatic malformation

Empty fully LA for ½ hour
Remove
Doxycycline
Leave it

Repeat 3 days

Doxycycline
Dermal Micro cystic LM
Diode Laser
Subcutaneous Micro cystic LM

Gravity technique

Pull till flow
Top up Doxy

Syringe Roadmap

Air at end contrast
Dermal Micro cystic LM

Diode laser / doxycycline

Pre

Post

7 year oozing stopped
If Leak > 500-1000 ml/day
Likely needs:
- Surgery
- IR

High mortality
Up to 50%

Lymphatic leak: anywhere
Lymph leak / Chylothorax / chylous ascites

**Causes:** cirrhosis, major surgery, trauma, cancer, infection/TB, congenital abnormalities, central venous thrombosis, etc.

**Chylous:**
- Intestinal lymphatics,
- TD
- Cisterna chyli

- Milky. TG>110-200 mg/DL (1.2-2.3 mmol/L)
- TG ratio >1
- Cholesterol ration <1
- WBC > 300 cell/mm³ and/or mainly lymphocytes

**Non chylous**
- Aortoiliac lymphatic system
- Hepatic

- High protein content

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**TABLE 2: Characteristics of ascitic fluids in chylous ascites (adapted from Cárdenas and Chopra) [1].**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Milky and cloudy</td>
</tr>
<tr>
<td>Triglyceride level</td>
<td>Above 200 mg/dL</td>
</tr>
<tr>
<td>Cell count</td>
<td>Above 500 (lymphocytic predominance)</td>
</tr>
<tr>
<td>Total protein</td>
<td>Between 2.5 and 7.0 g/dL</td>
</tr>
<tr>
<td>SAAG</td>
<td>Below 1.1 g/dL*</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>Low (ascites/serum ratio &lt; 1)</td>
</tr>
<tr>
<td>Lactate dehydrogenase</td>
<td>Between 110 and 200 IU/L</td>
</tr>
<tr>
<td>Culture</td>
<td>Positive in selected cases of tuberculosis</td>
</tr>
<tr>
<td>Cytology</td>
<td>Positive in malignancy</td>
</tr>
<tr>
<td>Amylase</td>
<td>Elevated in cases of pancreatitis</td>
</tr>
<tr>
<td>Glucose</td>
<td>Below 100 mg/dL</td>
</tr>
</tbody>
</table>

IU: international units; SAAG: serum-ascites albumin gradient.

*Is elevated above 1.1 g/dL in cases secondary to cirrhosis.
Post operative lymphocele

Papillary thyroid Cancer
Doxycycline powder

100 mg/kg

Each 100 mg: 5 ml contrast + 5 ml saline

Remove all and replace with Doxycycline
Sclerotherapy of lymphatic leak

**Multiple agents:** doxycycline, povidone-iodine, alcohol, talc, bleomycin or tetracycline, and fibrin sealants via the percutaneous drain

**Success rates of sclerotherapy for pelvic lymphoceles:**
70 to 100% depending on the study and the type of sclerosing agents

**Drain period:** 1-60 days (range of 10–20 days).

**Recurrence rate:** 20–25%, mostly resolved with additional session of sclerosis

• Intra inguinal nodes
• Warm Lipiodol
• 0.2 ml/minutes
• Hand or inflation device
• Reverse Tren-delenburg
• Compression boots
• Saline/contrast flush

Intra nodal lymphangiogram

Thoracic duct injury

Lymph node

< 10 ml lipiodol
Thoracic duct embolisation

Chiba 22 G Trans abdominal
V18/14
CXI Quick Cross
Coils 018
50% Glue
Direct needle contrast/ 30% Glue
Trans venous TD embolisation

- 4-5F Rim catheter
- Micro catheter
- 016wire
- Glue / Coils

- Difficult
- Valve
Chylothorax / Chylous ascites
Interpreted TD post blunt back trauma

PTA
Post PTA
6M: Patent TD

Recurrent idiopathic chylothorax
Penumonias, cough, malaise, weight loss (3 years)

Trans venous stent graft

Resolution in 2 weeks

5mm x 15 cm Viabahn
Post IVC tumour resection

Chyle leak 500-100 ml/day.
Intra nodal lymphangiogram
Leaking lumbar duct

Glue embolisation

Puncture lumbar duct
30% Glue

Resolved in 1 week.
Lymph leak/ascites post nodal dissection

21 patients. FU 11 month (7-18)
20 ovarian/endometrial
1 esophageal
95% success
No complications

9 patients. FU 26 week (8-77)
Prostate
100% success
No complications

- Puncture at leak
  - Glue 1 : 1 Lipiodol

- Puncture duct below leak
  - Glue 1 : 1 Lipiodol

- Puncture node below leak
  - Glue 1 : 6 - 8 Lipiodol

References:
lymphatic leak: Direct puncture

Catheter: Glue

Needle: Glue

Catheter Glue / Coils

Direct puncture and tras-collection

Gastric cancer

Needle puncture

Glue 2:1

Lymphangiogram

Coils Glue

Chylothorax and left subclavian thrombosis
Obese. Ovarian cancer
FU: 136 day
Chyle: 4000 ml $\rightarrow$ 65 ml in 2 days.

Pressurized Venogram

Puncture: Fluoro

Cannulation

Glue 1: 2

Leak
Thoracic duct anatomic variants

Typical anatomy: 40-60%

Figure 3. Anatomic variations of the TD described by Johnson et al (23). (a) Normal course: The TD arises from the cisterna chyli at T12-L2 to the right of midline and courses cranially to enter the thorax through the aortic hiatus. The intrathoracic portion of the duct crosses the midline to the left at T5-T6, ascends above the clavicle and behind the jugular vein, then curves inferiorly to drain into the left jugulosubclavian angle. (b) Complete left-sided course: the TD/cisterna chyli courses along the left aspect of the vertebral column throughout its entire length. (c) Complete right-sided course: the TD/cisterna chyli courses along the right aspect of the vertebral column and drains into the right jugulosubclavian angle. (d) Proximal duplication: the TD is partially duplicated proximally near its origin off the cisterna chyli; the two parts then join to form a single vessel that drains into the left jugulosubclavian angle. (e) Distal duplication: the TD is partially duplicated distally; the two parts then join to form a single vessel that drains into the left jugulosubclavian angle. (f) Plexiform variation: a plexiform variant TD, with numerous small web-like channels that eventually join and drain into the left jugulosubclavian angle. (g) Absence of the cisterna chyli: presence of only the TD, with no cisterna chyli.
Clinical Success
Intranodal Lymphangiogram
Thoracic duct /lymphatic embolisation

Traumatic Chylothorax
64 of 71 patients (90%). Itkin

55 adult patients
53/55 (96%) successful TDE

Overall >400 cases:
60 cases post failed TD ligation
89% success of TDE after failed TD ligation

Chylous ascites: +/- trauma

• 31 adult patients
  – 55% success

• 11 lymphatic embolization
  – 9/10 (85%) success

• 20 lymphangiogram
  – 7/20 (35%) success.


Nadolski et al SIR 2016
Nadolski et al CIRSE 2016

Thoracic duct interruption

- Multiple needle punctures of duct

Causes leak to abdomen

Less flow to chest

This is absorbed by abdominal organs

Binkert CA et al. J Vasc Interv Radiol. 2005 Sep;16(9):1257-62
Gastro-esophageal tumour

Post Wipple procedure
Lymphatic leak

NM lymphoscintigraphy: -ve
Intra nodal lymphangiogram: -ve
Hepatic lymphatic embolisation

Hepatic lymphangiogram

Glue embolisation: 1:6 dilution

Liver lymphatics: Deep periportal 80%. Superficial: 20%
Fluid reduced from 1500 to 270 ml in 2 weeks then stopped in one month

Hepatic lymphatic embolisation
NHL with right chylothorax

Resolved in 1 week

No leak
Therapeutic lipiodol action (<500ml/day)

Aquous hydrolysis
Induces granulomatous reaction with extravasation
Saponification of surrounding tissues
Embolisation effect at leakage sites causing inflammation

- Leakage sites identified:
  64% to 86% of patients with chylothorax and chylous ascites

- Lymphangiogram successful therapeutic outcome
  in 56% to 86% of cases

- Lymphatic fistula:
  successful visualization of the leakage and therapeutic outcome in 75%

11 year old

Spontaneous left chyloous effusion

Refluxing collaterals without leak
Sirolimus: mTOR inhibitor
Liver and renal transplants: prevent rejection
Unclear mechanism of action on lymphatics

1 day post lymphangiogram
Resolved with Sirolimus (Rapamycin): 2 months
TDE Complications

Acute

- 3 out of 106 chylothorax (Itkin)
- 1 Lipiodol Glue embolization
  - Venous fistula
  - Systemic: with large volume
  - Right to left shunt
- 2 Lymphedema (resolved)
- Chylous ascites
- Hypoglycemia (1/18)
- Bile leak (transhepatic puncture)

Chronic: 14%

49 patients. Mean: 34 M

- 4 (8%) chronic leg swelling
- 3 (6%) abdominal swelling X
- 6 (12%) chronic diarrhea
  - 2: another cause
  - 2: severe needing medications

References:


Protein losing enteropathy
post Fontan

High venous pressure is transmitted to liver
flow in congested liver
Then to lymphatics
Lymphatic hypertrophy
And leak into small bowel
Protein loosing enteropathy

DORV, TGA, multiple VSD, non-committed posterior VSDs, CoA
Post Fontan. Ascites

IV Albumin: from BID to none in 2 months

Contrast + Methylene blue

Glue 1:6
Hepatic lymphatic embolization: PLE

IV Albumin: from twice daily to once weekly

Glue 1:6
Onyx
Needle
Albumin dose dropped from BID to 2-3/week.
Plastic Bronchitis (PB)

- **Cardiac**
  - Single ventricle
- **Non cardiac**
  - Cystic fibrosis
  - Sickle cell anemia
  - Asthma
  - Lymphangiomatosis

Mortality of CHD with PB: 33% (14-50%)
PB mechanism:

Dilated submucosal lymphatics

Trans mucosal seepage of cast
Type II plastic bronchitis

Type IV Plastic bronchitis

Lipiodol embolization of the branches of the TD

Plastic bronchitis type V

Single ventricle post Glen and Fontan.

Obstructed Thoracic duct with leak to lungs.
Type V Plastic bronchitis

Lipiodol embolisation

MR lymphangiogram

Intra nodal lymphangiogram

Mean FU: 315 days (45–770 days)

18 patients

Pulmonary lymphatic perfusion: 16

Lymphatic embolization: 17

significant improvement: 15/17 (88%)
1 chylothorax
1 Plastic bronchitis

Coils + Glue 1:3

1 Chylothorax + Occluded ilio-femoral veins

MRI  Lymphangiogram  Coils + Glue 1:3

Resolved  Failed.

Absent compensatory lymphovenous collaterals?

Lymphatic Leak access

Via liver to hilar ducts

Via cisterna chyli

Via collection to the leak

Leak directly

Via vein to thoracic duct

Via intestinal nodes

Duct pre

Node pre
Lymphatic /Thoracic duct embolization
adults/pediatrics

• Major role in lymphatic malformation
• Safe alternative to ligation.
• With leaks > 500 - 1000 ml/day
• High success for chylothorax > chylous ascites
• Role for lymph leak in congenital heart disease
• Stent-grafting may reduce chronic complications?
• There is a major role for:
  – Sclerotherapy: collection
  – Lipiodol lymphangiography: leaks
  – Sirolimus: leaks
Thank you

- Macrocystic lymphatic malformation
- Microcystic lymphatic malformation
- Lymphocele
- Lymph fistula / leak
- Lipiodol
- Intranodal lymphangiogram
- Thoracic duct embolization
- Plastic Bronchitis
- Protein loosing enteropathy
- Hepatic lymphatic embolisation
Microcystic LM

Gravity technique

Doxycycline

Early

Late

Takes long time!
Lymphatic malformation / leak
Sclerotherapy

Monthly

Doxycycline:
Gravity

Bleomycin

Bleomycin
Still ongoing treatment
Lymphatic malformation / leak
Post surgical debulking

Bleomycin

Gravity technique
Doxycycline
Dermal Micro cystic LM
Laser: Diode/CO2
Doxycycline
Bleomycin
Hypoplastic left heart syndrome
Heart transplant / Aortic arch repair
Chylous ascites and effusions

Leak is not always found
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>(I) Neoplastic</td>
<td>Cardiac</td>
<td>(I) Iatrogenic</td>
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<tr>
<td>Solid organ cancers</td>
<td>Constrictive pericarditis</td>
<td>(A) Surgical</td>
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<tr>
<td>Lymphoma</td>
<td>Congestive heart failure</td>
<td>Abdominal aneurysm repair</td>
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<td>Sarcoma</td>
<td>Gastrointestinal</td>
<td>Retroperitoneal lymphadenectomy</td>
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<tr>
<td>Carcinoid tumors</td>
<td>Celiac sprue</td>
<td>Placement of peritoneal dialysis catheter</td>
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<td>Lymphangioleiomyomatosis</td>
<td>Whipple’s disease</td>
<td>Inferior vena cava resection</td>
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<td>Chronic lymphatic leukemia</td>
<td>Intestinal malrotation</td>
<td>Pancreatoduodenectomy</td>
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<td>(II) Diseases</td>
<td>Small bowel volvulus</td>
<td>Vagotomy</td>
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<tr>
<td>(A) Congenital</td>
<td>Ménétrier disease</td>
<td>Radical and laparoscopic nephrectomy</td>
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<td>Primary lymphatic hypoplasia</td>
<td>Inflammatory</td>
<td>Nissen fundoplication</td>
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<td>Klippel-Trenaunay syndrome</td>
<td>Pancreatitis</td>
<td>Distal splenorenal shunts</td>
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<td>Yellow nail syndrome</td>
<td>Fibrosing mesenteritis</td>
<td>Laparoscopic adrenalectomy</td>
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<td>Primary lymphatic hyperplasia</td>
<td>Retroperitoneal fibrosis</td>
<td>Gynecological surgery</td>
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<td>Lymphangioma</td>
<td>Sarcoidosis</td>
<td>(B) Nonsurgical</td>
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<td>Familial visceral myopathy</td>
<td>Systemic lupus erythematosus</td>
<td>Radiotherapy</td>
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<td>(B) Acquired</td>
<td>Behçet’s disease</td>
<td>(II) Noniatrogenic</td>
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<td>Cirrhosis</td>
<td>Peritoneal dialysis</td>
<td>Blunt abdominal trauma</td>
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<td>Infectious</td>
<td>Hyperthyroidism</td>
<td>Battered child syndrome</td>
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<tr>
<td>Tuberculosis</td>
<td>Nephrotic syndrome</td>
<td>Penetrating abdominal trauma</td>
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<tr>
<td>Filariasis</td>
<td>Drugs</td>
<td>Shear forces to the root of the mesentery</td>
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<tr>
<td>Mycobacterium avium in AIDS</td>
<td>Calcium channel blockers</td>
<td>(III) Idiopathic</td>
</tr>
<tr>
<td>Ascariasis</td>
<td>Sirolimus</td>
<td>Rule out lymphoma</td>
</tr>
</tbody>
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Quick Cross / CXI 018

30% Glue

Resolved in 1 week.
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