Hepatopulmonary Syndrome

Presented by: Ross Gaudet, MD

Patient DL

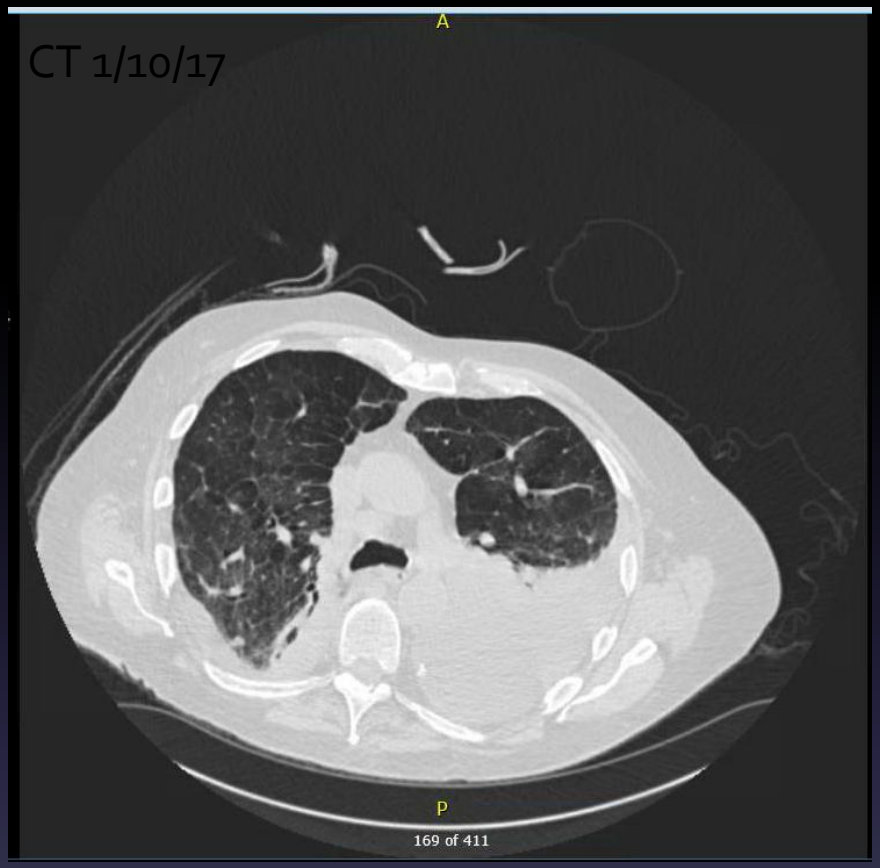
- HPI: DL is a 25 yo male with Abernathy syndrome and congenitally absent portal vein with resultant portopulmonary HTN and HPS physiology 2/2 high output state from IMV shunt s/p OLT (10/26/15) now s/p IMV shunt ligation
- PMhx: IDA, portopulm HTN
- PSHx: liver biopsy, liver transplant

Patient FM

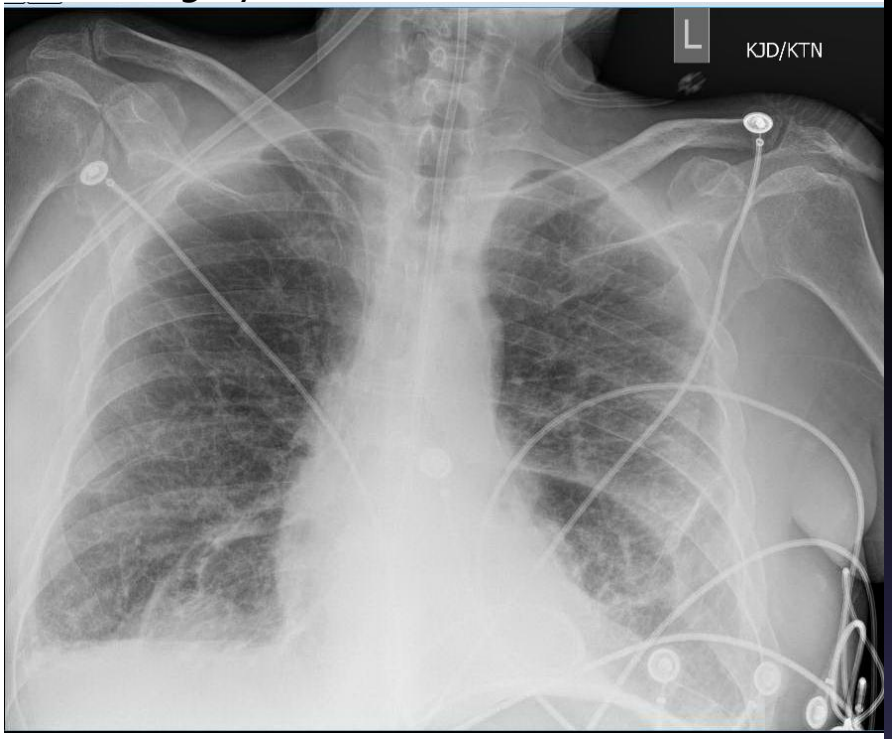
"68 year-old M with A1AT deficiency leading to ESLD which has been complicated by recurrent hydrothorax, hepatocellular carcinoma, and severe hypoxemia from hepatopulmonary syndrome now transferred from RACU to B12 ICU for progressive hypoxemia."

PMHx:
-alpha 1 anti-trypsin
-ESLD – (TIPS 2016) – **Awaiting Liver Transplant** (cancelled multiple times for respiratory insufficiency)
-HCC (s/p ablation)
-COPD (10L home O2 – PFTs 6/15 FEV1 37%, FVC 73%, FEV1/FVC 51%, DLCO 16%)
-Hepatopulmonary Syndrome
-Hydrothorax (s/p L Pleurex Cath)

CT 1/10/17



CXR 2/09/17



- RACU ABG – 7.37/33/40 (100% HF Facemask)
- B12 ABG – 7.37/36/47

- Multidisciplinary discussion w/ Drs. Mojica (Pulm Crit Care), Eikermann (Anes Crit Care), Chitilian (Anes Liver Team lead), Channick (Pulm) - Decision to intubate with goal of bridging to transplant.

- 2/9/17 Post-intubation ABG – 7.28/41/63 (sedated/ paralyzed, VC 400 PEEP 10, 70%)

- 2/10/17 ABG – 7.26/70 (Dex, PS 0/12, 80%)

- Candidate for LTX?

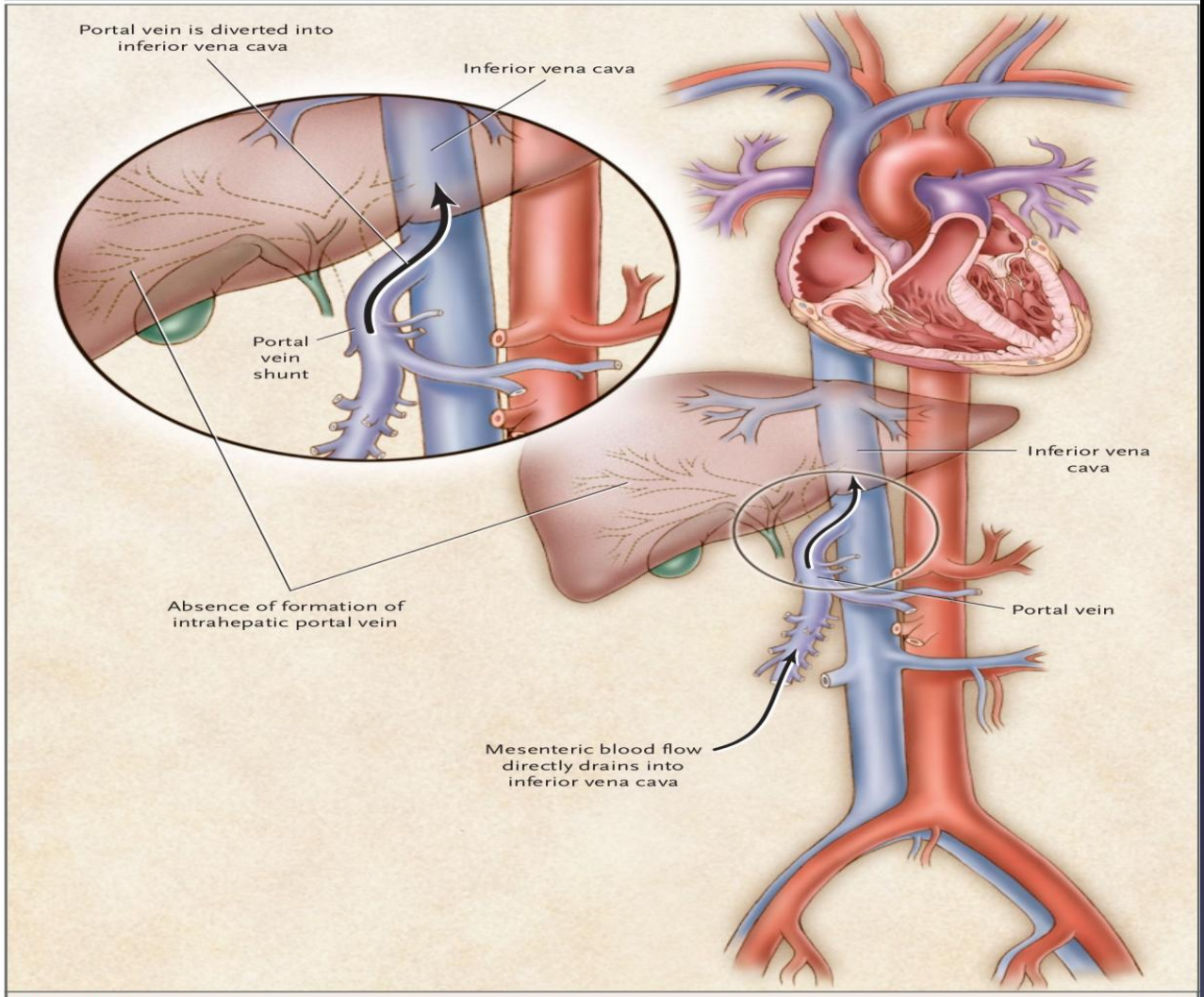


Figure 4. The Abernethy Malformation.
In the type 1 Abernethy malformation, which the patient in this case had, the portal vein is completely diverted into the inferior vena cava, instead of draining into the liver.

Patient DL

- RHC (11/2/16): pulm HTN 2/2 combination of increased PVR and high CO ; PA 64/27/42
- TTE (9/12/16): EF 70%, RV dilated (52mm), diastolic flattening of interventricular septum, dilated IVC, estimated RVSP 71

HPS vs. PPHTN

	Hepatopulmonary syndrome	Portopulmonary hypertension
Definition, Diagnostic criteria	A triad of: 1. Liver disease 2. Hypoxemia, abnormal P(A-a) > 15 mmHg 3. Intrapulmonary vascular dilatation	Pulmonary hypertension in patients with liver disease and portal hypertension Mean PAP > 25mmHg, PCWP or LA pressure <15 mmHg and other causes excluded
Symptoms	Progressive dyspnea Platypnea Cyanosis	Dyspnea on exertion Fatigue Palpitations Orthopnea Syncope-near syncope (rarely)
Chest X-ray	Usually normal	Hilar enlargement Cardiomegaly
Diagnostic tools	Contrast echocardiography (method of choice) Technetium-99-labeled macroaggregated albumin scanning Pulmonary angiography (rarely indicated for this aim)	Doppler echocardiography Right heart catheterization (gold standard)
Therapy	Oxygen supplementation Liver transplant (curative)	Vasodilators (epoprostenol, iloprost, sildenafil) Liver transplant for mild-to-moderate PPHT (partial improvement)

PPHT = Portopulmonary hypertension, LA = Left atrium, PCWP = Pulmonary capillary wedge pressure

Definition

- Broadly, symptoms of SOB and hypoxemia caused by vasodilation in the lungs in patients with liver disease

Requirements

1) Evidence of liver disease
2) Presence of hypoxemia
3) Intrapulmonary vascular abnormalities

Pathogenesis

- Increased bacterial translocation and toxin release from portal HTN may stimulate release of vasoactive mediators, increased NO and endothelin -1
  - 40 patients undergoing liver biopsy had increased levels of ET-1

Pathophysiology

- Formation of microscopic intrapulmonary arteriovenous dilations
  - Range in diameter from 15-500 microns
- NO causes more perfusion relative to ventilation, increasing VQ mismatch and oxygen diffusion limitation
- Can be corrected with O2 as oxygen is diffusion limited

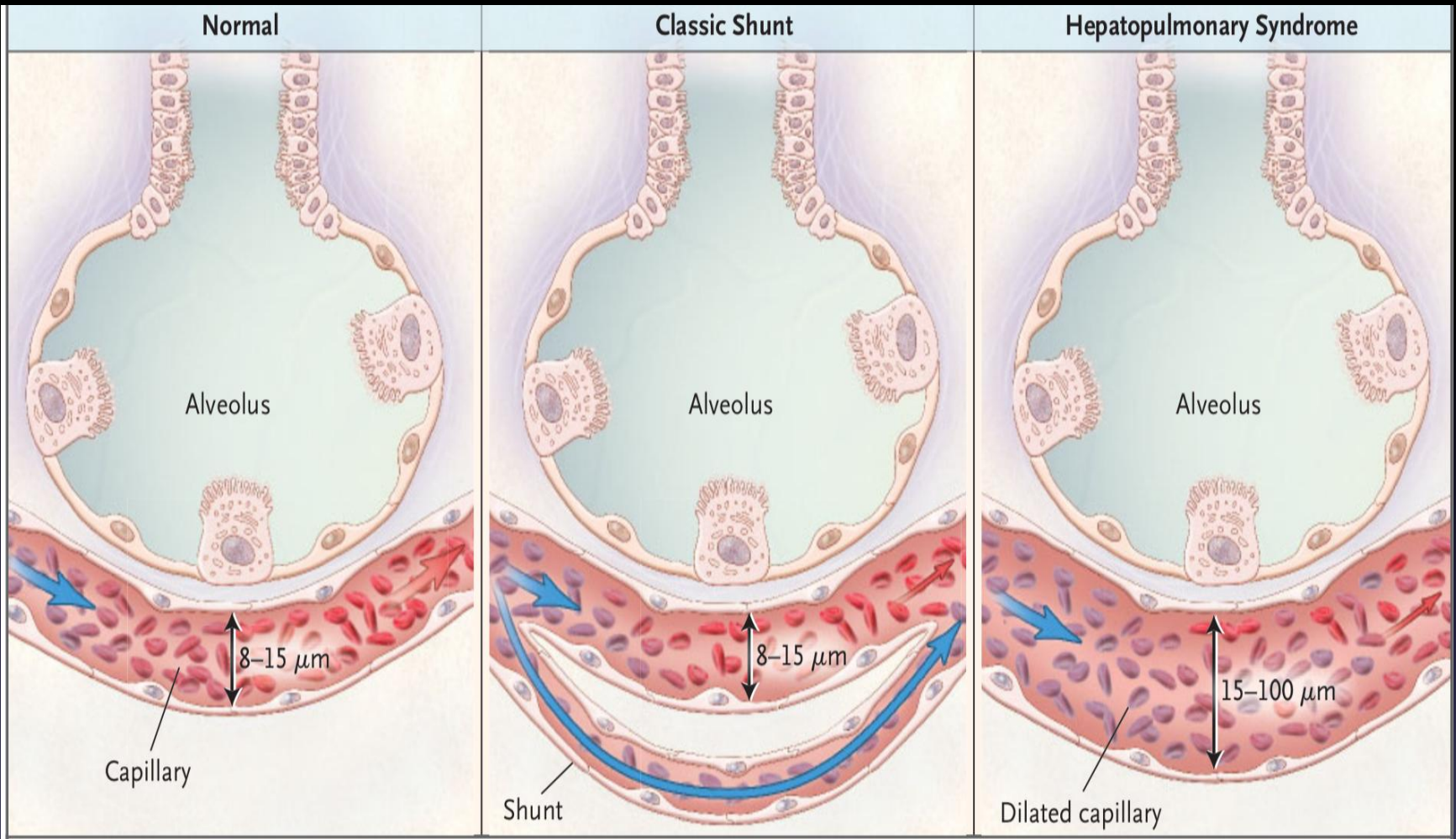


Figure 1. Mechanism of Shunting in the Hepatopulmonary Syndrome.

In a normal lung, the capillary diameter is 8 to 15 μm and oxygen diffuses rapidly into the capillary. In a classic shunt, blood bypasses the alveolus, whereas in the hepatopulmonary syndrome, the capillaries are dilated to 15 to 100 μm in diameter, and oxygen fails to diffuse into the

Symptoms/Presentation

- SOB
- Platypnea
- Orthodexia
  - PaO_2 of 4 or SaO_2 of 5% difference

Symptom Severity

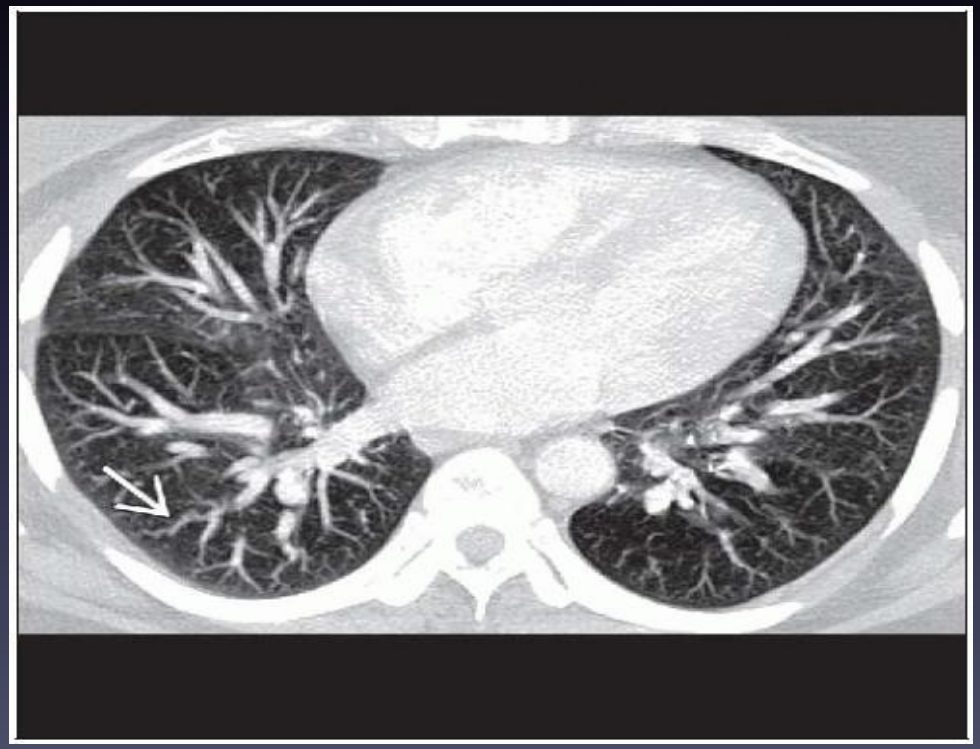
- Mild – Arterial oxygen tension (PaO_2) ≥80 mmHg while breathing room air
- Moderate – A PaO_2 ≥60 mmHg and <80 mmHg while breathing room air
- Severe – A PaO_2 ≥50 mmHg and <60 mmHg while breathing room air
- Very severe – A PaO_2 <50 mmHg while breathing room air or a PaO_2 <300 mmHg while breathing 100 percent oxygen.

Diagnosis: A-a

- Increased A-a gradient (calculation of alveolar oxygen:
  - $P_AO_2 = (F_iO_2 * (P_{atmos} - P_{H_2}O)) - (P_aCO_2 / RQ)$
- A-a > or = to 15 ; if age >65 > or = 20

Diagnosis: CT scan

- Dilated peripheral pulmonary vessels and increased pulmonary artery to bronchus ratios



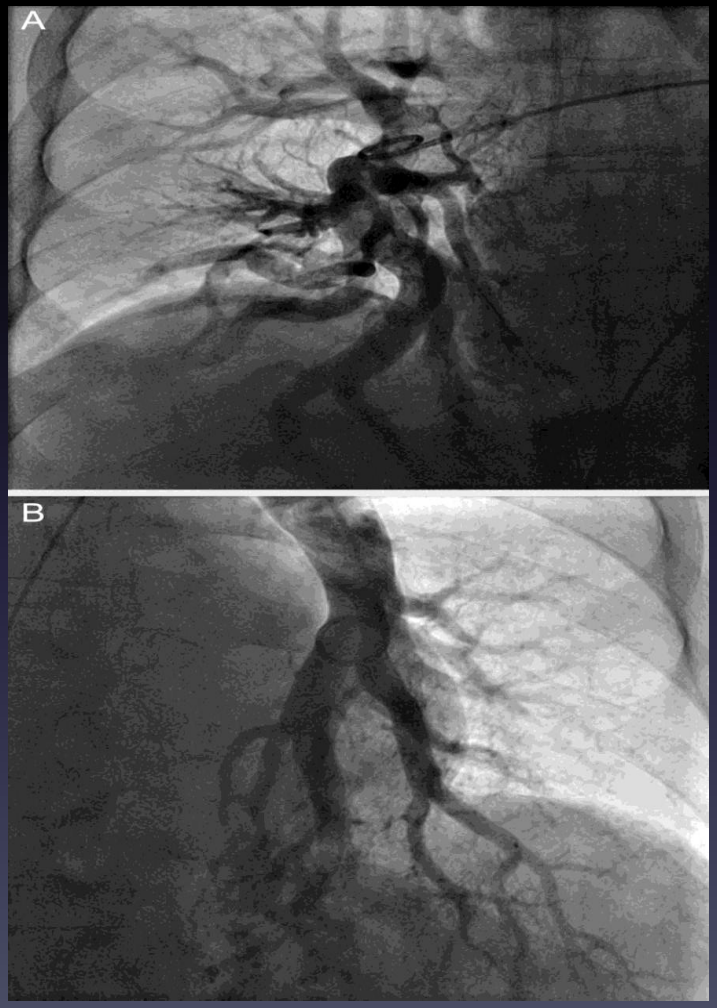
http://radiologykey.com/wp-content/uploads/2016/09/DA3-DB7-Hepatopulmonary_Syndrome-FF2.gif

Diagnosis: Contrast Echo

- Agitated saline that is normally obstructed by pulmonary capillaries appear in the left atrium within 3-8 heart beats

- https://www.youtube.com/watch?v=VuhGCCgEWTA

Diagnosis: Pulm Angio

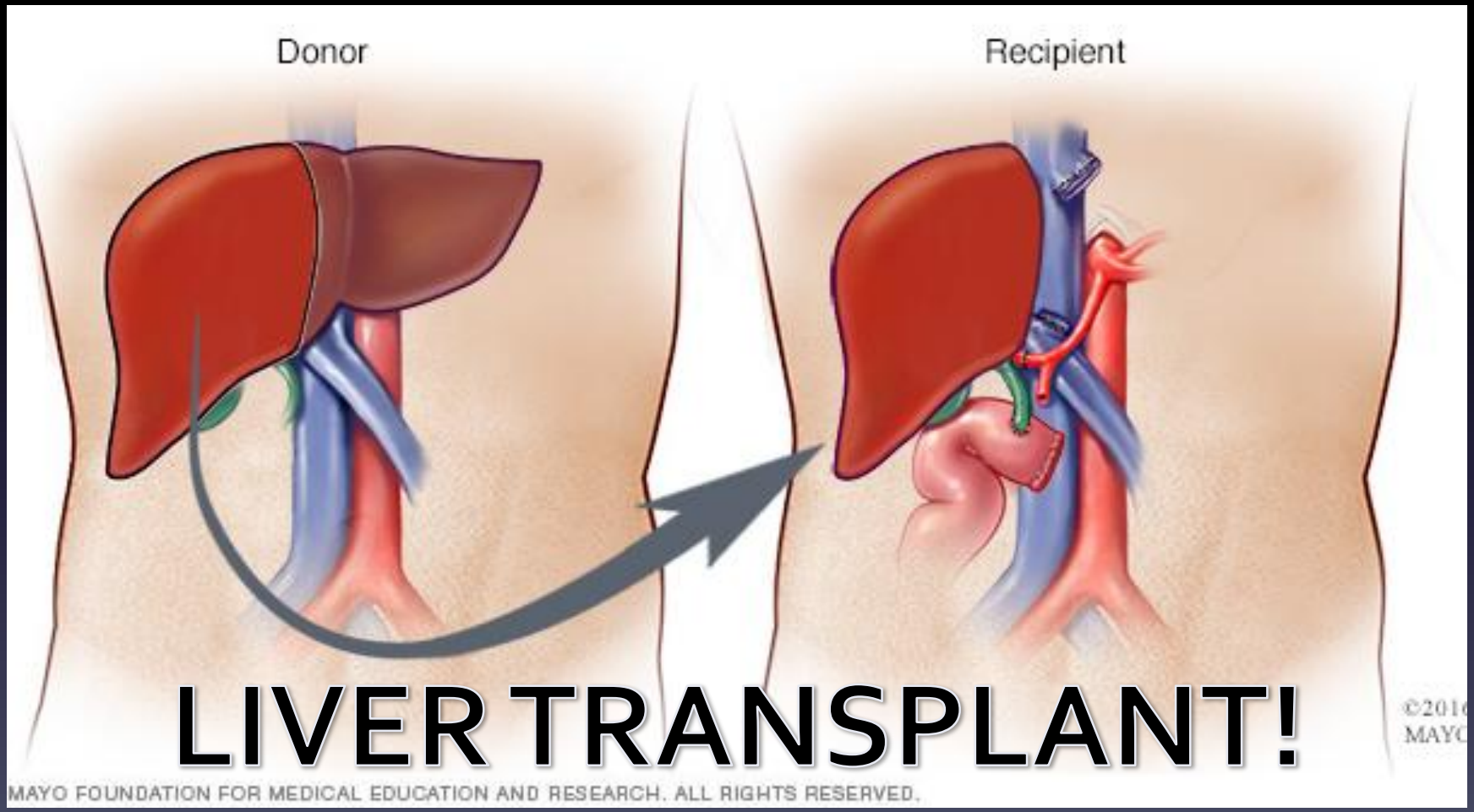


- Reveals diffusely blotchy vascular configuration

Treatment

- Supplemental oxygen
- Somatostatin – stops vasodilation
- Nitric Oxide – heterogenous vasodilation so able to improve V/Q matching

Treatment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BEWARE – Post tx HPS

- Severe post-tx HPS define as 100 Fio2 to maintain sat >85
  - Trendelenburg, epoprosteonol, nitric oxide, methylene blue, embolization, ECMO

Other Treatment Options

- TIPS
- Embolization
- Pentoxifylline - nonspecific PDE inhibitor with inhibitory effects on TNF-alpha
- Quercetin - flavonoid antioxidant

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DL: Patient Outcome

- Admitted to Blake 12 with persistent oxygen requirement after surgery – initially on FM 10-12 L with sats 88% → HFNC 100%
- Still with low sats, added veletri no change → inhaled NO, but stopped 2/2 no benefit (all while on home ambrisentan/tadalafil)
- PE/CT negative, TTE showing shunt (? PFO vs intra-pulm shunt), treated for possible CAP

DL: Patient outcome

- Slow wean of HFNC FiO_2 to 4L NC over week on Blake 12
- Discharged home on POD #7 on RA with home O_2 for exertion
- Readmitted 12/27-12/29 with back/abdominal pain, decreased voiding for thrombus in ligated IMV shunt, started on Eliquis
- Progress Note 1/17/17 – doing well, off oxygen

FM: considerations

- There was a question of whether the hypoxemia was based solely on HPS in the light of patient's severe COPD leading to massive auto-PEEP as been demonstrated by Dr. Chipman.
- Shunt was demonstrated on two recent echocardiograms (June '16 / December '16), but could this also be PFO-related?
- The nitric oxide trial may help improve oxygenation during perioperative period.