Disturbances of Circulation, Lab 1: Edema and hyperemia

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Edema

Defn: Abnormal accumulation of fluid in the interstitium or in body cavities

Diagram:
- Plasma hydrostatic pressure
- Plasma colloidal osmotic pressure
- Tissue colloidal osmotic pressure
- Tissue hydrostatic pressure
- Excess fluid
- Lymphatic drainage
Edema – 5 Pathophysiological Mechanisms of Development

1) ↓Plasma colloidal osmotic pressure
   - Hypoproteinemia– protein losing enteropathy or nephropathy, liver disease
   - Generalized edema

2) ↑Blood hydrostatic pressure
   - Generalized edema: heart failure
   - Localized edema: Occlusion of the local venous return

3) Lymphatic obstruction
   - Localized edema

4) Sodium retention
   - Generalized – seen with renal disease

5) ↑Vascular permeability
   - Edema of inflammation
   - Localized
Edema – Gross Appearance

- Wet and gelatinous tissues
- Organs heavy and swollen
- Fluid weeps on cut surface
Edema – Gross Appearance

- Wet and gelatinous tissues
- Organs heavy and swollen
- Fluid weeps on cut surface
Pulmonary edema – Gross appearance

First, remember normal:
Pulmonary edema – Gross appearance

Accumulation of fluid in the interstitium and alveoli

- Wet heavy lungs
- Interlobular septa expanded by fluid
- Often congested (red)

Courtesy of Dr Alfonso Lopez
Often see froth in trachea and exuding from the nares

Pulmonary edema – Gross appearance
Edema – Example 1

What do you see?

Swelling of the foot below the leg band
Edema – Example 2

Localized or generalized? Swelling is localized to the foot

Which of the following processes could this be due to?

- ↓ Plasma colloidal osmotic pressure
- Lymphatic obstruction
- ↑ Blood hydrostatic pressure
- ↑ Vascular permeability
- Sodium retention

In this case, a tight leg band has caused swelling: due to localized venous occlusion leading to a local increase in the hydrostatic pressure
2 day old calf:
Failure to thrive since birth. Calf collapsed and Farmer brought it to AVC

What do you see?

Morphologic Diagnoses?
Edema – Example 2

What do you see?
- Lungs are red, wet and shiny
- Fluid in the thorax
- Expansion of the interlobular septa

Morphologic Diagnoses?
- Pulmonary edema
- Pulmonary congestion
- Hydrothorax
Yellow gelatinous fluid expands the subcutaneous tissues

Morphologic Diagnosis

- Subcutaneous edema
Localized or generalized?

Generalized

Which of the following processes could this be due to?

- Plasma colloidal osmotic pressure
- Lymphatic obstruction
- Blood hydrostatic pressure
- Vascular permeability
- Sodium retention
Edema – Example 2

The most common cause of pulmonary edema = ↑ Blood hydrostatic pressure due to heart failure

“White muscle disease”
Edema in body cavities (effusions)

- Hydrothorax
  - Fluid in the thorax

![Image of Hydrothorax](image-url)
Edema in body cavities (effusions)

- Hydropericardium
  - Fluid in the pericardial sac
Edema in body cavities (effusions)

**Hydroperitoneum**
- Fluid in the abdominal cavity
Edema – Example 3

What do you see?

Facial swelling
Edema – Example 3

If this is localized to the face, which of the following processes is possible?

- \(\downarrow\) Plasma colloidal osmotic pressure (\(\downarrow\) protein)
- ✔ Lymphatic obstruction
- ✔ \(\uparrow\) Blood hydrostatic pressure
- ✔ \(\uparrow\) Vascular permeability
- ❎ Sodium retention

Facial swelling: Most often due to an allergic response, such as seen with an insect bite: Involves localized increase in vascular permeability (inflammatory edema)
Edema – Example 3

Chylothorax
- Accumulation of chyle (triglyceride-rich lymph fluid) in the thorax

Chyloabdomen
- Accumulation of chyle in the abdomen

Rupture of major lymphatic vessels:
- Trauma
- Neoplasia
- Congenital defect
- Inflammation
- Idiopathic
An excessive amount of blood in an organ (refers to both volume and flow)  
*Hyperemia ≠ Hemorrhage

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<th>Hyperemia and Congestion</th>
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<tr>
<td>Duration</td>
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<tr>
<td>- Acute (rapid)</td>
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<td>Extent</td>
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<tr>
<td>- Localized</td>
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<td>Mechanism</td>
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**Hyperemia**

- **Acute (rapid)**
- **Chronic (prolonged)**

**Congestion**

- **Localized**
- **Generalized**

**Mechanism**

- **Active = \( \uparrow \) arteriolar flow**
- **Passive = \( \downarrow \) venous drainage**
Passive hyperemia = Congestion

Acute local active hyperemia

Acute local passive hyperemia

Chronic local passive hyperemia

Chronic generalized passive hyperemia

Excessive blood in an organ

INFLAMMATION

Local obstruction to venous drainage – develops rapidly

CONGESTIVE HEART FAILURE

Local obstruction to venous drainage – develops slowly
Hyperemia/Congestion: Example 1

4 year old dog: Dog seemed more quite than usual, collapsed and died
Hyperemia/Congestion: Example 1

What do you see?

- Dark red discoloration of the small intestine
- Dilation of the small intestine

4 year old dog: Dog seemed more quite than usual, collapsed and died
Hyperemia/Congestion: Example 1

Torsion at the root of the mesentery
Hyperemia/Congestion: Example 1

Which one of the following categories would this fall into:

- Acute local active hyperemia
- Acute local passive hyperemia (acute local congestion) √
- Chronic local passive hyperemia (chronic local congestion)
- Chronic generalized passive hyperemia (chronic generalized congestion)

Rapidly developing local obstruction to venous drainage
Hyperemia/Congestion: Example 2

12 year old cat: Has been inactive with recent respiratory distress and collapse
Hyperemia/Congestion: Example 2

What do you see?

Dark red discoloration of the lungs

Wet lungs

Liver mildly enlarged with rounding of margins
Hyperemia/Congestion: Example 2

What do you see?

Enhanced reticular (zonal) pattern in the liver: Congestion (dark red) in central regions surrounded by yellow-brown tissue

“Nutmeg liver”
Hyperemia/Congestion: Example 2

Which one of the following categories would this fall into:

- Acute local active hyperemia
- Acute local passive hyperemia (acute local congestion)
- Chronic local passive hyperemia (chronic local congestion)
- Chronically generalized passive hyperemia (chronic generalized congestion)

✓ Chronically generalized passive hyperemia (chronic generalized congestion)
Hyperemia/Congestion: Example 2

“feline hypertrophic cardiomyopathy”
Hyperemia/Congestion: Example 2

Left heart failure: leads to congestion and edema of the lungs

“feline hypertrophic cardiomyopathy”
Hyperemia/Congestion: Example 2

Right heart failure: leads to congestion of the liver and generalized edema

“feline hypertrophic cardiomyopathy”
Hyperemia/Congestion: Example 3

What do you see?

Bright red discolouration of the skin of the ears and snout
Hyperemia/Congestion: Example 3

Which one of the following categories would this fall into:

- **☑** Acute local active hyperemia
- Acute local passive hyperemia (acute local congestion)
- Chronic local passive hyperemia (chronic local congestion)
- Chronic generalized passive hyperemia (chronic generalized congestion)

This is active hyperemia – hyperemia of inflammation. Hyperemia of the skin is a common finding in pigs with sepsis.