Circulatory Disturbances 2: Hyperemia and Congestion

Shannon Martinson, Feb 2016
http://people.upei.ca/smartinson/

VPM 152 General Pathology
CIRCULATORY DISTURBANCES

- Edema
- Hemorrhage
- Infarction

- Congestion and Hyperemia
- Thrombosis and Embolism
- Shock
Learning Objectives

• Define congestion and hyperemia
• Differentiate between the two with regard to:
  • Mechanisms / underlying causes
  • Appearance (gross and histologic)
  • Effects
• Understand / differentiate between the 2 types of hyperemia
• Know what kind of congestion is seen with right and left heart failure
• Be able to differentiate acute and chronic pulmonary congestion (gross and histology)
  • Know the consequences of chronic pulmonary congestion
• Be able to recognize and describe hepatic congestion and know under what condition it occurs
Hyperemia and congestion indicate a local increase in blood within a tissue.

Hyperemia: An excess of blood within blood vessels in a part of the body due to an active process.

Congestion: An excess of blood within blood vessels in a part of the body due to a passive process.
ALTERATIONS IN BLOOD FLOW & PERFUSION - HYPEREMIA

Hyperemia
- Active process
- Increased blood entering tissue via arterial flow
- Oxygenated (red)

NORMAL

Arteriole

Increased inflow
(e.g., exercise, inflammation)

VENULE

HYPEREMIA
Erythema
Active engorgement of vascular beds due to increased arteriolar inflow

Response to stimulus → Can be physiologic or pathologic
## Physiologic Hyperemia

<table>
<thead>
<tr>
<th>Digestion</th>
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<tr>
<td>Exercise</td>
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<tr>
<td>Dissipate heat</td>
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<tr>
<td>Neurovascular</td>
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<td>(blushing)</td>
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Pathologic Hyperemia

- Due to an underlying pathologic process → INFLAMMATION
- Arteriolar dilation in response to inflammatory stimuli / mediators
- Often accompanied by edema
Pathologic Hyperemia = Hyperemia of Inflammation

One of the cardinal signs of inflammation is reddening = “rubor”
Gross Findings

- Increased redness in the affected tissue
- Swelling, warmth

- Always a localized change*
- Best appreciated in the living
Histology Findings

- Capillaries +/- arterioles are dilated and filled with blood

Effect of hyperemia – hastens movement of metabolites into an area and flushing of catabolites from the area
ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

- Passive process
- Decreased outflow of blood
- Deoxygenated (blue)

Congestion

NORMAL

CONGESTION
cyanosis/hypoxia

Decreased outflow
(e.g., local obstruction, congestive heart failure)
- Passive engorgement of vascular beds
- Decreased/obstructed venous return
- Tissue dark red to blue / black (cyanotic)
- Poorly oxygenated hemoglobin
Gross Appearance

- Dark red to blue / black → depending on degree of stagnation of blood
- Tissues might be cooler than normal
- Cut surfaces ooze blood and are often wet due to accompanying edema
ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

Histopathology

Acute Congestion
• Engorged capillaries
• Some edema

Chronic Congestion
• Hypoxia (↓O₂)
  • Atrophy
  • Degeneration / necrosis

Effect of congestion
• Leads to hypoxia and accumulation of catabolites
• Often edema occurs
• Interference with normal tissue function
• May get thrombosis of congested veins
• +/- proliferation of connective tissue if chronic
Two factors used to define types of congestion

1. Duration
   - Acute (sudden)
   - Chronic (long-term)

2. Extent
   - Localized – Change is confined to a discrete area
   - Generalized – Indicates systemic change (eg heart failure)
ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

- Local obstruction to venous drainage
  - Such as when and organ twists

Localized congestion

Intestinal torsion

Intestinal intussusception
ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

- Sudden death due to heart failure or euthanasia with barbiturates
- Blood accumulates in lung, spleen and liver

Acute generalized congestion
Sudden death due to heart failure or euthanasia with barbiturates

Blood accumulates in lung, spleen and liver

Generalized congestion occurs with pathology of the heart or lung
- Left heart failure
- Right heart failure
- 1° Pulmonary disease
ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

- **LEFT** sided heart failure
- Congestion and edema of the lungs
ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

• Pulmonary congestion
  • Usually due to LEFT heart failure
  • When acute → lungs are red (congestion), wet (edema) and heavy
• Pulmonary congestion
  • Usually due to LEFT heart failure
  • When chronic → lungs can be light brown due to hemosiderin accumulation
Consequences of Chronic Pulmonary Congestion

1. Intra-alveolar hemorrhages
   • “Heart failure cells”

2. Pulmonary Edema
   • Interferes with gas exchange

3. Interstitial Fibrosis

4. Pulmonary Hypertension
   • ↑ Pressure in pulmonary artery
   • +/- Cor pulmonale
RIGHT sided heart failure

- Systemic congestion – Liver especially
- Generalized edema (SQ, ascites, hydrothorax)
Primary pulmonary disease

- Lung disease → progressive damage of pulmonary vascular bed → increased resistance /pulmonary hypertension → RIGHT heart failure
- Generalized edema (SQ, ascites, hydrothorax) and hepatic congestion

Cor pulmonale

- Right heart failure resulting from pulmonary disease
• Hepatic Congestion
  • Most often due to right heart failure
  • Less often secondary to pulmonary hypertension and cor pulmonale
• Hepatic Congestion
  • Gross appearance:
    • Liver is enlarged and dark brown with rounded edges
• Hepatic Congestion
  • Gross appearance:
    • Liver is enlarged and dark brown with rounded edges
• Hepatic Congestion
  • Gross appearance:
    • Cut surface may have a reticular / zonal pattern (= nutmeg liver)
ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

1 = caudal vena cava
21 = hepatic veins
38 = portal vein

ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

Histopathology – Acute hepatic congestion

Zone 1 - relatively normal

Zone 2 - fatty change (partial hypoxia)

Zone 3 - congested sinusoids, hepatocyte degeneration/necrosis/loss
ALTERATIONS IN BLOOD FLOW & PERFUSION - CONGESTION

Histopathology – Acute hepatic congestion
In zone 3
- Hemosiderin within macrophages (kupffer cells)
- Hepatocyte loss &/or atrophy and dilated sinusoids
- Increased connective tissue around central veins
ALTERATIONS IN BLOOD FLOW & PERFUSION

Hyperemia/Congestion vs Hemorrhage

Congestion / Hyperemia – RBCs are within the blood vessels (*)

Hemorrhage – RBCs are outside vessels (→)
Questions?
How would you describe this change

- Clear pale yellow gelatinous fluid expands the subcutis of the hind limb

What’s your morphologic diagnosis?

- Subcutaneous edema, locally extensive, acute, severe
What do these two findings tell you about the lungs?

- Froth in the trachea and exuding from the nares indicates that is pulmonary edema
What is your morphologic diagnosis?

- Hydropericardium, moderate

Possible cause?

- Hypoproteinemia, congestive heart failure
Give 3 morphologic diagnoses?

- Pulmonary edema, diffuse, acute, marked
- Pulmonary congestion, diffuse, acute, marked
- Hydrothorax, marked