

EDEMA

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EDEMA

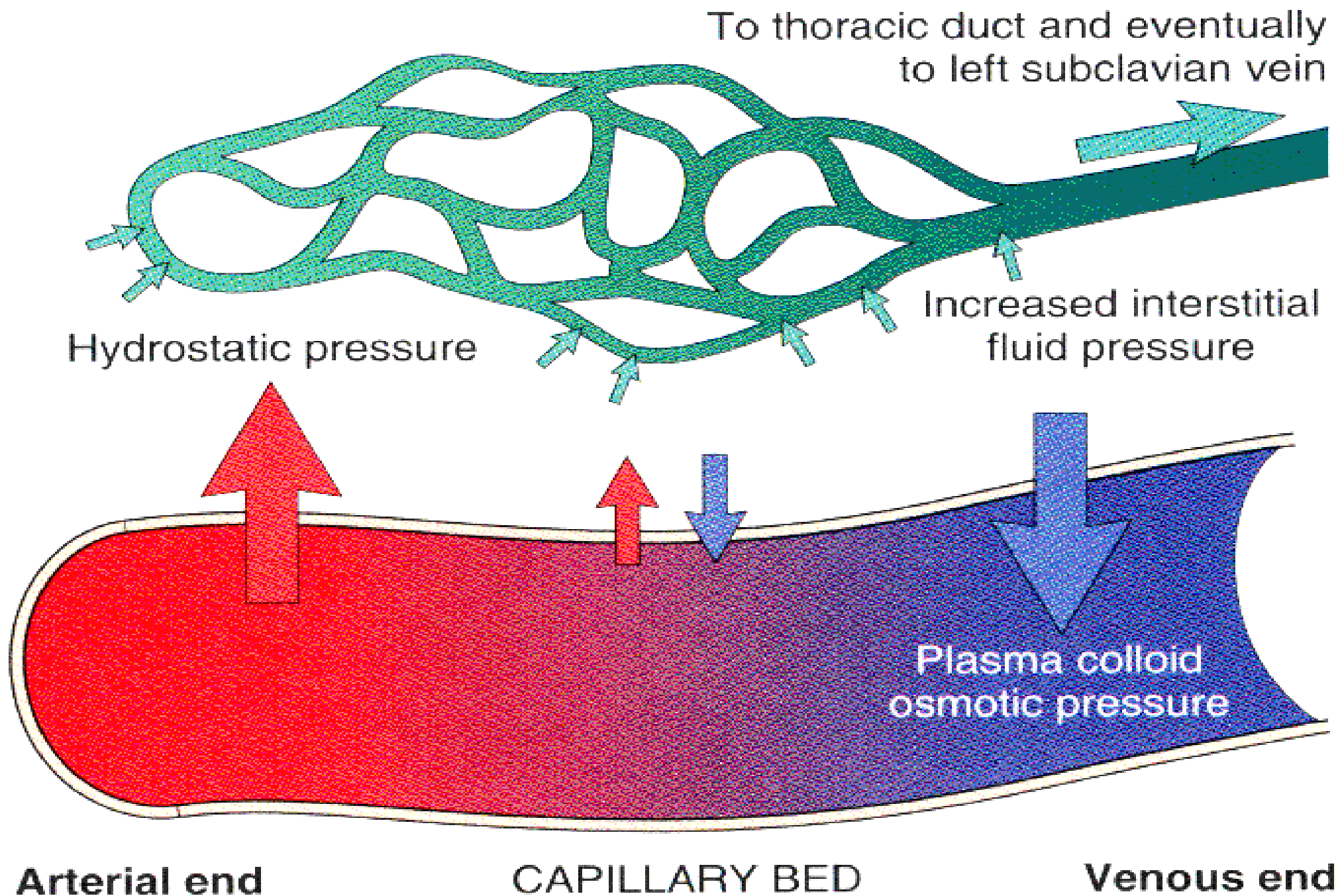
- Increased fluid in the *interstitial tissue spaces*.
- Generalized & massive edema with profound subcutaneous swelling is called *Anasarca*

EDEMA

- Fluid may also accumulate in body cavities
- These collections of fluid are referred to based on location as:
 - Hydrothorax, hydropericardium, hydro peritoneum
 - Hydroperitoneum is also called *Ascites*

Fluid Homeostasis

- maintained by opposing effects of vascular hydrostatic pressure and plasma colloid osmotic pressure
- Govern movement of fluid b/w vascular & interstitial space.



Edema Fluid = TRANSUDATE

- A **transudate** is an effusion caused by mechanical factors influencing the formation or reabsorption of fluid eg: decreased plasma albumin & or increased venous pressure.
protein-poor fluid with specific gravity <1.012 .
- An **exudate** is an effusion caused by inflammation or damage to mesothelial lining.
protein-rich fluid with specific gravity >1.020 .

TRANSUDATE & EXUDATE

- Occurs in hydrodynamic derangements
- Appearance: Clear
- Coagulation : Absent
- Protein- poor fluid($< 2.5\text{g/dl}$)
- Fibrinogen: 0.3-0.4% of total protein
- Sp. Gravity < 1.012
- Cells: few cells present
- Bacteria: Absent
- Eg: CCF, hepatic cirrhosis, Nephrotic syndrome

- Inflammatory edema
- Increased vascular permeability
- Appearance: Cloudy /purulent
- Coagulation : may be present
- Protein rich fluid($>2.5\text{g/dl}$)
- Fibrinogen: 4-6% of total protein
- Sp. Gravity > 1.020
- Cells: Many cells present
- Bacteria: May be present
- Eg: TB, Bacterial/fungal infection, neoplasms etc.

Pathophysiologic Categories of Edema

- I. Increased Hydrostatic Pressure
- II. Reduced Plasma Osmotic Pressure
(Hypoproteinemia)
- III. Lymphatic obstruction
- IV. Sodium retention
- V. Inflammation

Pathophysiologic Categories of Edema

I. Increased Hydrostatic Pressure

Impaired venous return

- Congestive Heart Failure
- Constrictive pericarditis
- Portal Hypertension (Ascites- cirrhosis)
- Venous Obstruction or compression
Thrombosis

External pressure (mass)

Lower extremity inactivity with
prolonged dependency

Pathophysiologic Categories of Edema

Reduced Plasma Osmotic Pressure (Hypoproteinemia)

- Nephrotic syndrome
- Liver cirrhosis – (ascites)
- Malnutrition
- Protein losing glomerulopathy

Pathophysiologic Categories of Edema

Lymphatic obstruction

- Inflammatory
- Neoplastic
- Postsurgical
- postirradiation

Pathophysiologic Categories of Edema

Sodium retention

- Excessive salt intake with renal insufficiency
- Increased tubular reabsorption of sodium

Renal hypoperfusion

Increased renin- angiotensin- aldosterone secretion

Pathophysiologic Categories of Edema

Inflammation

- Acute & chronic inflammation
- Angiogenesis

Increased Hydrostatic Pressure

- *Local increases* in hydrostatic pressure, result from impaired venous outflow. eg: deep vein thrombosis
- “*Generalized increases* in venous pressure, with resultant SYSTEMIC EDEMA, occur MOST COMMONLY in CONGESTIVE HEART FAILURE”
- Thus, Congestive Heart Failure is the most common cause of EDEMA due to Increased Hydrostatic Pressure

Congestive Heart Failure

- The Pump is FAILING!!! (All the blood going *in* IS NOT going **out!**)
- Blood backs up, first into the lungs,
- then into the venous circulation -
increasing Central Venous Pressure
(CVP)

Congestive Heart Failure

- Increased CVP leads to increased capillary pressure (Hydrostatic Pressure)
- Leading to Edema

Congestive Heart Failure

TWO main effects...

- 1.** Increased Central Venous Pressure
- 2.** Decreased Renal Perfusion

Congestive Heart Failure

Decreased Renal Perfusion

- Decreased Cardiac Output
- Leads to decreased ARTERIAL blood volume

Less arterial blood...Less renal perfusion...

The Kidney doesn't see enough blood coming through

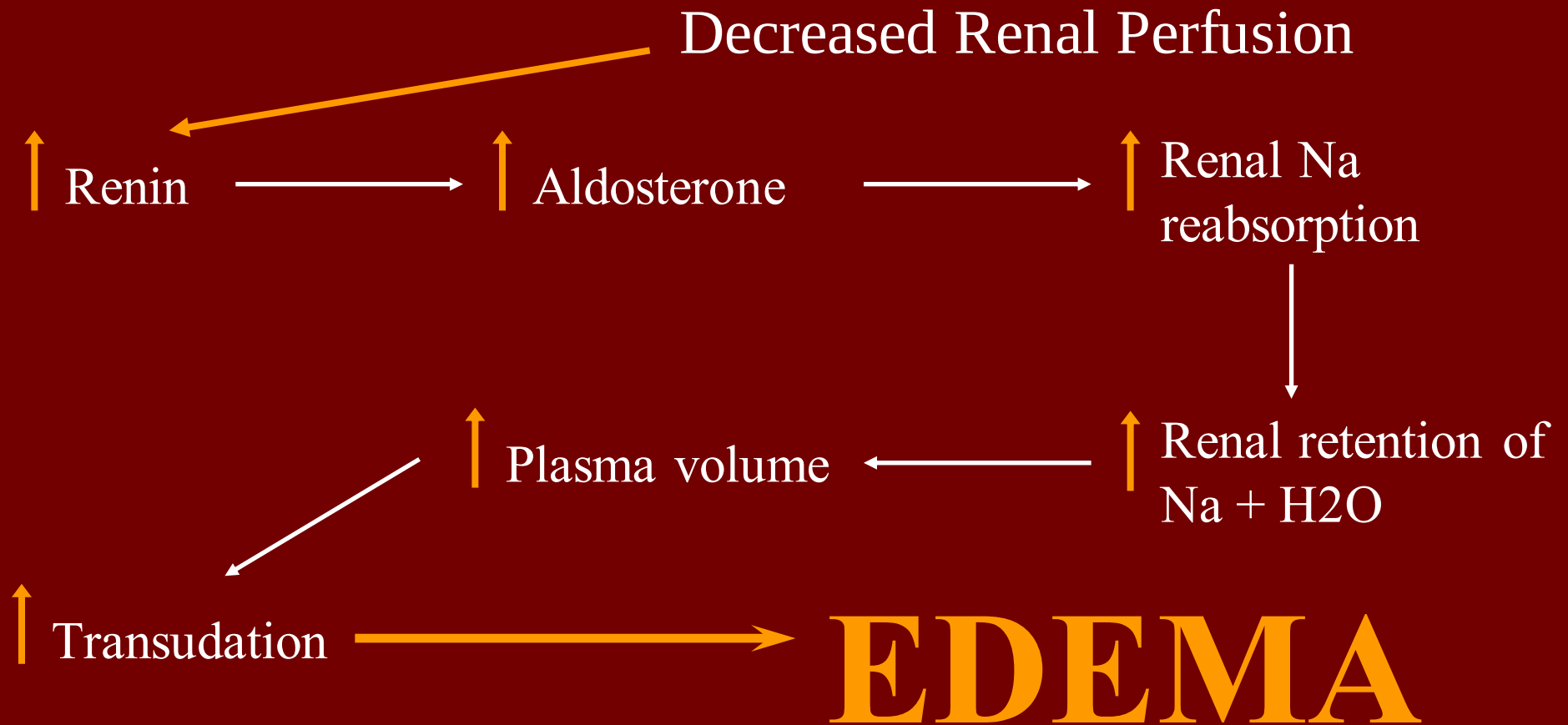
Congestive Heart Failure

Decreased Renal Perfusion

- Decreased Renal Perfusion activates the Renal Defense Mechanisms:
 - Renin- Angiotensin- Aldosterone Axis
 - Renal Vasoconstriction
 - Increased Renal Anti-diuretic Hormone (ADH)

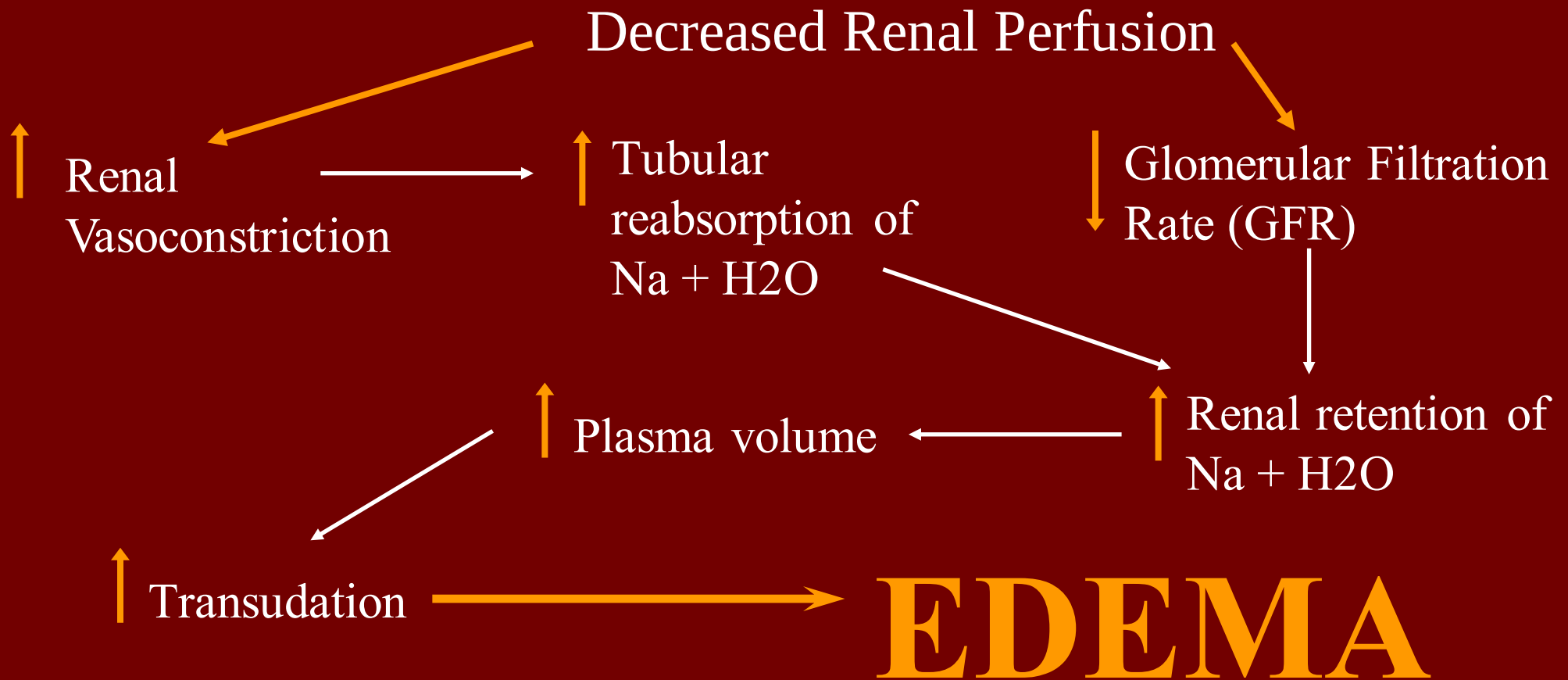
Congestive Heart Failure

Renin- Angiotensin- Aldosterone Axis



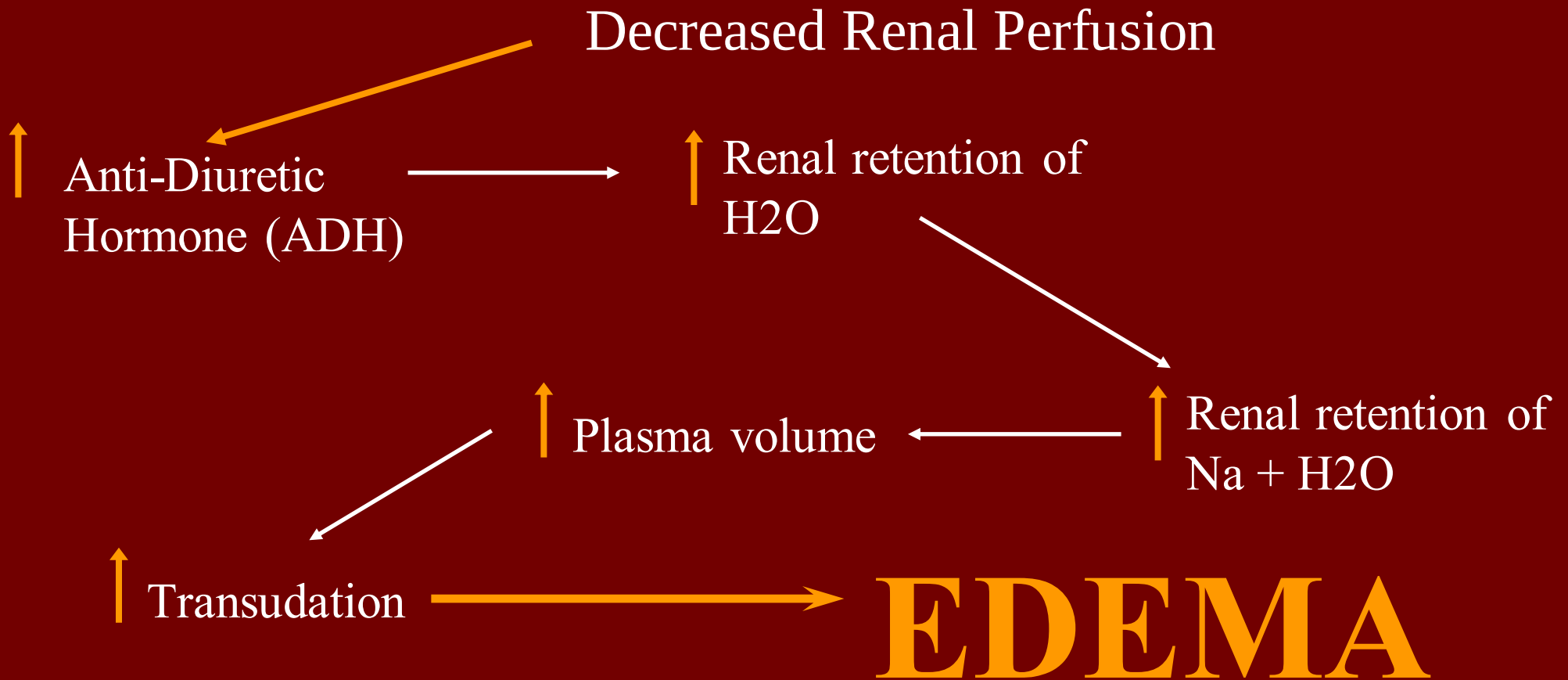
Congestive Heart Failure

Renal Vasoconstriction

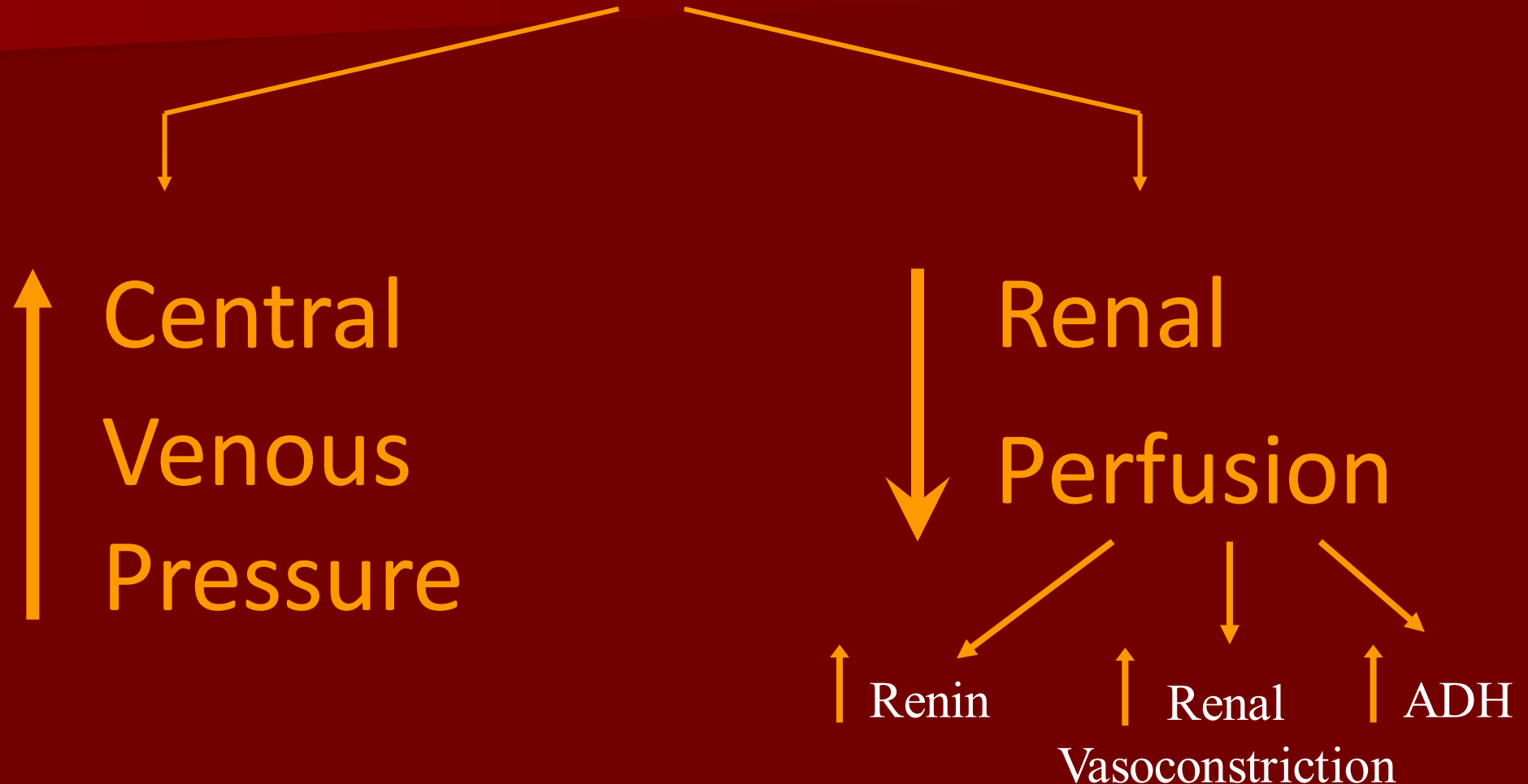


Congestive Heart Failure

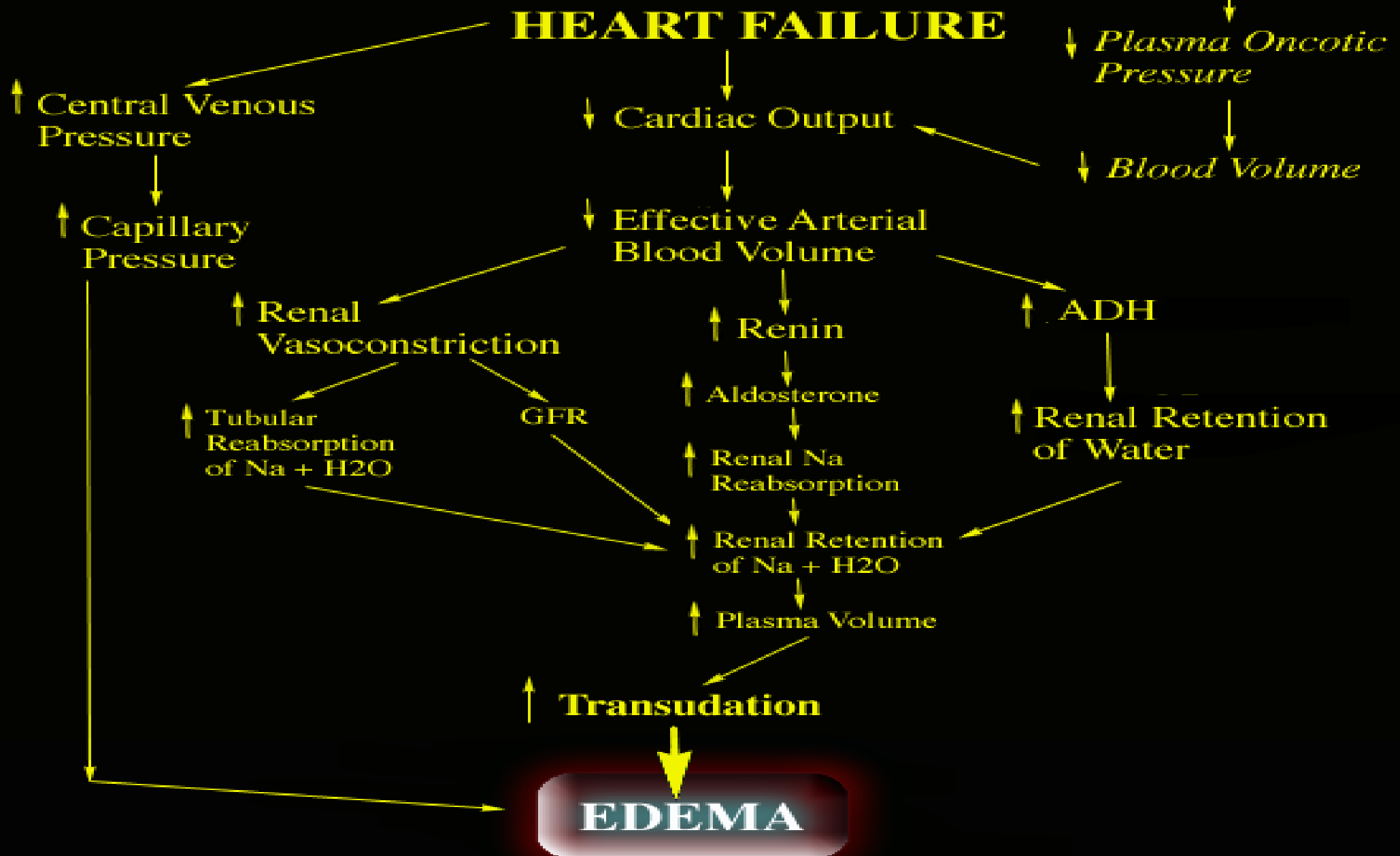
Anti-Diuretic Hormone



Congestive Heart Failure



NEPHROTIC SYNDROME



Portal Hypertension

“Ascites (Liver Cirrhosis)”

- Portal Hypertension is “Increased resistance to portal blood flow”
- The most common cause of Portal Hypertension is CIRRHOSIS

Portal Hypertension leads to ASCITES

- Pathogenesis of Ascites is complex
 - Increased Portal Pressure (hydrostatic pressure) leads to increased liver sinusoidal hypertension. Fluid moves into the Space of Disse then into lymphatics.

Pathogenesis of Ascites

- The hepatic lymph percolates into the peritoneal cavity
 - Normal thoracic duct lymph = 1 Liter/d
 - In cirrhosis, hepatic lymph flow far exceeds Thoracic duct capacity

Pathogenesis of Ascites

- Cirrhosis leads to hypoalbuminemia sneaking into the next category
- And ultimately, there is decreased renal perfusion leading to secondary hyperaldosteronism (increased renin etc.)

Portal Hypertension

Cirrhosis

Sinusoidal Hypertension

Serum
Albumin

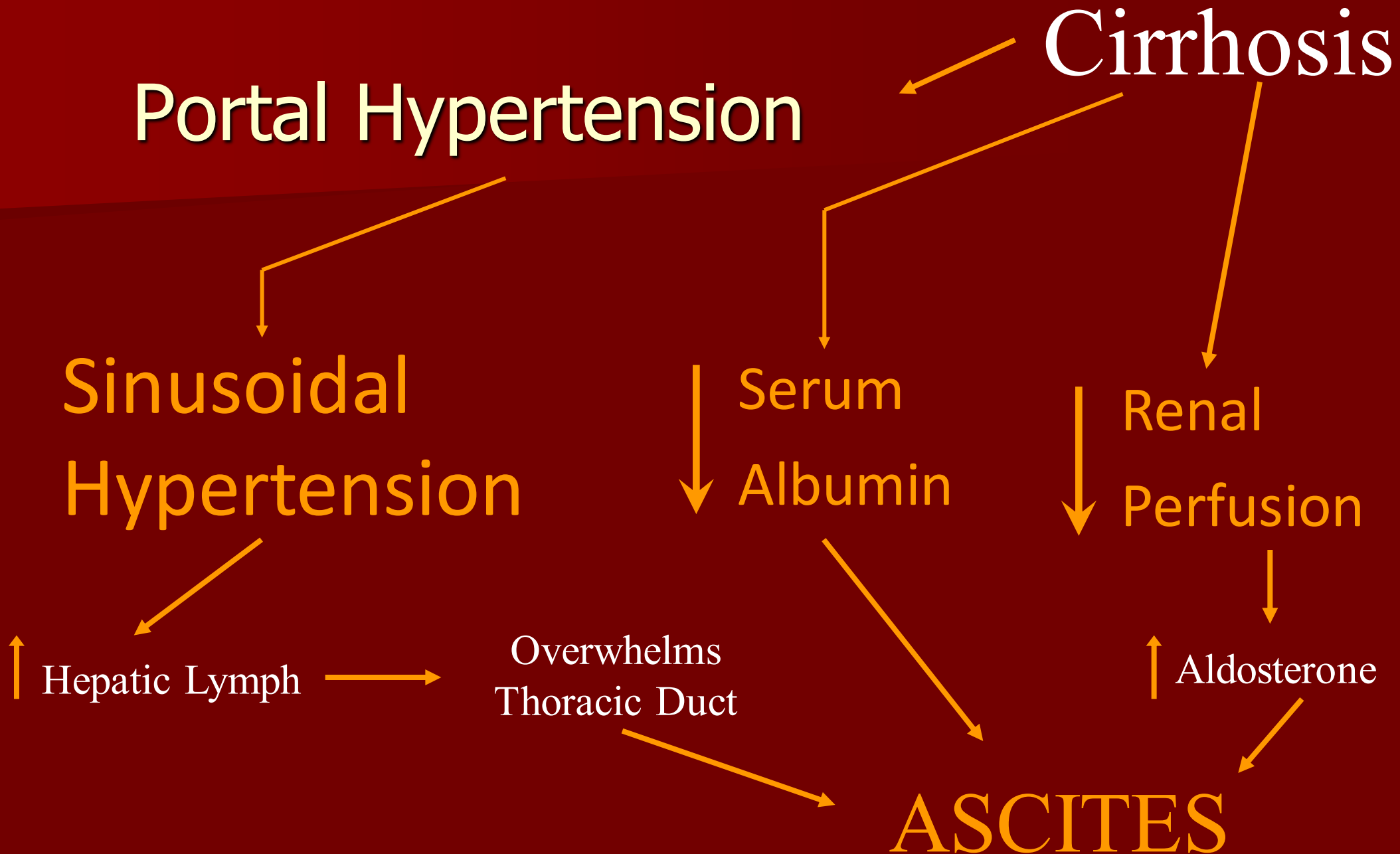
Renal
Perfusion

↑ Hepatic Lymph →

Overwhelms
Thoracic Duct

↑ Aldosterone

ASCITES



Venous Obstruction

- Impaired venous outflow increases hydrostatic pressure

Thrombosis

External pressure (mass)

Lower extremity inactivity with
prolonged
dependency

Reduced Plasma Osmotic Pressure

- "...Albumin is the serum protein MOST responsible for the maintenance of colloid osmotic pressure.
- A decrease in osmotic pressure can result from increased protein loss or decreased protein synthesis

Reduced Plasma Osmotic Pressure

- Increased albumin Loss:
 - Nephrotic Syndrome
 - Increased protein permeability of the glomerular basement membrane
- Reduced albumin synthesis
 - Cirrhosis
 - Protein malnutrition

Inflammation

- Both Acute and Chronic Inflammation are associated with EDEMA

Lymphatic Obstruction

- Impaired lymphatic drainage with resultant lymphedema, usually localized
 - Usually due to INFLAMMATION or NEOPLASTIC OBSTRUCTION
- Postsurgical
- postirradiation

Lymphatic Obstruction

Inflammation

- Filariasis - A parasitic infection affecting inguinal lymphatics resulting in elephantiasis.



Lymphatic Obstruction

Neoplasia

- Resection and/or radiation to axillary lymphatics can lead to arm edema
- Carcinoma of breast with obstruction of superficial lymphatics can lead to an unusual appearance of the breast - “peau d’orange” (orange peel)

EDEMA

INCREASED
HYDROSTATIC
PRESSURE

Congestive Heart Failure
Ascites
Venous Obstruction

■ HEART

■ LIVER

■ KIDNEY

DECREASED
ONCOTIC
PRESSURE

Nephrotic
Syndrome
Cirrhosis (Ascites)
Protein
Malnutrition

INCREASED
PERMEABILITY

Inflammation

LYMPHATIC
OBSTRUCTION

Inflammatory
Neoplastic

GENERALIZED EDEMA

- HEART

- LIVER

- KIDNEY

Edema : Morphology

- Edema of the Subcutaneous Tissue is most easily detected **Grossly** (not microscopically)
- Push your finger into it and a depression remains



Edema: Morphology

- Dependent Edema is a prominent feature of Congestive Heart Failure
- Facial edema is often the initial manifestation of Nephrotic Syndrome

Clinical Correlation :Subcutaneous Edema

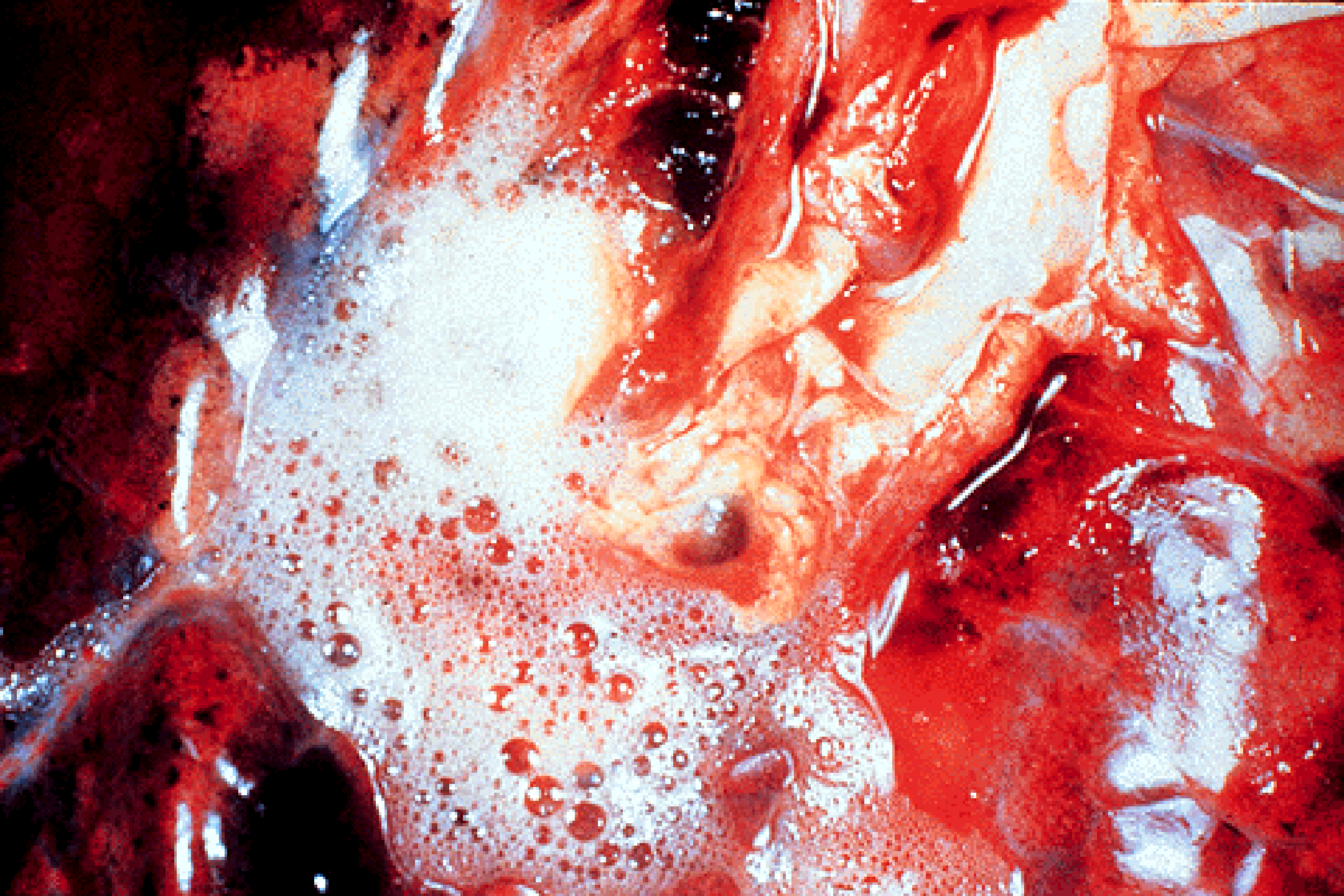
- Annoying but Points to Underlying Disease
 - However, it can impair wound healing or clearance of Infection

Edema : Morphology

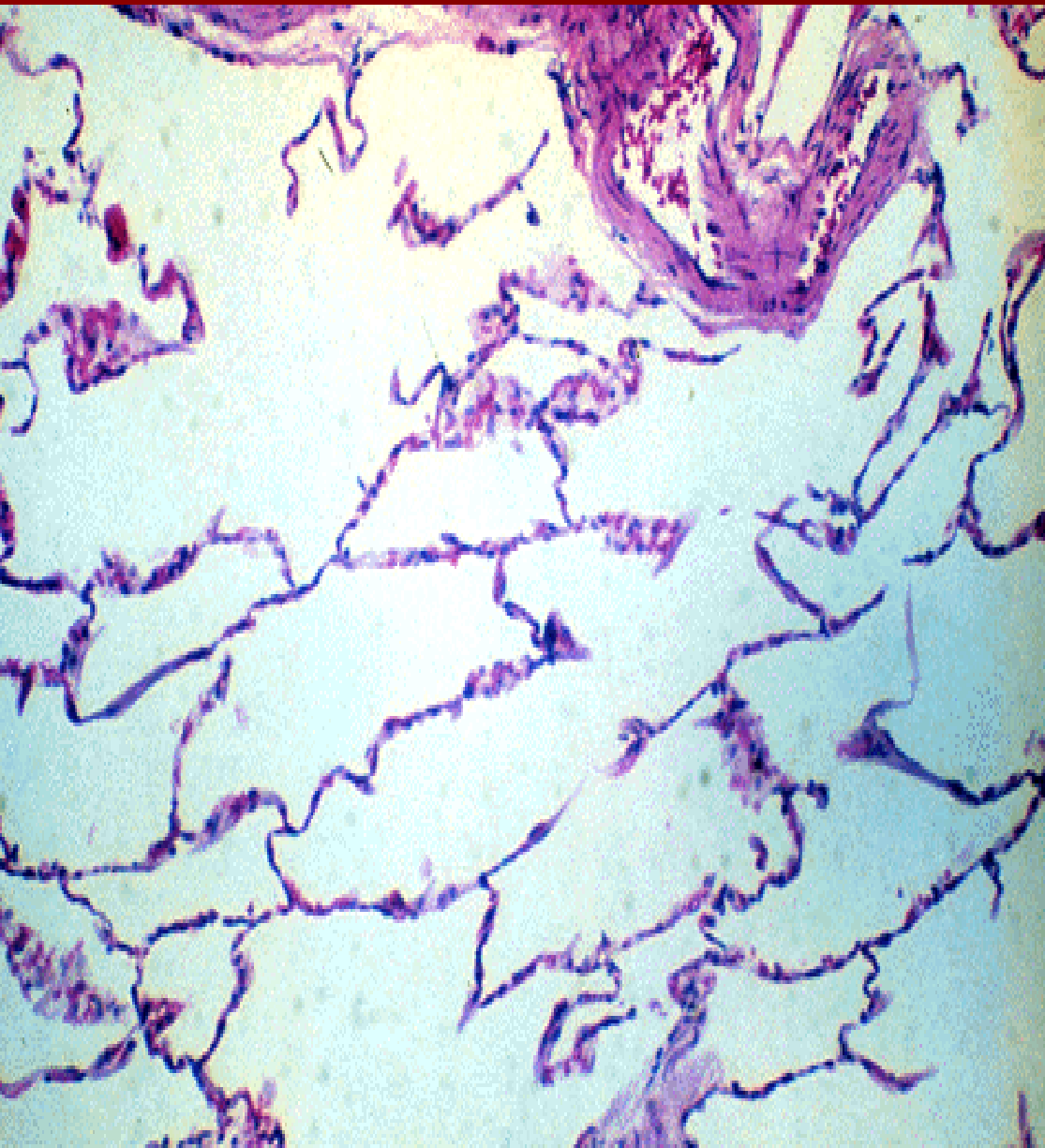
- Pulmonary Edema is most frequently seen in Congestive Heart Failure
 - May also be present in Renal failure, Adult Respiratory Distress Syndrome (ARDS), Pulmonary Infections and Hypersensitivity Reactions

Pulmonary Edema

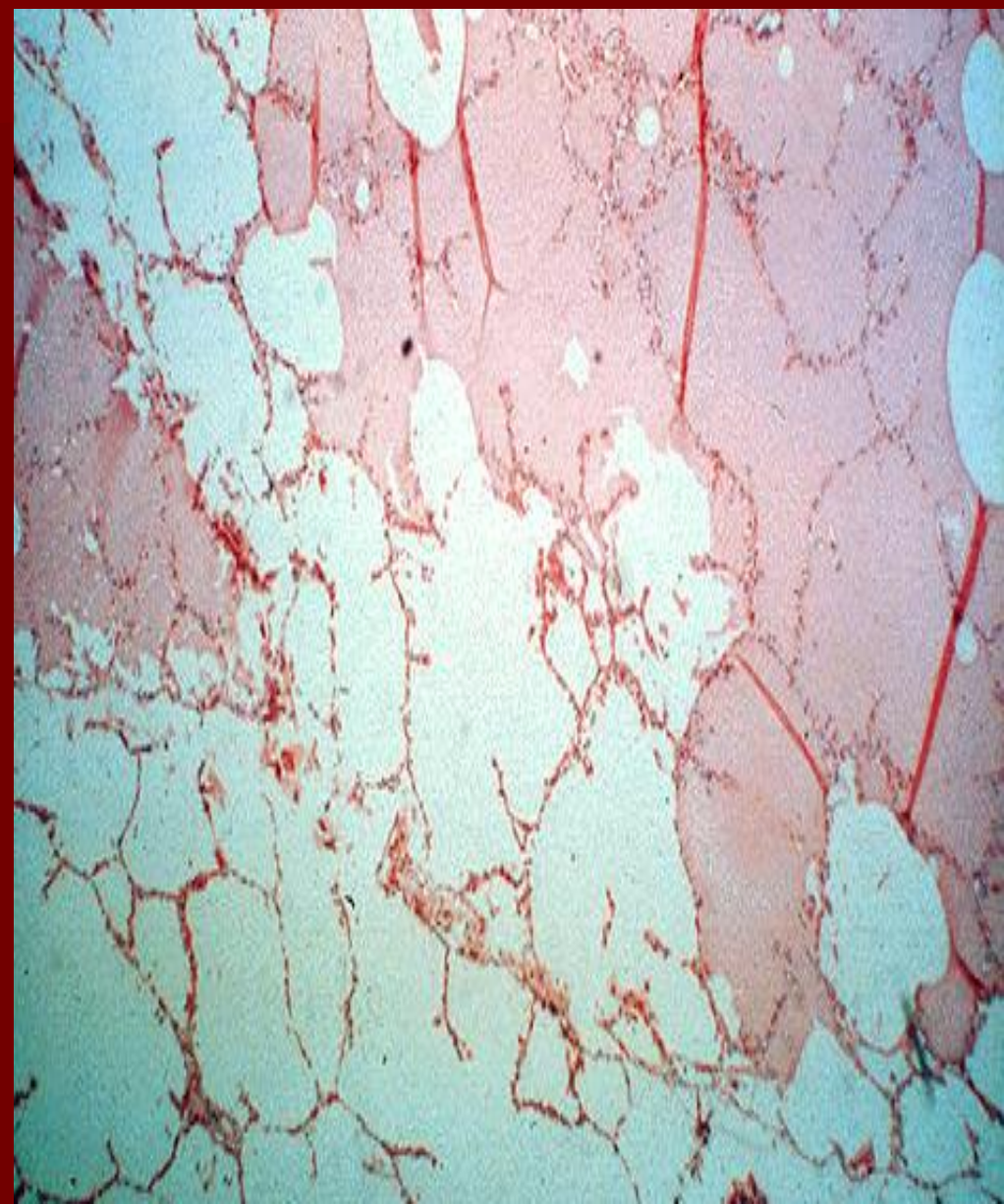
- The Lungs are typically 2-3 times normal weight
- Cross sectioning causes an outpouring of frothy, sometimes blood-tinged fluid



Normal



Pulmonary Edema



Clinical Correlation : Pulmonary Edema

- May cause death by interfering with Oxygen and Carbon Dioxide exchange
- Creates a favorable environment for infection
 - THINK “Culture Media”

Edema of the Brain

- Trauma, Abscess, Neoplasm, Infection (Encephalitis due to say... West Nile Virus), etc

Clinical Correlation :Edema of the Brain

- The big problem is: There is no place for the fluid to go!
- Herniation into the foramen magnum will kill.
- Brain stem vascular supply is compressed
- Grossly: swollen with narrowed sulci & distended gyri showing signs of flattening against underlying skull.

THANK YOU