

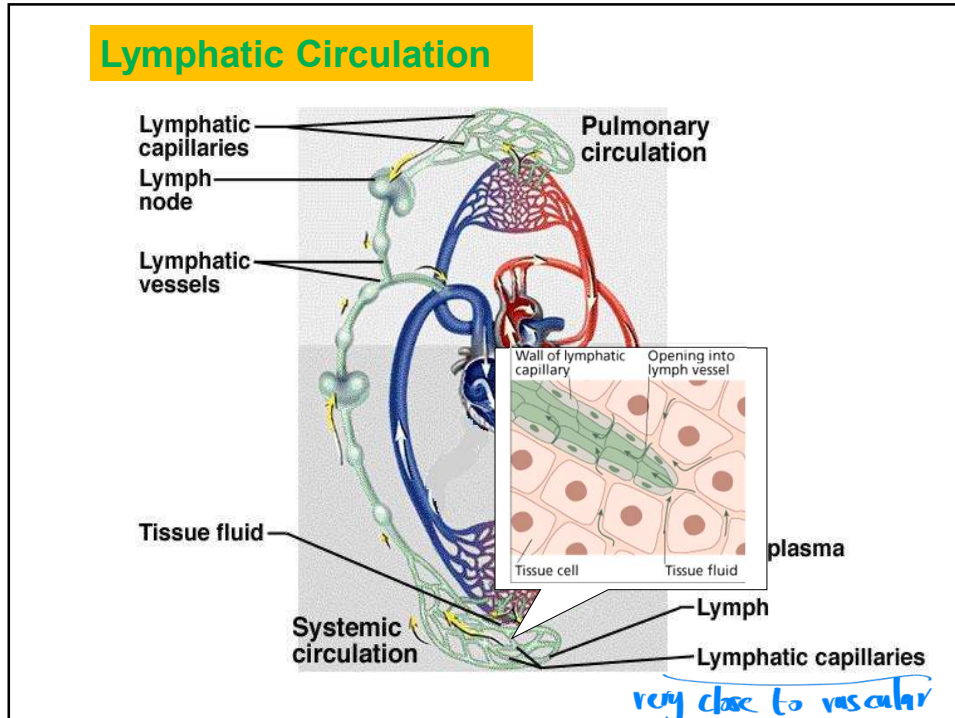


Objectives

- Describe the structure and function lymphatic vessel system.
- Explain the role in preventing fluid accumulation in interstitial space.
- Describe the formation of lymph.
- know the rate of daily lymph flow under normal conditions.
- Summary of factors that determine lymph flow.
- Describe the role of the lymphatic system in controlling interstitial fluid protein concentration, volume, and pressure.
- Define edema and differentiate between extracellular and intracellular.

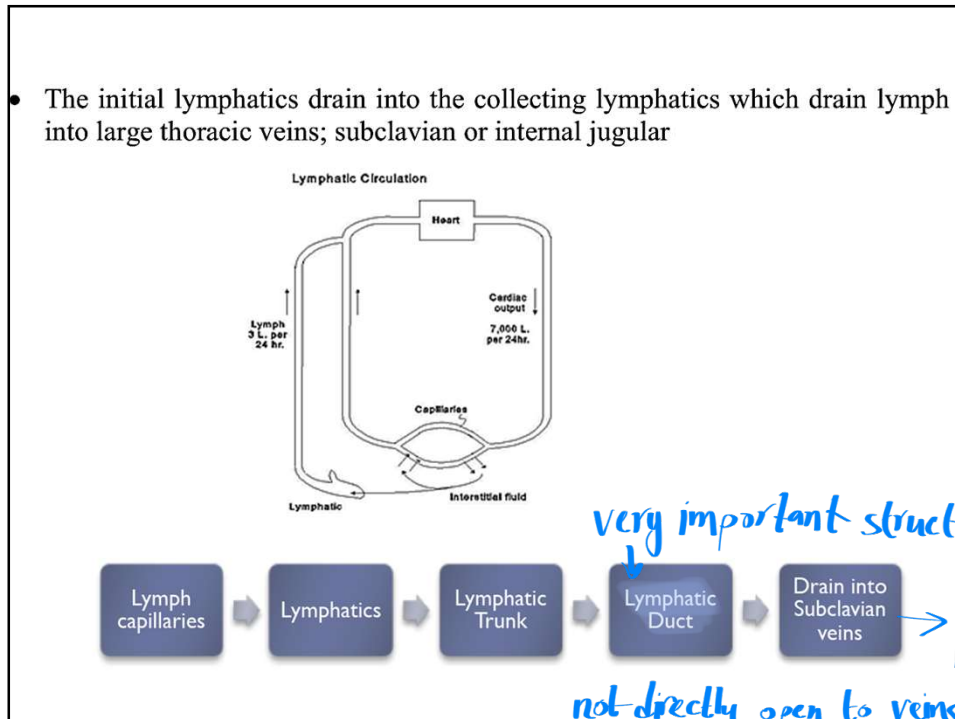
Dr.Shaimaa N.Amin, 2024 (L10)

15% reabsorption by lymphatic vessels



very close to vascular system capillaries

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very important structure

SVC IVC

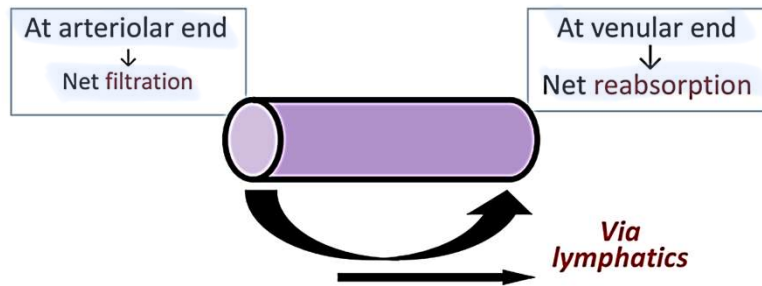
not directly open to veins

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Lymphatic Circulation

- Normally, the fluid efflux across the capillary wall exceeds the fluid influx. The extra fluid enters the lymphatics and drains back to the blood.
- The normal lymph flow is 2-4 L/day.
- Wall of the initial lymphatics in regions like the intestines and skeletal muscles have loose junctions between the endothelial cells. The extra fluid enters through these loose junctions.

drained back by lymphatic vessels



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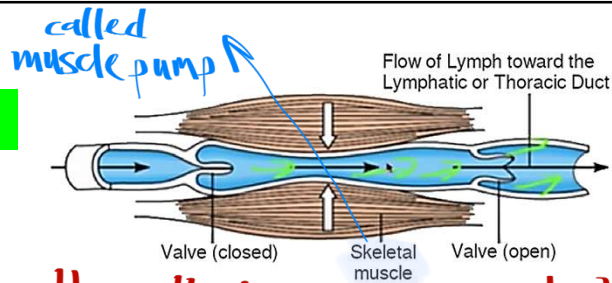
lymph contains → proteins, fats, fatty acids

Lymph Flow:

2-4 liters/day

Aided by:

- 1- Peristaltic contraction + Valves
- 2- Skeletal muscle contraction
- 3- Negative intra-thoracic pressure
- 4- Pulsations of nearby arterioles



تساعد بحدوث lymph flow

return

in the walls (by smooth muscles)

very high in protein

واحدة من العوامل
fat and other components

من سبب ضغط كثير حسب كلام

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طبيعاً هون اختلاف الضغط رح يكون هو العامل المؤثر بال lymph flow

المقصود هو رقم نسبي نسبة لل atmospheric pressure فمثلاً إذا كان atmospheric pressure ال 76 إذا كان أقل منه سيكون سالب وإذا كان أكثر منه سيكون موجب

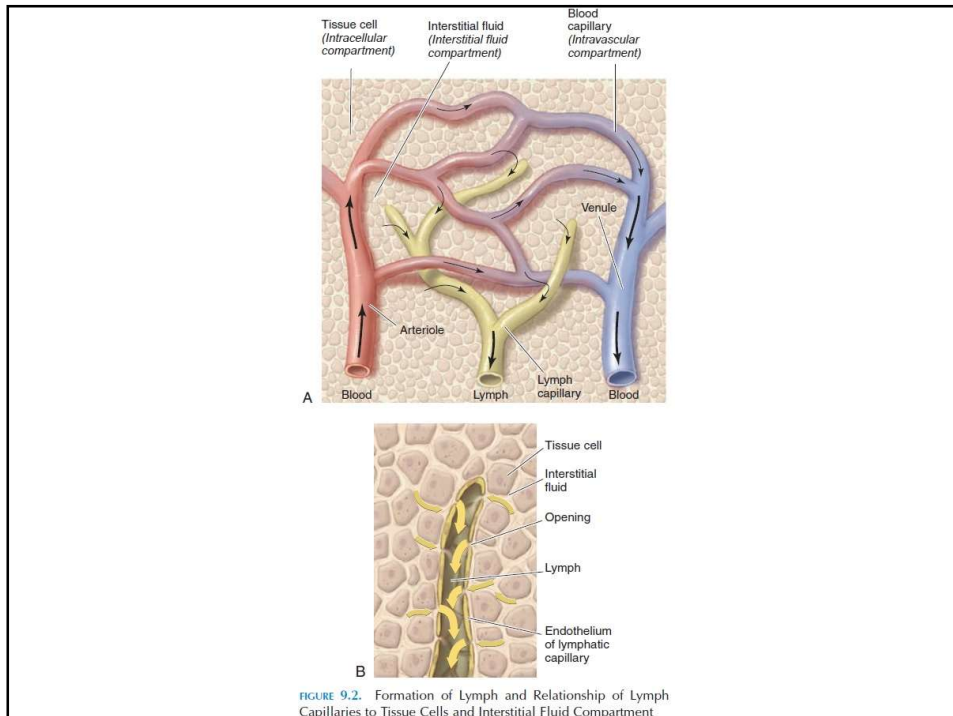
Functions of lymphatics

- 1- Drainage of the excess filtered fluid
- 2- Carry proteins and large particles away from the tissue spaces
- 3- Transport of absorbed long chain fatty acids and cholesterol from the intestine
- 4- Removal of bacteria and their delivery to lymph nodes

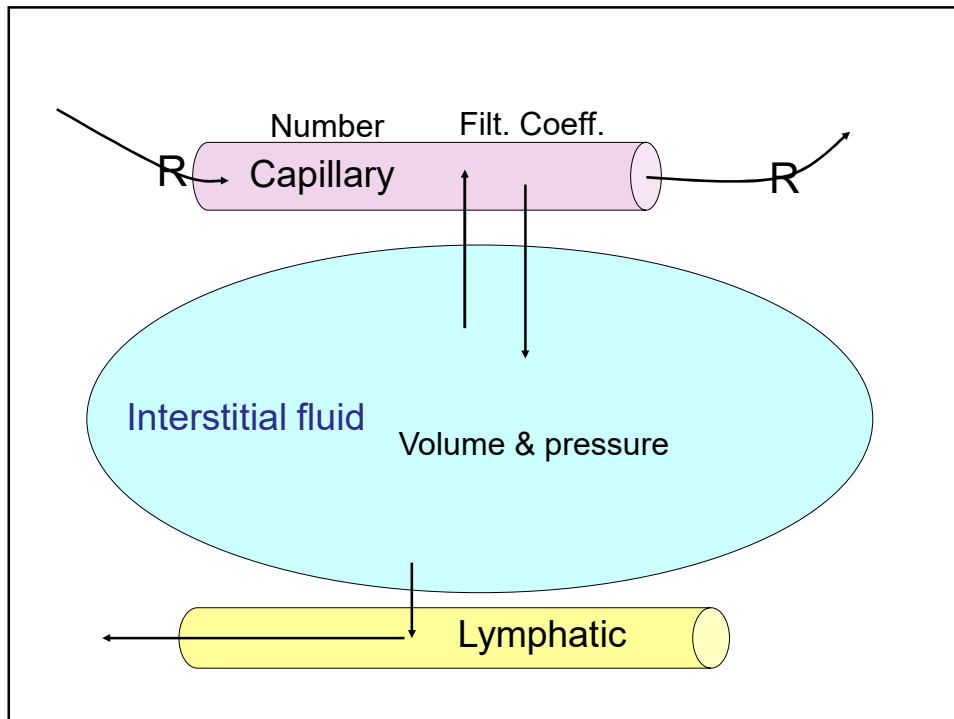
مقدار
physical
appearance
الليمفاويات

الليمفاويات
lymph nodes

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Lymph	
Contents:	
Lymph contents	
Proteins	Less than plasma proteins. $\frac{1}{3}$ compared to blood.
Lipids	<ul style="list-style-type: none"> Cholesterol & phospholipids (lipoproteins) Neutral fats (chylomicrons)
Electrolytes	Similar to plasma
Cells	<ul style="list-style-type: none"> Lymphocytes (all sizes & maturity) Rare monocytes/macrophages Granulocytes (only present following infection)

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Interstitial Fluid (ISF) Volume:**Factors that determine the ISF Volume:**

1. The capillary hydrostatic pressure.
2. Capillary osmotic pressure.
3. The ISF pressure.
4. The capillary filtration coefficient. (K)
5. The number of active capillaries.
6. The lymph flow.
7. The total extra-cellular (ECF) volume, and
8. The ratio of pre-capillary to post-capillary venular resistance. The pre-capillary constriction lowers the filtration pressure while the post-capillary constriction elevates it.

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Edema:

Edema is abnormal large accumulation of ISF. Because of the effect of gravity, the ISF tends to accumulate in dependent parts as lower limbs in the standing position, and back in the recumbent position. Changes in any of the factors that determine the amount of the interstitial (ISF) volume lead to edema.



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Edema

ECF edema // إذا دكتها كالماء
←

abnormal large accumulation of interstitial fluid

Causes of edema

- 1- Increased Filtration Pressure:
- 2- Decreased Osmotic Pressure Gradient Across Capillary
- 3- Increased Capillary Permeability:
- 4- Inadequate Lymph Flow:

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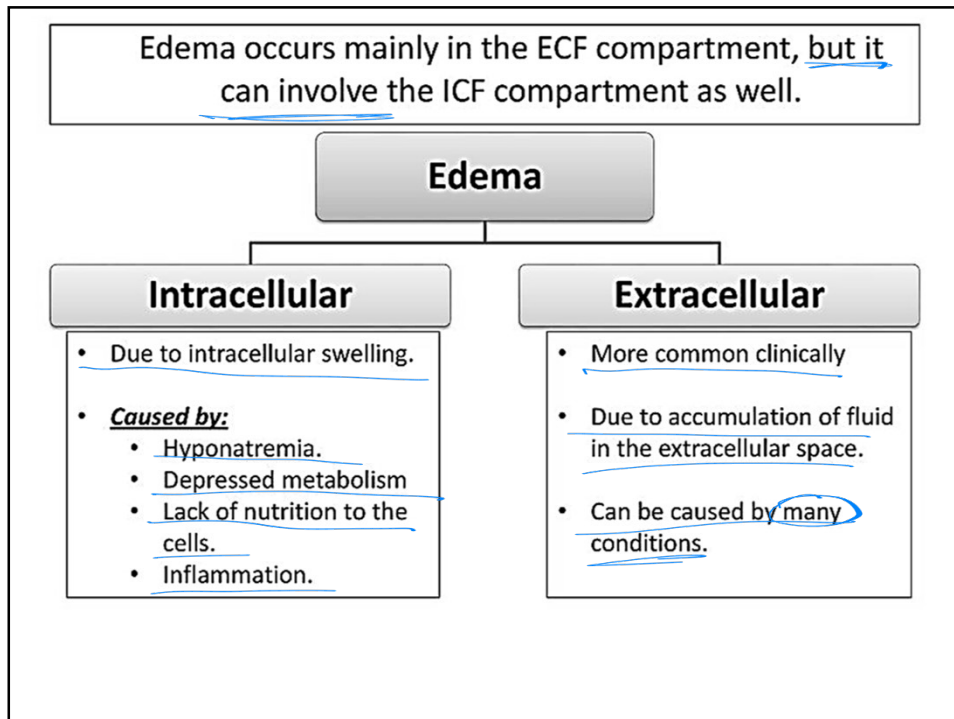
Causes of increased ISF volume and edema:

- 1- Increased Filtration Pressure:**
 - Arteriolar dilation.
 - Venular constriction.
 - Increased venous pressure (effect of gravity, increased total ECF volume, incompetent venous valves, venous obstruction, and heart failure.)
- 2- Decreased Osmotic Pressure Gradient Across Capillary:**
 - Decreased plasma protein level e.g. nutritional edema, liver cirrhosis (leading to decreased plasma proteins synthesis) and kidney diseases as nephrosis (leading to loss of plasma proteins in urine.)
 - Accumulation of osmotically active substances in IS space.
- 3- Increased Capillary Permeability:**
 - Substance P, histamine, kinins.
- 4- Inadequate Lymph Flow:**

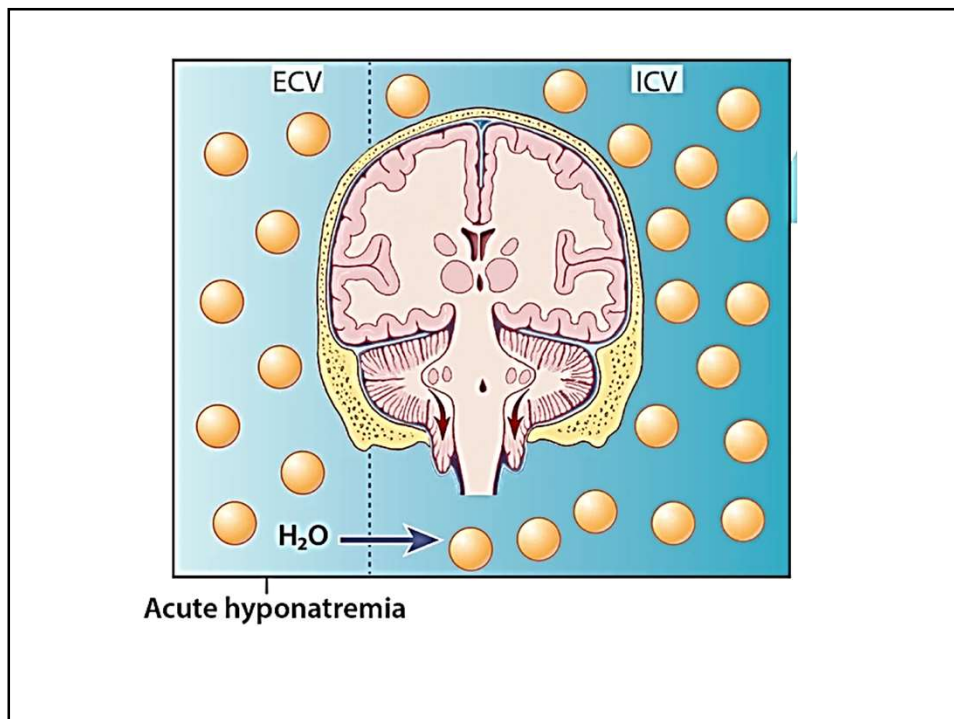
Edema is caused by lymphatic obstruction. The edema fluid has a high protein content associated with inflammation and fibrosis of the ISF (non-pitting edema) in longstanding diseases as elephantiasis.

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reabsorption
قوة الكون الطبيعي



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