

# LYMPHATIC SYSTEM

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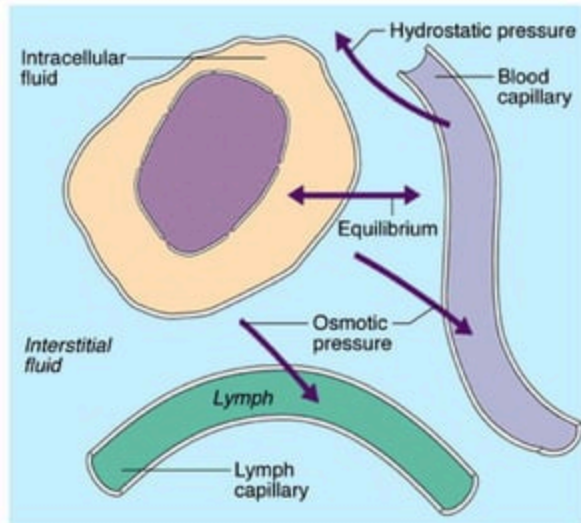
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# Objectives

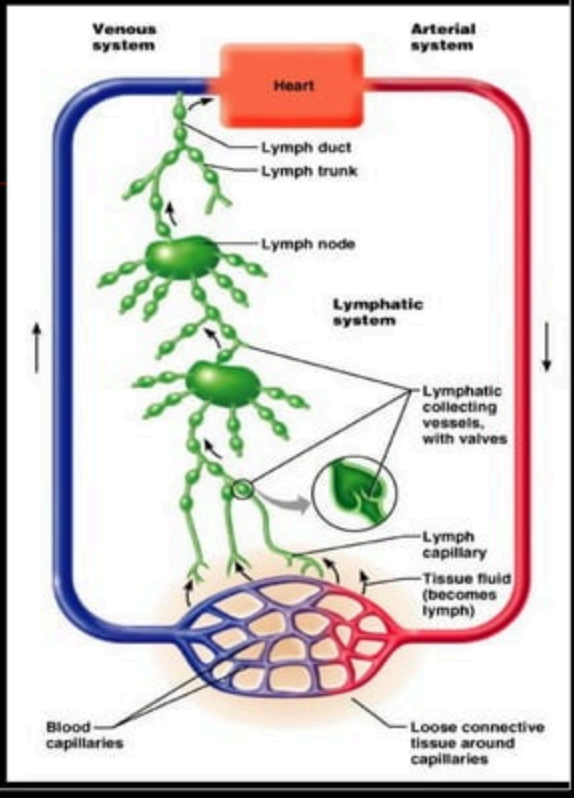
- Components
- Lymph formation & composition
- Lymph flow
- Pathology – Oedema



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# Components

- Lymph fluid
- Lymph vessels
- Lymphatic organs
  - Lymph nodes
  - Tonsils
  - Spleen
  - Thymus



# Lymph formation & composition

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- Formation
- Composition
  - Protein content
  - Fat content
  - Cellular content

# Composition of lymph

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1. **H<sub>2</sub>O**      **94%**
2. **Solids**      **6%**
3. **Cells**      **lymphocytes , plasma cells,**
4. **Electrolytes**      **same as that of plasma**
5. **Urea, creatinine & amino acid**
6. **Ca<sup>++</sup>, phosphorus**
7. **Chlorides and glucose**
8. **Clotting factors ,plasma enzymes &antibodies**  
**are present.**

# Formation of lymph Pressures acting across Capillary walls

**Outward**

**Cap. Hydrostatic pressure - 17mmHg**

**Negative interstitial pressure - 7mmHg**

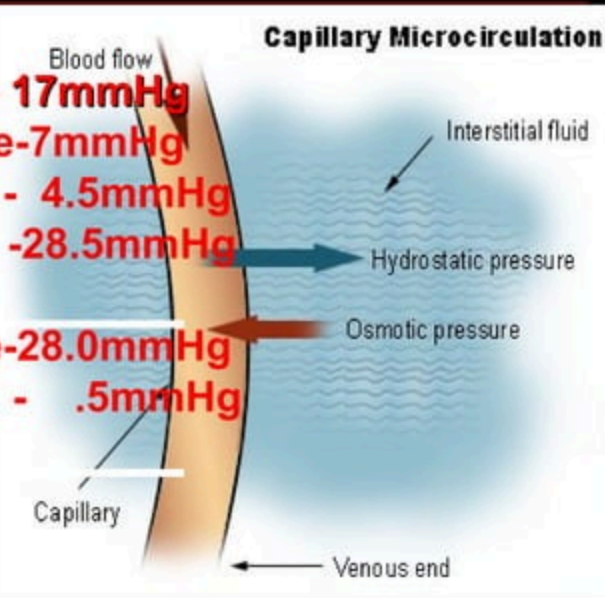
**Inter fluid osmotic pressure - 4.5mmHg**

**total outward**

**Inward**

**Cap. Fluid osmotic pressure - 28.0mmHg**

**Net difference**



TISSUE FLUID



LYMPH



LYMPHATIC CAPILLARY



AFFERENT LYMPHATIC VESS



LYMPH NODE



EFFERENT



LYMPHATIC TRUNK



COLLECTING DUCT



SUBCLAVIAN VEIN

**Lymph flow  
from the tissue**

# Lymphatic Vessels

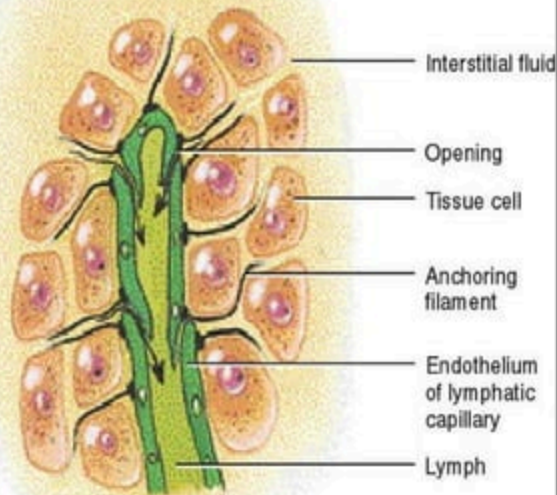
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- Lymphatic capillaries
- Lymphatic collecting vessels
- Lymphatic trunks
- Lymphatic ducts
- Accompany and parallel veins in most of body
- Not found in; nails, hair.
- Form an extensive system that flows one way toward the heart

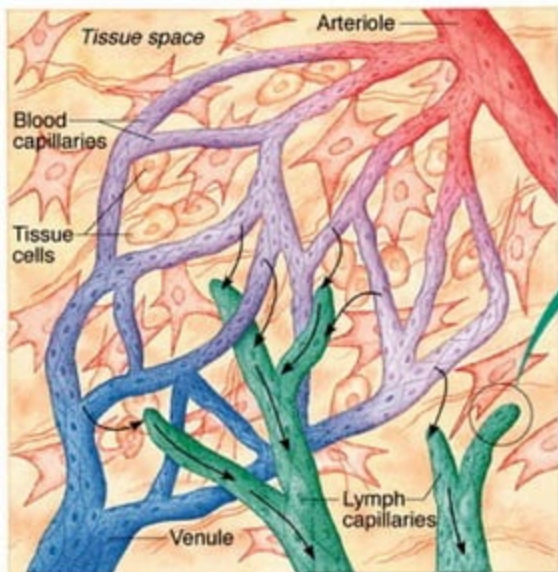


# Lymphatic Capillaries

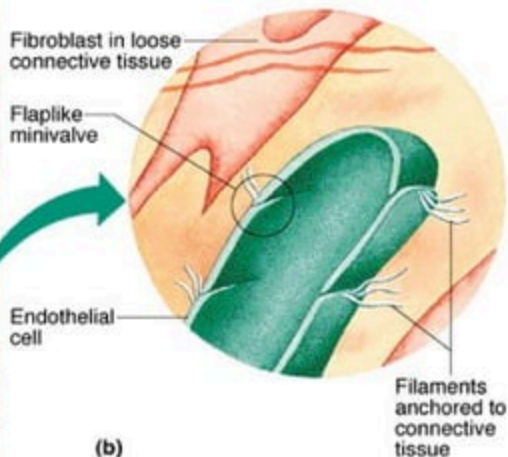
- Found in most places that contain capillaries  
Except bone marrow, cartilage, CNS, cornea, nail, spleen
- More permeable than blood capillaries
- Nature of lymphatic capillaries allows WBC's, pathogens, and cancer cells to enter easily



# Lymphatic Capillaries



(a)



(b)

# Lymphatic Collecting Vessels

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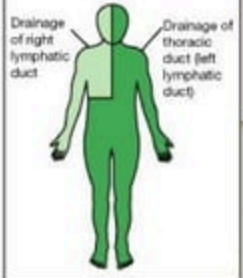
- Lymphatic capillaries join together to form lymphatic collecting vessels
- Morphologically similar to veins, except contain more valves
- Pass through lymph nodes
- Can be superficial or deep

# Lymphatic Ducts

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- Union of lymphatic trunks
- Two lymphatic trunks in humans
- Right duct drains right side of head, thorax, right arm. Enters right subclavian vein
- Thoracic duct drains left side of head, thorax, left arm, and lower  $\frac{1}{2}$  of body. Enters left subclavian vein

# Lymphatic Ducts



**Right lymphatic duct**

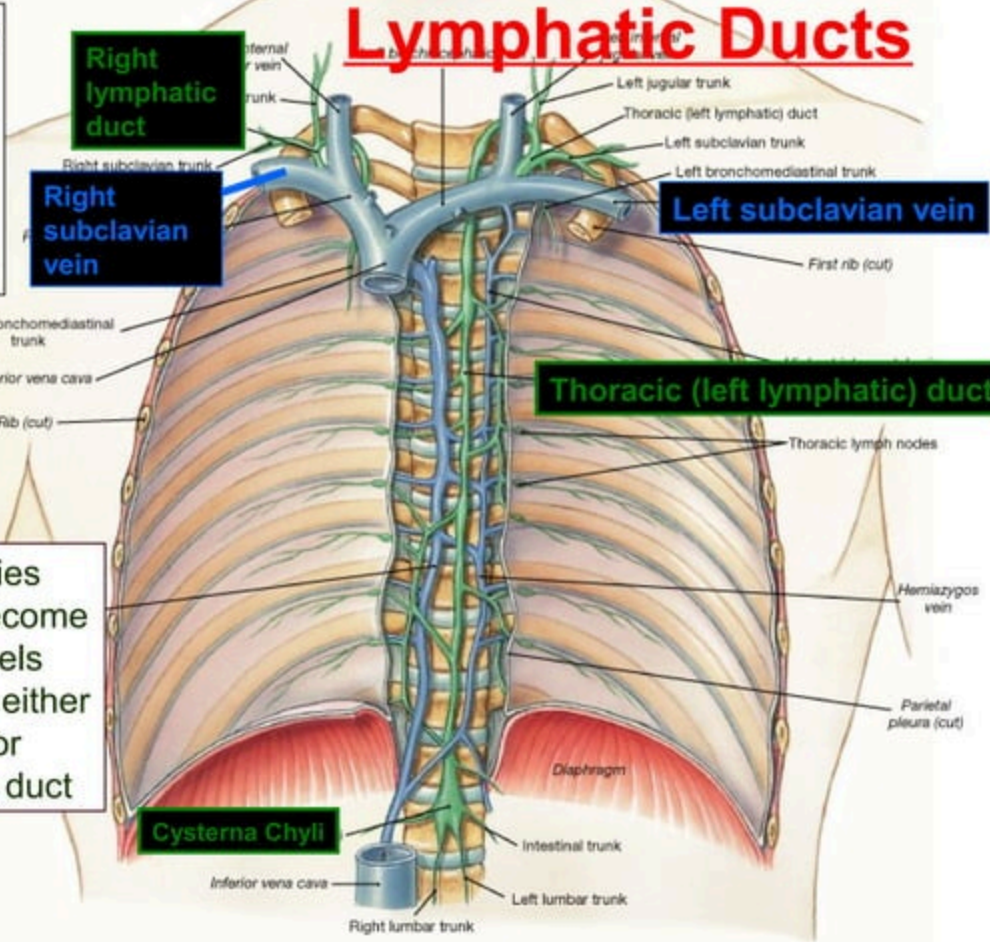
**Right subclavian vein**

**Left subclavian vein**

**Thoracic (left lymphatic) duct**

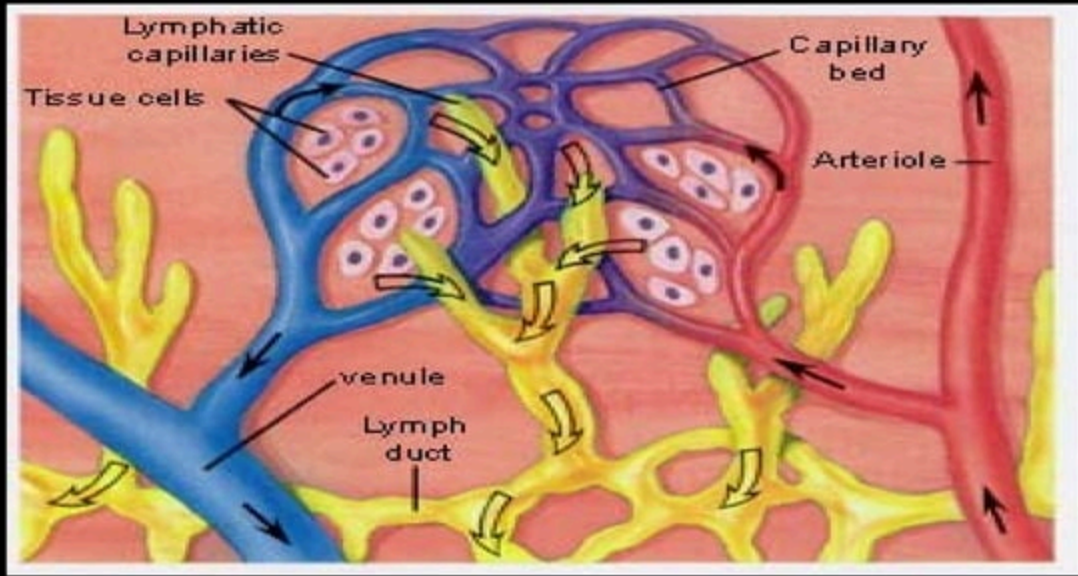
**Cysterna Chyli**

Lymph capillaries converge to become collecting vessels and end up as either Thoracic duct or right lymphatic duct





# Lymph flow



## Functions

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- Proteins from tissue spaces to blood
- Absorption of nutrients
- Transport mechanism
- Supply O<sub>2</sub> and nutrition
- Defense mechanism

# Mechanism

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- Factors affecting
  - Suction effect
  - Intrinsic lymphatic pump
  - Pumping by external compression
  - Negative intrathorasic pressure
  - Interstitial fluid pressure
  - Increase in capillary surface area
  - Increase in capillary permeability
  - Increase in functional activity of tissue.



## Normal lymph flow

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- Normal values – 120 ml/ hr or 2-4 L per day.
- Rate of lymph flow – 100 ml/ hr in thoracic duct  
& 20 ml/hr in other  
lymphatic

# Central = Primary lymphoid tissue

Site of production and maturation of the B and T cells of the immune system

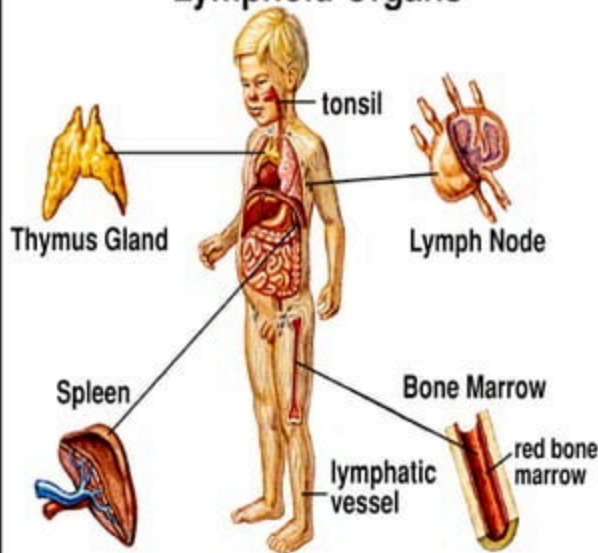
## 1. Thymus

encapsulated

T cells

## 2. Bone marrow

### Lymphoid Organs

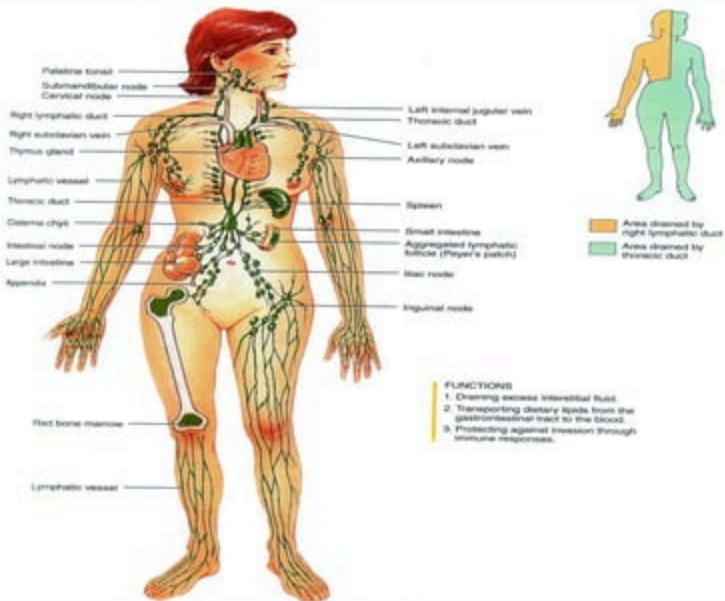


## Lymph Nodes

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- Between two lymphatic collecting vessels.
- Serve as filters to capture foreign material.
- Site of lymphocyte production
- Become inflamed / engorged with infectious material
- Can be found in large clusters in inguinal, cervical and axilla

# Lymph Nodes

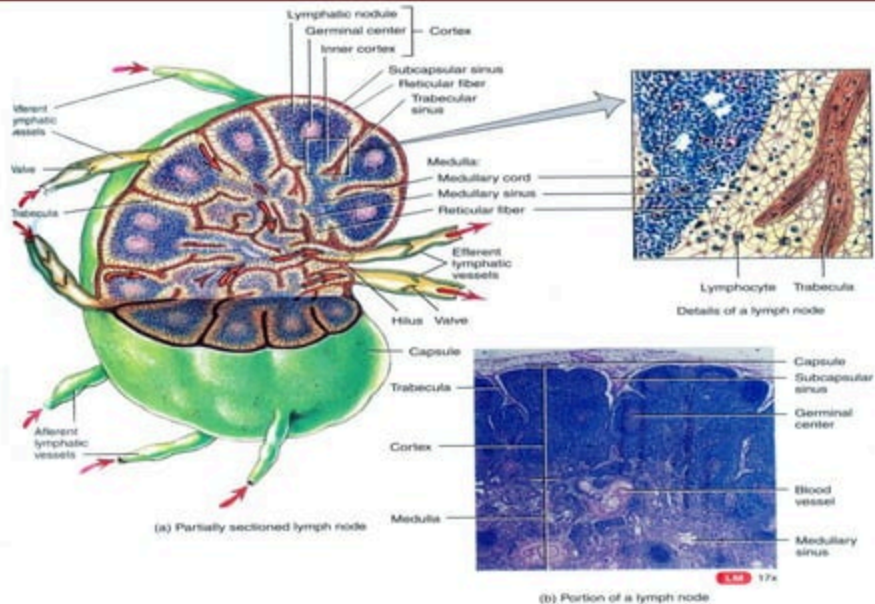


# Lymphatic Nodules

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- Filter and attack antigens.
- mucosa-associated lymphatic tissue (MALT) or tonsils detect antigens and initiate an immune response
- very prominent in the mucosa of the small intestine, primarily in the ileum Peyer patches
- also prevalent in the appendix

# Lymphatic Nodules



# Applied physiology

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- **Lymphadenopathy**
- **Elephantiasis**
- **Chyluria**
- **Chylo thorax**
- **Oedema of arm in radical mastectomy**

# Lymphadenopathy

Enlargement of lymph nodes throughout the body.





# Elephantiasis (filaris)

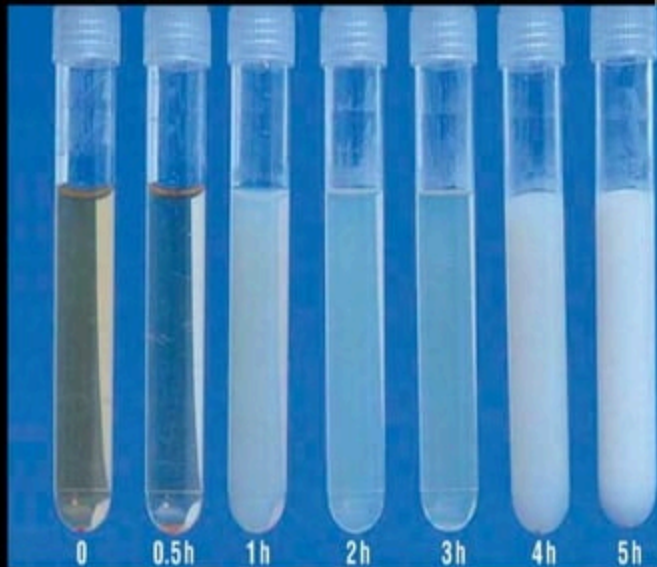
**Enlargement of lower limb and scrotum due to obstruction of lymphatic vessels by microfilaria.**



# Chyluria

**Excretion of milky urine.**

**Lymph from the small intestine is excreted into the urine.**



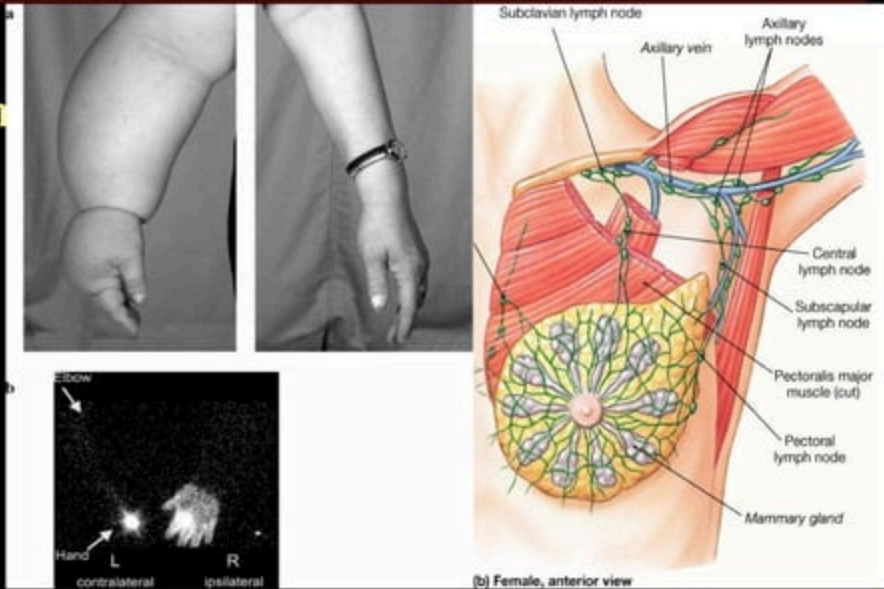
# Chylo thorax

Lymph from the small intestine accumulates in the pleural cavity.



# Oedema of arm in radical mastectomy

Due to interruption of lymph drainage



# Edema

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**Occasionally the balance of filtration and reabsorption between interstitial fluid and plasma is disrupted. This results in edema.**

# Types of edema

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1. Intracellular edema – due to increased ICF.
2. Extra cellular edema- due to increased fluid in the interstitial spaces.

# Intracellular edema

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## Causes

- depression of the metabolic systems of the tissues
- lack of adequate nutrition to the cells

# Extracellular edema

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## Cause

- an abnormal leakage of fluid from the plasma to the interstitial spaces.
- failure of the lymphatics from interstitium to the blood





## Factors affecting edema formation

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1. Increased blood hydrostatic pressure in capillary
2. Decreased oncotic pressure of plasma proteins.
3. Increased permeability of capillaries
4. Increased ECF fluid volume. (Kidney failure)
5. Blockage of lymphatic vessels

## **SAFETY FACTORS – PREVENTS OEDEMA**

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- Low compliance of interstitium in the negative pressure range
- Importance of interstitial gel
- Importance of proteoglycans filaments
- Increased lymph flow
- Washdown of interstitial fluid proteins
- Effusion– odema fluid in potential spaces.

# Lymphatogogues

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Any substance which increases lymph formation is called as lymphatogogues.

Eg : 1.sunlight

2.warmth

3.histamine.

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Thank  
you