OEDEMA

- The Greek word **OEDEMA** means swelling.
- It is also known as **Dropsy**/**Hydropsy**.
- Oedema may be defined as **abnormal** and **excessive accumulation** of **fluid** in the interstitial tissue space and serous cavity.
- In various disease excess fluid can accumulate in either one or both of these compartments.
- Serous cavity, Peritoneum – Ascites.
- Pleural cavity - Pleural effusion.
- Pericardium - Pericardial effusion.
- Fluid retention in interstitial space occur when fluid isn't removed from the tissue back.

GENERAL

- 60% of body's weight is water.
- 2/3rd of it is INTRACELLULAR and 1/3rd is EXTRACELLULAR.
- EXTRACELLULAR is further divided into Intravascular, Interstitial & Trans vascular

TYPES OF OEDEMA

3 TYPES :

1 LOCALISED :

1. Venous obstruction
2. Lymphatic Oedema
3. Inflammatory Oedema
4. Allergic Oedema

2 GENERAL :

1. Renal Oedema
2. Cardiac Oedema
3. Nutritional Oedema
4. Liver disorder Oedema
5. Myxoedema

3 SPECIAL :

1. Pulmonary Oedema
2. Cerebral Oedema

SIGNS AND SYMPTOMS

- Swelling or puffiness of the tissue directly under the skin specially in legs & arms.
- Stretched or shiny skin.
- Skin that retain a dimple after being pressed for several seconds.
- Increased abdominal size.
- Shortness of breath.
- Difficulty in breathing.
- Chest pain.
- Weight gain or weight loss.
- Decreased urine production.
- Visual anomaly.

CAUSES

- Heart
- Kidneys
- Protein
- Lack of exercise
- Others

- **HEART**:
- The pumping force of the heart should help to keep a normal pressure within the blood vessels , but if the HEART begins to fail …then pressure changes can cause very severe water retention .In this condition, water retention is mostly visible in legs, feet & ankles. But water also collects in the LUNGS, where it cause a chronic cough~~~This condition is usually treated with diuretics ,otherwise the water retention may cause breathing problem and additional stress on HEART.

- **KIDNEYS** -
- Where the kidneys are no longer able to filter fluid out of the blood and turn it into urine, kidney disease often starts with inflammation – ex. Nephritic syndrome, the swelling is generally seen as puffy eyes.

- **PROTEIN** –
- Protein attracts water and plays an imp. role in water balance, in case of severe protein deficiency, the blood may not may not contain enough protein to attract water from the tissue spaces back into the capillaries~~~this is the cause, why starvation often shows an enlarged abdomen.
- When the capillary walls are too permeable, protein can leak out of the blood and settle in tissue spaces , this protein act like a magnet for water. This water reflects as OEDEMA.

LACK OF EXERCISE:

- Is the another cause of water retention in the legs~ Exercise helps the leg veins work against gravity and return blood to the HEART. If blood travels too slowly and starts to pool in the leg vein, the veins can become swollen, painful and distorted and this condition known as varicose veins.
- Muscle action is needed not only to keep blood flowing through the veins but also to stimulate the lymphatic system to fulfill its overflow function.

OTHERS:

Pregnancy, weight of uterus cause pressure on major veins of pelvis.

This is physiological and relieved after delivery.

Certain Medicines as Oestrogens, NSAIDs and Beta blockers.

Premenstrual water retention.

PATHOGENESIS

- OEDEMA is caused by mechanism that interfere with normal fluid balance of plasma, interstitial fluid and lymph flow.
  The following mechanism may be involved in this process.

1. Decreased plasma oncotic pressure.
2. Increased capillary hydrostatic pressure.
3. Lymphatic obstruction.
4. Tissue factor (increased interstitial oncotic pressure and decreased tissue tension).
5. Increased capillary permeability.
6. Sodium and water retention.

DECREASED PLSMA ONCOTIC PRESSURE

- The plasma oncotic pressure exerted by the total amount of plasma proteins, tends to draw fluid into vessels normally. A fall in the total plasma protein level (hypoproteinaemia of less than 5gm/dl) resulting in lowering of plasma oncotic pressure in this way that it can't counteract with hydrostatic pressure of blood. This results in increased outward movement of fluid from capillary wall and decreased inward movement of fluid from interstitial space causing OEDEMA. Usually generalized OEDEMA is produced.
- Malnutrition with decreased protein intake, Cirrhosis with decreased synthesis of Albumin, Nephrotic syndrome, Nephritic syndrome, Malabsorption syndrome is of decreased protein absorption.
- Fluid type is transudate type.

LYMPHATIC OBSTRUCTION

- Normally 10% of the interstitial fluid is reabsorbed by lymphatic system. Obstruction to outflow of these channels causes localized Oedema.
- Removal of axillary lymph node produces lymphoedema of affected arm, Thoracic duct obstruction due to tumours, Inflammation of lymphatics in Filariasis, Occlusion of lymphatic channel by malignant cells, Milroy's disease (hereditary lymphoedema).

Reduced oncotic pressure

- Incd loss – nephrotic syndrome
- Decd synthesis – liver failure
- Malnutrition/malabsorption
  - → nutritional oedema
    - kwashiorkar
    - wet beri-beri
    - c/c alcoholism

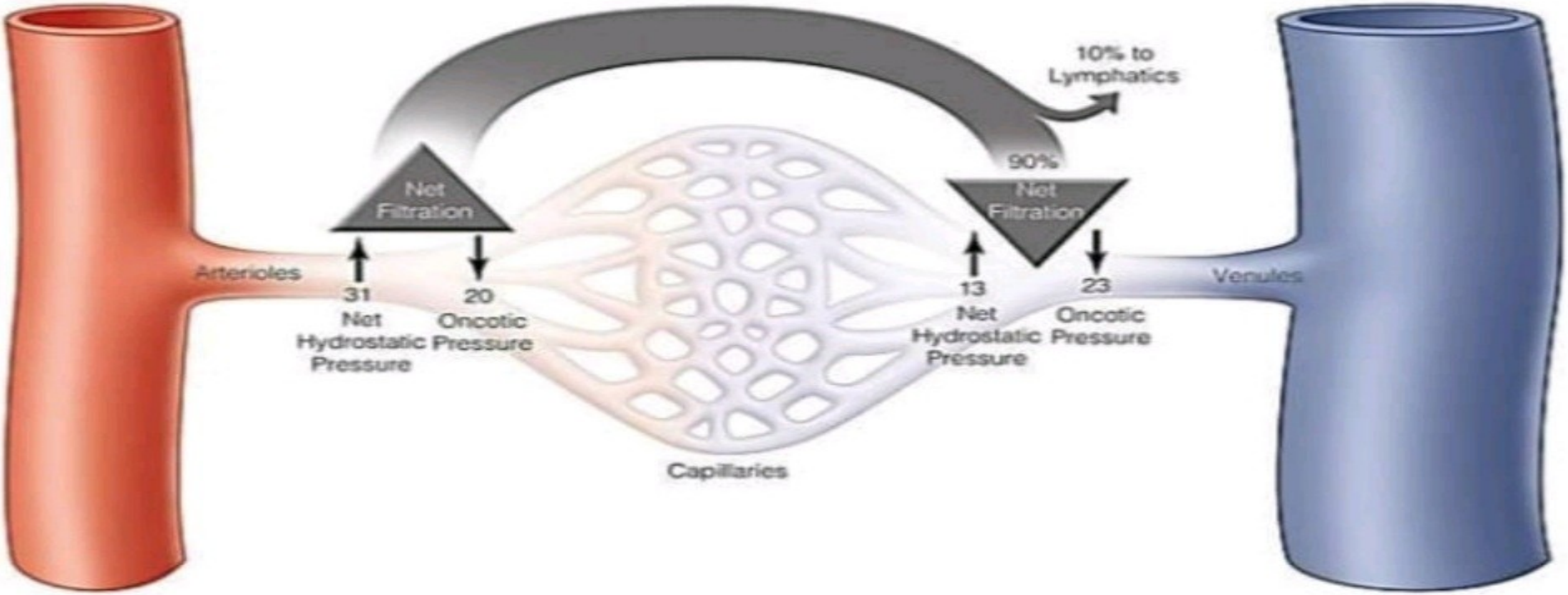
INCREASED CAPILLARY HYDROSTATIC PRESSURE

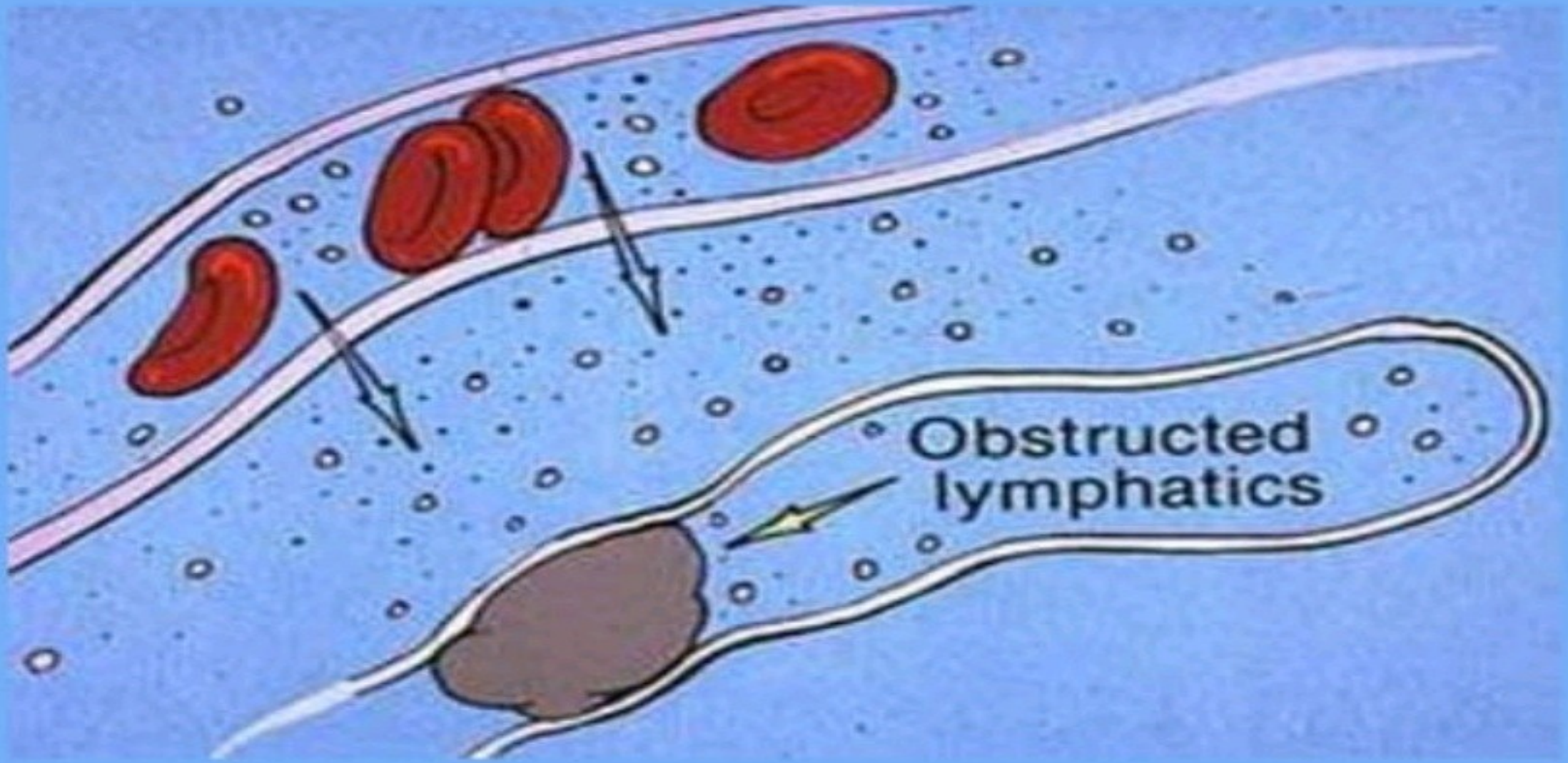
Normal hydrostatic pressure in capillaries at arterial end is 32mm hg and 12 mm hg at venous end. Osmotic pressure exerted by plasma protein is 25 mm hg in capillaries. Due to pressure gradient, hydrostatic pressure forces water out of capillaries at the arterial end, and at the venous end, 90% of extravasated fluid is drained back in capillaries due to oncotic pressure exerted by plasma albumin.

Remaining 10% fluid in interstitial tissue is drained by lymphatic channel in circulation.

A rise in the hydrostatic pressure at venous end results in minimal or no absorption of fluid at venous end consequently accumulation of fluid in interstitial space.

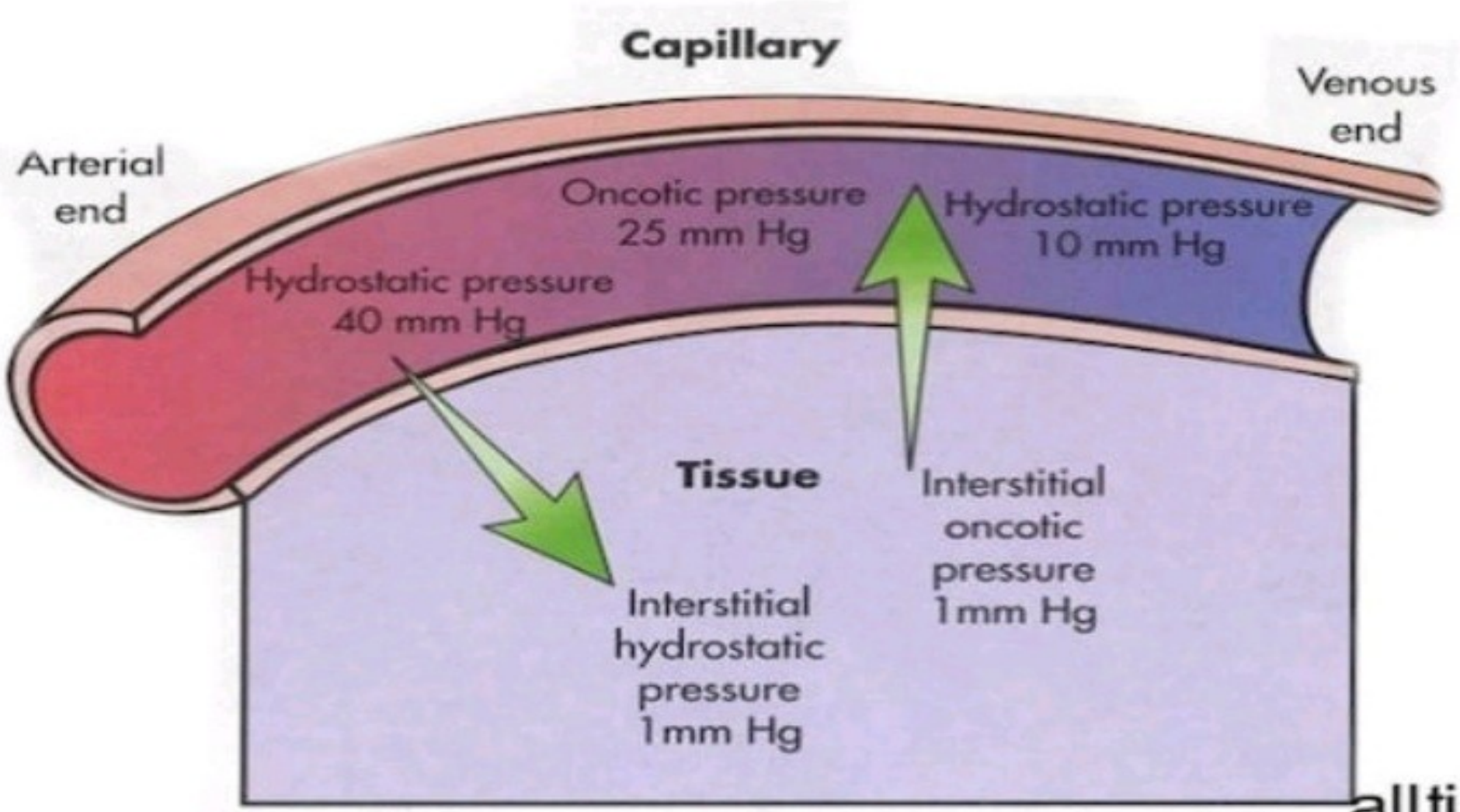
Oedema of cardiac disease, Ascites of liver disease, Passive congestion in mechanical obstruction (due to thrombosis) in veins of lower legs, Varicosities, Pregnancy & Postural Oedema.


10% to Lymphatics
90%
Net Filtration
Net Filtration
Arterioles
31
Net Hydrostatic Pressure
20
Oncotic Pressure
13
Net Hydrostatic Pressure
23
Oncotic Pressure
Venules
Capillaries


Obstructed
lymphatics

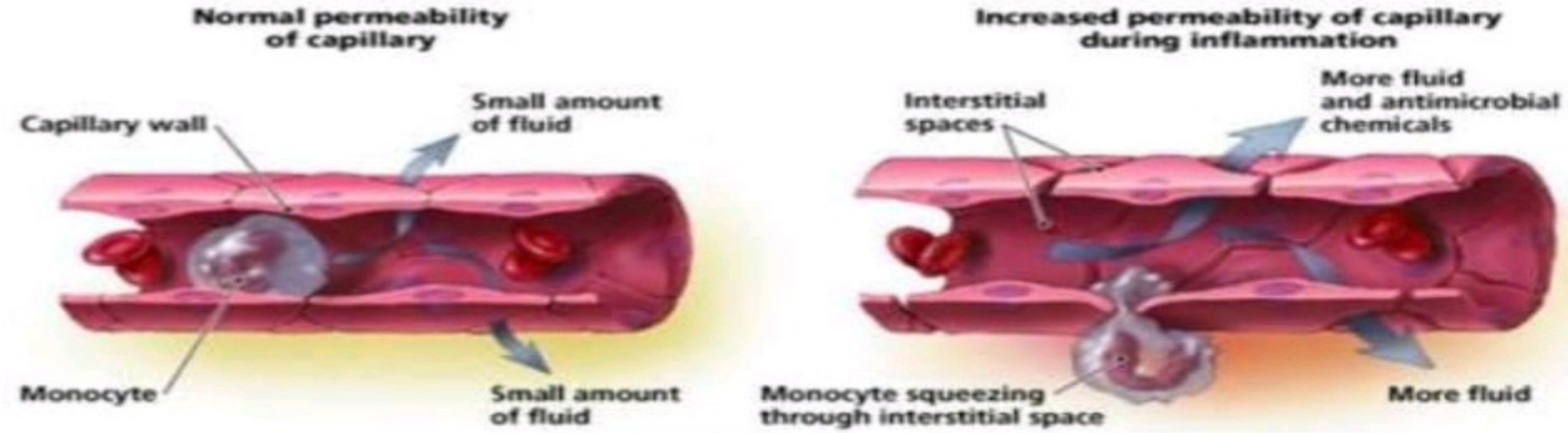
TISSUE FACTORS

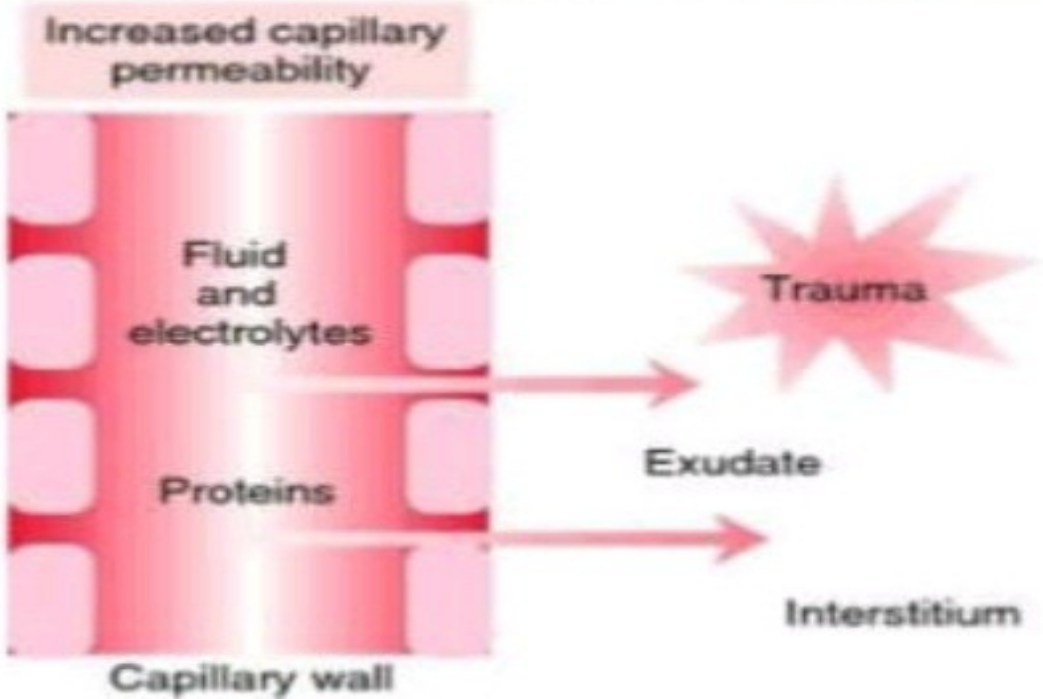
- The oncotic pressure of interstitial space and tissue tension are normally quite small and insignificant to counteract the plasma oncotic pressure and capillary hydrostatic pressure.
  Though in some situation the tissue factors play a role in causation of OEDEMA.
- 1. Elevation of interstitial oncotic pressure due to increased vascular permeability and inadequate removal of protein by lymphatics.
- 2. Lowered tissue tension as seen in eyelids and external genitalia.


Capillary
Venous end
Arterial end
Oncotic pressure 25 mm Hg
Hydrostatic pressure 10 mm Hg
Hydrostatic pressure 40 mm Hg
Tissue
Interstitial oncotic pressure 1mm Hg
Interstitial hydrostatic pressure 1mm Hg

INCREASED CAPILLARY PERMEABILITY

- An intact capillary endothelium is semipermeable which permits the free flow of water and crystalloid but minimal passage of plasma protein. When the capillary endothelium is injured by various capillary poison like Histamine, Venome, Certain Drugs and Chemicals. Then the capillary permeability to plasma protein is enhanced due to development of gap between the endothelial cells.
- This cause reduced plasma oncotic pressure of interstitial fluid and cause OEDEMA.
- EX. Systemic infections, Poisoning, Allergic reactions, Insect bite, Irritant Drugs and Chemicals.
- Angioneurotic Oedema --- Lips, Larynx, Pharynx and Lungs.


Normal permeability of capillary
Capillary wall
Small amount of fluid
Monocyte
Small amount of fluid
Increased permeability of capillary during inflammation
Interstitial spaces
More fluid and antimicrobial chemicals
Monocyte squeezing through interstitial space
More fluid


Increased capillary permeability
Fluid and electrolytes
Proteins
Capillary wall
Trauma
Exudate
Interstitium

Na and Water Retention

- Normally about 80%of Na is reabsorbed by proximal convoluted tubule under the influence of intrinsic renal mechanism or extra renal mechanism.
- Intrinsic Renal Mechanism - is activated in response to sudden reduction in the effective arterial volume (in severe haemorrhage).
  Hypovolemia stimulates the arterial baroreceptors.
- Baroreceptors are found in Carotid sinus & Aortic arch. This results renal ischaemia which causes reduced GFR, finally decreased excretion of Na in urine and consequent retention of Na.
- Extra Renal Mechanism - decreased GFR in acute renal failure and glomerulonephritis, results in increased Renin production, which stimulates liver to synthesize Angiotensinogen which is converted in Angiotensin_2. It act on adrenal cortex to synthesize Aldosterone.
  Aldosterone increases Na reabsorption in renal tubules.

- ADH mechanism - *retention* of Na leads to retention of water secondarily under the influence of ADH or VASOPRESSIN. ADH is secreted in hypothalamus under the stimulation of increased Na level and hypovolemia.
- Excessive retention of Na and Water in response to hypovolemia and lower concentrations of Na in renal tubules, and increased plasma volume and dilution effect of albumin results in decreased Oncotic pressure and OEDEMA.
- In CHF, Oedema of renal disease, Ascites of liver disease.

CLINICAL TYPES

- Peripheral Oedema - is extracellular fluid accumulation in the legs and arms specially around the ankle.
- It has 2 types – Pitting Oedema and Non Pitting Oedema.
- Pitting Oedema- It occurs when pressure is applied on swollen area a pit or indentation will remain for some time.
- (1) < 40 seconds in Renal Oedema.
  (2) > 40 seconds in Cardiac Oedema.
- Non Pitting Oedema - No pit or indentation occur on applying pressure in Myxoedema System Oedema.

EDEMA

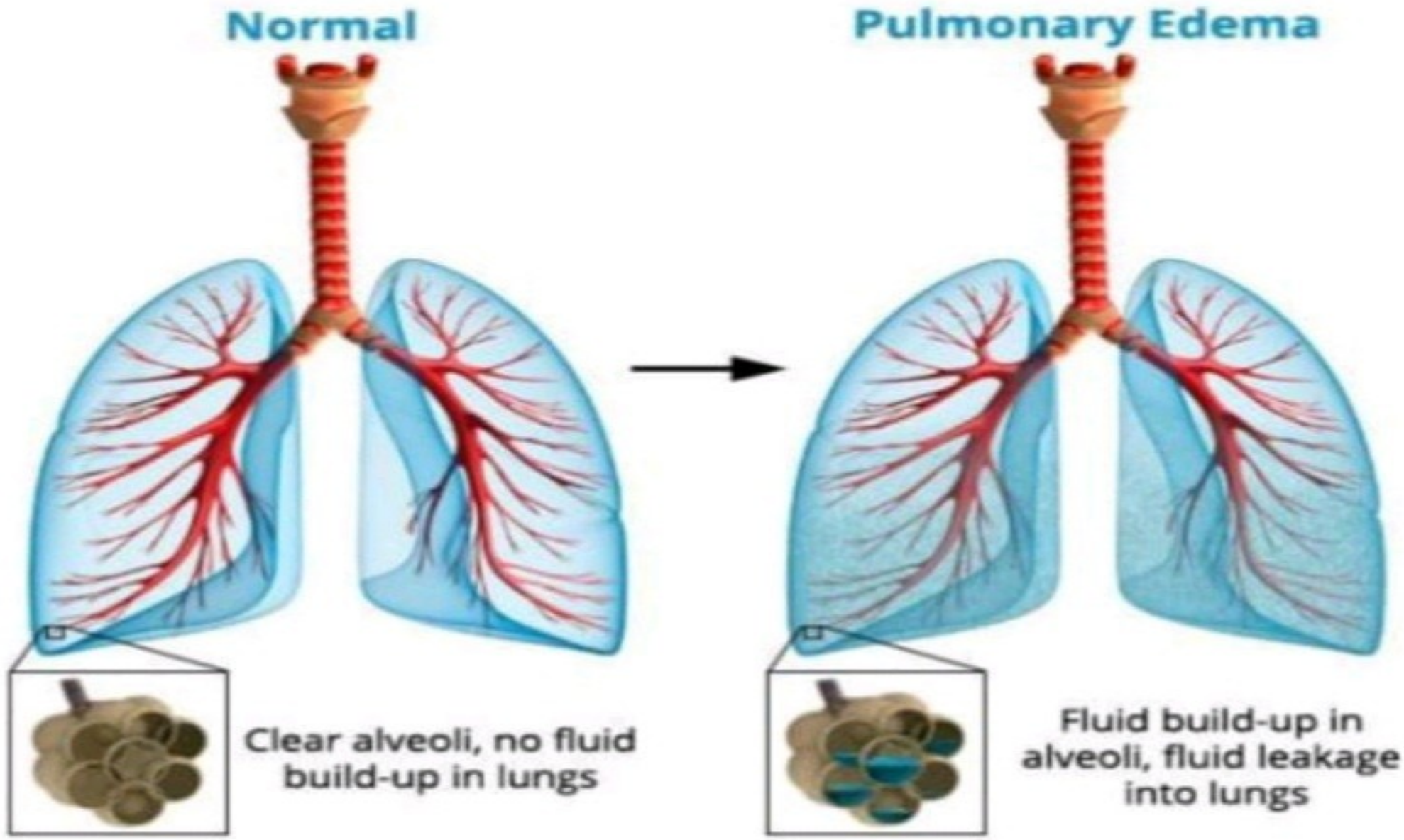
Pitting edema

Non-pitting edema

- **Cerebral Oedema** - extracellular or intracellular fluid accumulation in brain toxic effect, abnormal metabolic state, injury, infection, reduced oxygen in brain, radiation, post-surgical changes, hyponatremia and high altitude cerebral Oedema.

- **Pulmonary Oedema** - pressure in blood vessels of the lungs is raised, because of obstruction to the removal of blood via pulmonary veins LVF, altitude sickness, toxic inhalation pleural effusion may occur in advanced condition.

Cerebral Edema: narrow sulci, flat gyri.


Normal
Pulmonary Edema
Clear alveoli, no fluid build-up in lungs
Fluid build-up in alveoli, fluid leakage into lungs

- **Periorbital Oedema** - puffy appearance of eyes and orbits is preorbital oedema. blurred vision, redness, pain maybe associated. Acute infection, Nephrotic syndrome, Allergic conditions, Sinusitis, Thyroid disease, Aging, Crying.
- **Macular Oedema** - this is serious complication of diabetic retinopathy swellingin macula.
- Person may notice changes in central vision and how he see colours.
- **Cutaneous Oedema** - mosquito bite, spider bite, bee sting. Another cutaneous oedema is myxoedema which is caused by increased deposition of connective tissue.

- **Lymphedema** - insufficient removal of interstitial fluid.....caused by failure of Lymphatic system, Cancer, Enlarged lymph nodes, Destruction of Lymphatic vessels.

- **Renal Oedema** - Renal Oedema Is generated by Nephrotic syndrome, glomerulonephritis and tubular injury. The kidney may not be able to eliminate enough fluid & Na from blood, this put pressure on blood vessels, which causes some of the liquid to leak out and swelling can occur around legs and eyes.

- **Cardiac Oedema** - Generalised Oedema develops in rt. sided and CCF.
  Reduced cardiac output----hypovolaemia which stimulate intrinsic renal and extra renal mechanism and leads to Oedema.
- **Liver disease** - cirrhosis affects liver function------- it can lead to changes in secretion of hormones and fluid regulating chemicals and reduced protein production. This cause fluid to leak out of the blood vessels into surrounding tissues.
  Cirrhosis itself increases pressure Within portal vein, Oedema can occur in legs and abdominal cavity.
- **Angioneurotic Oedema** - an acute attack of localized oedema occurring on the skin of face, trunk. It may be Neurogenic or Allergic in origin.

INVESTIGATIONS

- **CBC** - Hb%, wbc.
- **Renal function** - BUN, S.creatinine in Renal Oedema.
- **24 hours urine collection** - to measure Protein and Creatinine clearance.
- **Albumin** - < 0.5gm/24 hour.....in CHF, Cirrhosis, Hypertension, malnutrition hypothyroidism.
  > 0.5gm/24 hour..... In glomerular disease, Preeclampsia. 3gm/24 hour.....in Nephrotic Syndrome.
- **Liver Function Test** - S.bilirubin, ALP, D-dimer.

- **Ultrasonography** - Venous USG to rule out DVT, Proximal thrombosis and chronic venous insufficiency
- **Lymphoscintigraphy** - Lymph flow can't be detected with USG. Indirect Radionuclide Lymphoscintigraphy which show absent or delayed filling of lymphatic channels.
- **MRI** - Magnetic Resonance Angiography with Venography of lower limbs and pelvis can be used to evaluate for intrinsic or extrinsic pelvic or thigh DVT.
- **Chest radiograph** - chest film reveals the pneumonia,CHF,vascular congestion etc.

INFLAMMATION versus SWELLING

Inflammation	Swelling
Inflammation is human body’s immune system response. It is defined as a defense mechanism in the human body. The body's immune system identifies injury, damaged cells, pathogens and pathogens, and it aids in the healing process.	Swelling occurs when there is abnormal enlargement of a part of the body due to accumulation of fluid into the tissues.
Symptoms include Pain, redness, immobility, swelling and heat. If it is chronic inflammation, the symptoms include fatigue, mouth sores, abdominal pain, fever, discomfort in the chest and temperature.	Symptoms include itching, vomiting, flatulence, pain in the affected area. If it is internal swelling, the symptoms include nausea, insomnia, pain, fever, fatigue, dizziness and vomiting.

INFLAMMATION versus SWELLING

Inflammation	Swelling
Inflammation could be dangerous especially when the causes are internal.	Swelling is usually not dangerous and is described as a common response to any inflammation or a bruise.
Inflammation is not a component of swelling	Swelling can be component of inflammation i.e. It can actually occur within the body without inflammation occurring.
A part of the body is called inflamed if it is larger than usual because of increase in the blood supply triggered by the body's response to infection.	A part of the body is called swollen if it is larger than its usual self.

Thank you.