

## The Lymphatic System

network of tissues, organs and vessels that help to maintain the body's fluid balance & protect it from pathogens

lymphatic vessels, lymph nodes, spleen, thymus, tonsils, etc without it neither the circulatory system nor the immune system would function can be thought of as an accessory to the circulatory system it helps the circulatory system to do its job the two systems are directly connected together it consists of fluid derived from plasma =**lymph**

and **white blood cells** (esp lymphocytes and macrophages (monocytes))

the lymph travels in only one direction ^ it doesn't circulate

### Lymph

Lymph is a clear watery fluid that resembles blood plasma but: have fewer proteins

its composition varies depending on organs that it drains, the lymphatic system handles 125 ml/hr (2500-2800 ml of lymph/day)

~1/2 of this from the liver and small intestine alone

### Lymphatic Vessels

#### Lymphatic Capillaries

originate in tissues as tiny blind ended sacs lie side by side with blood capillaries single layer of endothelial cells like blood capillaries but much more permeable to solvents, and large solutes and whole cells, these small lymphatic capillaries merge with others to form larger lymphatic vessels

lymphatic vessels resemble veins in structure:

- a. three layers - but much thinner
- b. 1-way valves - but many more (every few mm or so)
- c. also has lymph nodes at intervals along its course

as they converge they become larger and larger **Lymphatic Ducts** these lymphatic trunks merge together to form two major **Lymphatic Ducts**

←—————→  
equivalent to major vessels of circulatory system but more like veins than arteries

### **Two major Lymphatic Ducts:**

#### Right Lymphatic Duct

- very short
- drains upper right quadrant of body
- drains into right subclavian vein at jugular V

#### **Thoracic Duct**

- much larger and longer drains the rest of body (3/4ths):
- all of body below diaphragm and left arm and left side of head, neck and thorax

begins just below the diaphragm, anterior to vertebral column lumbar trunks and intestinal trunk join to form saclike **cysterna chyli** drains into left subclavian vein

#### **Flow of Lymph:**

fluid pressure in lymphatic system is very low, as in veins vessels contract rhythmically

- direction of flow is maintained by 1-way valves

also body movements and pulsing of arteries help to move lymph along

^ many vessels are wrapped *مغلقة* in connective tissue with arteries: the pulsing of the arteries also helps move lymph along

#### **Lymph nodes**

**also called lymph glands**

oval, vary in size from pinhead to lima bean most numerous of the lymphatic organs (100's)

Functions of lymph nodes:

1. cleanse lymph

as lymph flows through sinuses of node it slows down and microorganisms and foreign matter are removed

2. alert immune system to pathogens

3. important in hemopoiesis

^ lymphocytes and monocytes are made here

lymph moves into nodes by way of several **afferent lymphatic vessels**

**moves through sinus channels lined with phagocytic white blood cells**

**exits via 1-3 efferent lymph vessels**

the WBC's in each node remove ~99% of impurities المواد الضارة

as lymph passes from node to node virtually all impurities are normally removed

lymph nodes are widespread in body but most occur in groups or clusters:

eg. Submental تحت الذقن & submaxillary تحت الفك الاسفل lymph nodes, floor of mouth; drain nose, lips teeth, eg. Cervical الرقبة lymph nodes ,neck: drain neck and head

eg. axillary lymph nodes

armpit (axilla) and upper chest

drains arm and upper thorax including breasts

breasts contains 2 sets of lymphatics:

(NOT mammary glands)

abdominal nodes

eg. Inguinal الاربية lymph nodes in groin area drain legs and genitals

## Major Accessory Lymphatic Organs

### 1. Tonsils

masses of lymphoidal tissue embedded in mucous membranes of pharynx covered by epithelium, with deep pits(=crypts) ,crypts often contain food debris بقايا, bacteria, dead wbc's etc

three main sets of tonsils:

**pharyngeal tonsils (=adenoids) بلعومي**

on wall of pharynx behind nasal cavity

**palatine tonsils الحنكية**

At post margin of oral cavity largest and most often infected = tonsilitis usually *Streptococcus* today usually treated with antibiotics

**lingual tonsils لسانية**

on each side of root of tongue

### 2. Spleen

-largest of the lymphatic organs

-located below diaphragm in left hypochondriac region المنطقة المراقية  
ovoid in shape

inside is a network of interlacing fibers: red pulp , packed with RBC's

white pulp , crowded with lymphocytes, monocytes, and neutrophils  
performs several functions:

1. defense

helps screen blood and removes pathogens and bacteria

2. hemopoiesis

monocytes and lymphocytes are made here (before birth, RBC's also made here)

3. erythrocyte and platelet destruction

spleen is "erythrocyte graveyard مقبرة" iron is salvaged from RBC's

4. blood reservoir

able to store blood (~350ml)

can constrict and pump blood into circulatory system if hemorrhaging=  
self-transfusion (can squirt 200 ml into blood in <1minute)

also, helps stabilize blood volume by transferring excess plasma from  
blood to lymphatic system

**3. Thymus**

is single unpaired organ in mediastinum and neck region

plays vital role in initial set up of body's immune system

source of lymphocytes before birth which circulate to spleen, nodes and  
vessels

soon after birth it secretes a hormone that causes lymphocytes to develop  
into plasma cells, once this function is done it degenerates seems to  
complete its essential function by end of childhood, largest when young,  
esp puberty, then gets smaller and is replaced with fat

### **General Functions of Lymphatic System:**

**1. Returns Fluid from Tissues to Blood**

~85% of fluids that leak out of blood return to blood via blood capillaries

~15% returns via lymph capillaries

**2. Returns Large Molecules to Blood**

~25-50% of blood proteins leak out of capillaries each day they cannot  
get back into capillaries, instead lymphatic capillaries pick them up and  
return them to the blood

if lymphatics are blocked blood protein decreases leading to fluid

**3. Absorb and Transport Fats**

Special lymphatic capillaries (= **lacteals**) in villi of small intestine absorb all lipids and fat soluble vitamins from digested food bypasses liver much goes straight to adipose tissues

#### **4. Hemopoiesis**

Some WBC's (lymphocytes, monocytes) are made in lymphatic tissues (not bone marrow), main supply of lymphocytes

#### **5. Body Defense/Immunity**

lymphoid tissue is an important component of the Immune System (forms a diffuse surveillance defense system in all body tissues and organs the major role of WBC's is in body defense

lymphatic system screens body fluids and removes pathogens and damaged cells

fever, anorexia, weight loss, night sweats, severe itching often progresses to neighboring lymph nodes

#### **Non-Hodgkin Lymphoma**

lymphoma similar to above but more comon

more widespread distribution in body with higher mortality rate

#### **Ruptured Spleen**

one of most common consequences of blows to left thoracic or abdominal wall

it bleeds profusely if damaged, may cause fatal hemorrhaging removal of spleen usually not serious since functions are shared with liver and bone marrow