McKinnon BTC
Touch, Health, and Common Conditions

Segments 17 & 18 (Section 9)
Lymph and Immune Systems and Massage

1

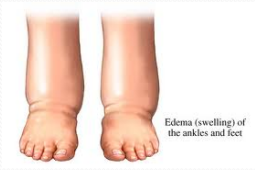
Q. What do the thymus gland, swollen ankles, red bone marrow, and peanut allergies have in common?

A. They all pertain in some way to the dual systems we call the lymphatic and immune systems.

2

Two Systems in One… Sort of

The Lymphatic System and the Immune System use a lot of the same hardware – and their functions are inextricably tied to each other – but their overall purposes are distinct.



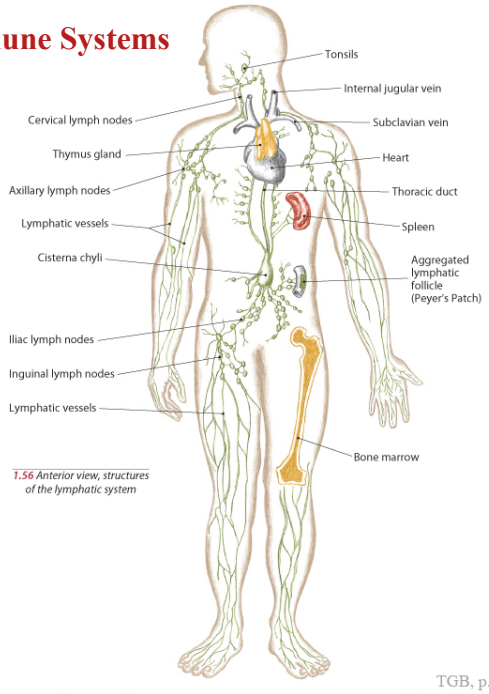
Lymphatic System…

Immune System…

3

The Lymphatic and Immune Systems

The heart is shown for reference… but the rest of these structures – everything from bone marrow to the tonsils, lymph nodes to the spleen – function together to form the Lymphatic and Immune Systems.



1.56 Anterior view, structures of the lymphatic system

There are great illustrations of lymphatic structures in Werner, p. 291, 6th and 315, 7th

TGB, p. 43

4

Focus on Lymphatic Structure and Function

5

Functions of the Lymphatic System

- Manage and Maintain Fluid Balance
  - Maintain homeostasis by returning accumulated tissue fluid to the blood stream
  - Prevent edema and help to maintain blood pressure

lymph, L = clear water

6

Functions of the Lymphatic System

- Transport proteins, fats, and fat-soluble vitamins
  - Some of these molecules are too large to enter the blood capillaries in the digestive system. They are transported from the digestive system to the blood via the lymph.

7

What are the components of the Lymphatic System?

✓ Lymph vessels (capillaries and lacteals, vessels, trunks, ducts, and the cisterna chyli)
✓ Lymph nodes
✓ Lymphatic fluid, aka "lymph"
✓ Red bone marrow
✓ The thymus (gland)
✓ Leukocytes 
✓ The spleen (organ)
✓Mucosa-associated lymphoid tissue (tonsils, Peyer patches, vermiform appendix)

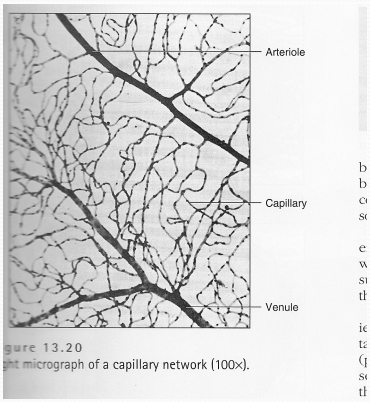
8

Origins of Lymphatic Fluid…

How do these parts work together to accomplish the functions listed?

Let's start with where lymphatic fluid comes from…

Remember the smaller structures of the cardiovascular system?

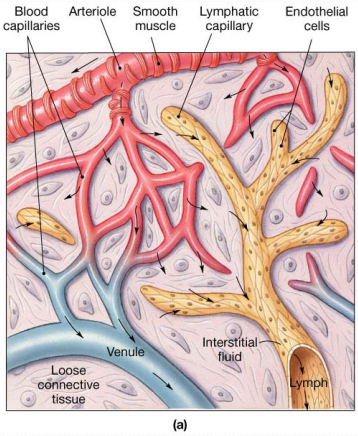


gure 13.20
ght micrograph of a capillary network (100×).

9

Alongside of and interwoven with the blood capillaries are lymph capillaries (illustrated in yellow). Fluid moves out of the arterial capillaries as part of essential substance transport – but only 90% of the fluid returns to the venous capillaries and gets returned to the lungs and heart in that fashion. The lymphatic capillaries pick up the rest.

Origin of Lymph…

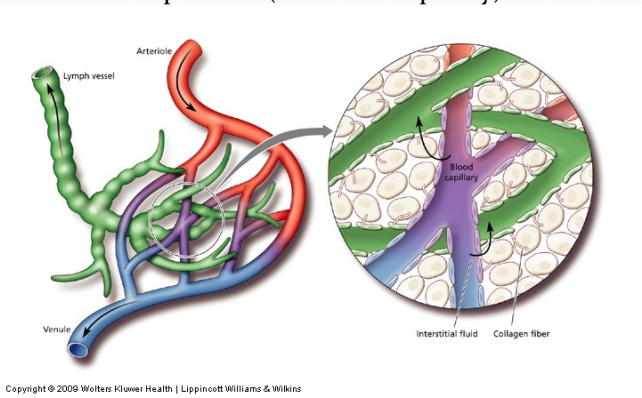


(a)

10

From Interstitial Fluid to Lymph…

Tiny collagen fibers attach the lymph capillary walls (green, below) to the surrounding tissues. When tissue pressure changes or when tissues move or stretch, the collagen connectors pull the walls of the lymph capillaries open, allowing fluid to flow from the area of greater pressure (interstitial areas) to the area of less pressure (inside the capillary).



11

Starling equilibrium

Of the fluid that exits our blood capillaries, 90% re-enters the capillaries and re-joins the bloodstream. The remaining 10% becomes Interstitial Fluid… and then Lymph. The forces that orchestrate this balance (the Starling equilibrium, named for Ernest Starling in 1894) include hydrostatic pressure, protein gradients, and vascular permeability. The hypothesis was revised recently to include information that technology now affords, but the Starling forces are still the main way we explain and understand the movement of fluid that begins as plasma and becomes lymph.

http://www.pathwaymedicine.org/starling-forces

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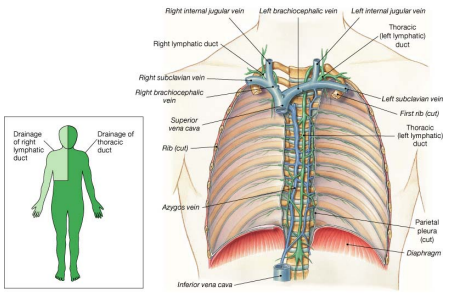
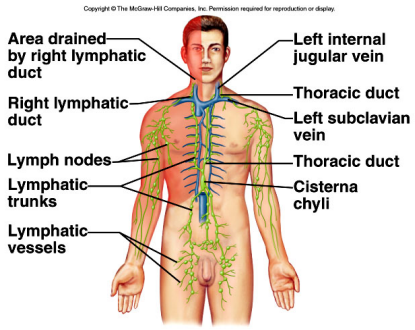
Lymph flows into the lymph capillaries, then into larger vessels, trunks, and eventually, into the right lymphatic and left thoracic ducts. The ducts empty the lymph into the blood stream at the right and left subclavian veins.





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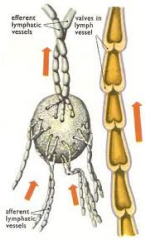
Movement of Lymph vs. Blood

The lymphatic drainage system is **one way**. It has **no central pump** like the heart. The **same mechanisms that move blood back to the heart through our veins** move lymph back to the merger point with the bloodstream (close to the clavicles).



Lymph vessels that are larger than capillaries are **valved** – and they have **many more valves than our veins** do, giving them a beaded appearance. The density of valves means that **any pressure** exerted on or by the lymph vessel **walls is "interpreted" as one-way movement** toward the place where the right lymphatic and left thoracic ducts intersect with the bloodstream.

14

A Summary of What Helps Lymph Move…

Page 290, Werner 6th
Page 316, Werner 7th

1. Hydrostatic pressure favors movement of interstitial fluid into lymphatic capillaries. **Lymphatic capillaries are pulled open when collagen fibers, attached to the capillary walls, pull the walls apart.**

2. Contraction of skeletal muscle and rhythmic contraction of smooth muscle in the walls of larger lymphatic vessels moves fluid along in one direction… because…

3. …Lymph vessels are valved, as are veins: lymph can only flow in one direction when pressure is exerted on the vessels.

4. **Pressure changes associated with breathing** move lymph.

5. **Alternating hot and cold hydrotherapy applications** can increase contractions in the smooth muscle tissue of lymphatic vessels to move fluid along.

6. **Massage** – circulatory/mechanical massage (to a smaller degree) and **Manual Lymphatic Drainage** (to a larger degree) – can also contribute to fluid movement within the lymphatic system.

7. Gravity helps to move lymph if a limb is elevated.

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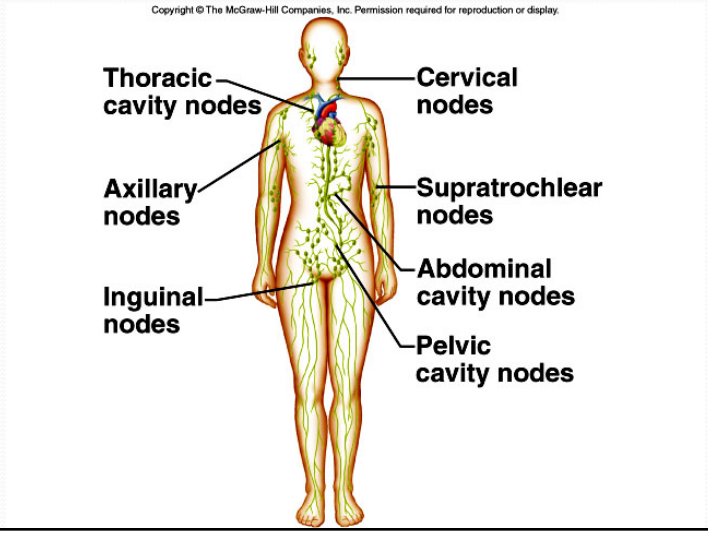
Along the way, lymph is filtered by the (600 to 900!) lymph nodes.



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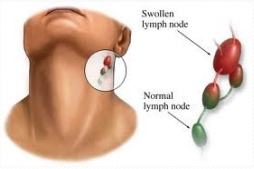
Lymph nodes…

- **Slow the flow** of lymph so that filtration can take place.
- **House macrophages and lymphocytes** to disable and disassemble pathogens and mutated cells.
- **Can encapsulate harmful substances** that can't be broken into harmless parts and recycled.
- **Ensure that lymph** – which is full of waste materials – **is cleaned** before it is dumped back into the blood stream to again become part of plasma volume.
- **Swell when they are especially active**.



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Pix of Lymphatic Structures…

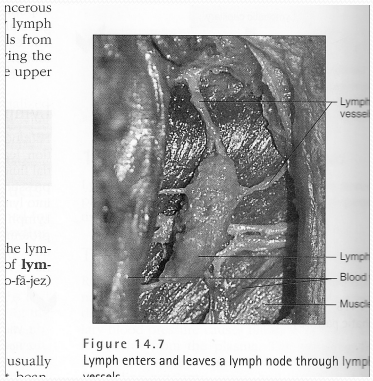

Figure 14.7
Lymph enters and leaves a lymph node through lymph vessels

Photo of a lymph node in situ.

Close-up of a lymphatic vessel valve.

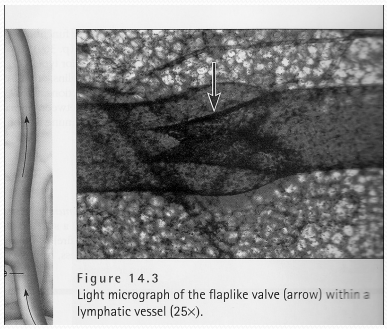

Figure 14.3
Light micrograph of the flaplike valve (arrow) within a lymphatic vessel (25×).

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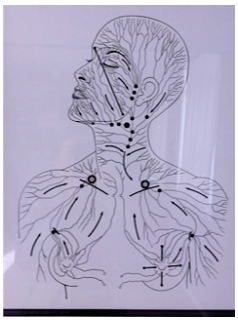
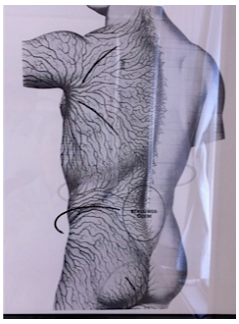
Nodes and Pathways

Superficial lymph nodes are concentrated in the axillary, inguinal, and cervical regions.

Superficial lymph drainage takes place in certain directions. These lines of drainage (movement) are called Pathways.





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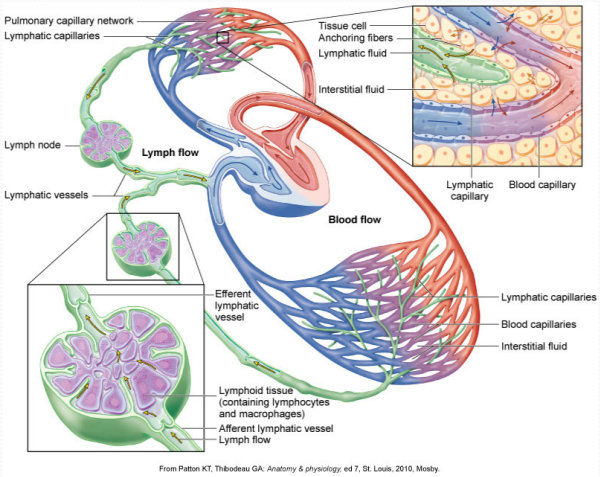
Schematic of Lymph and Blood Flow…



From Patton KT, Thibodeau GA: *Anatomy & physiology*, ed 7, St. Louis, 2010, Mosby.

Fig. 27-2. Flow of lymph.

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Review…

1. Where does lymphatic fluid come from?

Plasma that has seeped out of blood capillary walls. The plasma becomes interstitial fluid. When it enters a lymph capillary, it becomes lymph.

2. What are some structures of the lymphatic system?

Lymph capillaries, lymphangions, vessels, trunks, ducts; nodes; cisterna chyli

3. What and where are lymph nodes, and what do they do?

Small organs that clean and monitor lymph as it returns to the bloodstream, nodes are located along lymphatic vessels. Superficial nodes are concentrated in the axilla, groin, and cervical region.

4. What does the Starling equilibrium state?

Due to various forces, 90% of fluid leaving blood capillaries returns to the capillaries and 10% remains as interstitial fluid that becomes lymph.

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When the Lymphatic System Fails…

- When fluid balance fails: EDEMA

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Remember the Starling Equilibrium?

What if it (homeostasis) is not maintained??

If anything blocks veins, lymph nodes, or lymph vessels -- or changes the chemistry of the interstitial environment – the proportion of interstitial fluid that is taken up by the lymphatic capillaries can be reduced… resulting in EDEMA (swelling).

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Edema

Any conditions that interfere with lymph movement cause fluids to build up in interstitial spaces. This causes swelling or *edema.* Edema can be a local or systemic problem, and it is usually associated with chemical imbalance, inflammation, or poor circulation.

Edema is generally only noticeable when interstitial fluid volume is about 30% above normal.

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Causes of Edema…

Mechanical Factors…

- Heart Failure
- Liver Dysfunction
- Kidney Dysfunction
- Venous Obstruction
- Lymph Node Removal
- Tight socks, braces, etc.

Chemical Factors…

- Accumulation of salts or proteins in the interstitial fluid, which causes water retention
- Inflammatory responses to infection or allergies

Larger-scale Edema is usually systemic. Localized Edema is often connected to a smaller-scale problem.

Lymphedema (resulting from damage to lymphatic structures and subsequent accumulated proteins) will be discussed when you learn about cancer.

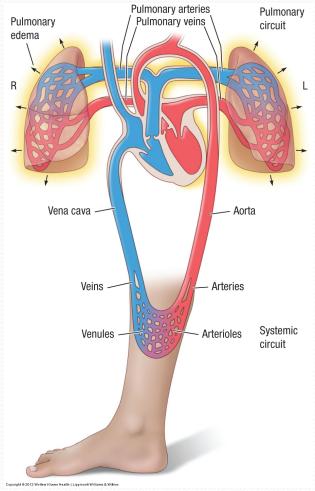
25

Edema from Injury…

Degrees of edema or changes in swelling can be monitored through careful measuring.

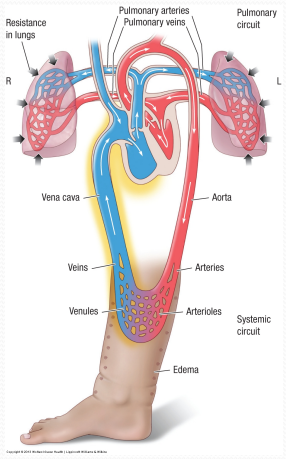
26

Edema Related to Heart Failure



The left ventricle is impaired, and blood backs up into the pulmonary circuit. Fluid seeps into the lungs, causing coughing, shortness of breath, and sometimes bloody sputum. Pneumonia is a common complication.

Left-sided heart failure causes PULMONARY EDEMA.



In cases of pulmonary disease or as a complication of left-sided heart failure, resistance to blood flow through the lungs increases. The right ventricle cannot move blood into the pulmonary circuit, and blood backs up through the rest of the body. Gravity determines where the excess fluid collects.

Right-sided heart failure causes EDEMA IN THE LEGS OR ABDOMEN.

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Lymphedema…

Edema from lymph system damage due to surgery…

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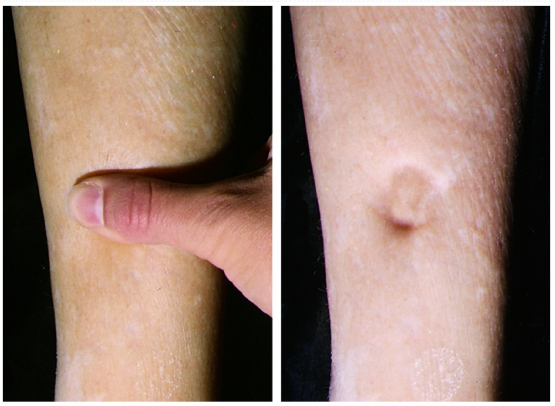
Pitting Edema…



The tissues become "water logged," and cannot spring back once pressure is applied.

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Edema and Massage…

Most types of edema contraindicate all but the lightest forms of bodywork because the delicate lymphatic capillaries are already overwhelmed.

A notable exception is edema related to subacute or post-acute musculoskeletal injuries – or "functional" edema that has arisen temporarily (standing too long on a hot bus, for example). In either of these cases, hydrotherapy and massage may help to resolve the edema.

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Review…

1. Broadly, what is edema?

Edema occurs when fluid builds up in the interstitial spaces.

2. What is pitting edema?

Tissues become so filled with excess fluid that they cannot spring back when pressure is applied.

3. Most kinds of edema contraindicate massage. A notable exception is when edema is the result of…?

Sprains or other sub-acute or post-acute musculoskeletal injury; also, simple, temporary swelling from something like standing for a long time in a hot environment

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Focus on Immune Structure and Function

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Functions of the Immune System

- Orchestrate and Provide Immunity
  - Generate, house, and transport leukocytes
  - Orchestrate innate/non-specific and acquired/specific responses to threats to individual health/integrity
  - In sum, to **notice and disable pathogens that come from external sources as well as mutations that arise internally** (worn out cells, debris from dead cells, mal-formed cells, improperly folded proteins, etc.)

33

What are the components of the Immune System?

- ✓ Lymph vessels (capillaries and lacteals, vessels, trunks, ducts, and the cisterna chyli)
- ✓ Lymph nodes
- ✓ Lymphatic fluid, aka "lymph"
- ✓ Red bone marrow
- ✓ The thymus (gland)
- ✓ Leukocytes

- ✓ The spleen (organ)
- ✓ Mucosa-associated lymphoid tissue, aka MALT (tonsils, Peyer patches, vermiform appendix)

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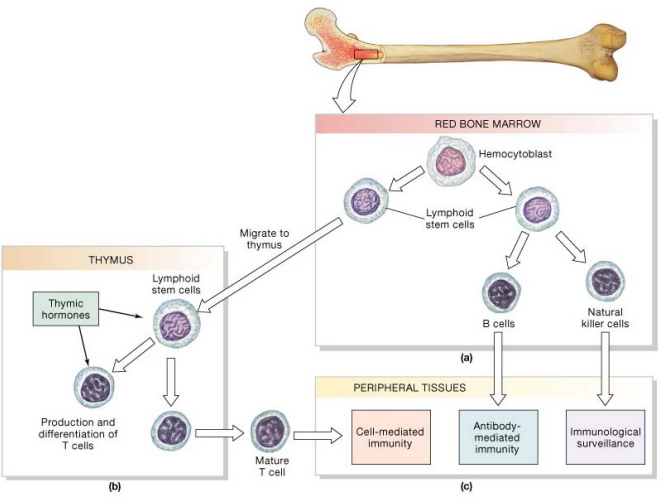
Immune System Structures and Functions



Stem cells in **red bone marrow** become a variety of **leukocytes**. Some migrate to the **thymus** and mature there (T cells). Others mature and reside in the blood (B cells).

35

Varieties of Leukocytes….

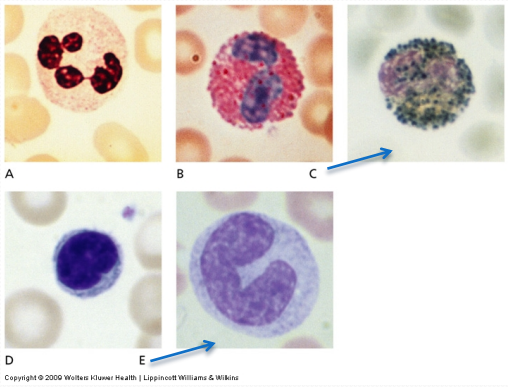
1. Granulocytes
A = Neutrophils (phagocytic)

B = Eosinophils

C = Basophils

2. Lymphocytes = D

3. Monocytes = E (phagocytic)



For a perky but/and interesting take on the immune system, view https://www.youtube.com/watch?v=CG931UYMbNo

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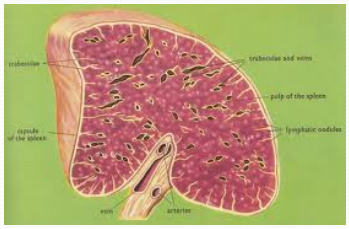
The Spleen…

•The spleen is the largest lymphoid organ.
•It filters and cleanses the blood just the way lymph nodes clean and filter lymph – and then passes the filtered blood to the liver for further cleaning.
•It also requires red blood cells to make their way through narrow and torturous vessels. If the red blood cells are too old and inflexible, they break apart (are "retired") and their components are recycled along with other wastes and cellular debris.



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…And the Mucosa-Associated Lymphoid Tissue (MALT)

• **Tonsils** are located in the oral cavity and pharynx and include the adenoids and palatine and lingual tonsils. They are positioned to be a first line of defense for the respiratory tract.
•**Peyer Patches** house white blood cells and are located in the small intestines. They, like the Appendix, are positioned to protect the digestive system.
•The **Vermiform Appendix** also houses white blood cells and is located at the start of the large intestine (cecum).

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Two Sorts of Immunity (*immun,* L = safe, free)

1. We are **born with** certain protective features and mechanisms. These are called our **innate, non-specific, and/or natural defenses.**

2. Our bodies also have the capacity to **learn to protect us in tailored ways** against specific threats. These mechanisms are called our **acquired, specific, and/or adaptive defenses**.

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Innate, Non-specific, Natural Defenses…

pp. 430-33, Premkumar

- Physical Barriers
- Reflexes (coughing, sneezing)
- Species Resistance and Chemical Defenses
- Cellular Responses (protein complement; natural killer cells)
- Inflammation
- Fever

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Specific, Acquired, Adaptive Defenses…

pp. 433-436, Premkumar

Varieties of Lymphocytes "recognize" and/or "remember" specific, foreign molecules and then defend against them.

- **Cellular Immunity**
  - T-Cells (those which mature and are "educated" in the Thymus) differentiate into several types.
  - Some (Cytotoxic T-Cells) react directly to disable cancer cells and viruses.
  - Others do not react directly but act as holders of memory and prior experience (Memory T-Cells). These cells can then replicate into Cytotoxic T-Cells if a specific pathogen shows up again.
  - Still another group of T-Cells are called Helper T-Cells. These help to activate the…
- **Humoral Immunity** (*humor*, L = fluid)
  - B-Cells (those which remain in the blood) produce antibodies which destroy cells bearing certain markers (antigens).
  - Some B-Cells also become holders of memory and experience so that rapid response to subsequent exposure to a specific antigen is possible.

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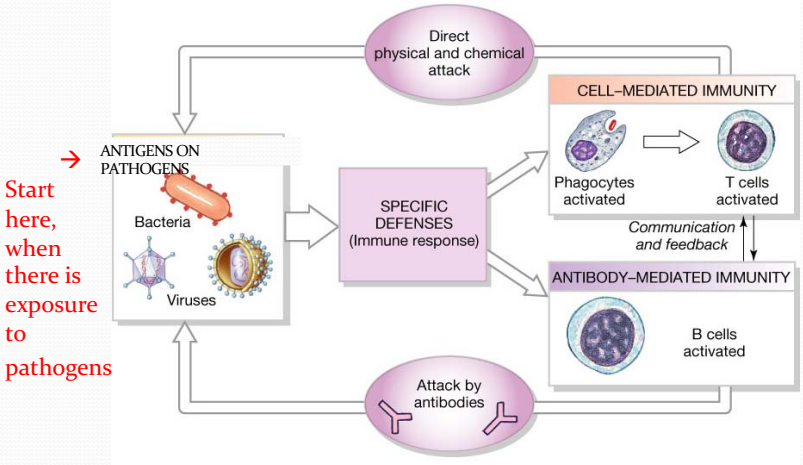
Specific, Acquired, Adaptive Defenses…

→ Start here, when there is exposure to pathogens



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Our astonishing bodies…

A plasma cell (a type of B-Cell), secretes up to 2,000 identical antibodies **per second**.

An individual's B-Cells can produce an estimated 10 million to 1 billion different varieties of antibodies, each reacting against a specific antigen.

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Consider what happens…

…when someone touches a contaminated doorknob and then wipes his/her eye. Rhinovirus 14 has just been introduced into the body…

Page 292, Werner, 6th
Pages 316-17, Werner 7th

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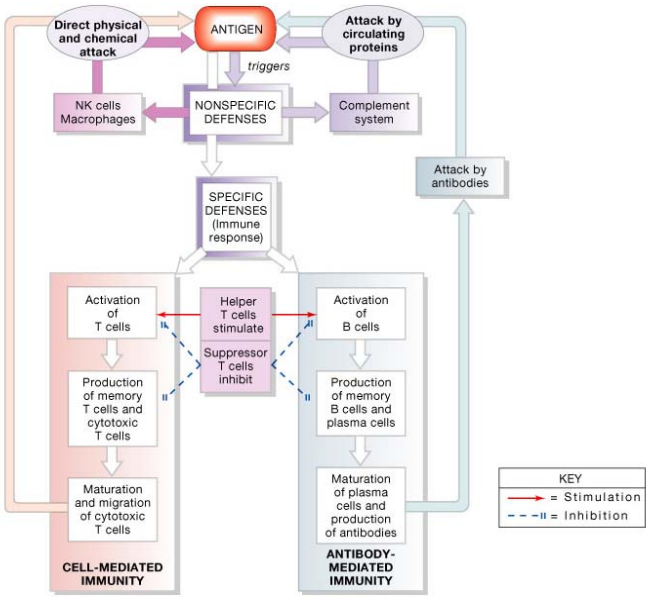
A Final Look at the Immune System…



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Review…

1. Name 3 structures of the immune system.

Leukocytes, spleen, thymus, bone marrow, MALT

2. What are leukocytes?

White blood cells that fight infection and clean up cellular debris

3. What's an example of an innate, non-specific immune defense mechanism?

Protein complement, inflammation, fever, coughing, intact skin, etc.

4. T-Cells and B-Cells (and the antibodies the B-Cells produce) are part of which branch of defenses?

Acquired, adaptive defenses

5. Which items mentioned in Question 4 are part of Humoral Immunity?

B-Cells and antibodies reside in the blood, therefore they are humoral (fluid-based)

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When the Immune System Fails…

- When cells mutate and proliferate: CANCER
  - When lymphatic cells mutate & proliferate: LYMPHOMA/CANCER
- When defenses are disabled or overwhelmed: HIV/AIDS, CHRONIC FATIGUE SYNDROME, FEVER
  - When lymphatic structures are infected or compromised: LYMPHANGITIS, MONONUCLEOSIS
- When defenses mistake the harmless for the harmful: ALLERGIC REACTIONS
- When defenses mistake self for other: AUTOIMMUNE DISEASES

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When the Immune System Fails…

- When cells mutate and proliferate: CANCER
  - When lymphatic cells mutate & proliferate: LYMPHOMA/CANCER

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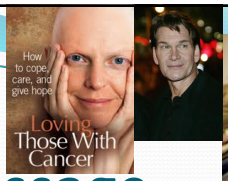

Cancer and Massage

Cancer used to be thought of as an absolute contraindication. We have learned much more about the mechanisms of metastasis and the effects of massage on immune function and quality of life: massage is no longer a systemic contraindication across the board.

That said: caution is required. One should always consult with a client's treatment team. Particular care needs to be taken if a client's lymphatic system has been compromised by surgeries or if metastases are present.

Gayle MacDonald is an experienced practitioner who has written several very good books for MTs about working with people who currently have or who have had cancer.

Recommended Books: Medicine Hands and Massage for the Hospital Patient and Medically Frail Client

meta = beyond
stasis = standing

Metastasis = when cancer spreads beyond the part of the body initially affected

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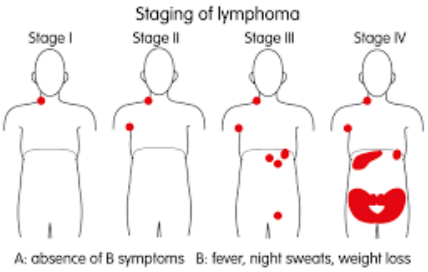
- Cancer of the lymph nodes, specifically some leukocytes (B or T cells)
- Very similar to leukemia
- Two types: Hodgkin (more treatable) and Non-Hodgkin (harder to treat)
- Lymphoma contraindicates any lymphatic massage, though gentle touch suitable for those experiencing cancer is indicated
- Survivors can enjoy all types of massage

Lymphoma



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When the Immune System Fails…

- When defenses are disabled or overwhelmed: HIV/AIDS, FEVER
  - When lymphatic structures are infected or compromised: LYMPHANGITIS, MONONUCLEOSIS

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HIV/AIDS

What is it?

Acquired Immune Deficiency Syndrome (AIDS) is a disease caused by Human Immunodeficiency Virus (HIV), which attacks and disables the immune system by ultimately targeting the Helper T-Cells. This leaves a person vulnerable to a host of diseases that are usually not a threat to people uninfected with HIV.

Symptoms

Most people with HIV have a week or two of flulike symptoms within several weeks of being infected, followed by an interval with no symptoms (Phases 1, 2, and 3). In Phase 4, when the virus has successfully inactivated the immune system, infection by opportunistic pathogens (many varieties of Herpes; Pneumocystis carinii [fungal infection of the lungs]) occurs and other opportunistic conditions (Kaposi sarcoma [pictured]; lymphoma; candidiasis; toxoplasmosis, etc.) take hold.

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HIV/AIDS

Transmission

HIV is spread through the exchange of intimate fluids (blood, sexual secretions, breast milk) and can be acquired through blood transfusion or shared needle use as well as through sexual contact. Virus concentrations in sweat, tears, and saliva are too low to cause infection. Also, the virus is unstable outside a human host, so it is not transmissible via surfaces or through living vectors like bedbugs, mosquitoes, or ticks.

Massage…

All Phases of HIV infection/AIDS indicate massage as long as

1. The practitioner is healthy and does not pose any risk to the client; and
2. The massage is geared to the level of challenge or change that the client's body can manage. Side effects of medication must be taken into account. Most HIV positive people who are asymptomatic can receive benefit from massage with usual techniques and pressure.

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FEVER, aka PYREXIA

If 97.88F is the new normal oral body temperature, what is the new fever threshold? Following general guidelines, fever would be present at 100F.

- A healing mechanism in the body
- Controlled by the hypothalamus
- Generally identified when internal temperature is at or above 101 degrees F (old standard)
- Can be fatal if temperature rises above 112 degrees F, but this is highly uncommon
- Systematically contraindicates massage because
  - The client's system is already challenged, and
  - The practitioner shouldn't risk exposure to a contagious, infectious condition

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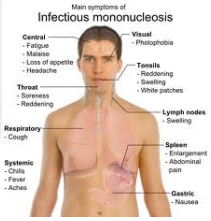
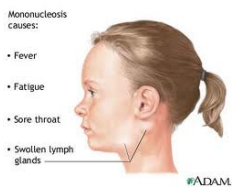
Mononucleosis

- Viral Infection (Herpes Family): fever, fatigue, sore throat and swollen nodes
- Begins in the salivaries and moves into the lymphatic system
- Transmitted through saliva
- Usually self-limiting
- Complications: strep throat, enlarged spleen
- Possible future development of lymphoma
- Avoid massage while condition is evident





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Lymphangitis

- Infection with inflammation in the lymphatic capillaries
- Associated with a variety of bacteria
- Tiny lesions on the hands increase vulnerability (MT's at risk)
- Infection can get past nodes and enter bloodstream, causing septicemia (blood poisoning)
- Starts with pain, heat, swelling, then scarlet track from involved vessel
- Antibiotic treatment required
- Do not massage when there is evidence of condition

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When the Immune System Fails…

◆When defenses mistake the harmless for the harmful: ALLERGIC REACTIONS

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Allergic or Hypersensitivity Reaction

What is it?

Allergic reactions are immune system mistakes in which an inflammatory response becomes irritating or dangerous as it reacts inappropriately to a variety of triggers. "Hay fever" and poison oak rashes are examples -- as are systemic *anaphylaxis* (massive amounts of histamine and other chemical mediators are released, causing edema and a rapid drop in blood pressure), which can interfere with or block breathing, and *angioedema* (rapid onset swelling reaction that can block breathing). The latter are emergencies.

G: ana = up, *phylaxis* = protection

Massage…

Most allergic and hypersensitivity reactions contraindicate massage in the acute stage, since inflammation is present and increasing blood flow to the affected region would be counterproductive. Mild and general allergies do not contraindicate massage. Care should be taken to avoid potential triggers like scents in lubricants, candles, or linens. Allergies can be exhausting, and massage can help restore energy if it is not too demanding. Any massage or touch that works to reduce subacute inflammation in the sinuses and throat may provide temporary relief from respiratory allergies.

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When the Immune System Fails…

◆When defenses mistake self for other: AUTOIMMUNE DISEASES

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Chronic Fatigue Syndrome

- Collection of signs and symptoms
- Not well understood: probably multifactoral, including autoimmune and external factors
- Resembles and often occurs with fibromyalgia and irritable bowel syndrome
- Treatment involves managing the effects of stress
- Massage is indicated – but/and must be geared to the client's level of stamina and resilience
- Common modifications include reducing the vigor and duration of massage

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Autoimmune Diseases

Causes… Symptoms… Massage?

Ankylosing Spondylitis
Crohn Disease
Lupus
Multiple Sclerosis
Psoriasis
Rheumatoid Arthritis
Scleroderma
Ulcerative Colitis

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Autoimmune Diseases, in General…

What are they?

In an autoimmune condition, the **body's defenses are mobilized *against* the body itself**; that is, the immune system mistakenly characterizes some part of the body as "other" or "non-self," – and then goes about trying to destroy it. Autoimmune diseases can be triggered by genetic or environmental factors and perhaps even by injury. Common conditions include rheumatoid arthritis, lupus, multiple sclerosis (MS), allergies and hypersensitivity reactions, ankylosing spondylitis, Crohn, psoriasis, scleroderma, and ulcerative colitis.

auto, L = self; immun, L = free

Massage…

Massage is contraindicated in acute or flare phases and often indicated in phases of remission. The practitioner must be attentive and responsive to changes in condition and severity and must be able to modify the massage accordingly.

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In general, when we work with immune-compromised individuals…

We work in ways that invite change rather than force it. We must always be mindful of how much our interventions challenge our clients' systems – and not challenge them more than they are able to easily handle.

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Review…

1. Why are massage therapists at risk for lymphangitis?

Any small lesions on our hands leave us vulnerable to infection.

2. What are some signs of serious allergic reaction?

Swelling of the mouth or lips; difficulty breathing; sudden drop in blood pressure (faintness)

3. Why do we view fever as a general contraindication?

A client's system is already challenged – and practitioners should not risk infection in order to protect themselves and others from contagious conditions

4. What is a general rule regarding working with those experiencing autoimmune conditions?

Avoid working during flare phases and work with clients to modify each session based on their feedback around past and present experience. Conditions change. Invite, rather than force.

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