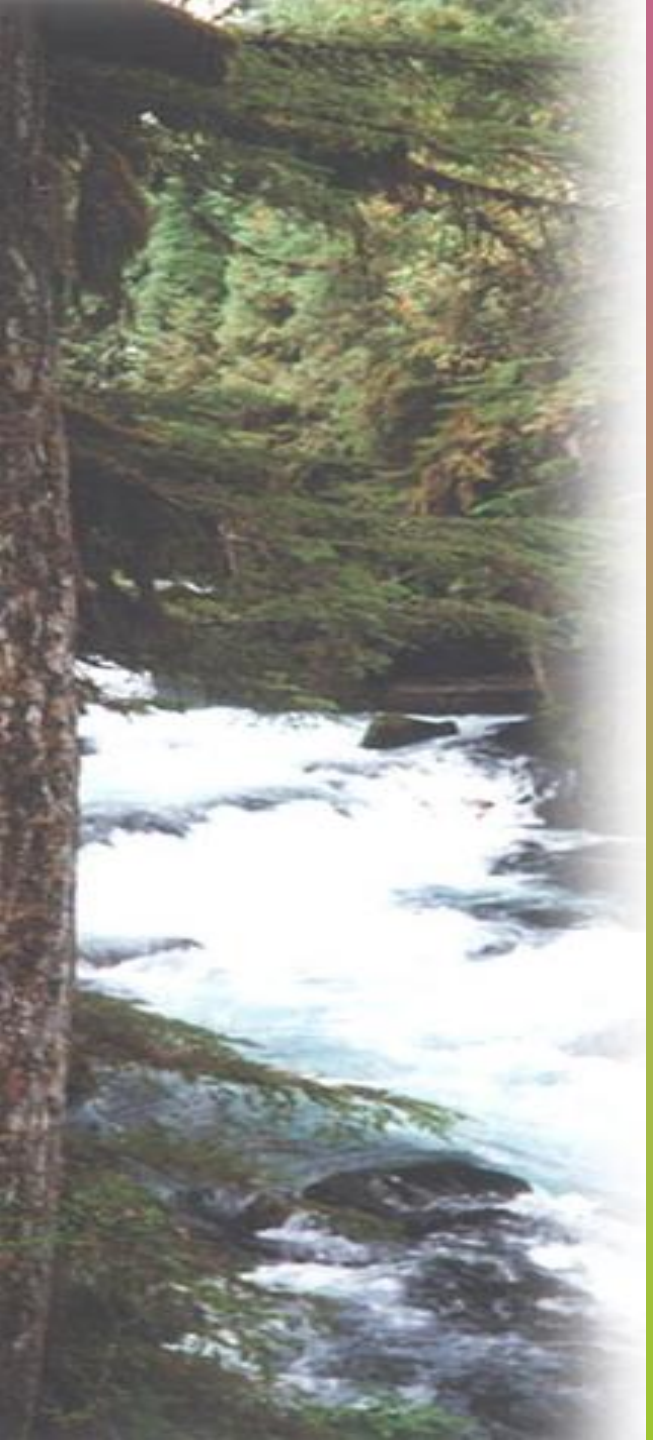

Lymphedema

Loraine Lovejoy-Evans, MPT, DPT, CLT-Földi

Földi-Certified Swelling Disorders Specialist
Physical Therapist

Loraine Lovejoy-Evans, MPT, DPT, CLT-Földi

Földi-Certified Edema Disorders Specialist

- 2017-present: Olympic Medical Home Health
- 2014-2017: Crestwood and Sequim Health and Rehab
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- 2007: Clinical Excellence Award, WA State Physical Therapy
- 2006: Doctorate in PT, Univ of Puget Sound, Tacoma, WA
- 1997-2002: Swelling Disorders Clinic developed
  Olympic Medical Center, Port Angeles, WA
- May 1999: Földi Clinic CDP Certification, Hinterzarten, Germany
- 1993: Masters in PT , University of Puget Sound, Tacoma, WA
- 1986: Bachelors of Music Therapy, Willamette U, Salem, OR

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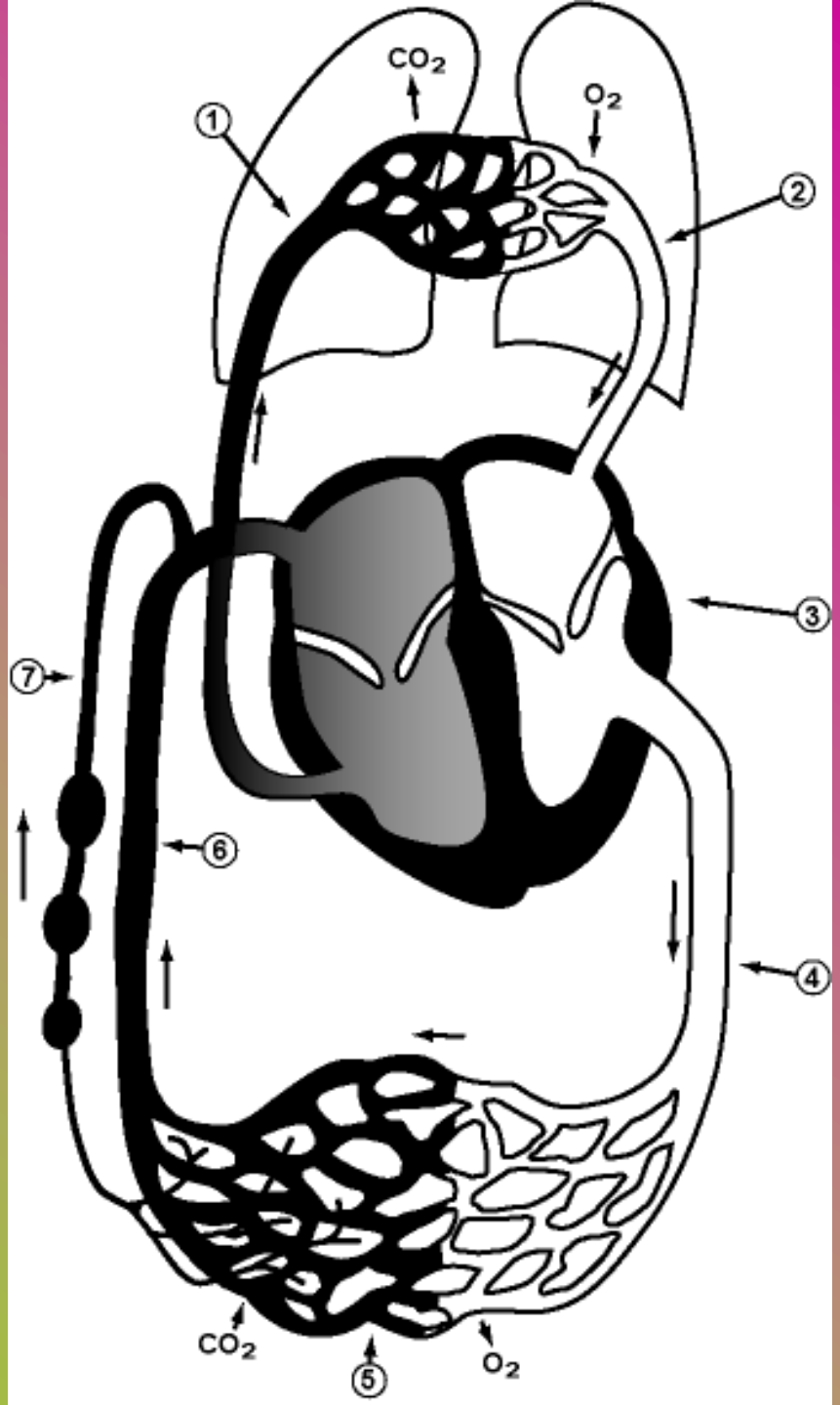
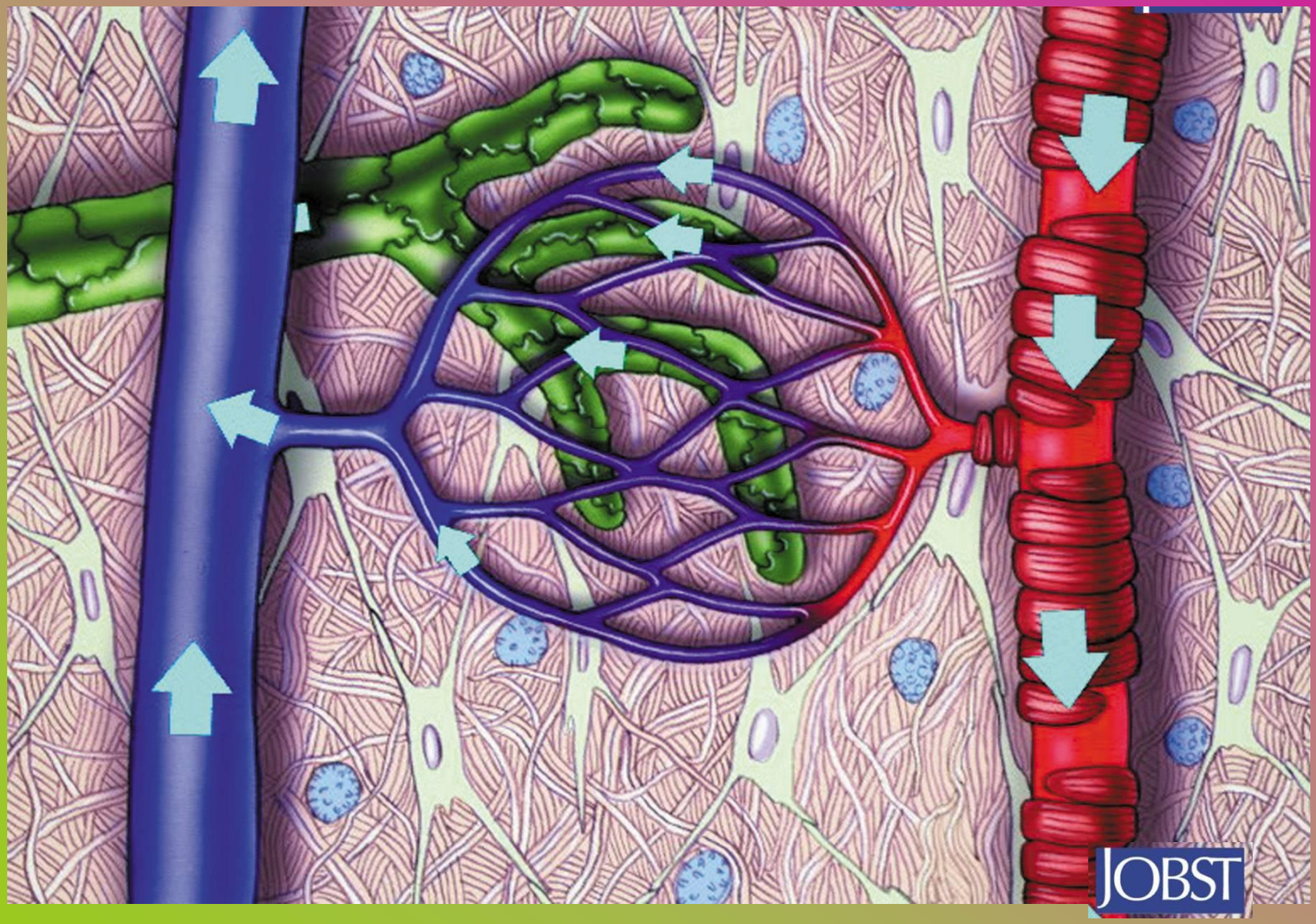
Blood Circulation and the Lymph Vessel System

1—Pulmonary Artery
2—Pulmonary Vein
3—Heart
4—Aorta
5—Capillaries
6—Venous System
7—Lymphatic vessels & lymph nodes




JOBST

Initial Lymphatic

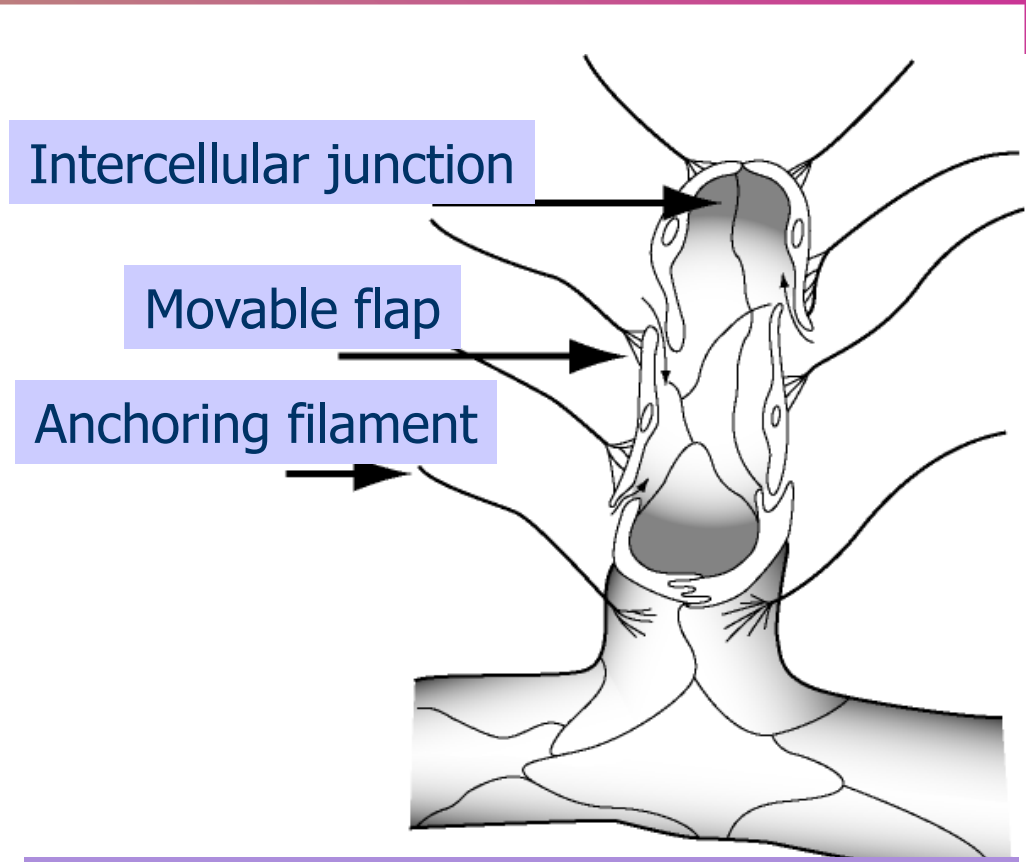
As Interstitial pressure ↑

becomes >

initial lymphatic pressure

valves open

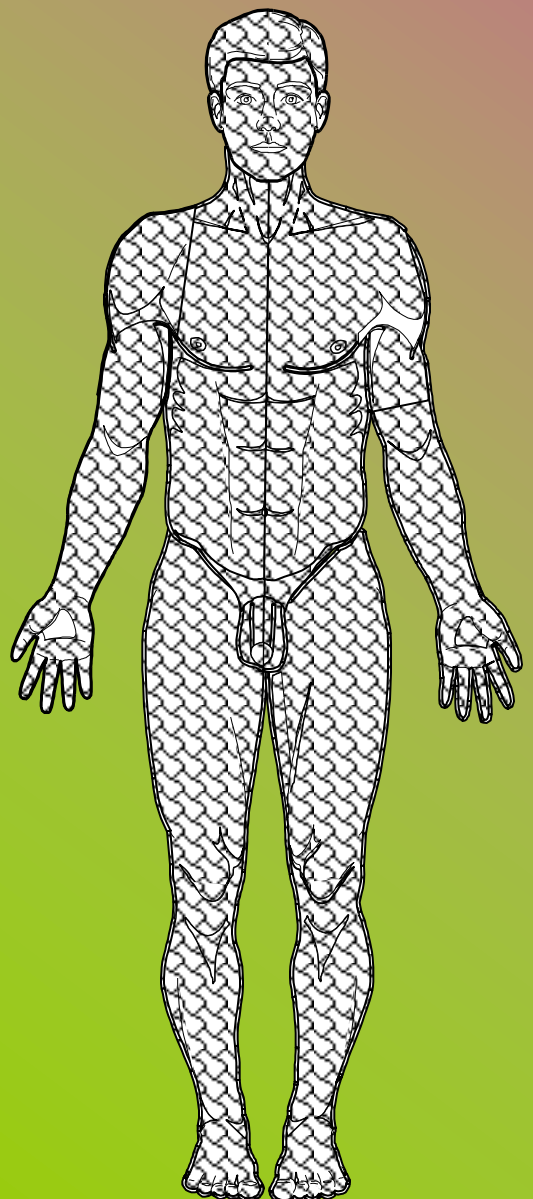
fluid enters



Filling phase: moving flaps are opened and the tissue fluid moves inside becoming lymph fluid.

Initial Lymphatic

Initial Lymphatic Network

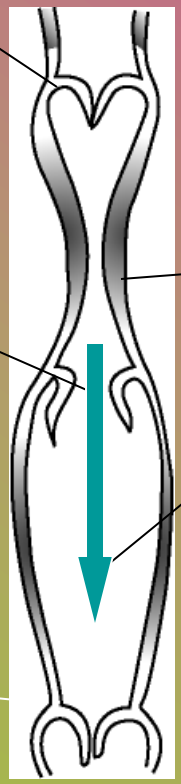


Initial lymphatics form a superficial network throughout the body

In soft connective tissue of the skin and mucous membranes

Think of this network of initial lymphatics as a "Spiderman suit"

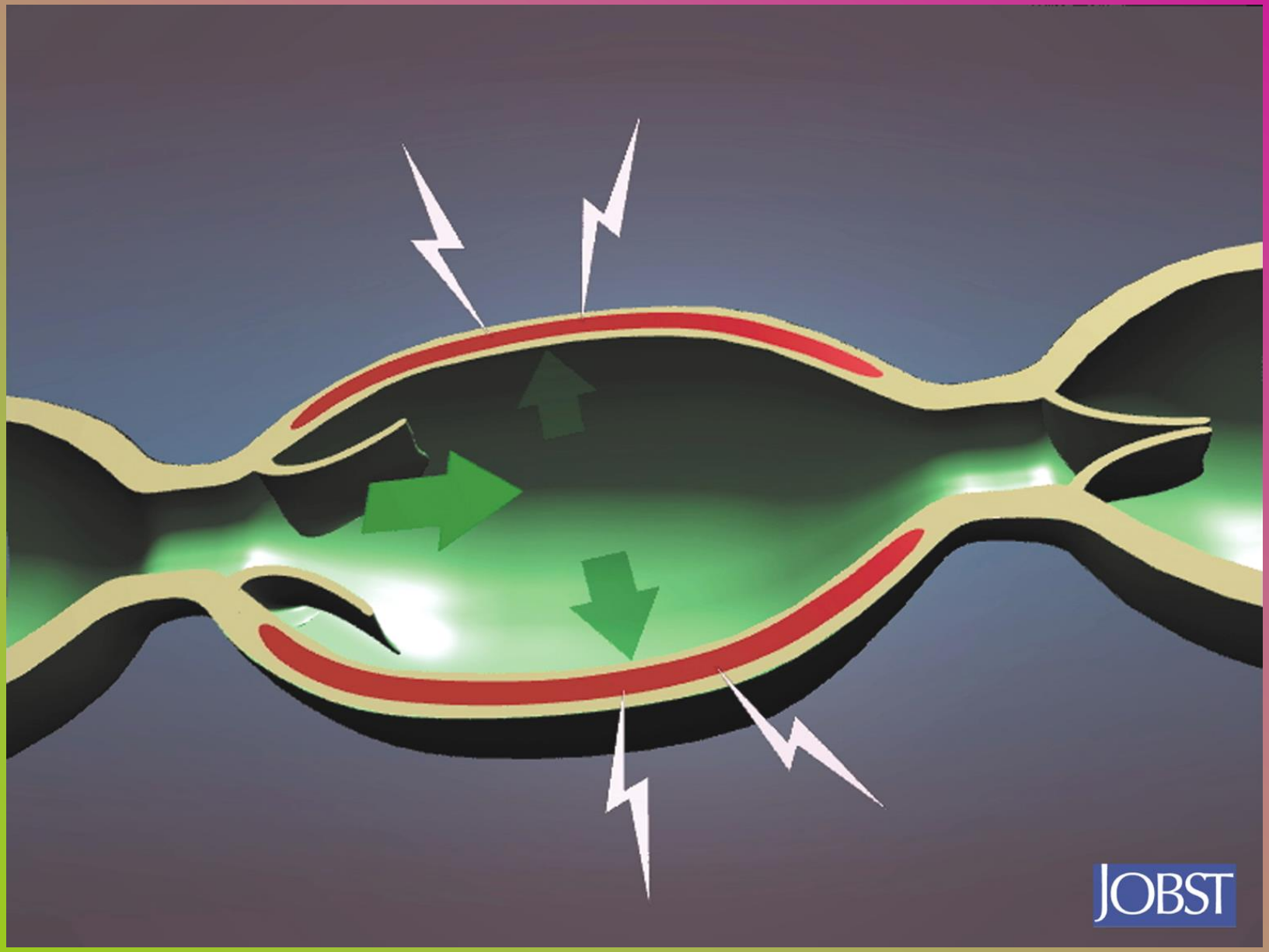
LYMPH ANGION



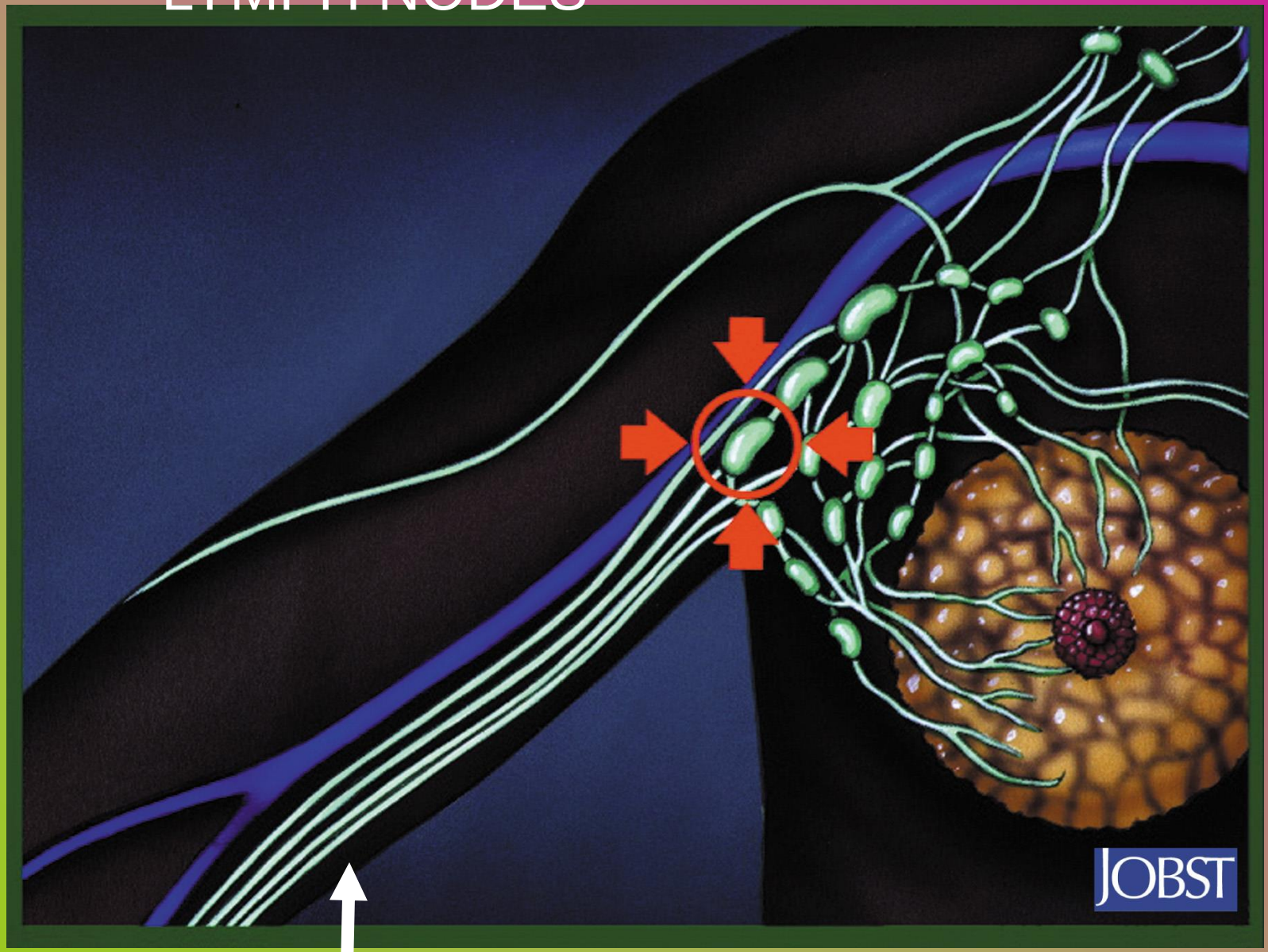
LYMPHANGION DURING SYSTOLE

Lymph Angion = Segment of lymphatic vessel between two sets of valves

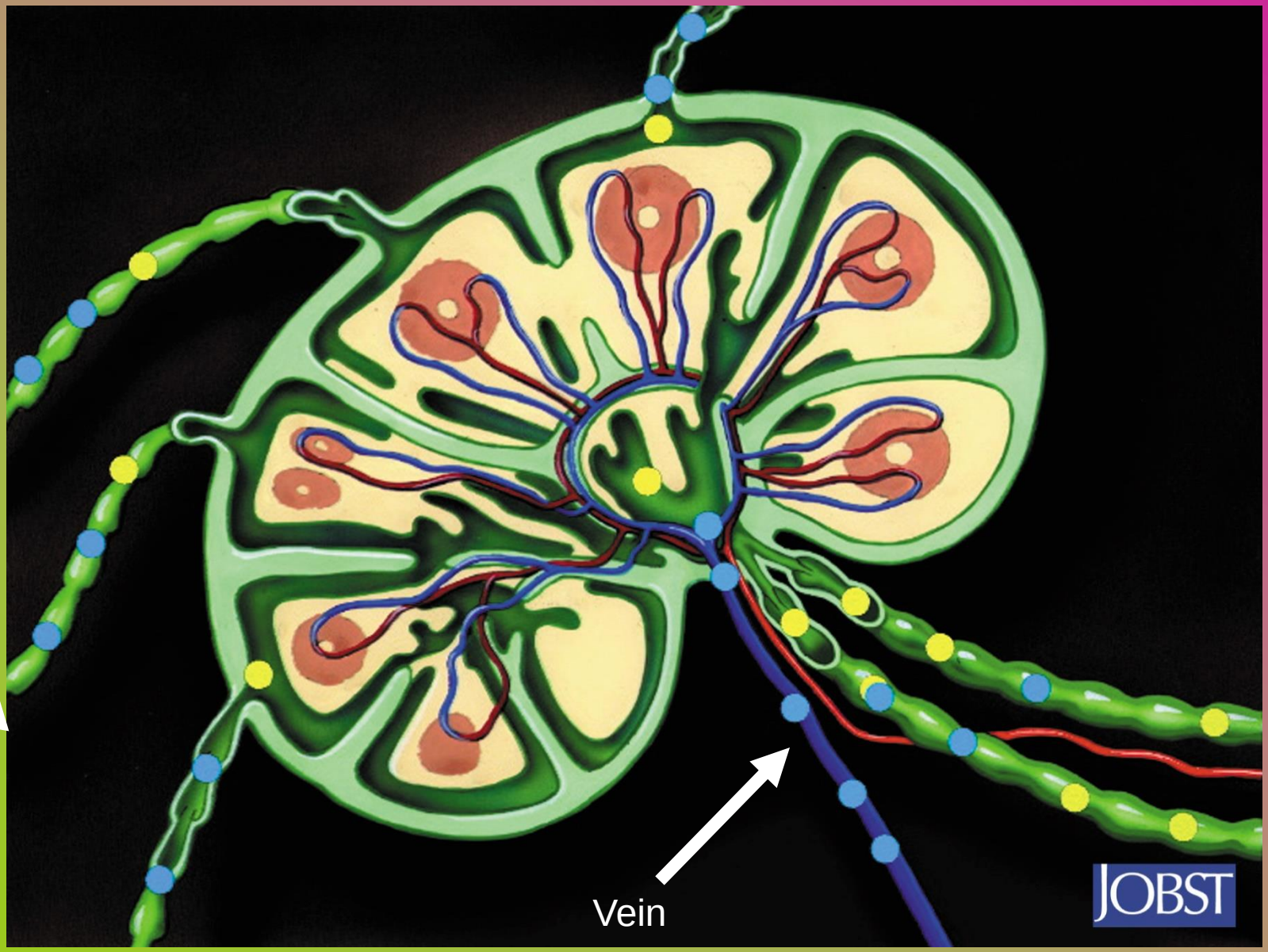
LYMPHANGION DURING DIASTOLE


JOBST

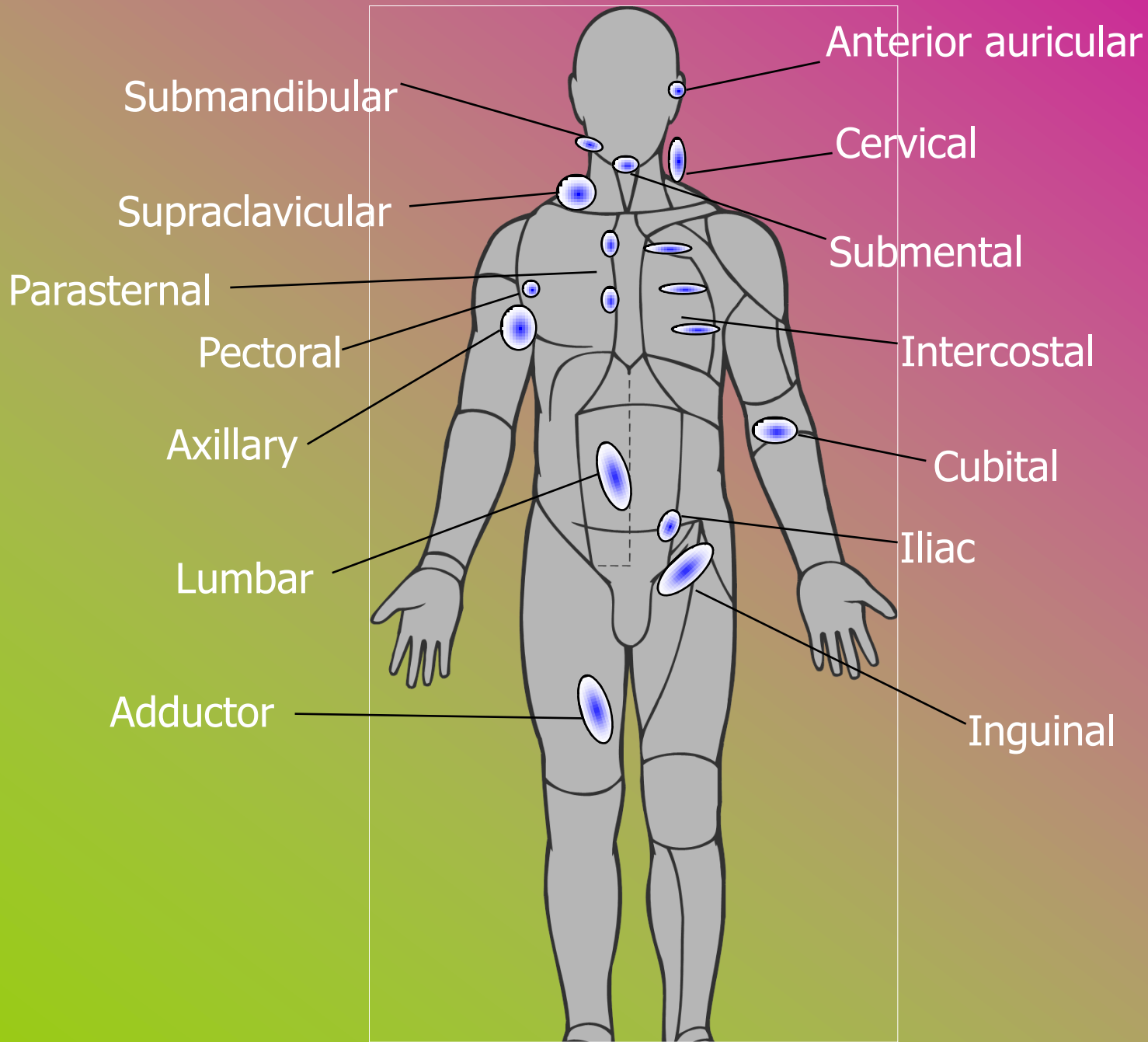
LYMPH NODES

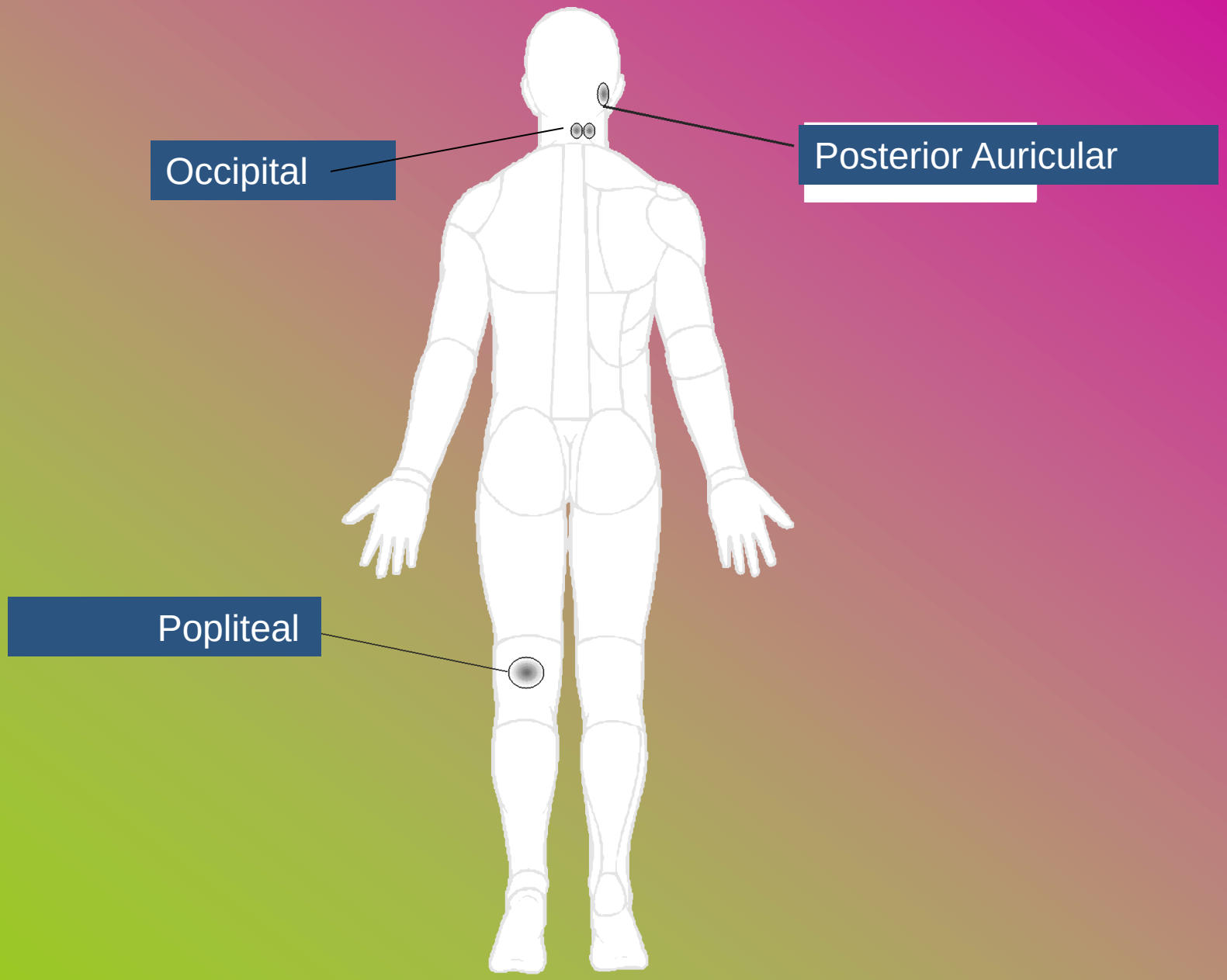


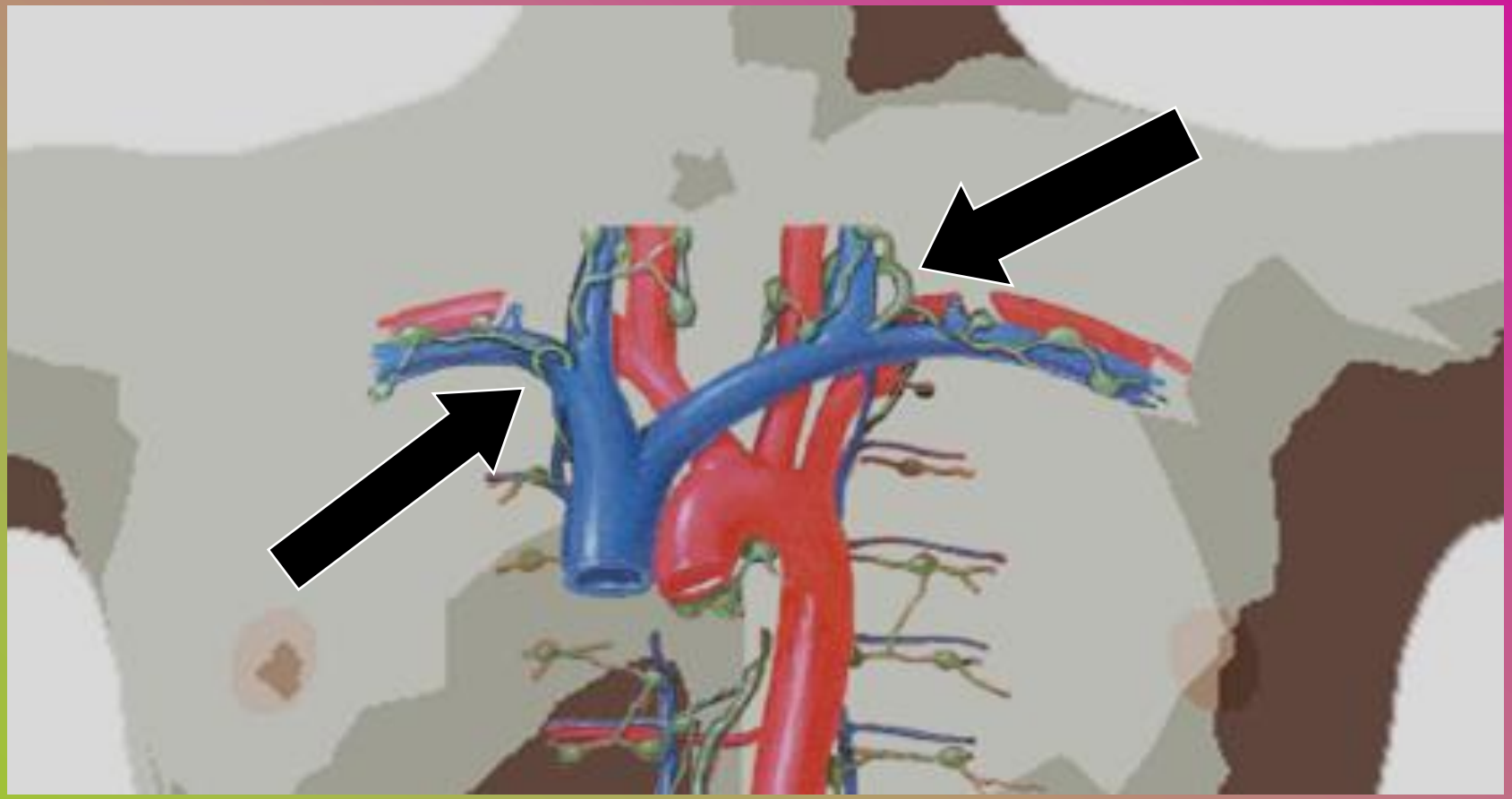
Collecting vessels


Artery
Vein
JOBST
Afferent vessels
Vein
Efferent vessels

Lymph node with collecting vessels seen with help of oily blue dye


Anterior auricular
Submandibular
Cervical
Supraclavicular
Submental
Parasternal
Intercostal
Pectoral
Axillary
Cubital
Iliac
Lumbar
Adductor
Inguinal


Occipital
Posterior Auricular
Popliteal



The lymphatic fluid from right upper quadrant drains into the right lymphatic duct.

The lymphatic fluid from both legs and the left upper quadrant drains into the thoracic duct.

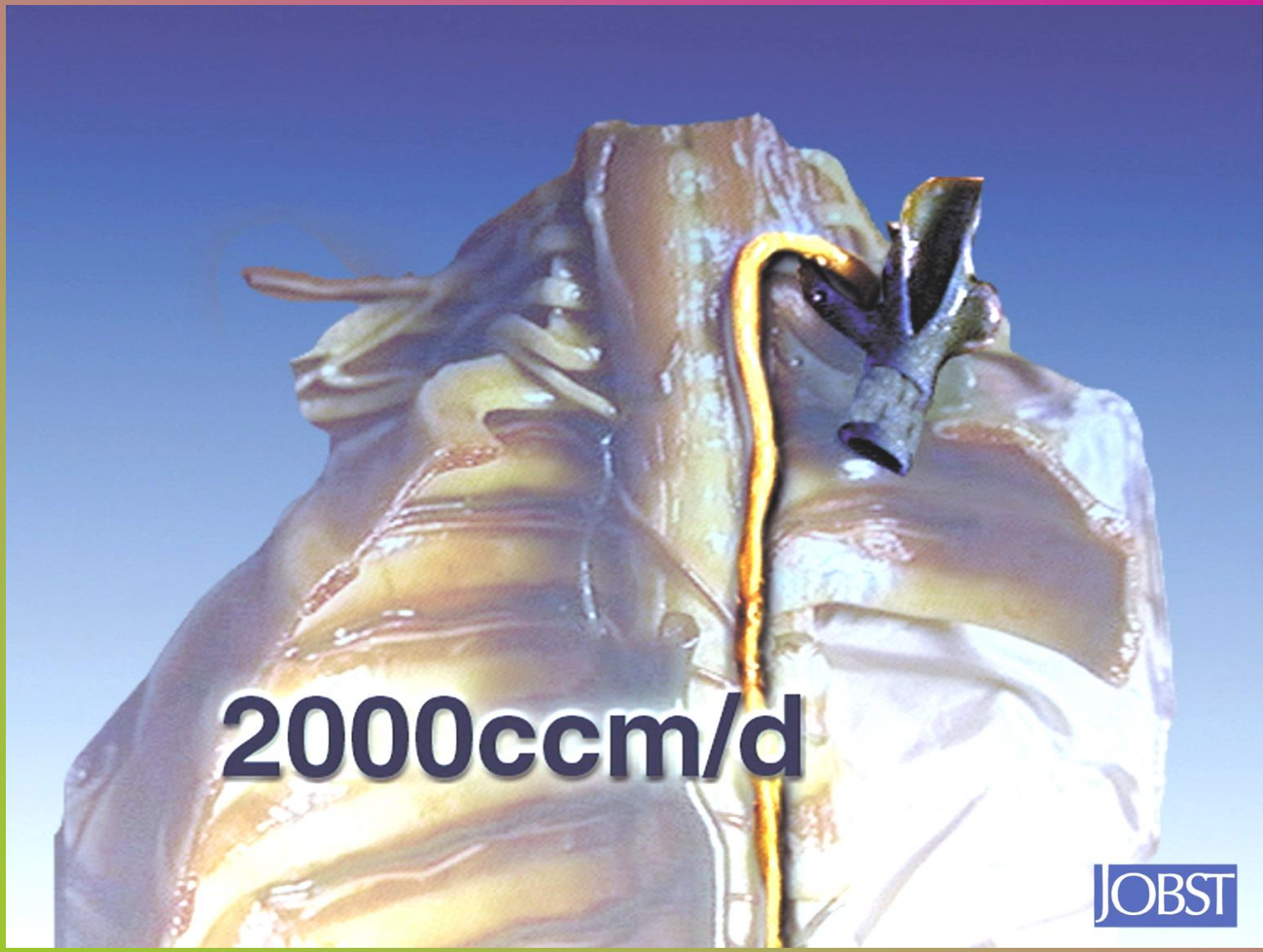
These are comprised of the following for each respective duct: jugular, subclavius, and bronchomediastinal veins at the right and left venous angles.

Thoracic duct

The Cisterna chyli anterior to L2 is the starting of the thoracic duct.

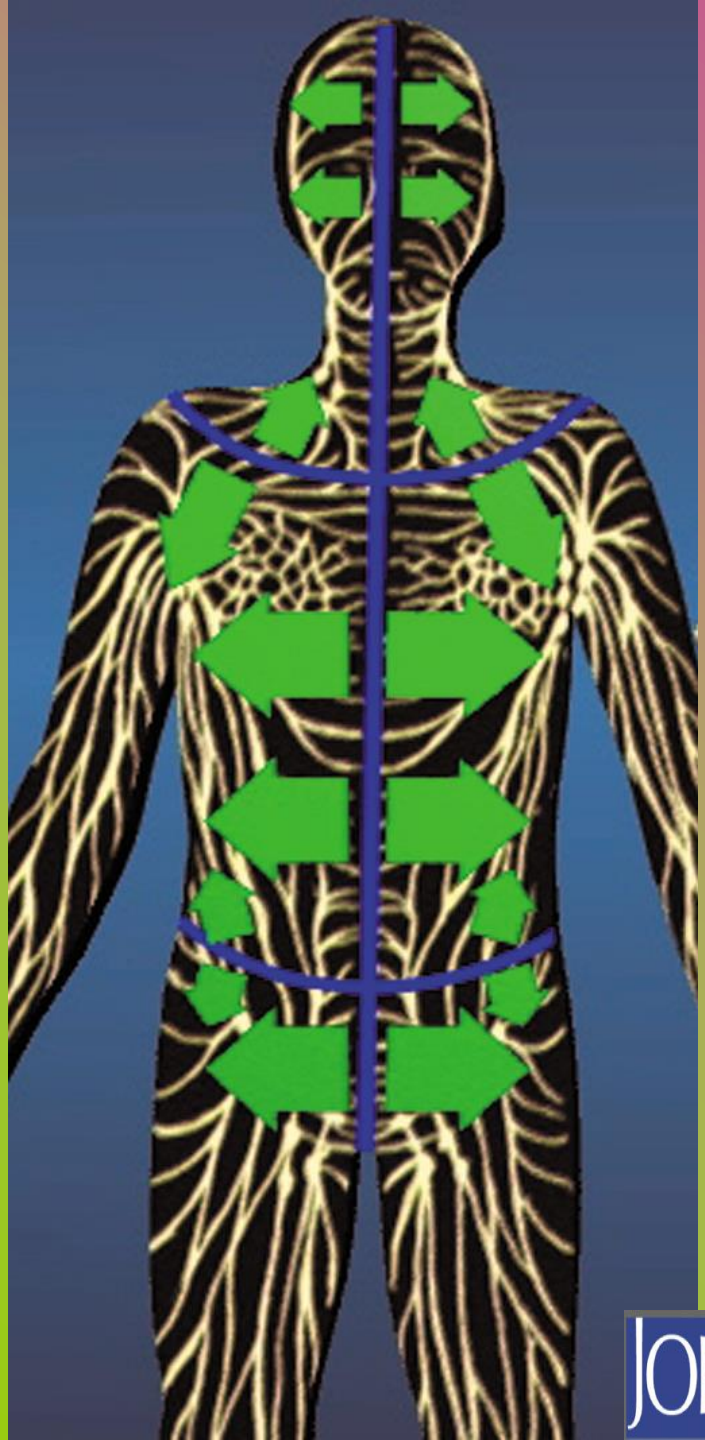
The largest lymphatic trunk is the thoracic duct.

2-4 liters of lymph flows into the blood circulation every day.



How do we know this silly massage works?

- After the lymph fluid moves back into the circulatory system it then gets cycled through to the kidneys eventually
- Increased urinary output
  - Either frequency or duration



Lymphatic Watersheds

Lymphatic watersheds are invisible barriers that separate regions of the body into lymphatic drainage fields.

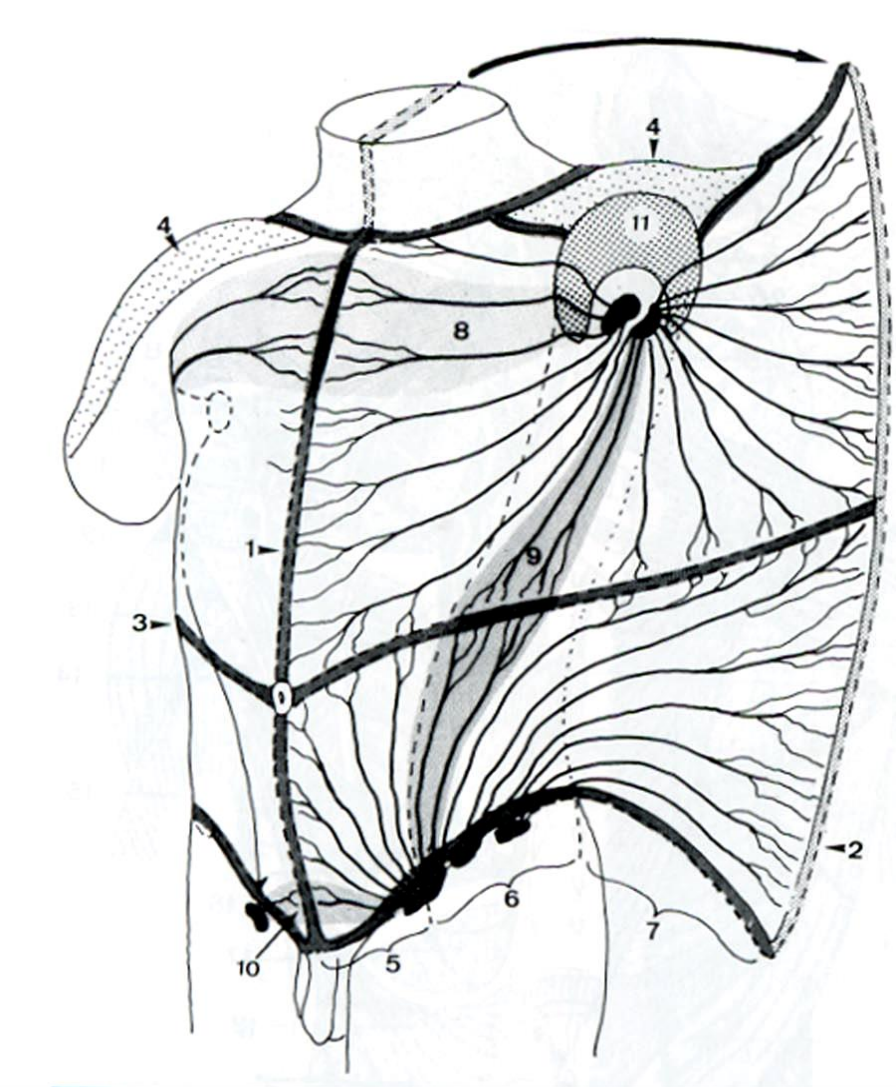
They act like the top of a mountain-fluid runs away from the watershed to the nearest regional lymph node group.

The trunk is divided by the watersheds into quadrants. At the level of the navel there are two watersheds:

Transverse-horizontal
Sagittal-vertical

JOBST

Tributary Zones

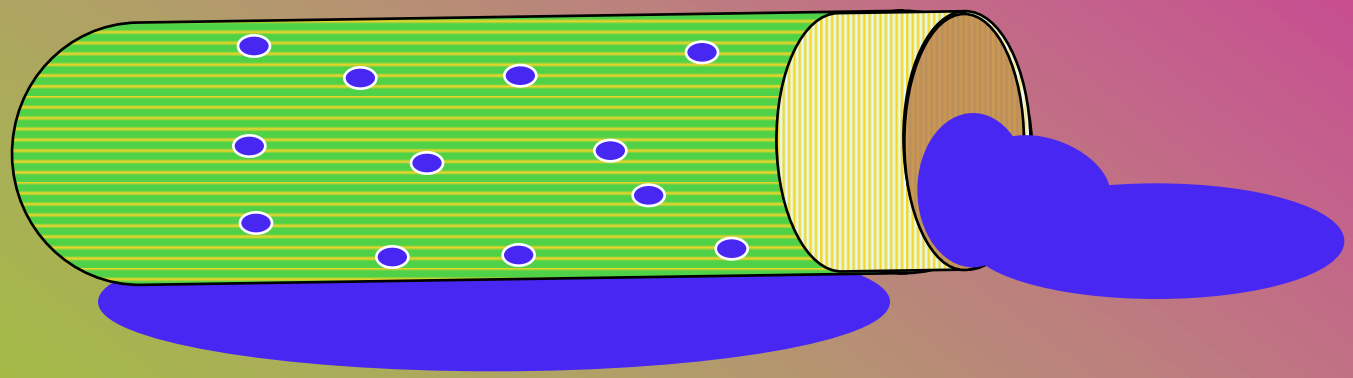


Each LN receives lymph fluid from a specific region. This area is considered the ***tributary zone*** of the ***regional LN***.

Tributary zones are also known as lymphotomes.

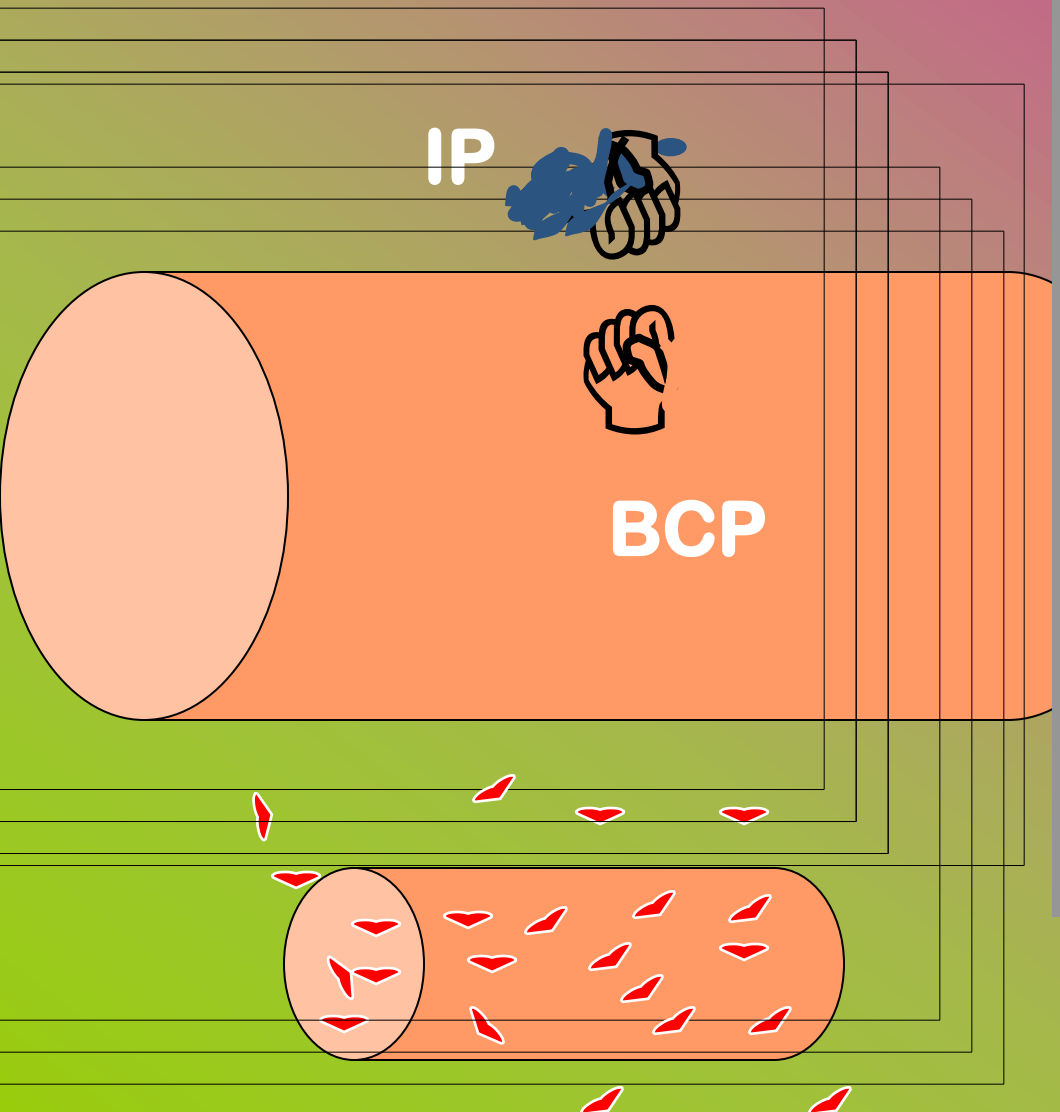
The lymph collectors of the trunk originate at the watersheds and move lymph fluid into the closest regional LN group--axillary and inguinal nodes.

Arterial Ultrafiltration



Arteries are like soaker hoses = leaking fluid (blood)out into the tissue spaces/interstitium. This process is called: Ultrafiltration

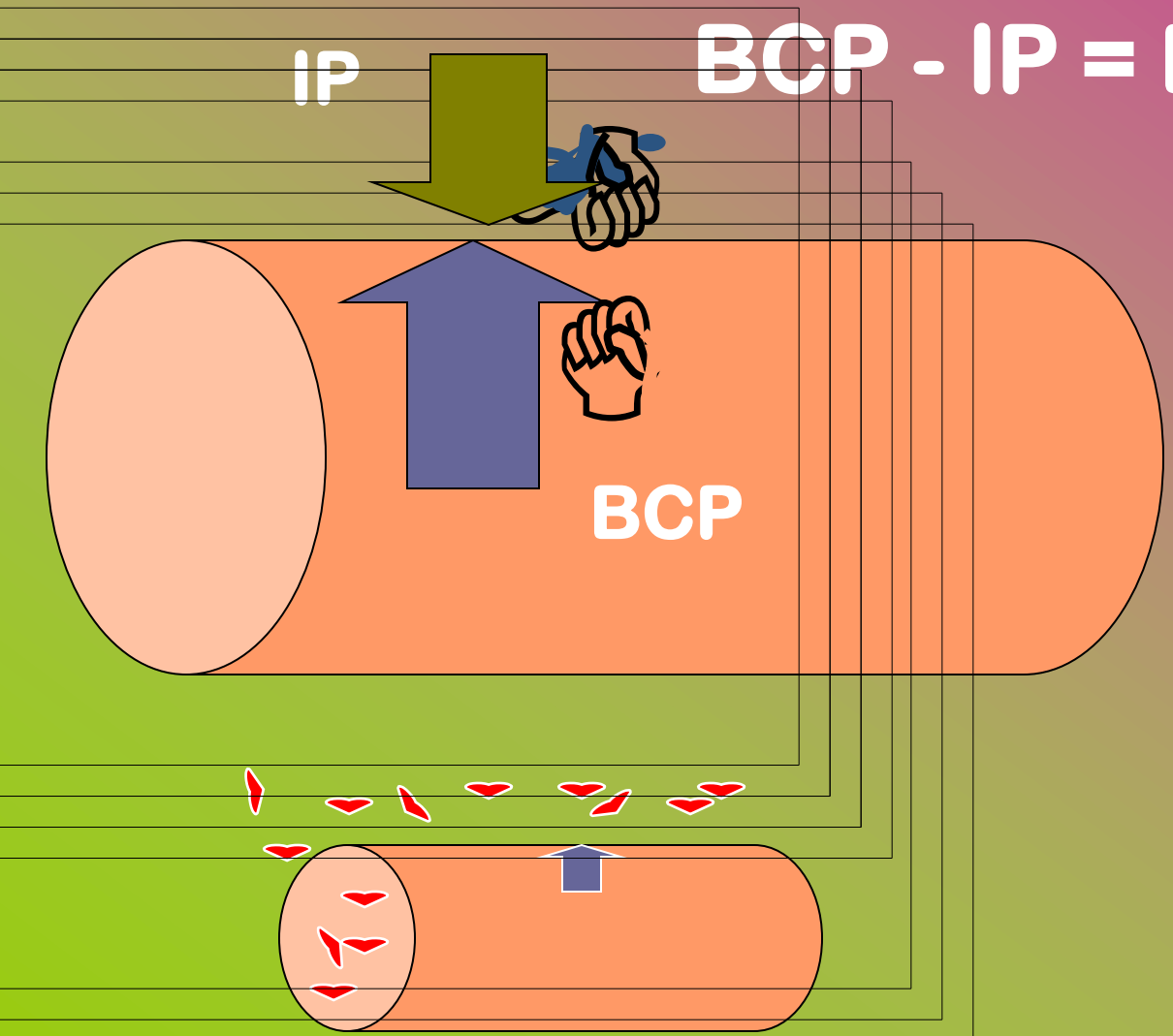
Pushing Pressures



BCP=Blood capillary pressure: Force of blood cells pushing inside of vessel wall trying to get out into interstitium.

IP=Interstitial pressure: Force of blood cells pushing on outside of vessel wall trying to get inside vessel

EFFECTIVE (NET) ULTRAFILTRATION PRESSURE



BCP - IP = EUP

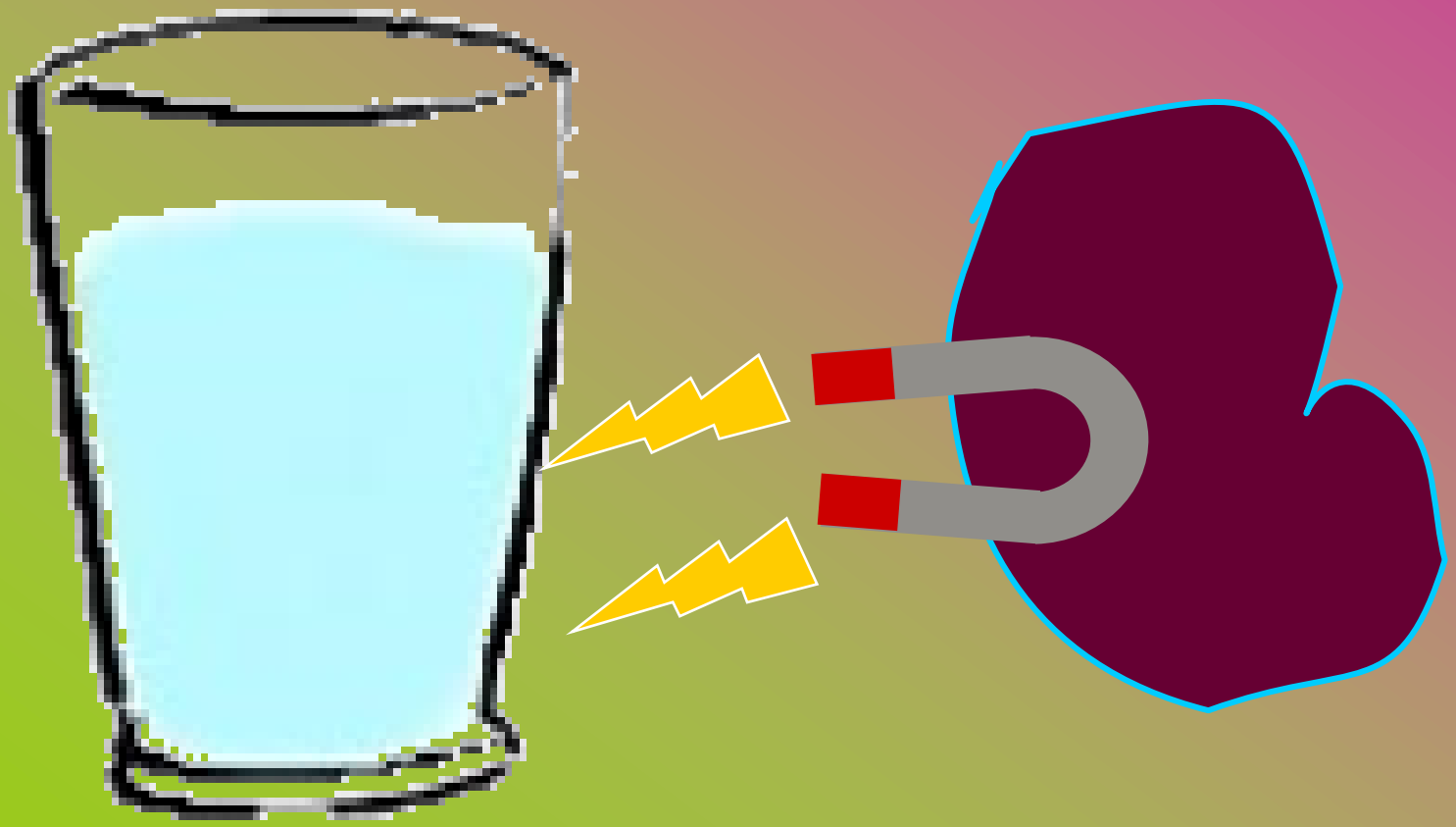
BCP

—

IP

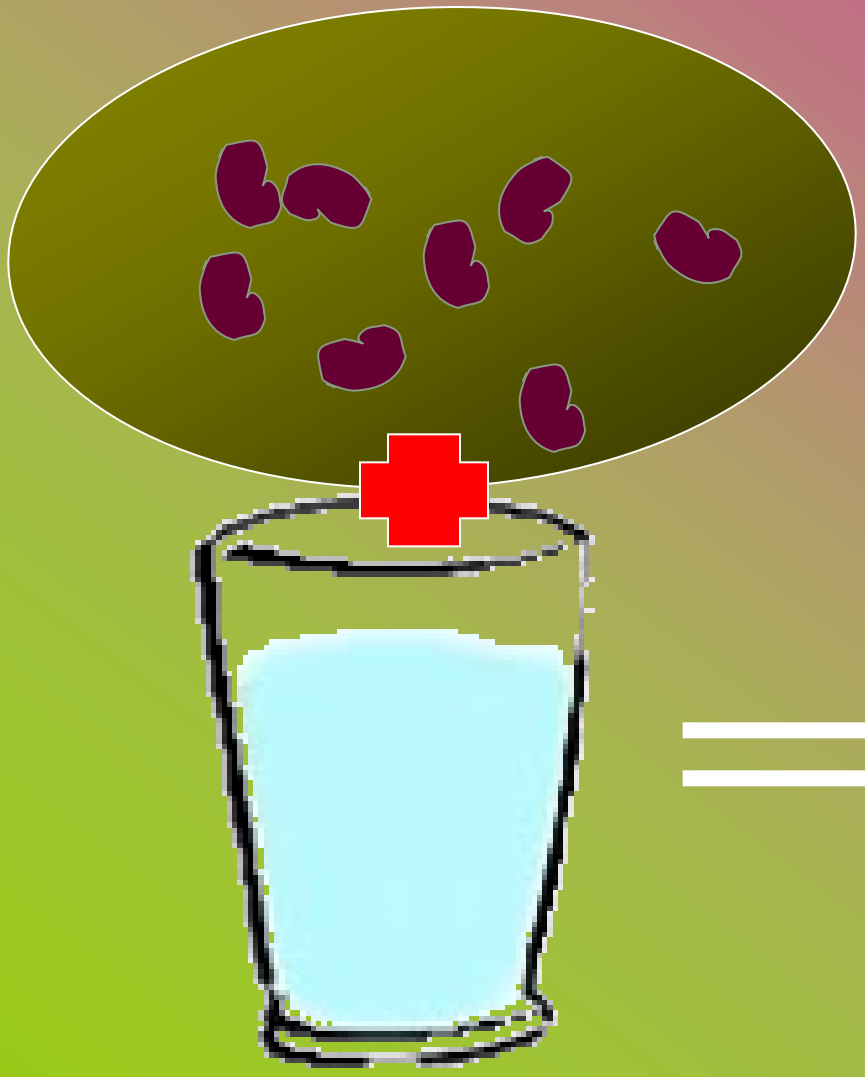
═ EUP

Protein attracts water



Osmosis

Dried beans (PROTEIN) absorb water and swells=OSMOSIS



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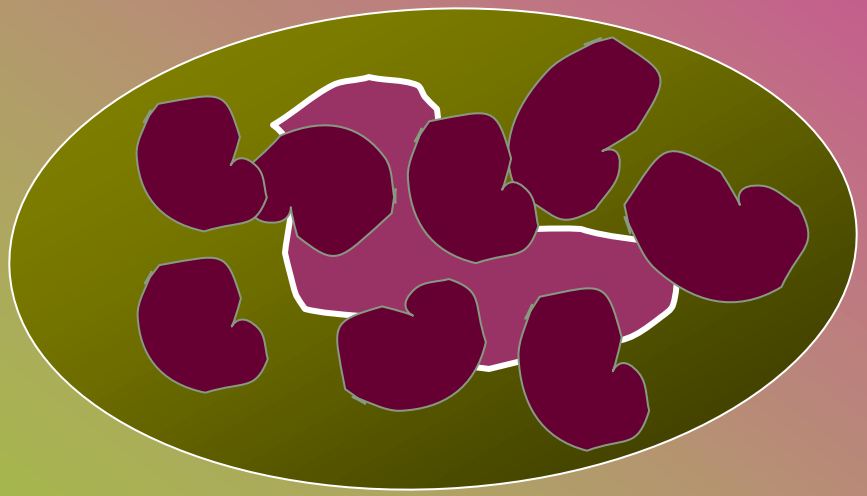
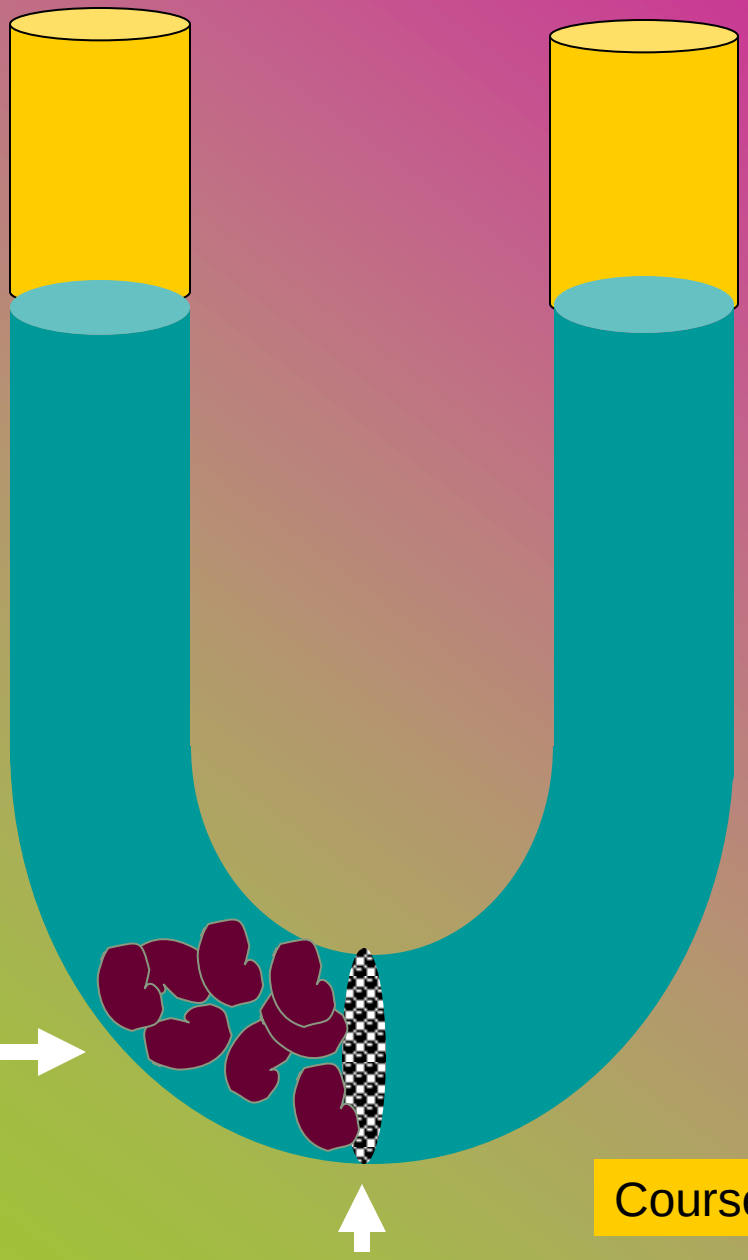


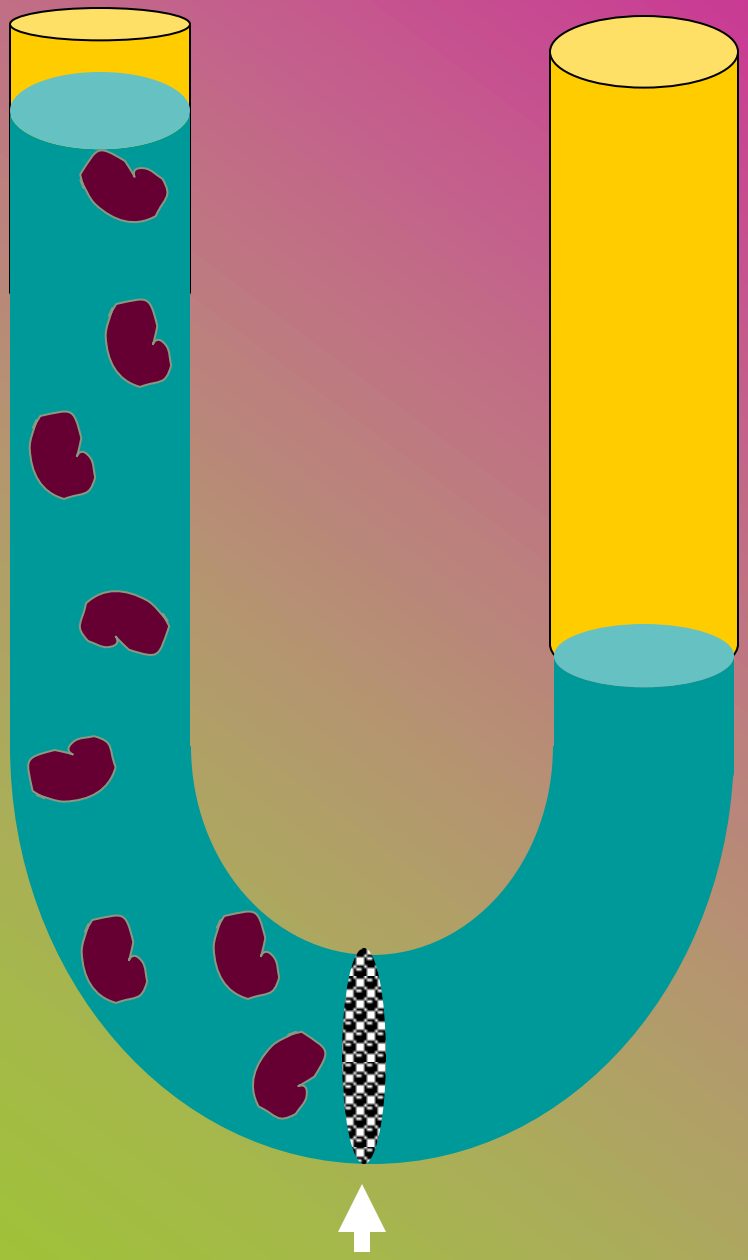
Colloid Osmotic Pressure



Course Manual Page 21

Semi-permeable membrane=water can get through but the protein molecules are too big to fit

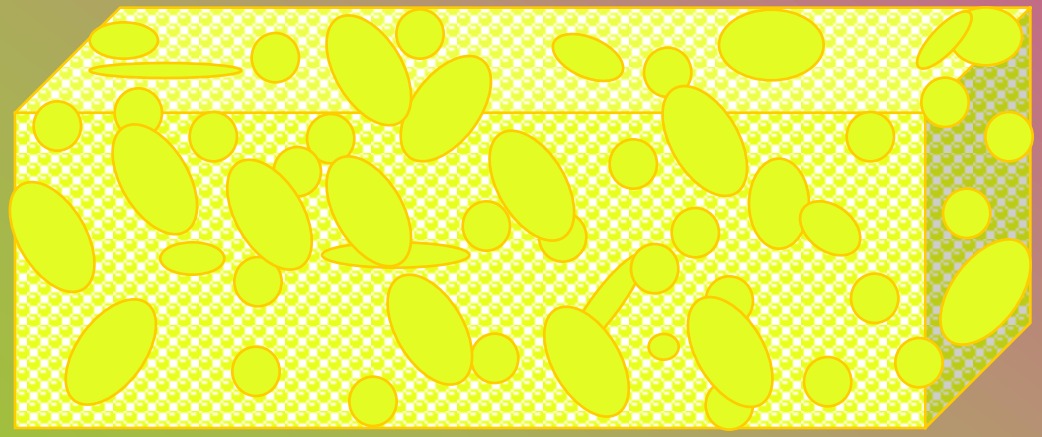
OSMOSIS=water molecules diffuse along concentration gradient.

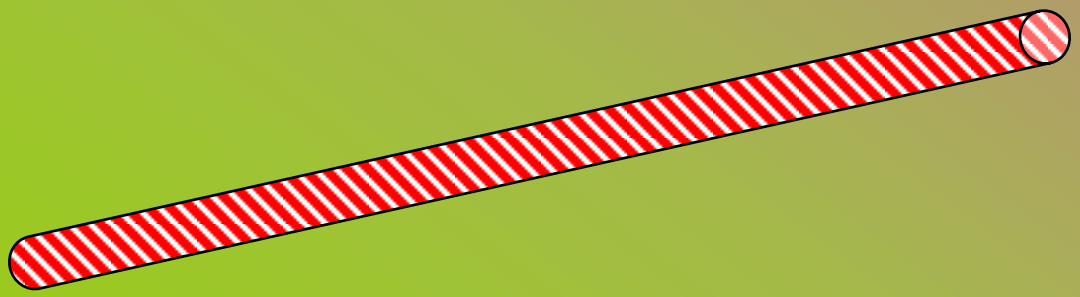


Semi-permeable membrane

Since protein molecules are too big to fit through holes in semi-permeable membrane the water moves to the side of the protein in order to equalize # of molecules on both sides. This raises the level of water on the side of the protein.

Venous Reabsorption



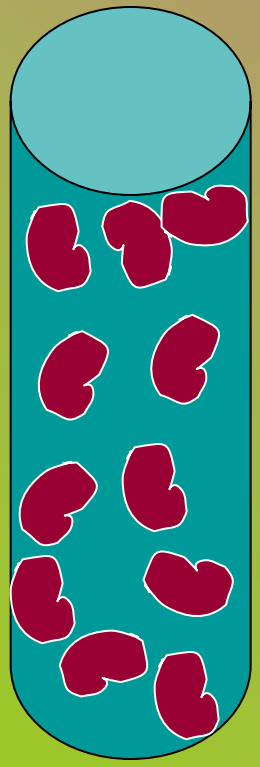


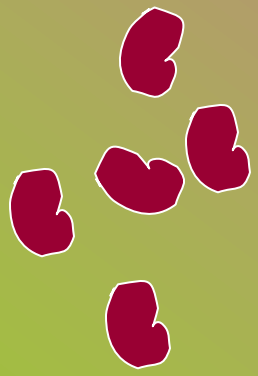
Veins and Lymphatics:

Act like a sponge or a straw. They both pull fluid (blood) from the interstitium with a suction force.

Pulling (suctioning) Pressures

COPP



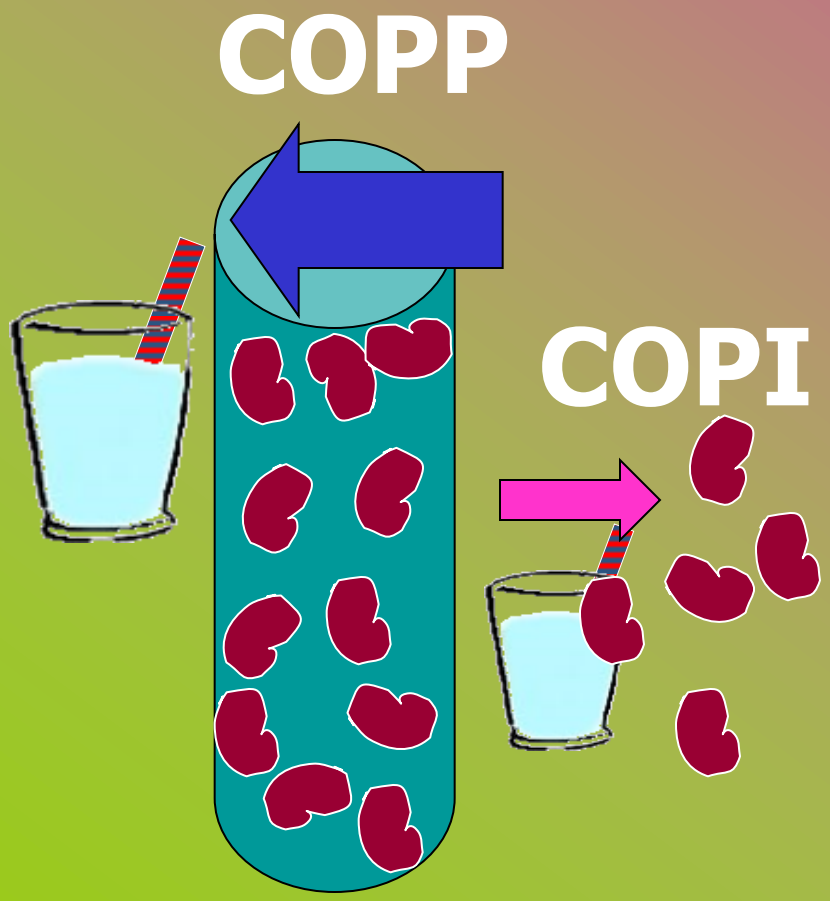


COPI

COPP=Colloid Osmotic Pressure of Plasma: Suctioning force pulling water to protein inside vessel wall in plasma.

COPI=Colloid Osmotic Pressure of Interstitium: Suctioning force pulling water to protein outside vessel wall in interstitium.

Effective (Net) Re-absorption Pressure



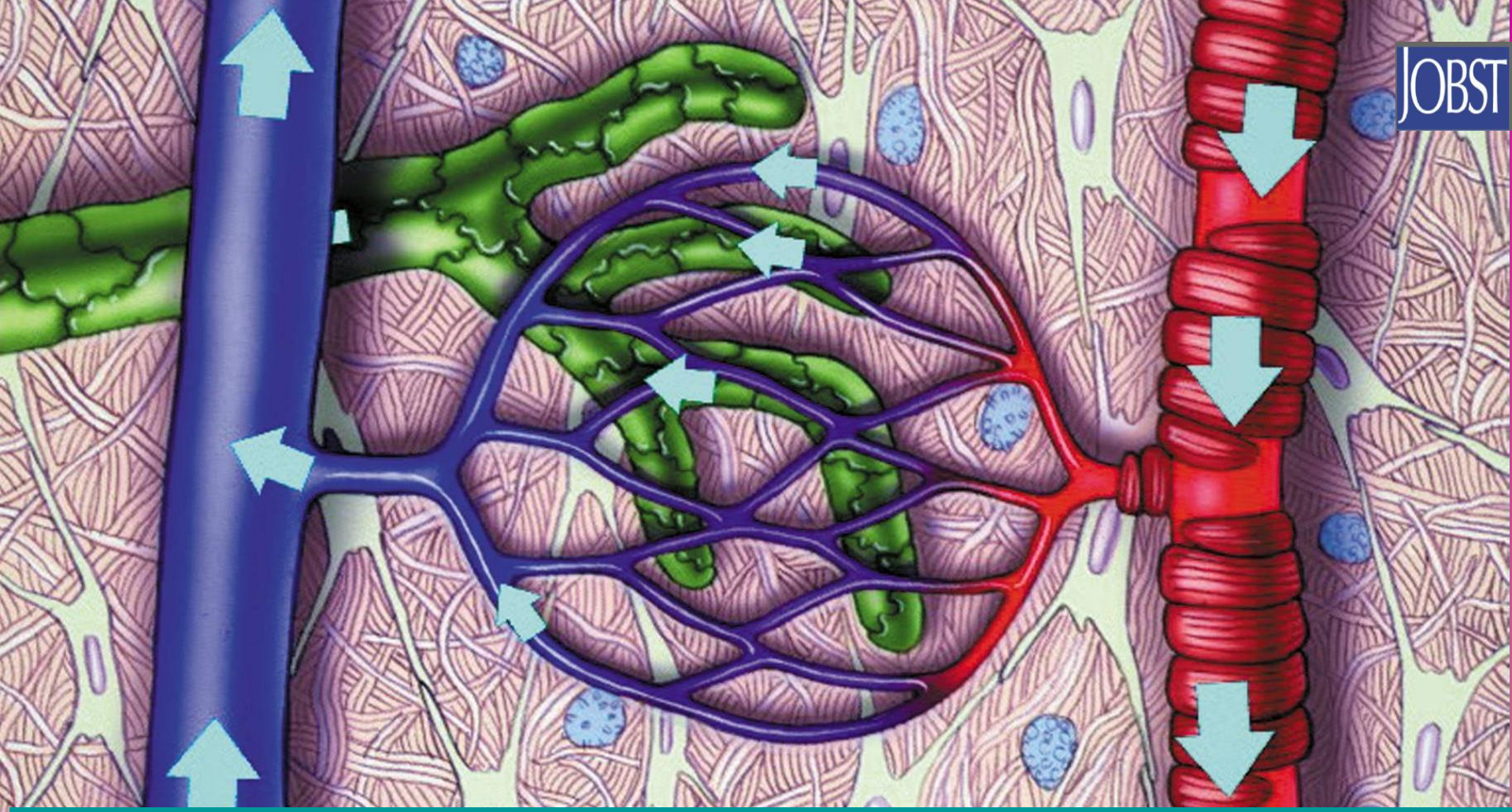
COPP

— COPI

= ERP

COPP=Colloid Osmotic Pressure Plasma

COPI=Colloid Osmotic Pressure Interstitium

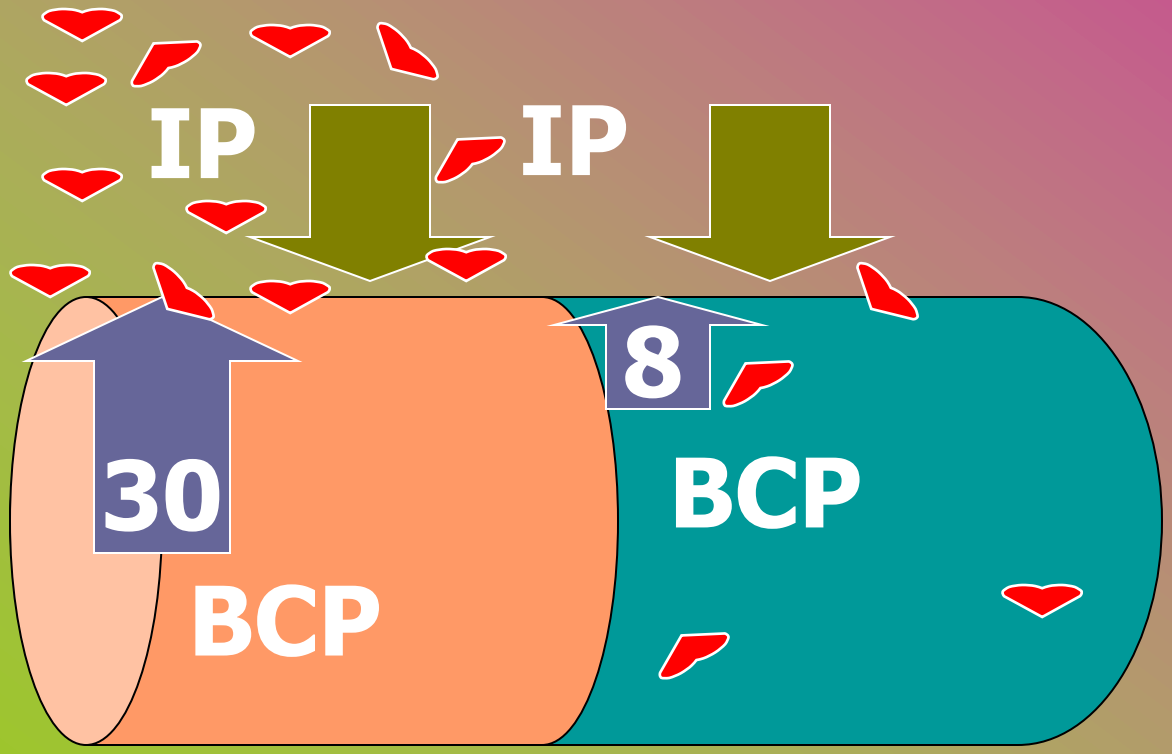


20 liters of fluid is pushed out by the arteries each day.

Only 90% of this is reabsorbed through the veins.

The remaining 10% is the net ultrafiltrate which is reabsorbed via the lymph system=2-4 liters of lymph daily.

Effective Pressures



BCP

—

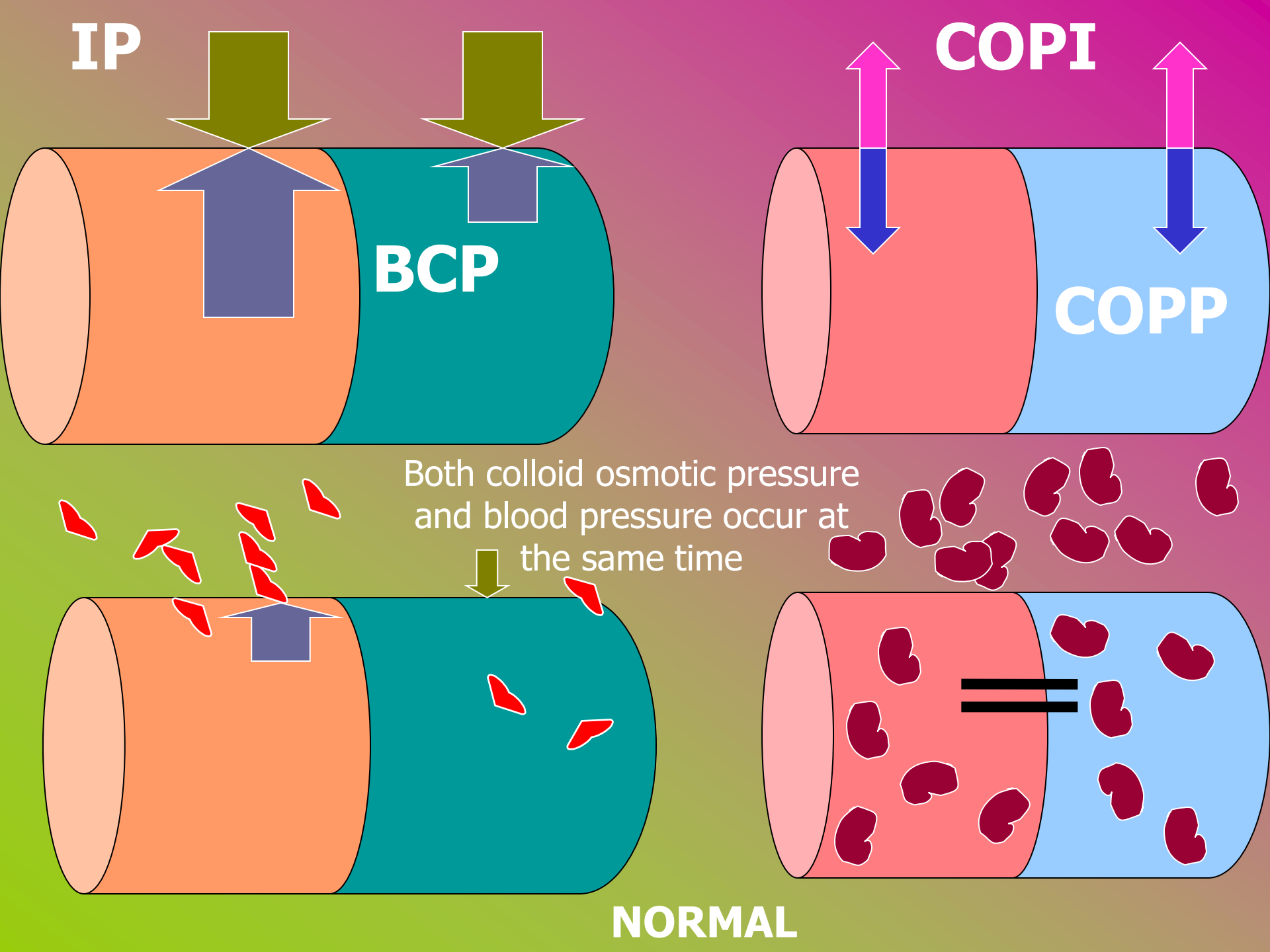
IP

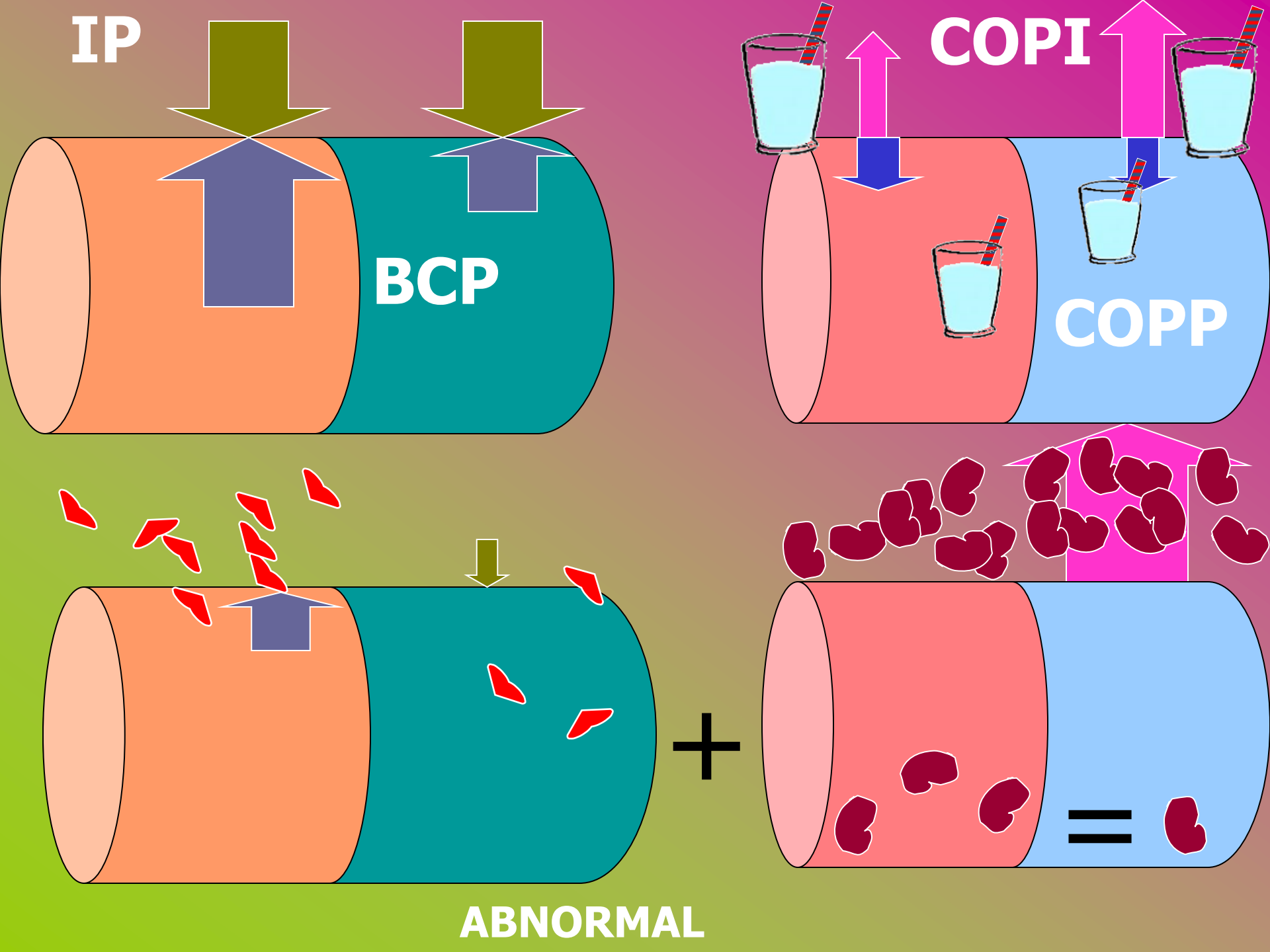
= EUP

Arterial End

Venous End

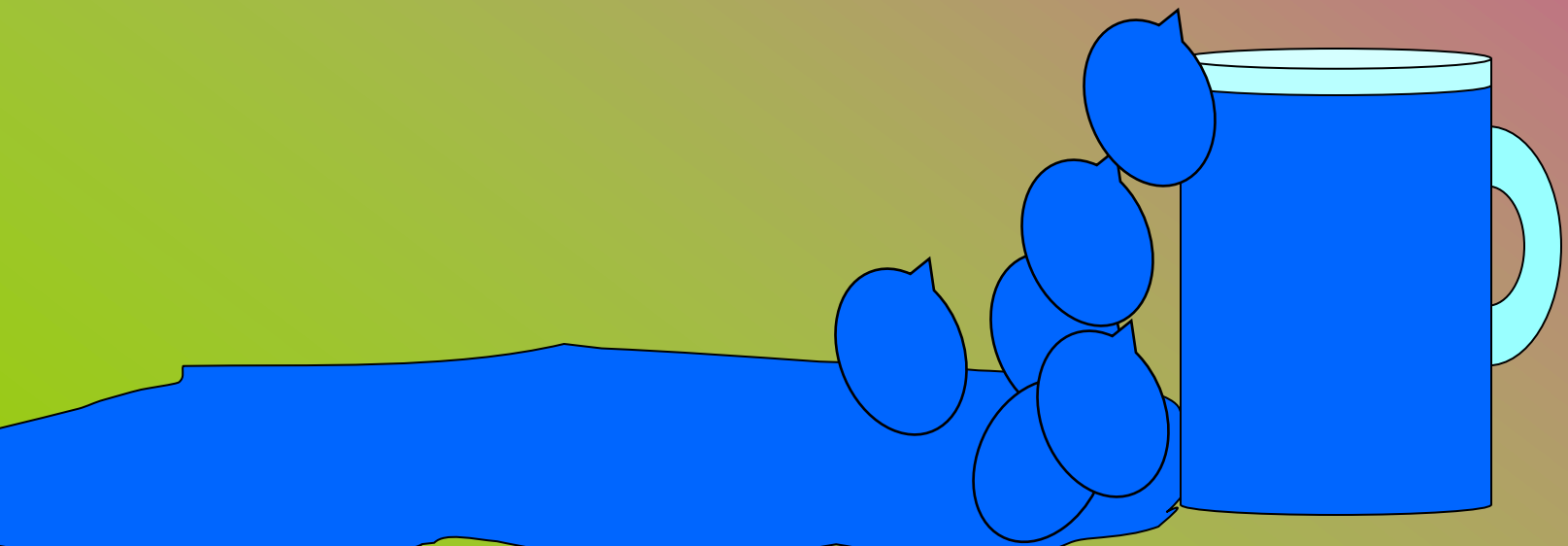
= ERP

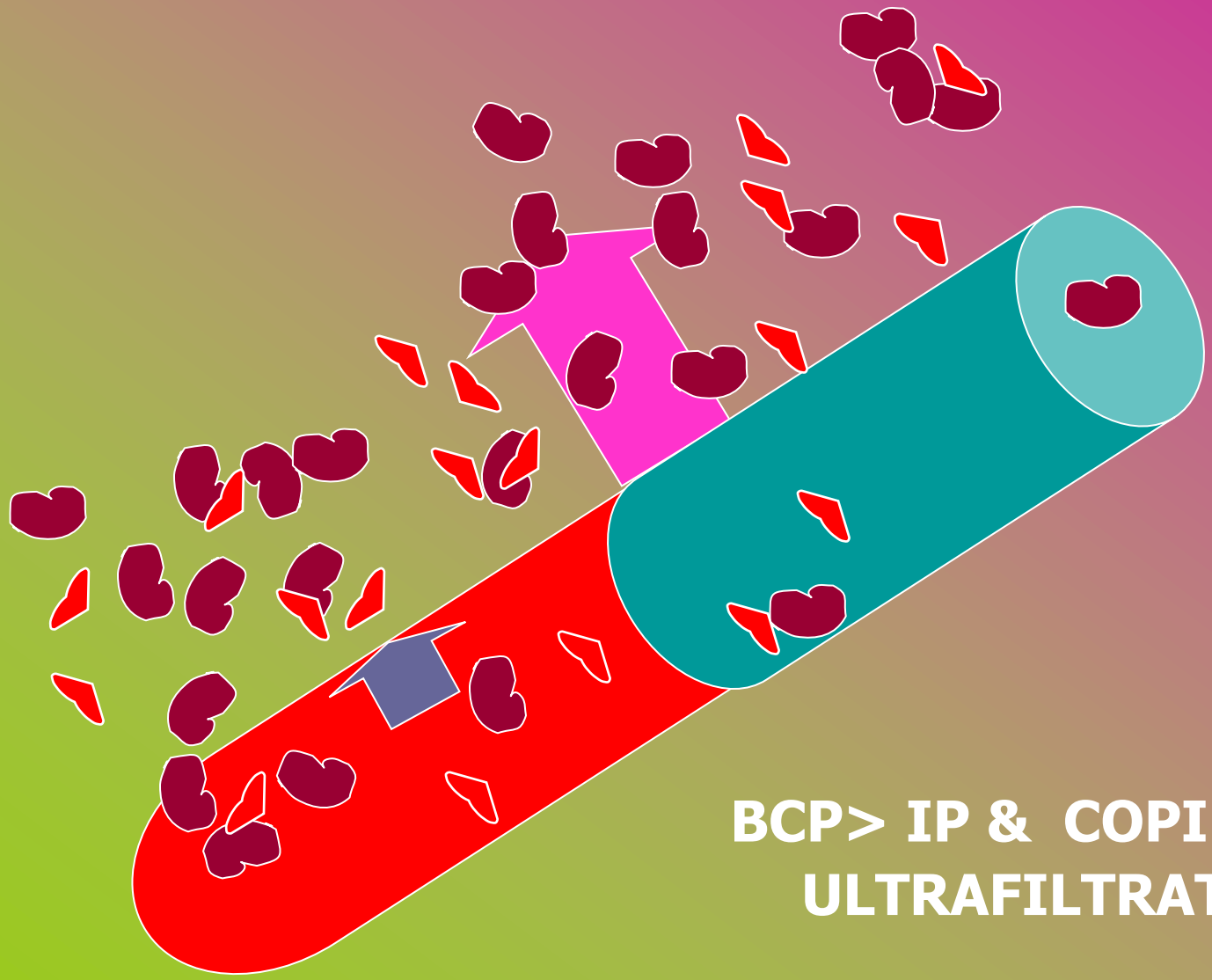

IP
BCP
COPI
COPP
Both colloid osmotic pressure and blood pressure occur at the same time
NORMAL


IP
BCP
COPI
COPP
+
=
ABNORMAL

Increased ULTRAFILTRATION + Decreased REABSORPTION=

Increased EDEMA





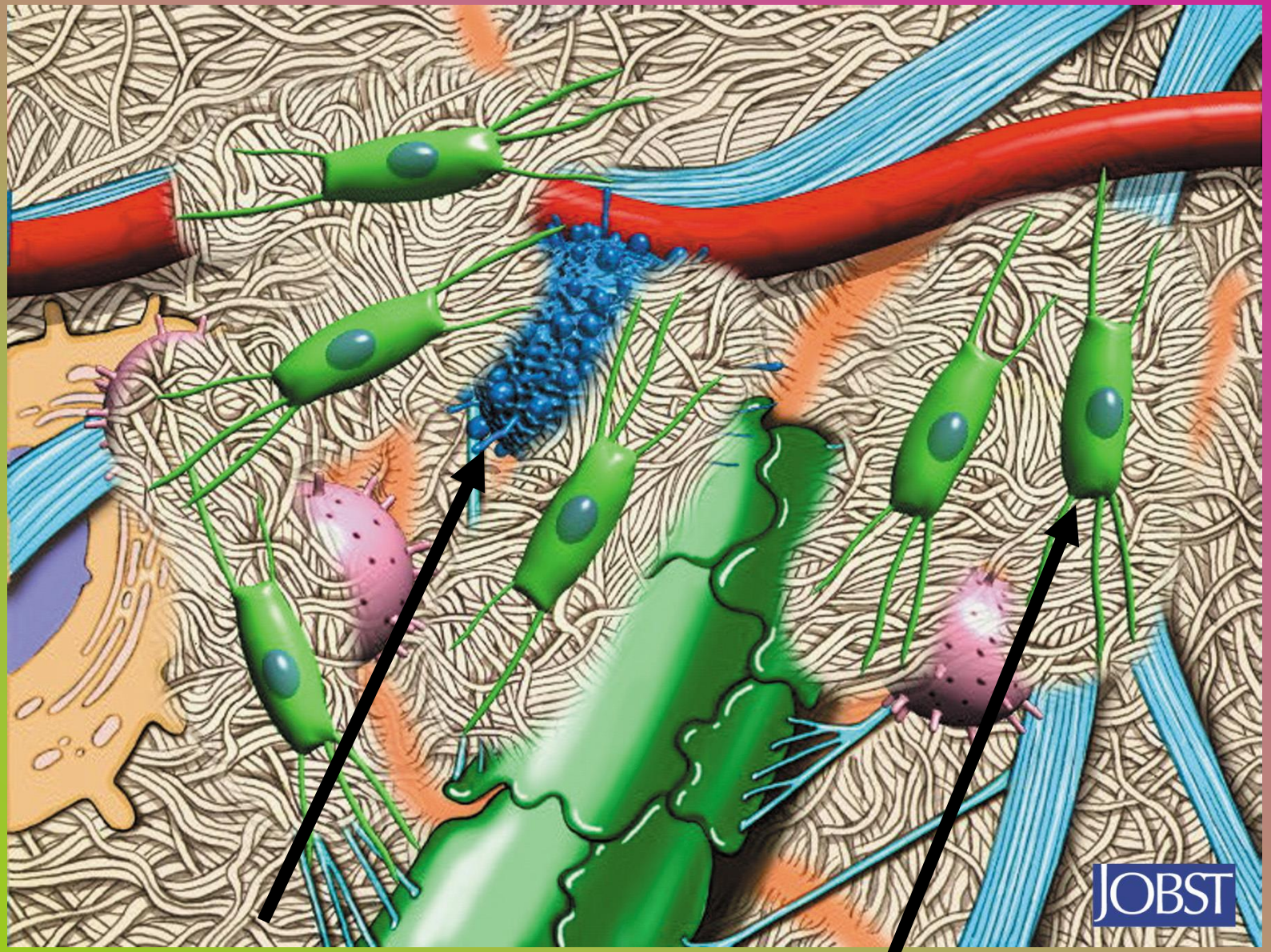
BCP> IP & COPI > COPP=
ULTRAFILTRATION

= EDEMA

Protein molecules left in interstitium can cause:

- increased fluid in tissue spaces
  - increased edema
- scar tissue development
  - skin gets hard
- fatty tissue deposited
  - swelling pathologies worse when overweight

Pathophysiology---Lymphedema



Activated macrophages

Fibroblasts laying down collagen

Dermatolypo-sclerosis–

LYMPHEDEMA

Lymphedema can develop in any region of the body that has suffered enough damage to the lymphatic system.

LYMPHEDEMA SECONDARY TO CANCER TREATMENTS

- Modified **radical** mastectomy
  - axillary node dissection
  - radiation treatment
  - **OVER 40% develop LYMPHEDEMA**
- Lumpectomy
  - axillary node dissection
  - **20% develop LYMPHEDEMA**
  - adiation
  - **30% develop LYMPHEDEMA**

Easier to see swelling in this position

Lymphedema can develop due to:

- Surgery--removal of lymph nodes
- Surgery without removing lymph nodes
- Radiation therapy
- Significant injury to the skin
- A body without enough lymphatics--Primary lymphedema
- After infection
- Insect bite
- Following blood clot
- Acute injury/trauma

Edema Spectrum

ACUTE INJURY

Normal Inflammatory Cascade

CVI

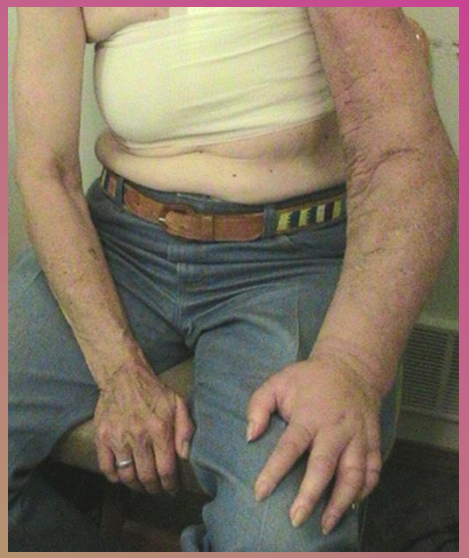
LYMPHEDEMA

Lovejoy-Evans Swelling Spectrum: Severity Lymphedema UE

Mild

Moderate

Severe



Lovejoy-Evans Swelling Spectrum: Severity Phlebolymphedema: CVI + Lymphedema

Mild

Moderate

Mod-Severe

Severe

Lovejoy-Evans Swelling Spectrum: Severity

Lipedema + CVI + Lymphedema

Starts in puberty and worsens without RX

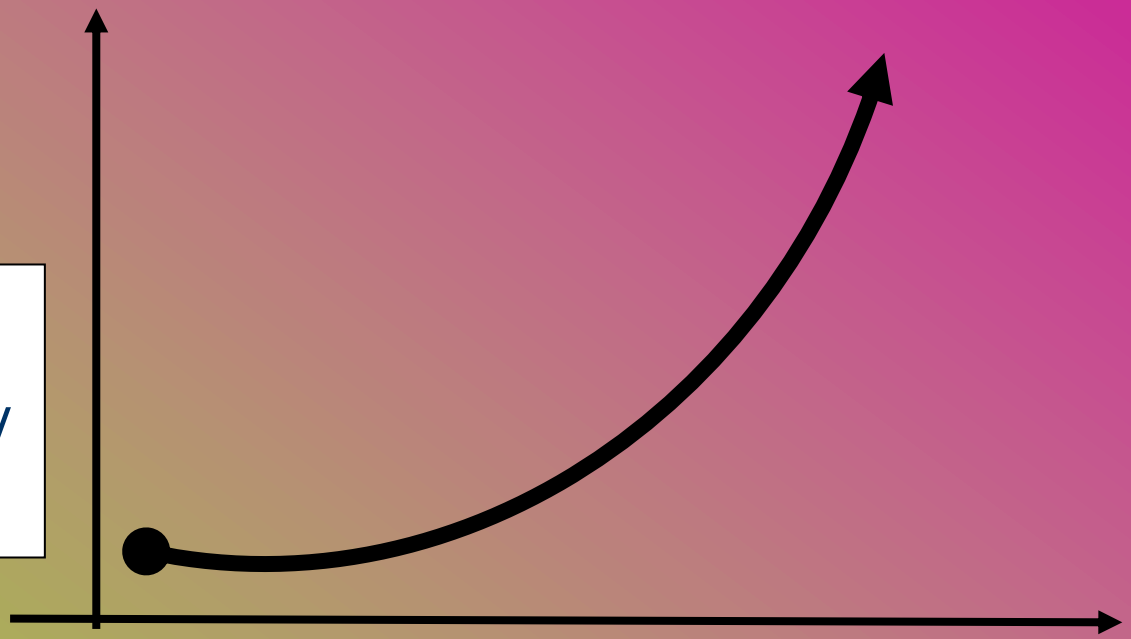
Mild Moderate Mod-Severe Severe





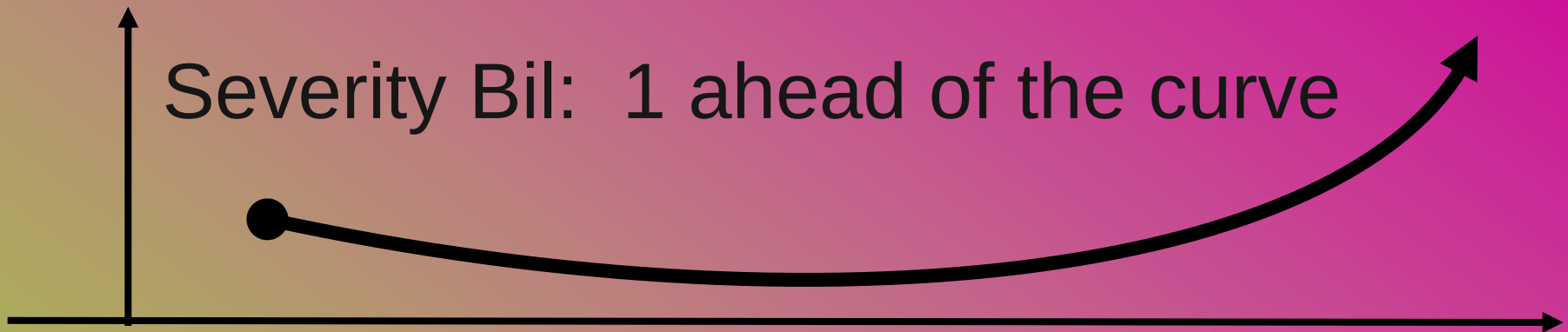

Lovejoy-Evans Swelling Spectrum

Amount of Pressure in Compression Garment / Massage Frequency



Time Present / Amount of Swelling & Fibrosis

Severity Bil: 1 ahead of the curve



Assessing patient complaints: numbness, tingling, burning, pain, weakness, loss of ROM, loss of endurance, QOL

impairments: Look for HX of lymphatic system compromise-orthopedic traumas

Consider the less obvious limb…the obvious limb is ahead of the curve but the other limb is on the same swelling spectrum. The pathology may have been less severe but it then had to compensate and kick into overdrive. Attend to it as well

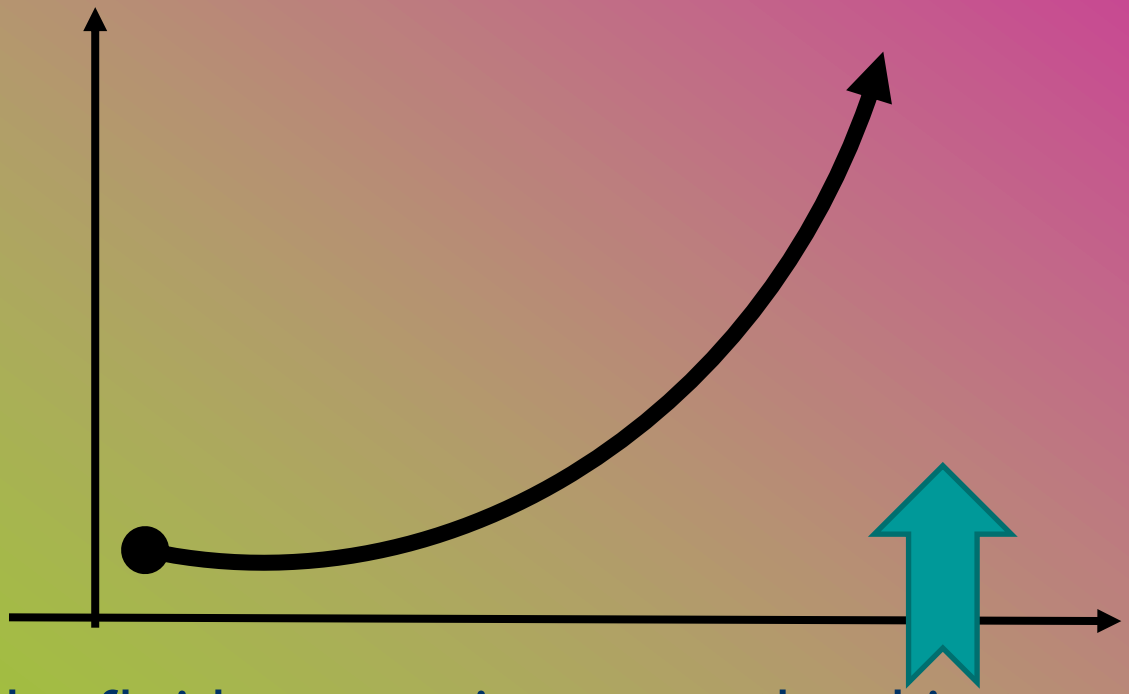
Catching pathology earlier will require less care

Orthopedic Trauma: Consider underlying lymphatic pathology

When patients fail standard PT protocols:
Exercise & Modalities: ice/heat, US, E-stim
Consider the underlying lymphatic system's capabilities prior to the trauma/surgery.
PT underwent TKR with subsequent DVT failing standard PT sent to ITPT for CDP RX
EVAL: Underlying lymphatic system failure noted:
CVI: red color lower leg, shine, hair-loss, teleangiectaias, congestion/fibrosis-loss of skin mobility

AROM	EVAL	2D Wraps + HEP MLD 5xD
Knee Flex:	90 deg 4/10	118 deg 1/10 pain

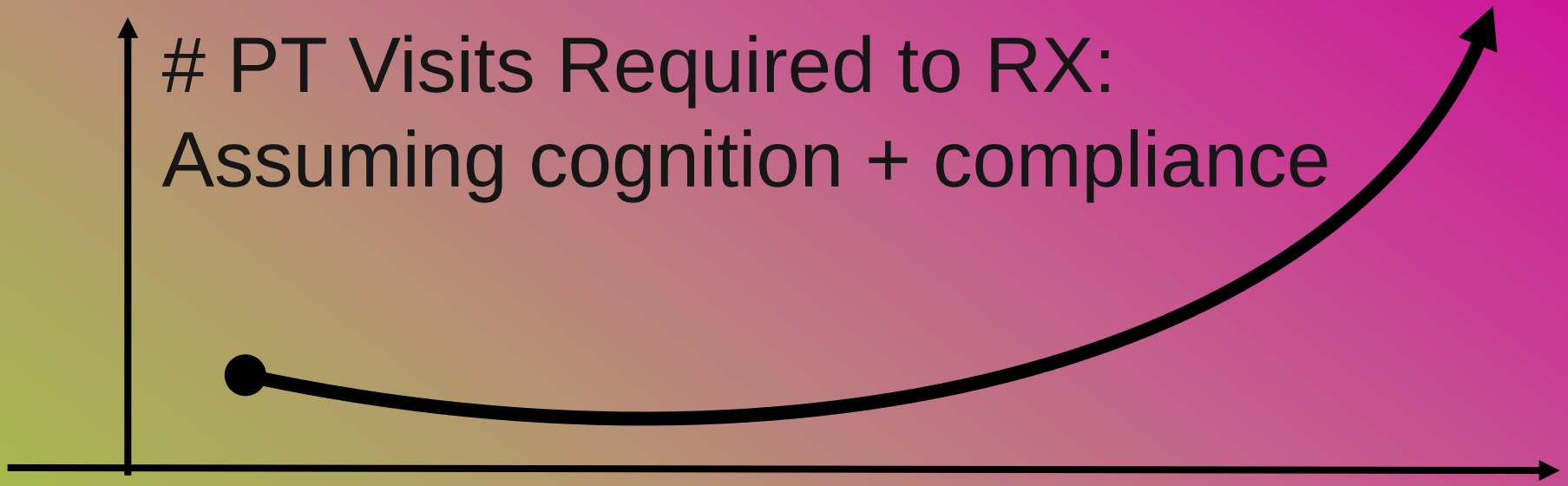
Most RX needed-right side of spectrum



Allowing the fluid to remain causes the skin to stretch out, veins to fail and after enough trauma the lymphatics will fail.

Eventually lymphedema will develop even in orthopedics

PT Visits Required to RX:
Assuming cognition + compliance



2-3

3-5

5-7

10-20

Financial cost: PT Visits ~$100/hr

2-3=$300

3-5=$500

5-7=$700

10-20=$2000

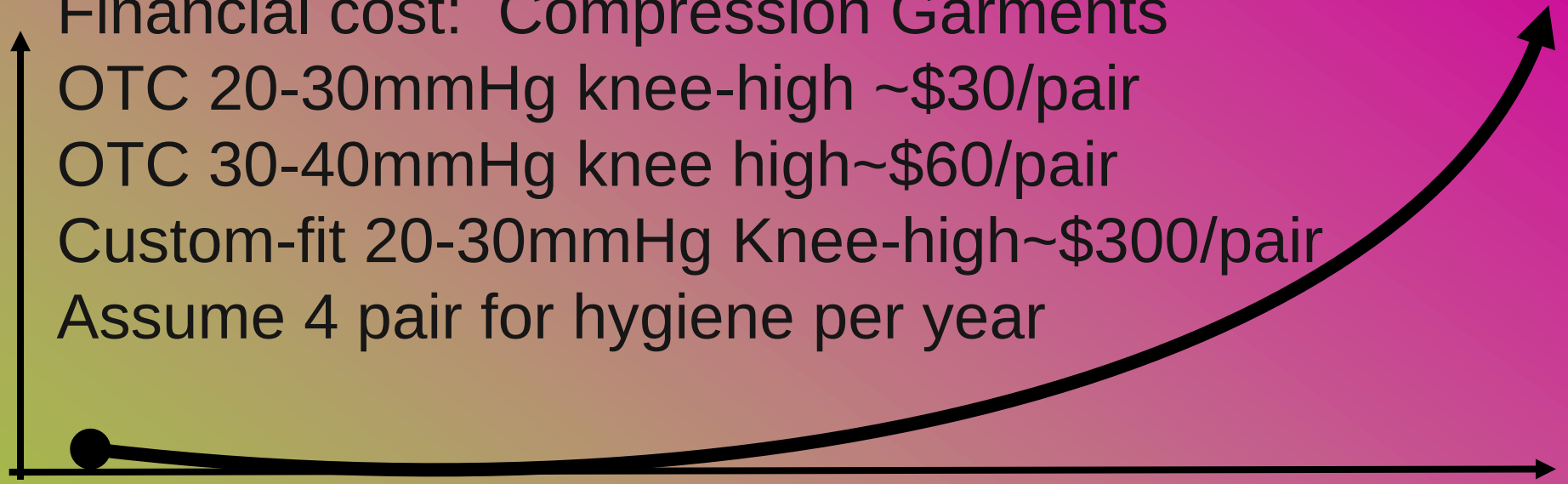
Financial cost: Compression Garments

OTC 20-30mmHg knee-high ~$30/pair

OTC 30-40mmHg knee high~$60/pair

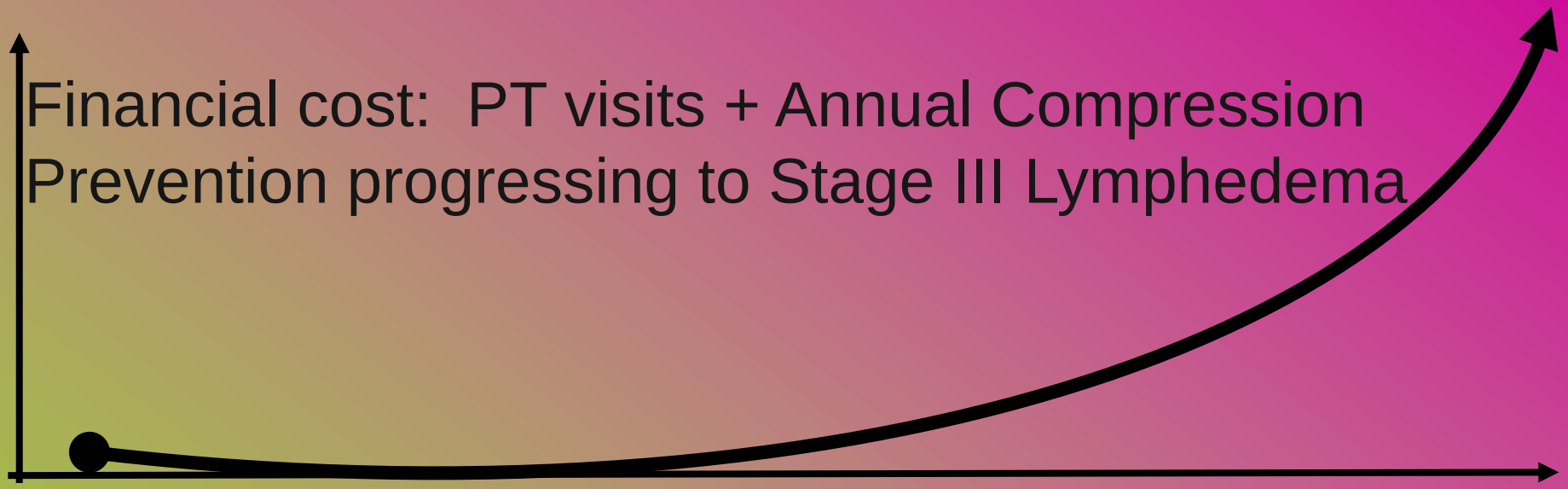
Custom-fit 20-30mmHg Knee-high~$300/pair

Assume 4 pair for hygiene per year



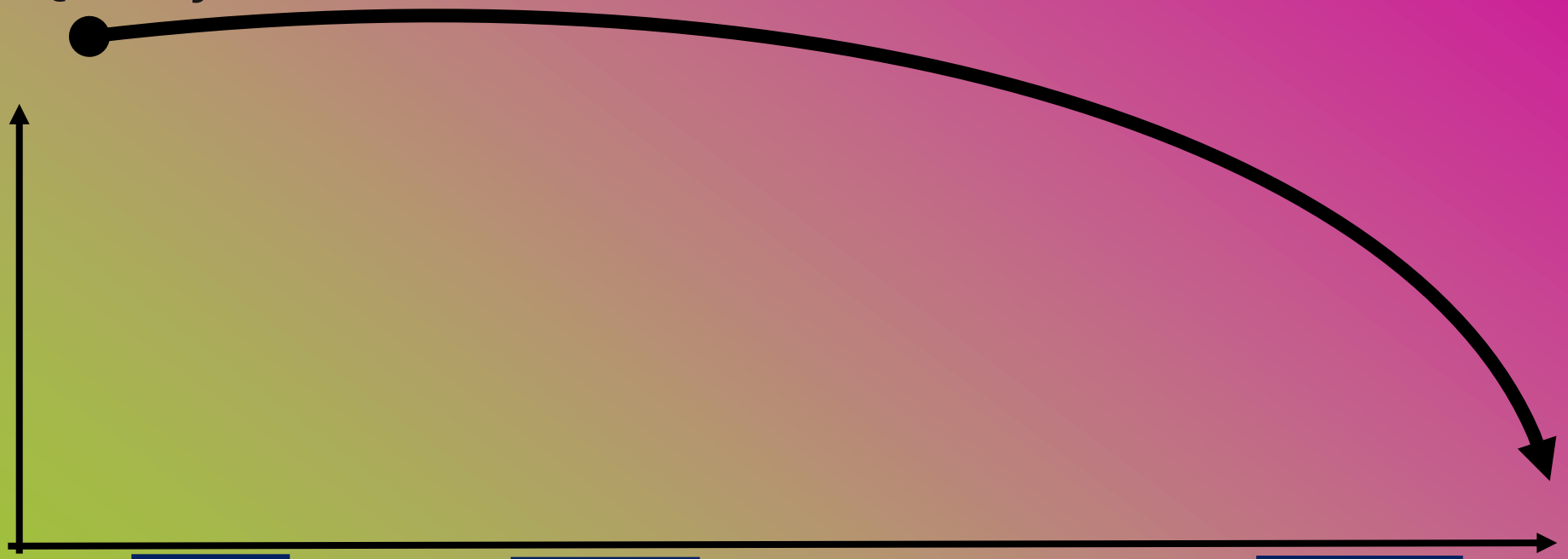
OTC 20-30	OTC 20-30	Custom 20-30	Custom 30-40
$120	$240	$1200	$1200

Financial cost: PT visits + Annual Compression
Prevention progressing to Stage III Lymphedema



$420 $740 $1900 $3200

Quality of life: Turns the curve around



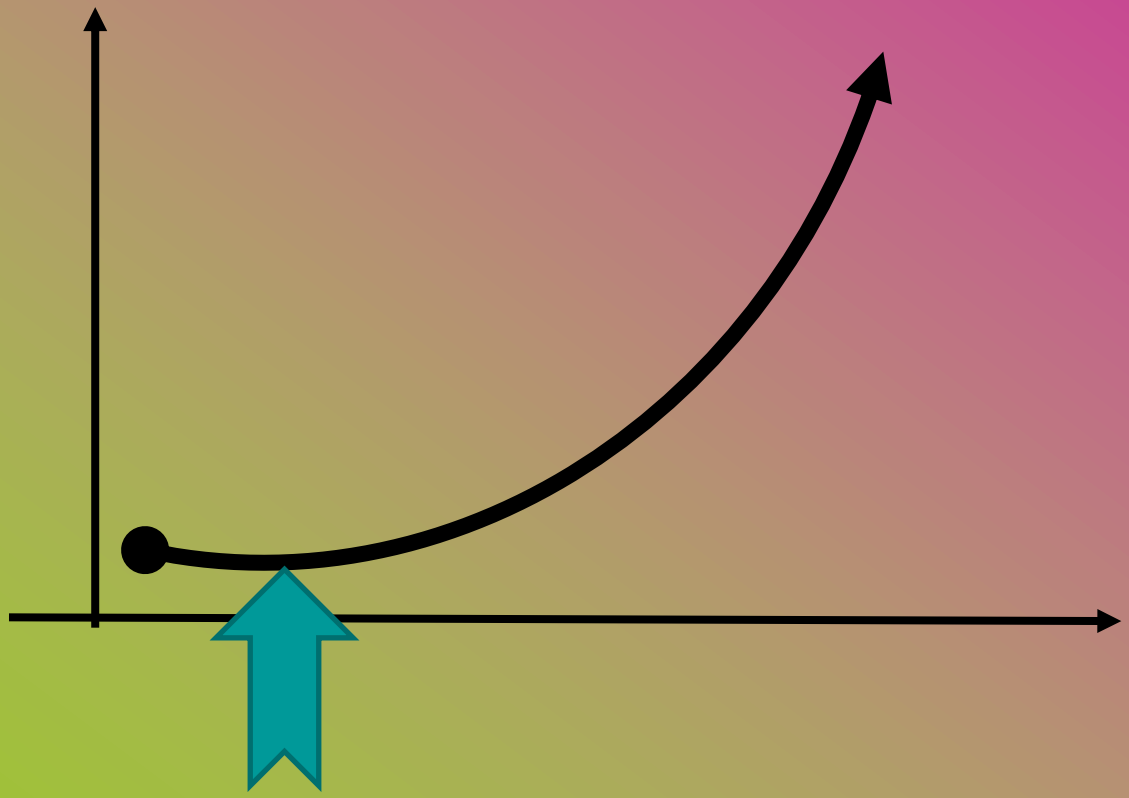
QOL due to: work needed to control lifelong:

Occasionally no sock
Light OTC sock
Easily donned
MLD shower
No congestion

Daily sock
Stiffer custom sock
Tools or caregiver don
MLD QID-QH
Fibrosis=Tennis ball




Least /Easiest RX needed-left side of spectrum=Best option prevention



By catching swelling early less RX required=cheaper
Less difficult to manage physically & emotionally
Better QOL

What is Lymphedema?

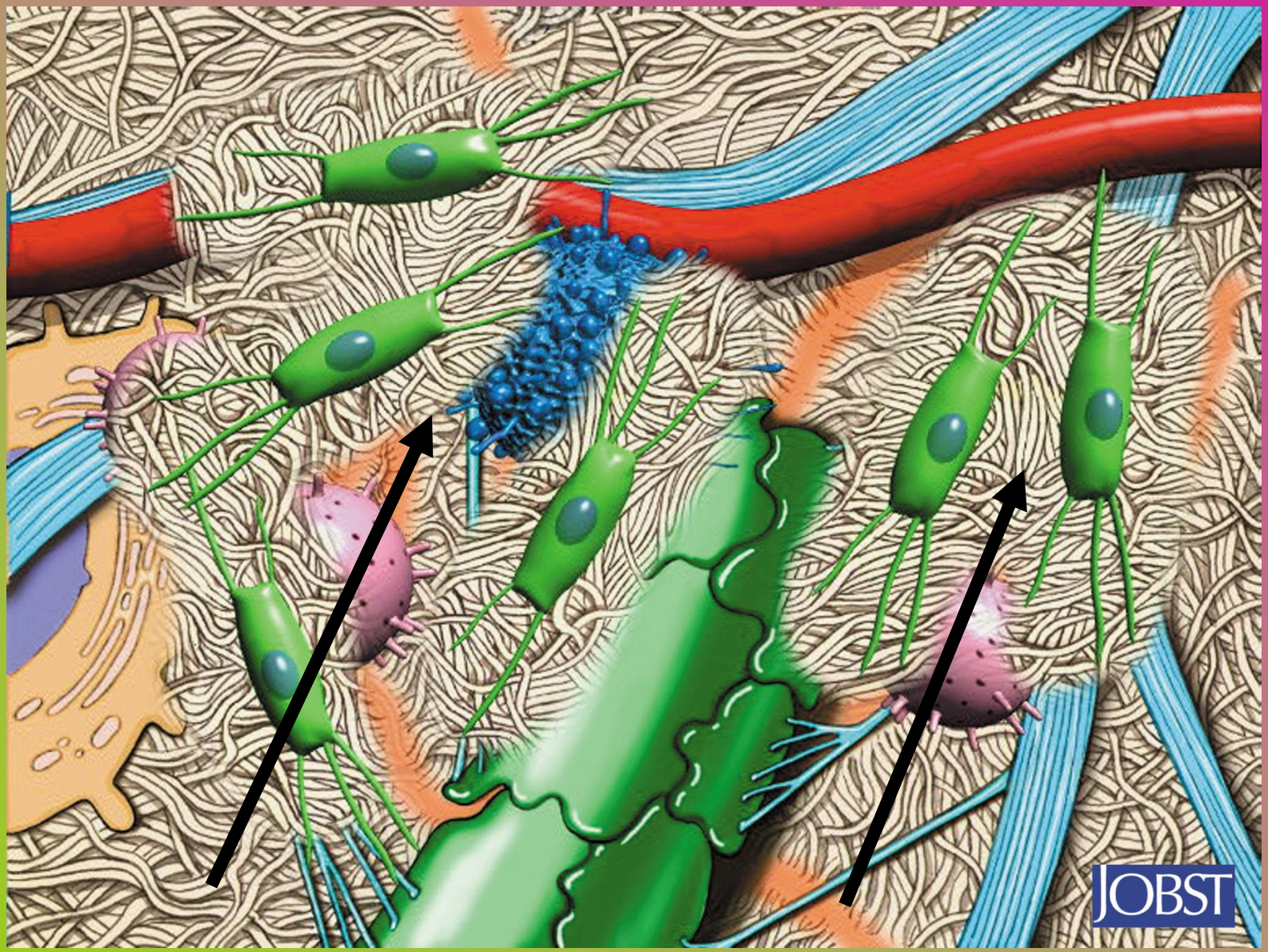
- Abnormal accumulation of protein-enriched lymph fluid within the interstitial spaces
- Results from insufficiency of the lymphatic transport capacity due to injury or dysplasia of the lymphatic vessels or nodes
- Causes proliferation of keratinocytes and fibroblasts which leads to hardening of dermal tissues, hyperkeratosis, papillomas of the skin and abnormal deposits of adipose tissue
- Chronic inflammatory condition therefore patients are at risk for infections such as cellulitis

Földi & Kubik Lymphyology, pg 232

- 74 y/o LLE lymphedema
- s/p removal of Squamous cell carcinoma

Normal-healthy state

Pathophysiology---Lymphedema



Activated macrophages

Fibroblasts synthesizing collagen

TYPES OF LYMPHEDEMA:

Primary Idiopathic Lymphedema

Secondary Lymphedema

Földi & Kubik Lymphyology, pg 240

TERMINOLOGY
Primary Lymphedema

- Initial onset of lymphedema:
  - @ Birth — congenital lymphedema
  - Before age 35 — lymphedema praecox
  - After age 35 — lymphedema tardum

Hereditary Lymphedema

- Type I NonneMilroy:
  - Congenital elephantiasis
  - Birth
  - Defect in B LE
  - Lymphedema located distal to the inguinal ligament
- Type II Meige:
  - Non congenital familial
  - Occurs at puberty
  - Associated with anomalies; myopia, yellow nails, vertebrae anomaly, partial syndactyly of the toes hearing loss, cleft palate

Causes of Secondary Lymphedema:

- Surgical removal of lymph nodes/vessels
- Radiation therapy
- Blockage of lymph nodes/vessels
  - Tumor
  - Scar tissue caused by surgery
  - Filariasis
  - Obesity
  - Pregnancy
- Lipedema
- Trauma / burns
- Venous failure (DVT, PTS, CVI)

continued:

Causes of Secondary Lymphedema continued:

- Fibrosis of the Inguinal Lymph Nodes: LNs replaced by scar tissue
- Cellulitis / Infection
- Animal bites/scratches or bug bites (filariasis)
- Cyclic idiopathic edema syndrome (fluid-retention syndrome)
- Immobility-lack of ROM i.e. hand swelling s/p rotator cuff
- Medical procedures
- Self-induced

RX Considerations

- Keep this list of causes in the back of your head and ask yourself:
- What potential underlying lymphatic system compromise or failure did the patient have prior to this orthopedic trauma?
- I.E. lipedema or CVI will definitely worsen prognosis for TKR if not adequately addressed
- Or a HUGE leg after minor trauma such as sprain? Consider primary lymphedema

Lipedema

- Swelling pathology of unknown etiology
- Often mistaken for obesity and sometimes lymphedema
- Predominately affects women usually familial
- Epidemiological study performed by the Foeldi's in 2001 lipedema present in 11% of female population
- Often manifests at menarche, or menopause, or during pregnancy
- Bilateral symmetrical fatty deposits from ankles to pelvis
  - "Saddle bags" at greater trochanters
  - The feet are not involved
  - small trunk set on large pair of hips/legs
- Quality of the tissue is quite spongy
- Capillaries have to cork-screw around fat cells and become stretched and fragile leads to CVI
  - Bruise easily
  - Complain of pain/aching in the legs ("growing pains"?)

Földi & Kubik Lymphyology, pg 396

Patient Education: Lipedema

- Handout: Lipedema

Lipedema

- Bilateral LE swelling from ankles to greater trochanters- “saddle bags”
- Early stages skin appears normal
- During progression signs of “cellulite”
- Occasionally can affect UEs
- Diet and exercise alone will not change the shape of the legs
  - Can abuse diuretics and laxatives
  - Quality of life impairment –
  - pts feel ugly and misshapen-
  - leads to depression
  - Give up on trying to diet and exercise
  - can lead to obesity

****Loraine believes this is etiology of Fibromyalgia**

Catching this pathology early can prevent significant swelling and discomfort

Young woman in her mid teens

Same person at 64 years old. Note difference with visualizing trunk versus hips

Chronic Venous Insufficiency (CVI)

Clinical Stages of CVI:
Stages of CVI:

- **STAGE I:** Venous insufficiency – CVI
  - RX: Lymph mobs not required/compression only

- **STAGE II:** Phlebolymphodynamic insufficiency lymphatics are healthy but unable to handle load.
  - RX: Lymph mobs beneficial-compression with socks or wraps.
  - (shorter course 1-2 days)

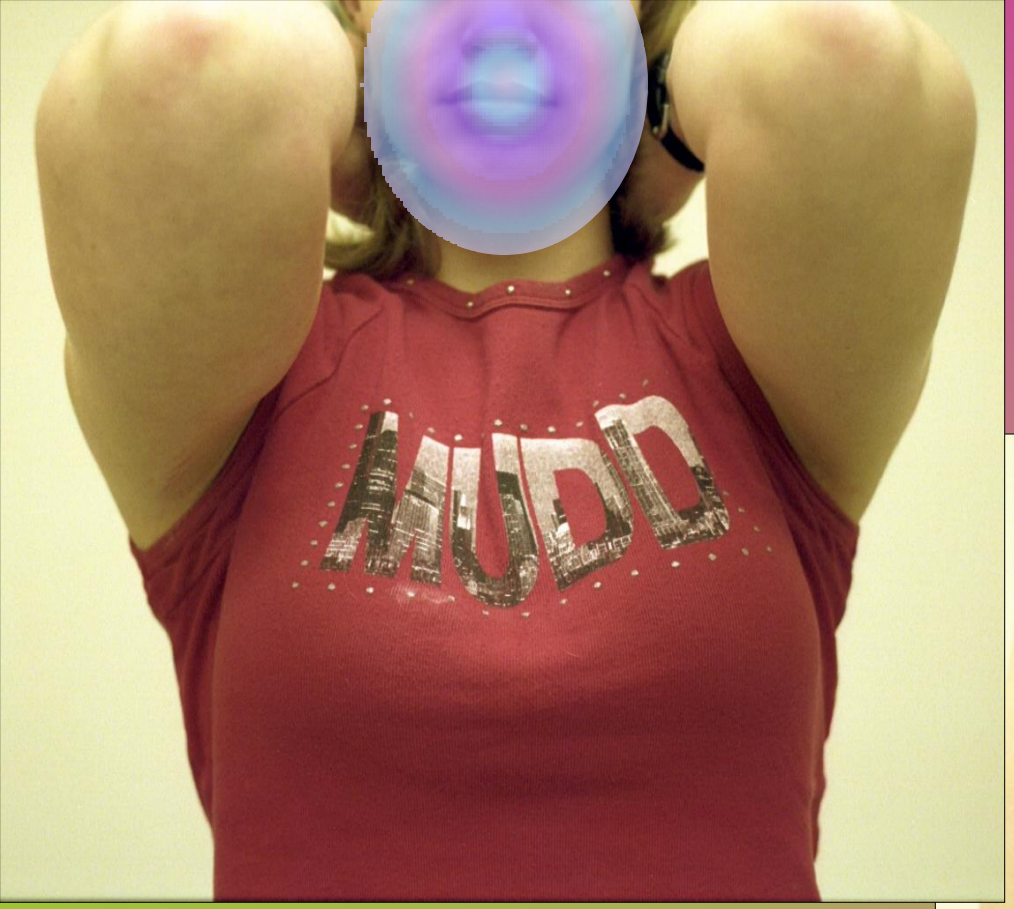
- **STAGE III:** Phlebo lymphostasis - increased fluid load and injured vessels-safety valve insufficiency.
  - RX: Lymph mobs and compression with bandages until reduced adequately then socks.
  - (longer course 3-5 days)

CVI with secondary lymphedema

(phlebolymphedema)

Protein molecules left in interstitial spaces due to failure of the lymphatics cause proliferation of scar tissue and fatty tissue deposits. Skin becomes waxy, shiny, and thickened.

“Dermatolypo-sclerosis”



20-year-old S/P DVT right subclavian vein

@ Age 17 from weightlifting

With secondary lymphedema

Lymphedema Stages in Brief

- **Stage 0 Latency**: At-risk limb no clinical S/S
- **Stage I:** Tissues soft; able to create imprint; swelling reduces with rest and elevation
- **Stage II:** Tissues hard; no longer able to create pit; swelling does not reduce
- **Stage III:** Deepening of the joint folds, papillomas of the skin, lymph cysts or fistulae, fibrosis, sclerotic skin

Early Subjective Symptoms

- Tingling
- Numbness
- Burning
- Tightness
- Swelling
- Thickening
- Heaviness
- Fullness
- Aching
- Inability to wear jewelry, watches, rings
- Clothes become tight
- Symptoms fluctuate with activity

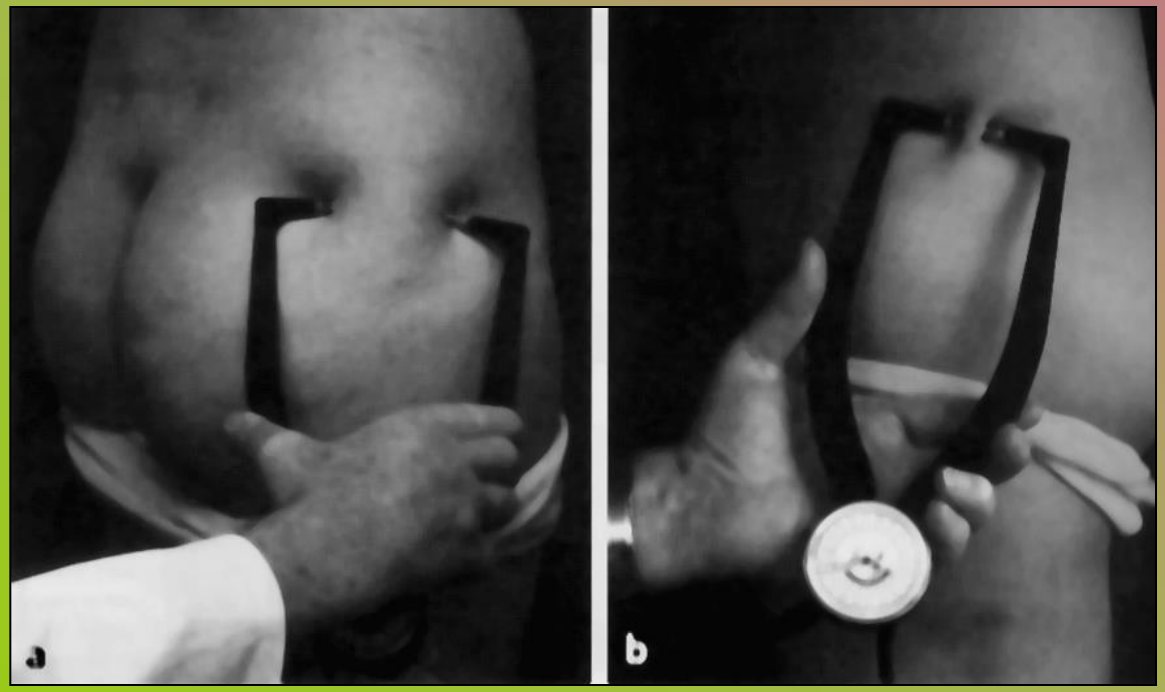
Increased Risk of Infections

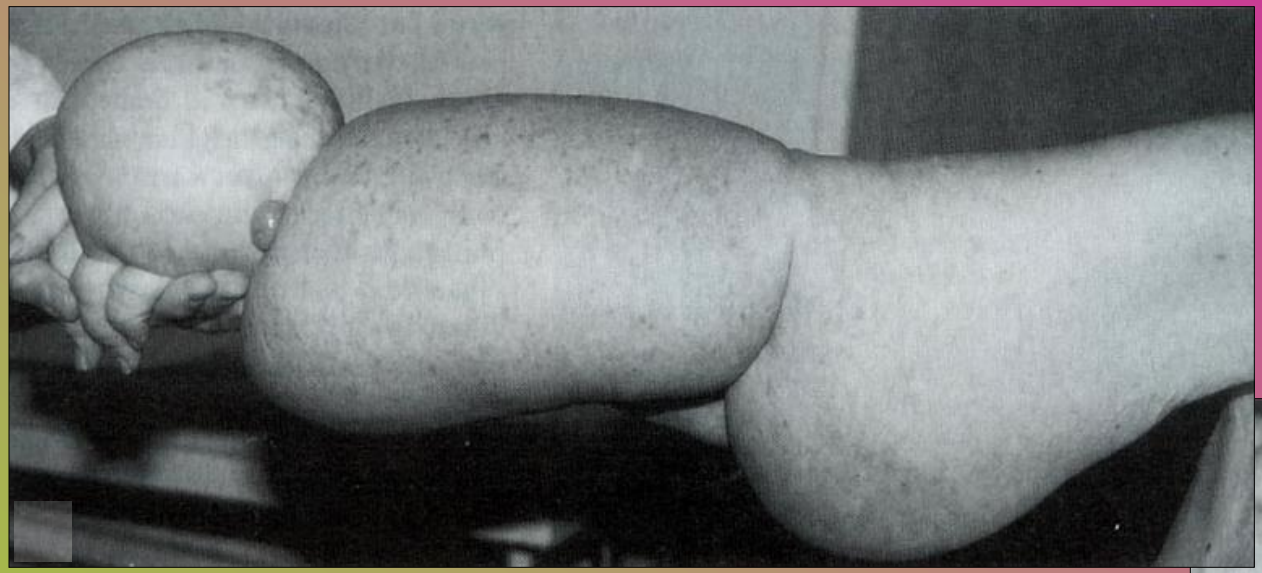
- Stagnating lymphocytes in regions of the body with lymphedema cause decreased immune response capabilities
- Skin is unable to function as an immune defense organ
- Susceptible to fungi-mycotic infections, streptococcus, staphylococcus which leads to cellulitis
- Repeated cellulitis can cause a stage 2 lymphedema to become stage 3

DIFFICULT PHOTOS

Stemmer's Sign: Unable to lift skin away from body

Stemmer’s sign is a skin calipers test-if positive-unable to pinch or lift the skin.

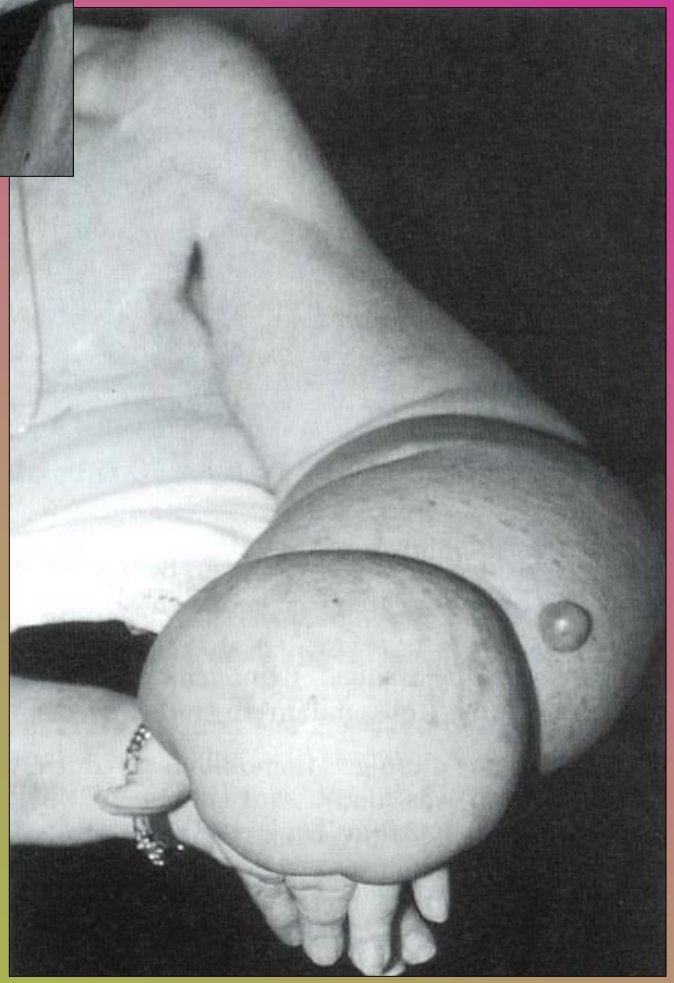




Stage 3 Lymphedema of the arm with a lymph cyst on the side of the wrist-

Note how patient is unable to raise arm independently-

co-morbidity of orthopedic pathology



Oncology signs continued:

Contact physician to R/O CA prior to initiating RX

- Non-healing wound
- Swelling more proximal than distal
- Supraclavicular mountain rather than fossa
- Ear is closer to shoulder than normal
- Hard protrusions not softening with MLD
- Lymphangiosis Carcinomatosa-lymph vessels CA filled
- Paralysis accompanying lymphedema
- Translucent or almost see-through skin
- Dead feeling tissue under your hands

Pt sent by Radiation Oncologist to try CDP

Pt Chief Compliant: Itching

Unable to soften edema or resolve itching with CDP

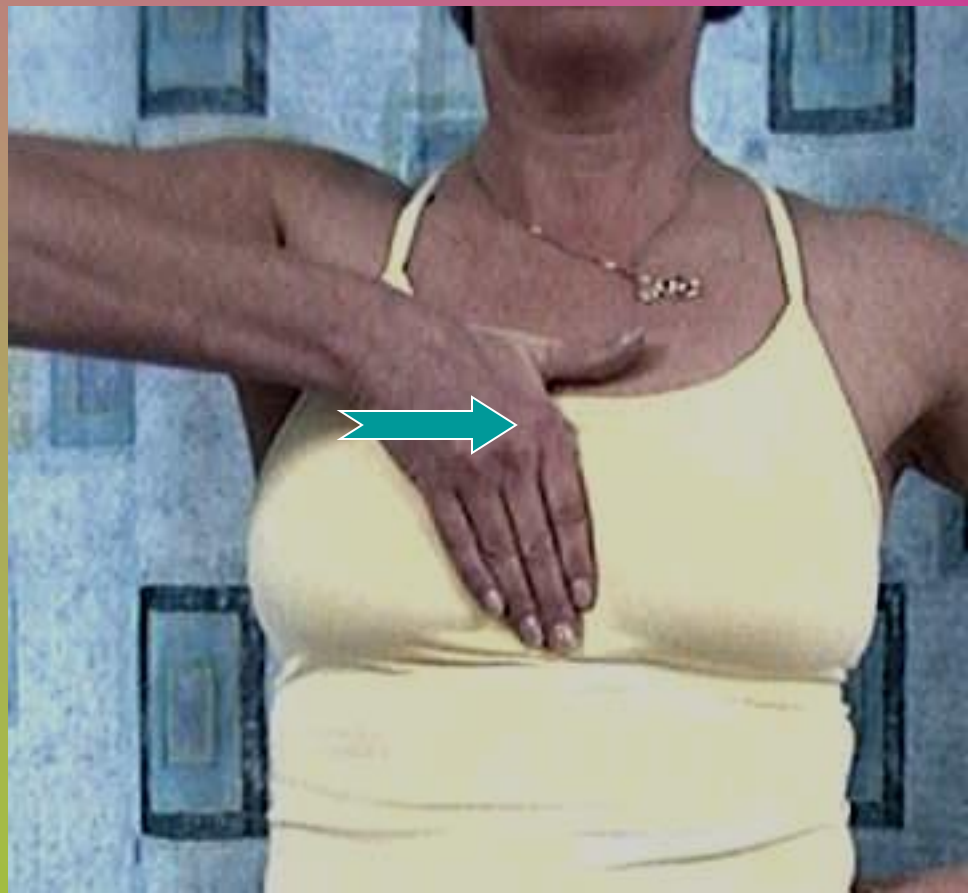
Lymphangiosis Carcinomatosa= Inflammatory Breast Cancer?

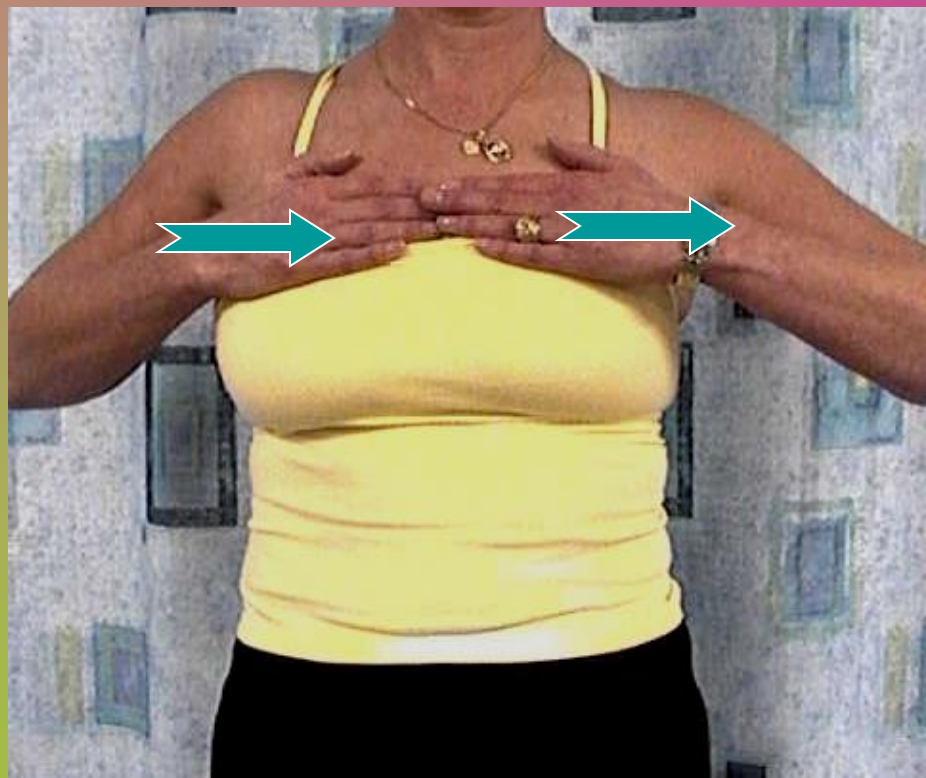
Progression of same pt-s/p R MRM

Treatment Approaches

Using specialized lymphedema compression bandages

Manual Lymphatic Drainage (MLD) massage technique





"OUR PROBLEMS WITH LYMPHEDEMA ARE BURDENED WITH IGNORANCE"

-M. Földi