



RUHANI COLLEGE

RU RMT 21 · ANATOMY & PHYSIOLOGY 04

LECTURE 04

The Cardiovascular System II: Blood, Vessels and Massage

Vessels, venous return and the composition of blood — together with the vascular pathologies, above all deep vein thrombosis, that every registered massage therapist must screen for before applying circulatory technique.

Registered Massage Therapy Diploma Program · CMTCA-aligned curriculum

One instructional day · 7 contact hours · Theory

Follows directly from Lecture 03. Screening competence developed here is assumed for the remainder of the course.



How This Session Works

Seven contact hours, delivered in person at the Brampton campus and simultaneously live online via Zoom.

- Block 1 (65 min) — Vessel structure and function: arteries, arterioles, capillaries, venules and veins; capillary exchange.
- Block 2 (60 min) — Venous return: the skeletal muscle pump, the respiratory pump, venous valves and external compression.
- Block 3 (55 min) — The lymphatic link: fluid balance, lymph flow, oedema and the place of manual lymphatic drainage.
- Break (30 min).
- Block 4 (70 min) — Blood: plasma, formed elements, haemostasis and blood groups.
- Block 5 (75 min) — Vascular and blood pathology, with an extended treatment of deep vein thrombosis and the screening workflow.
- Block 6 (55 min) — Circulatory technique, the lower limb decision flow, contraindications, applied scenarios and review.
- Assessment note — Deep vein thrombosis screening is examined in this course and is assessed again in clinical placement.



Learning Outcomes (1 of 2)

By the end of this lecture the student will be able to:

- Compare the structure, function and pressure characteristics of arteries, capillaries and veins.
- Explain capillary exchange and the balance of hydrostatic and osmotic forces that governs it.
- Explain the mechanisms of venous return, including the skeletal muscle pump and the respiratory pump.
- Describe the lymphatic system's contribution to fluid balance and immunity.
- Distinguish the principal causes of oedema and state which are appropriate for manual treatment.
- Describe the composition of blood and the function of each formed element.
- Outline haemostasis and explain its clinical relevance to bruising, bleeding and thrombosis.



Learning Outcomes (2 of 2)

By the end of this lecture the student will also be able to:

- Describe the ABO and Rh blood group systems at an introductory level.
- Recognise common vascular and blood conditions and state their treatment implications.
- Describe the pathophysiology, risk factors and clinical signs of deep vein thrombosis.
- Apply a structured deep vein thrombosis screening workflow to every lower-limb presentation.
- State why provocative testing for deep vein thrombosis is not performed by massage therapists.
- Describe the effects of massage on circulation and venous return, distinguishing mechanical from reflexive effects.
- Determine indications, contraindications and cautions for circulatory technique, and document the reasoning.

Key Terminology for This Lecture

- **Haematocrit** the percentage of blood volume occupied by red blood cells, normally about 45 per cent.
- **Erythrocyte** red blood cell; a biconcave, anucleate cell carrying haemoglobin.
- **Leukocyte** white blood cell; the cellular arm of the immune response.
- **Thrombocyte** platelet; a cell fragment essential to haemostasis.
- **Haemostasis** the physiological process that stops bleeding after vessel injury.
- **Thrombus** a clot formed within an intact vessel.
- **Embolus** material that travels in the bloodstream and lodges in a distant vessel.
- **Virchow's triad** the three conditions predisposing to thrombosis: stasis, endothelial injury and hypercoagulability.
- **Oedema** accumulation of excess fluid in the interstitial space.
- **Lymphoedema** chronic swelling from impaired lymphatic drainage, most often after node removal or radiotherapy.
- **Centripetal** directed toward the centre or the heart; the direction of circulatory strokes.
- **Varicosity** an abnormally dilated, tortuous superficial vein with incompetent valves.
- **Claudication** cramping limb pain on exertion, relieved by rest, indicating arterial insufficiency.
- **Anticoagulant** a medication that reduces the blood's ability to clot.



SECTION 1

Blood Vessels and Venous Return

The transport network, the exchange that happens within it, and the mechanisms that return blood to the heart against gravity.

- Structure and function of arteries, capillaries and veins
- Capillary exchange and the forces that govern it
- Mechanisms of venous return
- The lymphatic link and the causes of oedema

Arteries, Capillaries and Veins

Vessel	Structure	Function	Pressure
Elastic arteries	Thick walls with abundant elastin; aorta and its major branches	Carry blood from the heart and smooth the pulsatile flow by recoil	High and pulsatile
Muscular arteries	Thick smooth muscle layer; named arteries of the limbs	Distribute blood to organs and regions; alter diameter under sympathetic control	High
Arterioles	Small, with a prominent smooth muscle layer	The principal site of resistance; regulate flow into capillary beds	Falling rapidly
Capillaries	A single endothelial layer on a basement membrane	The only site of exchange of gases, nutrients and wastes	Low
Venules	Thin-walled convergences of capillaries	Collect blood and permit leukocyte migration into tissue	Low
Veins	Thin walls, large lumen, one-way valves in the limbs	Return blood to the heart; hold about 60 to 70 per cent of blood volume as a reservoir	Low, non-pulsatile

The Vessel Wall: Three Tunics

Except for capillaries, every vessel wall has the same three layers. The relative thickness of each layer is what distinguishes an artery from a vein.

The three layers

- Tunica intima — a single layer of endothelium on a basement membrane; smooth, continuous with the endocardium, and actively anti-thrombotic when healthy.
- Tunica media — smooth muscle and elastic fibres under sympathetic control; thickest in arteries and responsible for vasoconstriction and vasodilation.
- Tunica externa (adventitia) — collagen and elastic fibres anchoring the vessel; carries the vasa vasorum supplying larger vessel walls.
- Capillaries have only endothelium and a basement membrane, which is what makes exchange possible.

Why the structure matters clinically

- Healthy endothelium resists clot formation; damage to it exposes collagen and initiates the clotting sequence — the second component of Virchow's triad.
- Atherosclerotic plaque develops within the intima and progressively narrows the lumen.
- The thick arterial media allows arterioles to be the main site of resistance and therefore the main determinant of blood pressure.
- Thin venous walls collapse easily, which is why external compression from muscle contraction or from a therapist's hands moves venous blood effectively.
- Venous valves are folds of intima; their failure produces varicosities and chronic venous insufficiency.

Blood Flow, Velocity and the Control of Distribution

Blood flow is not distributed evenly or constantly. It is continuously redirected according to demand, and massage participates in that redirection only locally.

- At rest, roughly 20 to 25 per cent of cardiac output goes to the kidneys, 20 per cent to skeletal muscle, 15 per cent to the brain, 15 per cent to the abdominal viscera and 5 per cent to the coronary circulation.
- During exercise, skeletal muscle can receive over 80 per cent of a much larger cardiac output, while visceral and renal flow are reduced.
- Flow velocity is highest in the aorta and slowest in the capillaries, because the total cross-sectional area of the capillary bed is enormous — the slow transit is what permits exchange.
- Local blood flow is regulated by precapillary sphincters responding to local tissue conditions: low oxygen, high carbon dioxide, low pH, rising temperature and metabolites all produce local vasodilation.
- This local autoregulation is why a working or recently worked muscle receives more blood without any change in cardiac output.
- Sympathetic vasomotor tone sets the background level of constriction in most vascular beds; withdrawal of that tone is the principal mechanism of massage-related vasodilation.
- Nitric oxide released by healthy endothelium in response to flow and shear is a major local vasodilator, and its production is impaired in atherosclerosis and diabetes.
- Massage produces local hyperaemia in the worked tissue but does not meaningfully redistribute systemic cardiac output.
- This is the physiological reason why claims that massage 'increases circulation' throughout the body are not supportable as stated.

Capillary Exchange and the Origin of Interstitial Fluid

Everything a tissue needs arrives, and everything it discards leaves, across a single layer of endothelium. This is where circulation meets the tissue the therapist treats.

- Exchange occurs by diffusion for gases and small lipid-soluble molecules, by bulk flow for water and dissolved solutes, and by transcytosis for large molecules.
- Hydrostatic pressure at the arterial end of the capillary pushes fluid out into the interstitial space; this is filtration.
- Colloid osmotic pressure generated by plasma proteins, chiefly albumin, pulls fluid back in at the venous end; this is reabsorption.
- Net filtration slightly exceeds net reabsorption, so a small volume of fluid remains in the interstitium and must be returned by the lymphatic system.
- Roughly 20 litres are filtered and about 17 litres reabsorbed each day, leaving approximately 3 litres for lymphatic return.
- Oedema results when filtration rises, reabsorption falls, or lymphatic drainage is impaired.
- Raised venous pressure in heart failure or venous insufficiency raises capillary hydrostatic pressure and produces dependent oedema.
- Low plasma protein in liver disease, kidney disease or severe malnutrition lowers osmotic pressure and produces generalised oedema.
- Increased capillary permeability in inflammation, allergy or infection produces localised swelling with heat and redness.

Mechanisms of Venous Return

By the time blood reaches the venules, the pressure generated by the left ventricle is almost exhausted. Four mechanisms move blood the rest of the way home.

- 1. Skeletal muscle pump** Contracting muscles compress the deep veins running between them; one-way valves ensure blood is squeezed only toward the heart. Walking is the most effective form of this pump.
- 2. Venous valves** Prevent backflow, allowing blood to travel against gravity in stages. Valve failure produces varicosities and venous insufficiency.
- 3. Respiratory pump** Inspiration lowers thoracic pressure and raises abdominal pressure, drawing venous blood toward the thorax. Deep breathing enhances this.
- 4. Sympathetic venoconstriction** Reduces venous capacitance, shifting blood from the venous reservoir toward the heart when required.
- 5. Massage and external compression** Centripetal strokes and rhythmic compression mechanically assist venous and lymphatic return, adding to the muscle pump in a client who is inactive.
- 6. Clinical corollary** Immobility removes the skeletal muscle pump and produces venous stasis — the first component of Virchow's triad and the reason immobility is a thrombosis risk factor.

The Lymphatic Link

Not all capillary fluid returns to the venous circulation. The lymphatic system reclaims the remainder and supports immunity.

Structure and flow

- Lymphatic capillaries are blind-ended, highly permeable vessels that collect excess interstitial fluid and protein.
- Lymph flows through collecting vessels, through nodes, into trunks and finally into the thoracic duct and the right lymphatic duct, returning to the subclavian veins.
- There is no central pump; lymph moves by intrinsic vessel contraction, the skeletal muscle pump, the respiratory pump and one-way valves.
- Lymph nodes filter lymph, house lymphocytes and macrophages, and are the site where an immune response is mounted.
- The spleen, thymus, tonsils and gut-associated lymphoid tissue are the other lymphoid organs.

Clinical relevance

- Oedema results when lymphatic return cannot keep pace with capillary filtration.
- Lymphoedema is chronic swelling from impaired lymphatic drainage, most often after node dissection or radiotherapy for cancer.
- Manual lymphatic drainage is a distinct, very light, rhythmic technique with its own training; it is not simply gentle massage.
- Heavy pressure over a lymphoedematous limb can overload the remaining vessels and worsen the condition.
- Enlarged, hard, fixed or persistently tender nodes are a referral finding, not a treatment target.
- Acute infection with lymphangitis, seen as red streaking toward a node, is an urgent referral.



Distinguishing the Causes of Oedema

Oedema is a sign, not a diagnosis. Identifying its likely origin determines whether treatment is appropriate at all.

Pattern	Typical features	Likely origin	Action
Bilateral dependent, pitting	Both ankles, worse at end of day, improves overnight	Venous insufficiency, prolonged standing, heart failure, medication effect	If new or unexplained, refer before treating; if diagnosed and stable, gentle proximal work with clearance
Unilateral, warm, painful, of recent onset	One limb, calf tenderness, warmth, redness, swelling	Deep vein thrombosis until proven otherwise	Absolute contraindication. Do not treat. Urgent medical referral
Unilateral, chronic, non-pitting, firm	Longstanding, often after cancer treatment or node removal	Lymphoedema	Specialised manual lymphatic drainage by a trained practitioner; avoid heavy pressure
Localised, hot, red, tender	Confined to an injured or infected area	Acute inflammation or local infection	No local work; treat elsewhere; refer if infection is suspected
Generalised, including face and abdomen	Puffiness on waking, swelling in several regions	Renal disease, liver disease, low plasma protein	Refer for medical assessment; do not treat the swelling
Post-injury, localised	Follows a known mechanical injury, in proportion to it	Normal inflammatory response	Treat according to healing stage, working proximally to distally

The Superficial and Deep Venous Systems of the Limbs

Two parallel venous systems drain each limb, connected by perforating veins. Knowing which is which explains both varicosities and thrombosis.

Lower limb

- Deep veins accompany the arteries: posterior tibial, anterior tibial, peroneal, popliteal, femoral and external iliac.
- Deep veins carry the great majority of venous blood and lie between the muscles, which is what allows the skeletal muscle pump to work.
- Superficial veins are the great saphenous, running from the medial foot up the medial leg and thigh, and the small saphenous, running up the posterior calf.
- Perforating veins connect superficial to deep, with valves directing flow inward.
- Deep vein thrombosis forms in the deep system; varicosities are a disorder of the superficial system.

Upper limb and clinical points

- Deep veins of the arm accompany the arteries: radial, ulnar, brachial and axillary.
- Superficial veins include the cephalic on the lateral arm and the basilic on the medial arm, joined by the median cubital vein used for venepuncture.
- Upper limb thrombosis is far less common but occurs with central venous catheters, pacemaker leads and thoracic outlet compression.
- Superficial thrombophlebitis presents as a tender, red, firm cord along a superficial vein; it is a local contraindication and warrants assessment.
- The subclavian veins receive the thoracic duct and the right lymphatic duct — the point where lymph rejoins the blood.

SECTION 2

Blood

Composition, formed elements, haemostasis and blood groups — the fluid that every mechanism in this course ultimately moves.

- Plasma and the formed elements
- Erythrocytes, leukocytes and platelets
- Haemostasis and its clinical relevance
- Blood groups in brief



Composition of Blood

Whole blood is about 55 per cent plasma and 45 per cent formed elements. An average adult carries approximately 5 litres.

- Plasma is about 91 per cent water, and carries dissolved proteins, electrolytes, nutrients, hormones, gases and wastes.
- Albumin is the most abundant plasma protein and generates the colloid osmotic pressure that draws fluid back into capillaries.
- Globulins include the antibodies of the immune response and transport proteins for lipids, hormones and metals.
- Fibrinogen is the plasma protein converted to fibrin during clotting; plasma without it is called serum.
- The formed elements are erythrocytes, leukocytes and platelets, all produced in red bone marrow from a common stem cell.
- Haematocrit is the percentage of blood volume occupied by red cells, normally about 47 per cent in men and 42 per cent in women.
- Blood functions in transport, regulation of temperature, pH and fluid balance, and protection through immunity and clotting.
- Blood is a connective tissue: cells suspended in an extensive extracellular matrix, which in this case is fluid.
- Erythropoietin from the kidney regulates red cell production, connecting this lecture directly to Lecture 07.

The Formed Elements

Element	Structure and lifespan	Function	Clinical note
Erythrocytes	Biconcave, anucleate, packed with haemoglobin; about 120 days	Carry oxygen bound to haemoglobin and assist carbon dioxide transport	Reduced number or haemoglobin content produces anaemia, with fatigue and reduced exercise tolerance
Neutrophils	Most numerous leukocyte; hours to days	First responders to bacterial infection; phagocytosis	Raised count suggests acute bacterial infection
Lymphocytes	B and T cells; days to years	Specific immunity, antibody production and cell-mediated defence	Central to the immune competence of clients on immunosuppressive therapy
Monocytes and macrophages	Largest leukocyte; months in tissue	Phagocytosis of debris and pathogens; antigen presentation	Key to the clean-up phase of soft tissue healing
Eosinophils and basophils	Least numerous; days	Parasitic defence and allergic and inflammatory mediation	Basophils and mast cells release histamine, producing the flare seen after vigorous manual work
Platelets	Cell fragments from megakaryocytes; 8 to 10 days	Form the platelet plug and release clotting factors	Reduced number or function increases bruising and bleeding risk substantially

Haemostasis: How Bleeding Stops

Haemostasis stops bleeding after injury. Understanding it explains bruising, the effect of anticoagulants, and the danger of thrombosis.

- 1. Vascular spasm** Immediate reflex vasoconstriction of the injured vessel reduces blood loss within seconds.
- 2. Platelet plug formation** Platelets adhere to exposed collagen, become activated, change shape and recruit further platelets — a positive feedback loop.
- 3. Coagulation cascade** Intrinsic and extrinsic pathways converge on a common pathway; prothrombin becomes thrombin, and thrombin converts fibrinogen to fibrin.
- 4. Clot formation** Fibrin strands form a mesh that traps red cells and platelets, producing a stable clot.
- 5. Clot retraction and repair** The clot contracts, drawing wound edges together, while fibroblasts and new vessels repair the vessel wall.
- 6. Fibrinolysis** Plasmin gradually dissolves the clot once repair is complete, restoring normal flow.
- 7. Clinical corollary** Anything that impairs this sequence — anticoagulant medication, liver disease, low platelet count, a bleeding disorder — increases bruising risk and requires reduced pressure and no frictions.

Blood, Immunity and the Inflammatory Response

The blood carries the immune response to the tissues a therapist treats, and inflammation is the reason many contraindications exist.

- Innate immunity provides an immediate, non-specific response: physical barriers, phagocytic neutrophils and macrophages, natural killer cells, complement proteins and the inflammatory response itself.
- Adaptive immunity is slower, specific and has memory: B lymphocytes produce antibodies, T lymphocytes coordinate and deliver cell-mediated responses.
- The cardinal signs of inflammation — redness, heat, swelling, pain and loss of function — are all consequences of vasodilation and increased capillary permeability.
- Local inflammation is a normal and necessary repair process; the therapist works around it rather than against it.
- Systemic inflammation with fever, malaise, aching and raised temperature is a general contraindication to massage in almost all circumstances.
- Fever indicates the body is mounting a systemic response and has increased metabolic and cardiovascular demand; adding a treatment is unhelpful and potentially harmful.
- Clients who are immunosuppressed — through medication, chemotherapy, or disease — require rigorous infection control and may show a blunted inflammatory response, masking infection.
- Enlarged, firm, fixed or persistently tender lymph nodes are a referral finding.
- A client who is unwell should be rescheduled, both for their own recovery and to protect other clients and the therapist.

Blood Groups in Brief

General professional knowledge rather than a clinical skill for massage therapists, but part of a complete understanding of blood.

- The ABO system classifies blood by the presence or absence of A and B antigens on the erythrocyte surface.
- Group A carries A antigen and anti-B antibodies; group B carries B antigen and anti-A antibodies; group AB carries both antigens and neither antibody; group O carries neither antigen and both antibodies.
- Group O is described as the universal donor of red cells and group AB as the universal recipient, with important qualifications in practice.
- The Rh system classifies blood by the presence or absence of the D antigen; Rh-positive means the antigen is present.
- Rh incompatibility in pregnancy, where an Rh-negative mother carries an Rh-positive fetus, is managed with prophylactic anti-D immunoglobulin.
- Transfusion of incompatible blood produces agglutination and haemolysis, a potentially fatal reaction.
- Massage therapists do not need to know a client's blood group, and should not ask for it as part of intake.
- The relevance of this material is contextual understanding of clients' medical histories, particularly around surgery, transfusion and pregnancy.



SECTION 3

Vascular Pathology and Deep Vein Thrombosis

The conditions that change or prohibit treatment, and the single most important safety topic in the entire course.

- Common vascular and blood conditions
- Peripheral arterial disease and claudication
- Deep vein thrombosis: mechanism, risk factors and signs
- The screening workflow and why provocative testing is not performed
- Pulmonary embolism recognition



Common Vascular and Blood Conditions

Condition	Description	Massage relevance
Varicose veins	Dilated, tortuous superficial veins with incompetent valves	Avoid heavy or deep local pressure and no frictions over the varicosity; gentle proximal work is appropriate; elevate and advise movement
Chronic venous insufficiency	Longstanding venous hypertension with skin changes and possible ulceration	Work proximally with light pressure; never treat over an ulcer; medical management is required
Deep vein thrombosis	Thrombus in a deep vein, usually of the calf or thigh	Absolute contraindication. Do not treat. Refer urgently for medical assessment
Peripheral arterial disease	Atherosclerotic narrowing reducing limb perfusion; cramping on walking	Avoid vigorous work on an ischaemic limb; never apply heat; inspect the feet; refer any wound
Anaemia	Reduced red cell number or haemoglobin content	Client fatigues easily; shorter, lighter sessions; investigate whether the cause is known and managed
Bleeding disorders	Impaired clotting, for example haemophilia or thrombocytopenia	High bruising and bleeding risk; light pressure only, no frictions, physician clearance advisable
Atherosclerosis	Arterial plaque formation and narrowing	Caution for embolism and reduced perfusion; avoid vigorous work over major vessels
Sickle cell disease	Abnormal haemoglobin causing episodic vaso-occlusive crises	Avoid cold and dehydration; do not treat during a crisis; gentle supportive work between episodes



Deep Vein Thrombosis: Mechanism and Risk

A thrombus forming in a deep vein of the calf, thigh or pelvis. The danger is not local; it is that the clot may travel.

Why it forms — Virchow's triad

- Venous stasis — immobility, long travel, prolonged bed rest, plaster cast, paralysis, or a limb kept dependent for long periods.
- Endothelial injury — surgery, trauma, fracture, intravenous catheters or previous thrombosis.
- Hypercoagulability — cancer, pregnancy and the postpartum period, oestrogen-containing medication, inherited clotting disorders, dehydration, smoking and obesity.
- Risk multiplies when more than one component is present, which is why the post-surgical, immobile client is the classic case.
- Age over 60, previous venous thromboembolism and a family history all raise baseline risk.

How it presents

- Classically unilateral — one limb, not both. Bilateral swelling points elsewhere.
- Calf or thigh pain or aching, often described as a cramp that does not settle.
- Swelling of the calf, ankle or whole limb, sometimes with a measurable difference in circumference.
- Warmth and redness or discoloration over the affected area.
- Tenderness along the line of the deep veins, sometimes with a firm palpable cord.
- Important: a substantial proportion of thromboses produce few or no clear signs, so risk factors matter as much as physical findings.

The Deep Vein Thrombosis Screening Workflow

Screening is part of every lower-limb assessment, and is mandatory before any circulatory technique on a limb.

- 1. History** Ask directly about recent surgery, hospitalisation, immobility, long-haul travel, fracture or cast, pregnancy or recent delivery, cancer or its treatment, hormone therapy, previous clots and family history.
- 2. Observe and compare** Compare both limbs for swelling, colour, visible superficial veins and any difference in size. Note warmth by comparison, not in isolation.
- 3. Ask about symptoms** Ask about new calf pain, aching, heaviness or cramp that has not resolved, and whether it is worse on standing or walking.
- 4. Do not provoke** Do not perform provocative testing, do not squeeze or forcibly dorsiflex the limb, and do not palpate deeply along the deep veins to see whether it hurts.
- 5. Decide** If any suspicion exists, stop. Do not treat the limb, and do not treat elsewhere until you have considered whether the client should be seen the same day.
- 6. Refer and advise** Advise urgent medical assessment. Diagnosis requires ultrasound imaging and blood testing; clinical signs alone are never definitive.
- 7. Document** Record the findings, the questions asked, the decision made, the advice given and the client's response to that advice.

Pulmonary Embolism: Recognition and Response

The reason deep vein thrombosis is an absolute contraindication. A fragment of thrombus travelling to the pulmonary circulation is a medical emergency.

- Signs include sudden shortness of breath, sharp chest pain that is worse on inspiration, rapid breathing, rapid heart rate, cough sometimes with blood, anxiety and a sense of impending doom.
- Larger emboli can cause collapse, cyanosis and cardiac arrest.
- Onset may occur during or shortly after activity, movement, or manipulation of an affected limb.
- If a client develops these symptoms during or after treatment, stop, call 911 immediately, keep them still and in a position of comfort, and do not leave them.
- Do not attempt to move a client with suspected pulmonary embolism to a chair or to walk them out of the treatment room.
- Record the time of onset, the symptoms observed, the treatment being delivered at the time, and every action taken.
- Prevention is the screening workflow. The only reliable protection is to identify risk before treatment rather than to recognise consequences after it.
- This is the clearest example in the whole programme of why anatomy and physiology knowledge is a client safety issue and not an academic exercise.

Peripheral Arterial Disease and the Ischaemic Limb

Arterial insufficiency is less publicised than venous disease but is common in older clients, smokers and people with diabetes.

- Intermittent claudication is cramping pain in the calf, thigh or buttock brought on by walking a predictable distance and relieved within minutes of rest.
- Rest pain, particularly at night and relieved by hanging the limb down, indicates severe disease and requires prompt referral.
- Signs include cool pale skin, loss of hair on the limb, thin shiny skin, thickened nails, delayed capillary refill and weak or absent distal pulses.
- Arterial ulcers occur at pressure points and the toes, are typically painful with a punched-out appearance, and require medical wound care.
- Compare the two limbs and palpate the dorsalis pedis and posterior tibial pulses as part of lower-limb screening.
- Do not apply heat to an ischaemic limb: the tissue cannot increase perfusion to dissipate it, and burns occur readily.
- Do not apply vigorous or deep work to an ischaemic limb, and never work over an arterial ulcer.
- Light work proximal to the affected region for comfort and general relaxation may be appropriate with medical guidance.
- Any new or worsening limb pain, colour change or wound in a client with known arterial disease is a referral.



Anticoagulant and Antiplatelet Therapy in Practice

A large and growing proportion of clients take medication that alters clotting. Recognising it and adapting to it is routine practice, not an exception.

- Antiplatelet agents such as acetylsalicylic acid and clopidogrel reduce platelet aggregation and are used after cardiac and cerebrovascular events.
- Warfarin is a vitamin K antagonist requiring regular blood monitoring; its effect is influenced by diet, alcohol and many other medications.
- Direct oral anticoagulants such as apixaban, rivaroxaban and dabigatran are increasingly common and do not require routine monitoring.
- Injectable heparins are used in hospital and after surgery, and some clients continue them at home for a defined period.
- The practical consequence is the same for all of them: substantially increased bruising and bleeding risk from mechanical pressure.
- Adaptations: reduce pressure throughout, avoid deep specific work and all frictions, avoid vigorous tapotement, and check the skin during and after treatment.
- Ask at every visit whether the medication or dose has changed, and record it.
- Unusual, spontaneous or extensive bruising, bleeding gums, blood in urine or stool, or a severe headache in a client on these medications is a referral, not a treatment adaptation.
- The therapist never advises a client to stop, reduce or pause an anticoagulant before treatment. If treatment cannot be delivered safely, the treatment changes, not the medication.

Post-Thrombotic Syndrome and Chronic Venous Disease

Many clients have a history of thrombosis rather than an active one. Understanding the long-term picture allows safe, useful treatment.

- Post-thrombotic syndrome follows deep vein thrombosis in a substantial proportion of cases, and results from valve damage and residual venous obstruction.
- Features include chronic aching and heaviness, swelling worse at the end of the day, skin discoloration, itching and, in severe cases, venous ulceration.
- A history of thrombosis raises the risk of a further event, so screening must be repeated at every visit rather than assumed to be settled.
- Once a thrombosis has been medically treated and the client is stable on anticoagulation, treatment can usually resume with physician guidance and reduced pressure.
- The timing of that resumption is a medical decision, not a therapist decision; ask the client to confirm with their physician.
- Compression stockings, elevation and regular walking are the mainstays of management, and the therapist should support rather than replace them.
- Venous ulcers, typically around the medial malleolus with irregular borders and moderate pain, require medical wound care and are an absolute local contraindication.
- Manual work proximal to an affected region, with light pressure, may help comfort and mobility; deep local work does not.
- Client education on movement, hydration, avoiding prolonged static standing or sitting, and recognising warning signs is a genuine contribution.



Lymphoedema and the Client After Cancer Treatment

Lymph node removal and radiotherapy permanently reduce lymphatic capacity in the drained region, and the resulting swelling is lifelong and requires specialised care.

- Secondary lymphoedema most commonly follows axillary node dissection for breast cancer or inguinal node dissection, and may appear months or years after treatment.
- It presents as chronic, usually unilateral, non-pitting swelling that is firm, does not resolve overnight and is often accompanied by heaviness and reduced range of motion.
- Skin in a lymphoedematous limb is at high risk of infection; cellulitis in such a limb is a medical emergency requiring same-day assessment.
- Manual lymphatic drainage is a specific, very light, slow, rhythmic technique requiring dedicated post-graduate training; general massage is not a substitute and heavy pressure can worsen the condition.
- Complete decongestive therapy combines manual lymphatic drainage with compression, exercise and skin care, and is delivered by trained practitioners.
- An RMT without that training can still contribute: general relaxation work away from the affected region, scar work with clearance, education and vigilance for infection.
- Do not apply heat, deep pressure, blood pressure cuffs or constrictive contact to a limb at risk of lymphoedema.
- Clients at risk who have not yet developed swelling need the same precautions, because the risk is lifelong.
- Communication with the client's oncology or lymphoedema team is appropriate and expected for anything beyond general relaxation work.



SECTION 4

Massage Therapy Application

Supporting circulation safely: technique, direction, sequence and the decision flow that governs every lower-limb treatment.

- Effects of massage on circulation
- Circulatory technique and sequence
- The lower-limb decision flow
- Contraindications and cautions
- Applied scenarios, review and summary



Effects of Massage on Circulation

Effects are genuine but mostly local and supportive. Describe them accurately to clients.

Direct mechanical effects

- Assisted venous return where strokes are directed proximally, supplementing the skeletal muscle pump.
- Increased local blood flow in the tissue being worked, through cycles of compression and release.
- Movement of interstitial fluid toward lymphatic collectors, reducing localised non-pathological swelling.
- Improved local exchange supporting delivery of oxygen and nutrients and clearance of metabolites.
- Reduction of local ischaemia in a taut band, with reactive hyperaemia on release.
- These effects are confined to worked tissue and are measurable for a limited period after treatment.

Indirect reflexive effects

- Reduced sympathetic vasomotor tone, allowing peripheral vasodilation.
- Axon reflex and histamine-mediated vasodilation extending slightly beyond the point of contact.
- Modest reductions in heart rate and blood pressure through parasympathetic shift.
- Reduced pain and guarding, allowing the client to move more, which itself improves circulation.
- Improved sleep and reduced stress, supporting cardiovascular health over time.
- Encouraging activity and movement between sessions produces more circulatory benefit than any manual technique.

Circulatory Technique, Direction and Sequence

Screen first, then apply. Sequence and direction both matter when the intent is circulatory.

- **Screen before touching** complete the deep vein thrombosis screening workflow on every lower-limb presentation before applying any circulatory technique.
- **Work proximal first** clear the proximal segment before working distally, so that fluid moved from the distal limb has somewhere to go.
- **Then distal to proximal** apply effleurage and rhythmic compression from distal to proximal, following venous flow.
- **Use appropriate pressure** moderate pressure with a slow rhythm; heavy pressure does not move more fluid and increases bruising risk.
- **Elevate where appropriate** raising a limb assists venous drainage in venous conditions but is inappropriate in arterial insufficiency.
- **Avoid varicosities** no deep pressure and no frictions directly over dilated superficial veins; work proximal to them instead.
- **Adjust for anticoagulants** reduce pressure substantially, avoid frictions and deep specific work, and document the adaptation.
- **Pair with movement** active ankle movement, walking advice and breathing all engage the physiological pumps far more effectively than manual work alone.



Lower-Limb Decision Flow

Apply this flow to every client presenting with lower-limb symptoms, swelling or a request for leg work.

- 1. Any deep vein thrombosis risk factors or suspicious signs?** If yes, stop. Do not treat the limb. Refer for urgent medical assessment and document.
- 2. Any unexplained unilateral swelling, warmth or redness?** If yes, treat as suspected thrombosis until medically excluded. Do not palpate deeply and do not provoke.
- 3. Any signs of arterial insufficiency?** Absent pulses, cool pale skin, hair loss, claudication or rest pain: no vigorous work, no heat, refer if new or worsening.
- 4. Any open wound, ulcer or active infection?** Local or regional contraindication. Do not treat the site; refer for wound care.
- 5. Any varicosities?** Local contraindication over the vessel; gentle proximal work is appropriate.
- 6. Any anticoagulant or bleeding disorder?** Reduce pressure, avoid frictions, monitor for bruising and document the adaptation.
- 7. None of the above?** Proceed with circulatory technique: clear proximally, work distal to proximal, pair with active movement and self-care advice.



Contraindications and Cautions

Absolute

Suspected or confirmed deep vein thrombosis

Confirmed active thrombosis or embolism anywhere

Acute, undiagnosed, severe unilateral limb swelling

Severe uncontrolled bleeding disorder

Suspected pulmonary embolism — call emergency services

Active systemic infection with fever

Local or refer

Varicose veins — no deep local work

Open vascular or arterial ulcers

Acute phlebitis or thrombophlebitis

Recent significant bruise or haematoma

Ischaemic limb with rest pain or absent pulses

Local infection with red streaking toward a node

Caution and adapt

Anticoagulant or antiplatelet medication

History of previous thrombosis

Known and managed anaemia

Lymphoedema — light technique only, ideally by a trained practitioner

Pregnancy — increased thrombosis risk, adapt positioning and screen carefully

Recent long-haul travel or recent surgery — screen carefully before limb work

Self-Care Advice That Actually Supports Circulation

Advice within the scope of an RMT, grounded in the physiology taught in this lecture rather than in general wellness claims.

- **Move regularly** the skeletal muscle pump is the single most effective mechanism of venous return; walking, calf raises and ankle pumping all engage it.
- **Interrupt prolonged sitting or standing** brief movement every 30 to 60 minutes counteracts venous stasis, particularly during travel and desk work.
- **Ankle pumping during travel** simple repeated dorsiflexion and plantarflexion during long flights or drives directly reduces stasis in the calf.
- **Elevate the legs for venous symptoms** raising the limbs above heart level assists drainage where the problem is venous — but not where it is arterial.
- **Breathe fully** diaphragmatic breathing engages the respiratory pump and supports venous return to the thorax.
- **Wear prescribed compression** compression stockings prescribed by a physician are effective; the therapist supports adherence rather than advising on them independently.
- **Hydrate normally** adequate fluid intake supports normal blood volume and viscosity; this is sensible advice, not a detoxification claim.
- **Know the warning signs** new unilateral calf swelling, warmth and pain warrant same-day medical assessment — teach the client to recognise this.

Scenario Practice

Work in trios. For each scenario state your screening questions, your classification, your action and your documentation.

- Scenario 1 — A 45-year-old client books a relaxation massage and mentions in passing that her right calf has been swollen, warm and painful since she returned from a nine-hour flight three days ago.
- Scenario 2 — A client six days after knee replacement surgery attends for upper back tension. He is mobilising with a walker and reports his operated leg is swollen but that this was expected.
- Scenario 3 — A 70-year-old client with bilateral ankle swelling that is worse at the end of the day and better in the morning requests leg massage to help the swelling. He has no diagnosis and has not discussed it with a physician.
- Scenario 4 — A client with prominent varicosities on both calves requests deep tissue work on her legs after a hiking trip.
- Scenario 5 — A client on warfarin for atrial fibrillation reports a large bruise on the thigh that appeared after his last treatment.
- Scenario 6 — Mid-treatment a client becomes suddenly breathless with sharp chest pain worse on inspiration.
- For each scenario, name the mechanism from this lecture that explains why your decision is correct.



Review Questions

Answer in your own words without notes, then verify against the lecture material.

- Compare arteries and veins in structure, pressure and function, and explain why thrombosis forms in veins rather than arteries.
- Explain capillary exchange in terms of hydrostatic and colloid osmotic pressure, and state the approximate daily volume returned by the lymphatic system.
- Name four mechanisms of venous return and explain which of them massage supplements.
- State three different causes of oedema and describe how you would distinguish them clinically.
- Name the formed elements of blood and state one function of each.
- Describe haemostasis in sequence and explain why a client on an anticoagulant bruises more easily.
- Name the three components of Virchow's triad and give two clinical examples of each.
- List six risk factors and five clinical signs of deep vein thrombosis, and explain why unilateral presentation matters.
- Describe the deep vein thrombosis screening workflow in order, and explain why provocative testing is not performed.
- Describe the sequence you would use to apply circulatory technique to a lower limb once screening is clear.



Lecture 04 Summary

- Arteries are high-pressure and elastic; veins are low-pressure, valve-dependent and hold most of the blood volume.
- Capillary exchange is governed by the balance of hydrostatic and osmotic pressure, and the small surplus is returned by the lymphatic system.
- Venous return depends on the skeletal muscle pump, venous valves, the respiratory pump and venoconstriction, all of which massage can supplement but not replace.
- Oedema is a sign with several possible causes, and identifying the cause determines whether treatment is appropriate at all.
- Blood is a connective tissue of plasma and formed elements; haemostasis explains bruising, anticoagulant effects and thrombosis.
- Virchow's triad — stasis, endothelial injury and hypercoagulability — organises all thrombosis risk assessment.
- Suspected deep vein thrombosis is an absolute contraindication: do not treat, do not provoke, refer urgently and document.
- Circulatory technique is applied only after screening: clear proximally, then work distal to proximal, and pair it with movement and self-care.
- Next lecture: the digestive system, the gut-brain axis and the abdominal technique that requires its own specific consent.



References (1 of 2)

Primary and supporting sources for this lecture. Citations in the slide footers refer to these entries.

- Rattray, F., & Ludwig, L. (2000). Clinical Massage Therapy: Understanding, Assessing and Treating Over 70 Conditions. Elora, ON: Talus Incorporated. [Primary text for this course.]
- Werner, R. (2019). A Massage Therapist's Guide to Pathology (7th ed.). Boulder, CO: Books of Discovery.
- Tortora, G. J., & Derrickson, B. (2020). Principles of Anatomy and Physiology (16th ed.). Hoboken, NJ: Wiley.
- Premkumar, K. (2004). The Massage Connection: Anatomy and Physiology (2nd ed.). Baltimore, MD: Lippincott Williams & Wilkins.
- Salvo, S. G. (2019). Massage Therapy: Principles and Practice (6th ed.). St. Louis, MO: Elsevier.
- Fritz, S. (2021). Mosby's Fundamentals of Therapeutic Massage (7th ed.). St. Louis, MO: Elsevier.
- Walton, T. (2011). Medical Conditions and Massage Therapy: A Decision Tree Approach. Baltimore, MD: Lippincott Williams & Wilkins.
- Norris, T. L. (2019). Porth's Essentials of Pathophysiology (5th ed.). Philadelphia, PA: Wolters Kluwer.
- Goodman, C. C., & Fuller, K. S. (2015). Pathology: Implications for the Physical Therapist (4th ed.). St. Louis, MO: Elsevier.



References (2 of 2)

- Marieb, E. N., & Hoehn, K. (2019). Human Anatomy & Physiology (11th ed.). Hoboken, NJ: Pearson.
- Magee, D. J. (2014). Orthopedic Physical Assessment (6th ed.). St. Louis, MO: Elsevier.
- Kisner, C., Colby, L. A., & Borstad, J. (2017). Therapeutic Exercise: Foundations and Techniques (7th ed.). Philadelphia, PA: F. A. Davis.
- Weerapong, P., Hume, P. A., & Kolt, G. S. (2005). The mechanisms of massage and effects on performance, muscle recovery and injury prevention. Sports Medicine, 35(3), 235-256.
- Moyer, C. A., Rounds, J., & Hannum, J. W. (2004). A meta-analysis of massage therapy research. Psychological Bulletin, 130(1), 3-18.
- Waugh, A., & Grant, A. (2018). Ross & Wilson Anatomy and Physiology in Health and Illness (13th ed.). Edinburgh: Elsevier.
- Biel, A. (2019). Trail Guide to the Body (6th ed.). Boulder, CO: Books of Discovery.
- College of Massage Therapists of Ontario. Standards of Practice, Regulations under the Massage Therapy Act, 1991, and the Regulated Health Professions Act, 1991. Toronto, ON: CMTO.
- Federation of Massage Therapy Regulatory Authorities of Canada. (2016). Inter-Jurisdictional Practice Competencies and Performance Indicators for Massage Therapists at Entry-to-Practice. Ottawa, ON: FOMTRAC.