Learning Outcomes

In today’s topic you will learn:

- About the circulatory system, including the structure & function of the blood vessels and heart.
- Blood pressure, blood cholesterol & pulse.
- Some common heart & blood vessel pathologies, including how to identify them & treatments.
Circulation

Systemic circulation:
Relating to the entire body.

Pulmonary circulation:
Pulmonary; from Latin, pulmo, meaning lungs.
Blood vessels

Transport blood:

1. Arteries & arterioles – OXYGENATED BLOOD
   - Oxygenated blood **away from the heart** to the body (exception: pulmonary & umbilical arteries are oxygen poor).
   - Blood under high pressure.

2. Veins & venules – DEOXYGENATED BLOOD
   - Deoxygenated blood **to the heart** (exception: pulmonary & umbilical veins are oxygen rich).
   - Blood under low pressure.

3. Capillaries –
   - Small blood vessels between / connecting arterioles & venules.
   - Where exchange of substances between blood & cells / tissues takes place.

NOTE: most tissues have more than one blood supply – where the blood vessels merge is called **anastomoses**. If circulation to a tissue ceases, **collateral circulation** can continue to provide a blood supply.
Blood vessels

Structure:

**Arteries & veins:**

- Three layers:
  - OUTER (*tunica externa*) – elastic & collagen fibres.
  - MIDDLE (*tunica media*) layer of smooth muscle (control blood vessel diameter by vasoconstriction / vasodilation) & elastic fibres (allow recoil).
  - INNER (*tunica interna*) is composed of a basement membrane & endothelium which is in contact with the blood.

1. **Arteries & arterioles:**
   - OUTER layer of fibrous tissue.
   - MIDDLE layer of smooth muscle & elastic tissue is THICK.
   - INNER lining of endothelium.

2. **Veins & venules:**
   - Thin walls.
   - OUTER layer is the thickest layer.
   - MIDDLE layer is thinner than arteries.
   - INNER layer is thinner than arteries.
   - Many veins contain **valves** – especially those in the limbs.

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**Tunic** – garment or coat
**Externa** – outermost
**Media** – middle
**Interna** – innermost
Blood vessels

Structure:
Arteries & veins:

http://leavingbio.net/
http://www.phschool.com/
Blood vessels

Structure:

3. Capillaries:
   - Composed of only 1 layer - endothelial.
   - Has NO outer (tunica externa) or middle (tunica media) layers.
   - The structure allows easier passing of materials between the blood and cells / tissues/ interstitial fluid - $H_2O$, $O_2$, $CO_2$ and many other nutrients & waste.
Major blood vessels of the body
Portal Circulation

- Venous blood passes from the digestive system, the spleen & pancreas to the liver.
- Known as the hepatic first pass.
Vasodilation & vasoconstriction

All blood vessels, except capillaries, have smooth muscles which are influenced by the **autonomic nervous system**:  
- **SYMPATHETIC** stimulation causes **vasoconstriction**.  
- **PARASYMPATHETIC** has little influence.  
- Dilation reduces blood pressure  
- Constriction increases blood pressure
Blood supply & exchange

Capillaries - exchange of:

- **Water** – by osmosis.
- **Nutrients** – by facilitated diffusion & active transport.
- **Gases** - by diffusion (remember: *internal respiration* is the exchange of gases between blood & body cells / tissues).
Heart

- Fist-sized **muscular** organ.
- **Pumps** blood through blood vessels via contractions.
- Beats 100,000 times each day.
- In a life-time will beat 2.5 billion times.
- Will pump 100,000 million gallons of blood through the 60,000 miles of blood vessels within the human body.

LOCATION:
- In the thoracic cavity (mediastinum).
- Pointing to the left middle thorax (left lung slightly smaller than right).
- Apex of the heart is in the 5th intercostal space.
Heart

LAYERS:

• **Pericardium** - a thin double-layered sac which encloses the heart. Fluid is contained within the layers and lubricates the constantly rubbing surfaces.

• **Epicardium** – contains blood and lymphatic vessels.

• **Myocardium** - cardiac muscle – pumps the heart.

• **Endocardium** – endothelium – a smooth surface for the heart chambers.
Heart – structure & blood flow

CHAMBERS:
• **Right atrium** – pumps deoxygenated blood from the body into the:
• **Right ventricle** - pumps the blood to the lungs (to be oxygenated).
• **Left atrium** - pumps oxygenated blood from the lungs into the:
• **Left ventricle** - pumps the blood around the body (5% of blood goes directly to coronary arteries which supply the heart)

VALVES:
• Tricuspid – 3 valves
• Bicuspid – 1 valve

**NOTE:** ventricle muscles are thicker than atria, the left ventricle is thicker than the right – muscle thickness is related to the force of contraction.
Activity: partner work

1. In your hand-out you will see a diagram of a heart – please label it. You can use your lecture slides and a textbook

2. Complete the flow chart in your hand-out indicating the direction of blood flow through the heart.
CONTROL:

- **AUTORHYTHMIC** - periodic, spontaneous contractions.

1. **Sympathetic nervous system** (involved in stress response: ‘fight or flight’) – increases rate & strength of contraction (& constriction of blood vessels).

2. **Parasympathetic nervous system** (involved in relaxed state: ‘rest & digest’) – decreases rate & strength of contraction (little influence on blood vessels).

- Hormones, age, gender, body position, exercise, stress and temperature all influence heartbeat.

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**aut(o)-** is Greek for self
Heart - contraction

1. SINOATRIAL NODE (SA node) initiates the heart's contraction by creating an electrical impulse which spreads through the walls of the atria causing them to contract.
   - The ‘pace-maker’ of the heart responsible for setting the rate & rhythm.
   - The impulse travels to:

2. ATRIOVENTRICULAR node (AV node) - a ‘relay station’ where the electrical impulse is relayed down conducting tissue called the ATRIOVENTRICULAR BUNDLE (Bundle of His):

3. It branches into the RIGHT BUNDLE BRANCH (RBB) and LEFT BUNDLE BRANCH (LBB) respectively to the bottom of the heart (apex):

4. The impulse travels up through the PURKINJE FIBRES in the ventricles causing them to contract.

5. The cycle repeats.
Electrocardiography (ECG / EKG)

P wave - records the electrical activity of the heart's two upper chambers (atria).
QRS wave – records the electrical activity of the heart's two lower chambers (ventricles).
T wave – records the heart's return to the resting state.

By studying the shape & size of the waves, the time between waves, and the rate & regularity of beating, abnormalities (disease) can be determined.
A blood pressure wave originating from the heart. Varies depending on the stage of life.

<table>
<thead>
<tr>
<th>AGE</th>
<th>PULSE RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>New-born</td>
<td>130</td>
</tr>
<tr>
<td>3 months</td>
<td>140</td>
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<tr>
<td>6 months</td>
<td>130</td>
</tr>
<tr>
<td>1 year</td>
<td>120</td>
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<tr>
<td>2 years</td>
<td>115</td>
</tr>
<tr>
<td>3 years</td>
<td>100</td>
</tr>
<tr>
<td>4 to 6 years</td>
<td>100</td>
</tr>
<tr>
<td>8 years</td>
<td>90</td>
</tr>
<tr>
<td>12 years</td>
<td>85</td>
</tr>
<tr>
<td>Adult</td>
<td>70 to 90</td>
</tr>
</tbody>
</table>

Radial

Carotid
Activity: partner work

Palpate their **carotid**, **radial** and **dorsalis pedis** pulses:

- How strong is it?
- How fast?
- Is it the correct rate for their age?
- Is it regular?
- Is the artery soft and pliable under the fingers?
Volume of blood being pumped out by the heart per minute:

**Output = stroke volume x heart rate**

(average = 5 L/min)

**Systole** - a force that drives blood out of the heart.

**Diastole** - from Greek, dia AND stellein, to set: the normal rhythmically occurring relaxation and dilatation of the heart.

**Tachycardia:** from Greek, tachys, quick, rapid AND kardia, heart.

**Bradycardia:** from Greek, bradys, slow AND kardia, heart.

- **TACHYCARDIA:** (rapid heart rate): resting heart rate >100/min.
- **BRADYCARDIA:** (slow heart rate): resting heart rate < 60-50/min.
Blood pressure

- The pressure exerted by circulating blood on the blood vessel walls.
- Constitutes one of the principal **Vital Signs**.
- The pressure progressively decreases as it moves away from the heart through arteries and then back toward the heart through veins.

- **Normal BP (UK) = <135/85 mmHg**
- **Vasoconstriction** increases blood pressure.
- **Vasodilation** causes it to fall.
- Highest priority for blood supply is to the **brain & heart**.

Activity: partner work

Using a **stethoscope** & **sphygmomanometer** check your partner’s blood pressure.

This may seem a bit tricky and awkward at first, but with practice you will become comfortable doing it – try it on your friends and family too.

**NOTE:** don’t test the blood pressure on the same arm more than once within a few minutes.
Cholesterol

- Cholesterol is in every cell of the body.
- It is essential for the health of all cells, many hormones & vitamin D.
- Some is obtained from the diet, & much is made by the liver.
- Cholesterol is vital but when you have too much, you may develop fatty deposits in your blood vessels (atheroma / atherosclerosis) which can increase your risk of heart disease.
- Because cholesterol is a lipid (hydrophobic) it needs to be transported around the body – lipoproteins is how it is transported.
- Lipoproteins are synthesised by the liver.

Atherosclerosis; from Greek, athere, meal AND sklerosis, hardening.
hydr(o)-; Greek, water, phob(ia)-; Greek, aversion to.
-oma; Greek for tumour or mass
Cholesterol - lipoproteins

TYPES:

Low density lipoproteins (LDL)
- Carry cholesterol from the liver to cells of the body.
- Sometimes referred to as “bad cholesterol” because this is the kind that can deposit in the arteries.

High density lipoproteins (HDL)
- Collects cholesterol from the cells to the liver.
- Sometimes referred to as the “good cholesterol”.

READINGS (recommended):
- Total cholesterol less than 9.0 mmol/litre.
- Non-HDL cholesterol less than 7.5 mmol/litre.
- Triglycerides less than 4.5 mmol/litre.
Cardiovascular system - homeostasis

The heart and blood vessels service the whole body, delivering nutrients & hormones, removing waste and distributing heat.

Skin:
- Blood delivers clotting factors and white blood cells to aid repair when the skin is injured.
- Changes in blood flow to the skin is used to adjust body temperature.

Skeletal system:
- Blood delivers bone minerals & hormones to control bone remodelling and RBC production (erythropoietin) to the bone.

Muscular system:
- Blood transports heat and lactic acid from the muscles.
Cardiovascular system - homeostasis

Endocrine system:
• Blood delivers hormones to their target tissues.

Lymphatic/Immune system:
• Blood distributes immune cells around the body.

Respiratory system:
• Blood transports oxygen from the lungs to the tissues and return carbon dioxide from the tissues to the lungs for exhalation.

Digestive system:
• Blood carries absorbed nutrients to the liver.
• Blood distributes hormones that aid digestion.

Urinary system:
• 20% of the (resting) cardiac output goes to the kidneys for filtering.

Reproductive system:
• Vasodilatation of arterioles in the penis and clitoris during sexual intercourse.
• Blood distributes reproductive hormones.
Pathologies – high cholesterol

Known as hypercholesterolaemia.

CAUSES / RISKS:
Hereditary, age, hypertension, diabetes, obesity, smoking, sedentary lifestyle, diet, excessive alcohol.

ALLOPATHIC DRUG TREATMENT:
Statins (side effects: insomnia, dizziness, fatigue, headaches, liver damage, gastrointestinal effects, muscle aches & more).

ALTERNATIVE TREATMENT: diet & lifestyle essential! Nutrition (fibre, EFAs, B₃), herbs (hawthorn, globe artichoke, garlic), exercise. Determine the cause! The body elevates cholesterol for a reason.

Hyper-; Greek, denotes something as beyond normal
aemia; from Greek, blood.
Pathologies – arteriosclerosis

A group of diseases whereby the **artery walls** have **thickened & elasticity lost** (**hardening**). Progressive degeneration of arterial walls increasing blood pressure & pulse pressure.

**Atherosclerosis**
A kind of arteriosclerosis. Atherosclerotic plaque forms in the walls in arteries. Can affect all large and medium-sized arteries (including the coronary, carotid, and cerebral arteries, the aorta, and major arteries of the extremities). It is the leading cause of morbidity and mortality in the US and in most developed countries.

**PATHOPHYSIOLOGY:**
Damage to a blood vessel wall causes inflammation in the area – increased permeability and migration of phagocytes. LDL builds up in the area (if LDL levels are elevated more LDL can accumulate), and lipids & proteins oxidise and bind to sugars. A cap is formed over the atherosclerotic plaque to wall off the plaque from the blood.

http://www.clinchem.org/
Pathologies – atherosclerosis

Atherosclerosis

CAUSES / RISKS:
Hereditary, gender, age, hypertension, diabetes, obesity, smoking, stress, sedentary lifestyle, diet, excessive alcohol.

COMPLICATIONS:
• Thrombosis - intravascular blood clot remaining in the place where it is formed.
• Embolism – an embolus (mobile blood clot) travels through the blood and causes a blockage.
• Haemorrhage – due to calcified plaques, brittle, rigid arteries.

SIGNS & SYMPTOMS:
• Angina pectoris - ischaemic heart pain (from thrombosis & embolism).
• Intermittent claudication - ischaemic lower limb pain (from thrombosis).
• Stroke (from thrombosis, embolism & haemorrhage).

Thrombosis; from Greek thrombo, blood clot AND osis, condition
Embolism; from Greek, embolos, plug.

Haemorrhage; from Latin, haima, blood, AND rhēgnymi, to burst forth.
Pathologies – atherosclerosis

Atherosclerosis

COMPLICATIONS:
Gangrene, senile dementia, stroke.

ALLOPATHIC DRUG TREATMENT:
Surgery – stents, statins.

ALTERNATIVE TREATMENT:
Reduce cholesterol (if indicated), antioxidants! Diet & lifestyle essential! Nutrition – high in antioxidants, fruit, vegetables, non-animal foods, EFAs, Vit. E, herbs (motherwort, garlic, globe artichoke), exercise.
Pathologies – angina pectoris

Ischaemic heart disease due to obstruction or spasm of the coronary arteries. NOT a cardiac arrest (arrested heartbeat).
NOT a heart attack (myocardial infarction), but angina may precede a MI.

CAUSES:

Ischaemia; from Greek Isch, restriction AND emia, blood.
Myocardial infarction; from Greek, mys, muscle AND kardia, heart, Latin, infarcire, to stuff.

Triggered by physical exercise.

SIGNS & SYMPTOMS:

Heavy, tight or gripping chest pains - centrally / retro-sternally which eases on rest.
Dyspnoea. Dyspnoea; from Greek dys, bad AND pnoē, breathing
Often pain in the arm & jaw.

ALLOPATHIC DRUG TREATMENT:

Nitro-glycerine – sublingually.

ALTERNATIVE TREATMENT:

Nutrition & herbs to thin blood – EFAs, Vit. E, turmeric, ginkgo, garlic, cayenne, motherwort for heart support, homeopathy, ozone therapy, exercise.
Pathologies – stroke

- Also known as a cerebrovascular accident.
- Infarction (tissue death due to lack of oxygen-rich blood) of brain tissue by occlusion or rupture of blood vessel/s.
- 4 minutes of ischaemia causes irreversible cell damage.

CAUSES:
Thrombus/embolus: ISCHAEMIC stroke - 80% of strokes.
Rupture of blood vessel (aneurysm) causing brain damage: HAEMORRHAGIC stroke - 20% of strokes with a 50% death rate.

RISK:
Hypertension
Atherosclerosis

SIGNS & SYMPTOMS:
Sudden weakness, numbness or tingling, loss of speech or comprehension, confusion, loss of vision, sudden severe headaches, unsteadiness

Pathologies – stroke

DIAGNOSIS:
CT scan, MRI scan.

TREATMENT:
Hospital, reduce inflammation, increase collateral circulation.

ALTERNATIVE SUPPORT:
Nutrition & herbs to thin blood – EFAs, Vit. E, turmeric, ginkgo, garlic, cayenne, homeopathy, ozone therapy, exercise.

PROGNOSIS:
Depends on severity & location: death, paralysis, transient problems.
Pathologies – mini stroke

- Also known as a transient ischaemic attack (TIA)
- Temporary reduction of blood flow.
- Can be warning sign for a full blown stroke.

CAUSES:
Micro-embolism.

RISK:
Hypertension
Atherosclerosis

SIGNS & SYMPTOMS:
Transient impaired functions resolves with 24 hours.
Depends on area of brain affected.

<table>
<thead>
<tr>
<th>Signs of a Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face, Arm, or Leg</td>
</tr>
<tr>
<td>numbness or</td>
</tr>
<tr>
<td>weakness (mainly</td>
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<tr>
<td>on one side of</td>
</tr>
<tr>
<td>the body)</td>
</tr>
<tr>
<td>Brain</td>
</tr>
<tr>
<td>confusion, trouble talking</td>
</tr>
<tr>
<td>or understanding speech,</td>
</tr>
<tr>
<td>dizziness, loss of balance,</td>
</tr>
<tr>
<td>bad headache</td>
</tr>
<tr>
<td>Eyes</td>
</tr>
<tr>
<td>trouble seeing in one or both eyes</td>
</tr>
<tr>
<td>Stomach</td>
</tr>
<tr>
<td>throwing up (or urge to)</td>
</tr>
<tr>
<td>Body</td>
</tr>
<tr>
<td>feel tired</td>
</tr>
<tr>
<td>Legs</td>
</tr>
<tr>
<td>trouble walking</td>
</tr>
</tbody>
</table>

Pathologies – aneurysm

Abnormal local dilations of arteries due to weakness of the vessel wall.

**SIGNS & SYMPTOMS:**

**Aortic:** asymptomatic, but if it bursts, it’s extremely dangerous and usually fatal. Around 8 out of 10 people with a ruptured abdominal aortic aneurysm (AAA) either die before they reach hospital or don’t survive surgery.

**DIAGNOSIS:**

Ultrasound.

**ALLOPATHIC DRUG TREATMENT:**

Depends on size / severity. Monitored.

**ALTERNATIVE SUPPORT:**

Connective tissue support – herbs & nutrition – Vit. C, Vit. E, EFAs.

**COMPLICATIONS:**

- Rupture & haemorrhage, micro-aneurysms can cause reoccurring small strokes.
- Thrombosis and embolism from damaged endothelium.

Aneurysm; from Greek, aneurysma, widening.
Thrombus forms in a DEEP vein.

CAUSES:
Micro-embolism.

RISKS:
Reduced blood flow (immobility, pressure on vein by tumour, shock, long-haul flights), changes in blood (dehydration, polycythemia, sticky platelets, oral contraceptive pill), damage to blood vessel wall.

SIGNS & SYMPTOMS:
May be accompanied by PAIN (heavy ache / tenderness to touch) and swelling of lower limb, but usually ASYMPTOMATIC (because it’s deeper).

TREATMENT (Rx):
Complete REST! (exercise only to prevent), refer to hospital (blood thinners).

ALTERNATIVE SUPPORT:
Thin the blood: EFAs & Vit. E, turmeric, ginkgo, garlic, hydration (good preventatives), homeopathy.
Pathologies – deep vein thrombosis (DVT)

COMPLICATIONS:
Pulmonary embolism.

Thrombophlebitis: superficial vein thrombosis.

SIGNS & SYMPTOMS:
Hard, red, painful area above superficial vein. Vein may be palpable.
Pathologies – varicose veins

Incompetent valves cause pooling of the venous blood & chronically dilated veins.

SIGNS & SYMPTOMS ($S_x$):
Aching & fatigue of legs, distended blue veins.

TREATMENT ($R_x$):
Compression, hydrotherapy, herbs (horse-chestnut), homeopathy (aesculus, hamamelis), exercise, elevation of legs daily.

COMPLICATIONS:
Haemorrhage, varicose ulcers.
Pathologies – haemorrhoids

Swelling & inflammation of veins in the rectum and anus.

CAUSES:
Straining during bowel movements (chronic constipation)
Hypertension (portal hypertension)
Obesity
Pregnancy & parturition.

SIGNS & SYMPTOMS:
May be asymptomatic.
Bright, red blood on faeces / toilet paper.
Protruding haemorrhoids causing pain & itching

TREATMENT (Rx):
Surgery.

ALTERNATIVE SUPPORT:
Herbs (horse-chestnut), exercise, homeopathy (aesculus, hamamelis),

http://haemorrhoids.ca/
Pathologies – scrotal varicocele

A varicocele is an enlargement of the veins in the scrotum.

CAUSES:
• Idiopathic (no known cause) - venous valves along the spermatic cord don't work properly.
• Secondary - compression of the venous drainage of the testicle. A pelvic or abdominal malignancy may be suspected when it is newly diagnosed in a patient older than 40 years old.

SIGNS & SYMPTOMS:
Dragging & aching pain in the scrotum, heaviness in the testicle(s), atrophy of the testicle(s), visible / palpable enlarged vein.

TREATMENT ($R_\alpha$):
Cause. Herbs (horse-chestnut).

COMPLICATIONS:
Infertility (increase in temperature), testicular atrophy.
Pathologies – oesophageal varices

Varicose veins of the Oesophagus.

CAUSES:
- Portal hypertension (liver cirrhosis)
- Right sided heart failure

SIGNS & SYMPTOMS:
Slight bleeding (occult blood in stool)
Anaemia - iron deficiency

TREATMENT (Rx):
Cause.

COMPLICATIONS:
Rupture & bleeding.
Pathologies – Raynaud's syndrome

Intermittent attacks of ischaemia in extremities (peripheral blood vessels). Most common in women 30-40 years old.

CAUSES:
• Extreme temperature
• Emotional stimuli

SIGNS & SYMPTOMS:
Vaso-spasming causes painful, pale, cold extremities.

TREATMENT (Rx):
Minimise stress, exercise regularly, keep warm, stop smoking, herbs – ginger, capsicum (chilli, pepper), homeopathy, acupuncture.
Pathologies – oedema

Excess tissue fluid build-up causing swelling.

CAUSES:
Increased venous hydrostatic pressure resulting from: heart failure; kidney disease; external pressure on limb, impaired lymphatic drainage, increased small vessel permeability, pregnancy, injury, some medications.

SIGNS & SYMPTOMS:
Skin discolouration, hold an imprint (known as pitting oedema), aching, tender limbs, stiff joints, raised blood pressure & pulse rate.

TREATMENT (Rx):
Treat the cause. Exercise, lose weight (if overweight), raise legs, avoid standing for long periods of time, lymphatic drainage, massage, herbs (nettle root, dandelion leaf).
Pathologies – ascites

Accumulation of fluid in the peritoneum in the abdominal cavity.

CAUSES - some include:
• Cirrhosis (81%)
• Heart failure
• Constrictive pericarditis (thickened, fibrotic pericardium that restricts heart expansion)
• Cancer
• Tuberculosis

SIGNS & SYMPTOMS:
May be asymptomatic, abdominal pain and bloating, shortness of breath.

TREATMENT (Rₓ):
Teat cause. No alcohol & salt. Diuretics may be implicated – herbs, homeopathy.
Pathologies – hypertension

High blood pressure (UK) – 135/85mmHg or higher (in the past was higher & has steadily been reduced).

TYPES:
**Essential (primary)** – over 90% of cases.
**Secondary** – as a result of: kidney damage (damaged kidneys release vasoconstrictors), hormones (adrenal, thyroid).

CAUSES:
Inherited tendency, obesity, excessive alcohol intake, smoking, lack of exercise.

SIGNS & SYMPTOMS: usually asymptomatic.

TREATMENT (R\textsubscript{x}):
Diet, exercise & lifestyle are essential. Lose weight (if overweight), avoid salt, avoid caffeine, regular exercise, reduce stress, herbs – hawthorn, mistletoe, dandelion leaf, olive leaf, massage, acupuncture, magnesium (as a mineral salt), Vit C., B\textsubscript{6}, B\textsubscript{9}, B\textsubscript{12} (to lower homocysteine).
COMPLICATIONS:
Cardiovascular events, chronic kidney disease (CKD), cognitive decline, premature death, retinal bleeding, cerebral oedema, renal disease, aneurysm, heart failure (left ventricle failure - blood pools in the lungs as it has nowhere to go back to; right ventricle failure - blood pools in the tissues / body as it has nowhere to go back to), stroke.
Pathologies – hypotension

Low blood pressure - < 90/60mmHg.
Leads to inadequate blood supply to the brain.

TYPES:
Postural hypotension syncope is fainting on standing up too quickly due to delayed response of the baroreceptors to the change in blood pressure on standing.

CAUSES:
• Shock
• Long-term adrenal fatigue

SIGNS & SYMPTOMS:
Unsteadiness, dizziness, light-headedness or fainting.

TREATMENT ($R_X$):
Not usually required. Hydration, ensure sufficient salt intake (in the mineral forms such as Himalayan salt – not processed!), smaller meals more often, dry skin brushing, treat for adrenal fatigue if indicated (herbs, nutrition, rest).
Pathologies – heart failure

The heart fails to pump sufficient blood around the body at the right pressure.

TYPES:
**Acute** - sudden decrease in output of blood from the heart.
**Chronic** - develops gradually. Heart muscle has become too weak or stiff to work properly.

CAUSES:
**Acute** - ischaemic damage to heart from atheroma / thrombosis, pulmonary embolism, rupture of heart chamber or valve, acute toxic myocarditis.
**Chronic** - chronic hypertension, valve disease, lung disease, degenerative changes (lack of exercise), smoking, obesity.

SIGNS & SYMPTOMS:
**Acute** - chest pain (pressed / squeezed), pain (can radiate to the jaw, neck, arms and back, shortness of breath, weak, lightheaded, overwhelming feeling of anxiety, a medical emergency.
**Chronic** - may be asymptomatic. An enlarged cardiac muscle, water & salt retention (to increase blood volume), vasoconstriction (to increase blood volume).
# Pathologies – heart failure

## SIGNS & SYMPTOMS:
### Chronic:

<table>
<thead>
<tr>
<th><strong>RIGHT SIDED FAILURE</strong></th>
<th><strong>LEFT SIDED FAILURE</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>CAUSE</strong></td>
<td><strong>SIGNS &amp; SYMPTOMS</strong></td>
</tr>
<tr>
<td>• Increased vascular resistance in the lungs (lung disease)</td>
<td>• Systemic oedema, Ascites Portal hypertension / oesophageal varices</td>
</tr>
<tr>
<td>• Back pressure from the left side of the heart (e.g. valve problems)</td>
<td>• Pulmonary oedema, Congestion bronchitis, Cardiac asthma</td>
</tr>
<tr>
<td>• Previous heart attack</td>
<td>(often most severe at NIGHT)</td>
</tr>
<tr>
<td>• High blood pressure</td>
<td><strong>CAUSE</strong></td>
</tr>
<tr>
<td>• Myocardial weakness</td>
<td><strong>SIGNS &amp; SYMPTOMS</strong></td>
</tr>
<tr>
<td>• Valve problems</td>
<td>• Pulmonary oedema, Ascites Portal hypertension / oesophageal varices</td>
</tr>
</tbody>
</table>

Pathologies – heart failure

ALLOPATHIC TREATMENT (Rx):

**Acute** - medical emergency! No drinking, sitting position, nitro-glycerine sublingually, cardio pulmonary resuscitation (CPR), 100 mg aspirin, periodic forceful coughs by patient.

**Chronic** - depends on the cause - lifestyle changes, drugs, devices or surgery.

ALTERNATIVE SUPPORT:

**Chronic** - diet, exercise & lifestyle are essential. Lose weight (if overweight), reduce salt intake, regular exercise, herbs – hawthorn, massage, EFAs & Vit. E, Vit. C, turmeric, ginkgo, garlic, hydration.
Pathologies – heart valves

**STENOSIS:**
Narrowing of a heart valve opening - usually affects the mitral valve.
Causes a heart murmur.

**INCOMPETENCE:**
Causes regurgitation into the previous chamber

**CAUSES:**
Congenital, infection causing endocarditis & scarring of the valve e.g. rheumatic fever, diphtheria.

**TREATMENT (both):** Treat cause. Valve repair, treat infection.
Pathologies – heart attack

Also know as **MYOCARDIAL INFARCTION (MI)**.

**PATHOPHYSIOLOGY:**
Occlusion / blockage of the blood supply to the heart, resulting in HYPOXIA, then tissue NECROSIS.

**CAUSES:**
Atherosclerosis or embolism.

**SIGNS & SYMPTOMS (Sx):**
Severe chest pain >20 mins which does NOT improve on rest, dyspnoea, syncope, fatigue, pale & clammy skin.

Greek, mys, muscle AND kardia, heart AND Latin, infarcire, to stuff
Hypoxia; from Greek, hypo, low AND oxys, oxygen, genein, to produce
Necr(o)- Greek, death
Pathologies – arrhythmias

Any disorder of heart rate / rhythm.

BRADYCARDIA: rate below 60
Physiological: athletes
Pathological: after infarction (myocardial / cerebral) or with intracranial pressure

TACHYCARDIA: rate over 100

FIBRILLATION: irregular rhythm and force
Inadequate blood supply.

Tachycardia; from Greek, tachys, quick, rapid AND kardia, heart.
Bradycardia; from Greek, bradys, slow AND kardia, heart.
Pathologies – arrhythmias

Heart block
• Electrical pulses that control the heart rate are disrupted, causing the heart to beat more slowly – the SA Node becomes diseased or damaged and the AV Node takes over.
• The AV Node beats at 40-60 beats a minute and is less capable of increasing heart rate in response to exercise, drugs, fever (NOTE: below 35-40 beats a minute for a prolonged period blood flow to vital organs is insufficient).
Pathologies – arrhythmias

Atrial Fibrillation

- The most common cardiac arrhythmia.
- Quivering / uncoordinated, rapid, small, local atrial contractions.
- Clinical observations: heartbeats don't occur at regular intervals or the absence of P waves on an ECG.
- Not life-threatening but may result in palpitations, fainting, chest pain or finally congestive heart failure. Significantly increases the risk of stroke because blood may pool & form clots in the poorly contracting atria.
Pathologies – arrhythmias

Cardiac arrest
• Conduction arrest (not a heart attack, but may cause a heart attack).
• Occurs when the heart develops an arrhythmia causing it to stop.
• It is a MEDICAL EMERGENCY.

TREATMENT: CPR to provide circulatory support until availability of defibrillation (application of an electric current, via paddles, to reset the electrical impulses running through the auto-rhythmic cells).
Pathologies – endocarditis

An inflammation of the **inner layer** of the **heart** and valves. Mostly in those with heart defects.

**CAUSES:**
Infection.

**SIGNS & SYMPTOMS:**
Fever / chills, paleness, heart murmur, fatigue, aching muscles & joints, night sweats, dyspnoea, persistent cough, swelling in your feet, legs / abdomen, weight loss, blood in urine, tenderness in spleen, microbes in the bloodstream, Osler's nodes (red, tender spots under the skin of the fingers), petechiae (tiny, purple / red spots on the skin, inside the mouth / whites of the eyes).

**TREATMENT:** intravenous antibiotics.

**ALTERNATIVE SUPPORT:** Herbs & nutrition – antimicrobials, immune support.

**COMPLICATIONS:**
Septic embolus causing stroke or damage to other organs, if untreated it can become fatal – permanent damage to heart valves and inner lining leading to the heart having to work harder to pump blood, eventually causing heart failure.

http://www.medindia.net/
Pathologies – pericarditis

An inflammation of the **pericardium**. Mostly in those with heart defects.

**CAUSES:**
Complication of infection, secondary to another health disorder e.g. tuberculosis, cancer, autoimmune (inflammation), secondary to a heart attack, systemic inflammatory condition e.g. lupus, rheumatoid arthritis (RA), trauma.

**SIGNS & SYMPTOMS:**
Chest pain (radiating to the back and relieved by sitting up & forward and worsened by lying down or breathing deeply), dyspnoea when reclining, low-grade fever, weakness, fatigue & feeling nauseous, dry cough, oedema (abdominal / leg).

**TREATMENT:**
Rest, NSAIDs, antibiotics if infection is the cause. In severe cases surgical fluid drainage from the pericardium.

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Pericardium; from Greek, peri, around AND kardia, heart.
Oedema; from Greek oidêma, a swelling.
Dyspnoea; from Greek dys, bad AND pnoē, breathing.

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Pathologies – pericarditis


COMPLICATIONS:
1. Constrictive pericarditis: permanent thickening, scarring & contracture of the pericardium, losing its elasticity & functionality.
2. Cardiac tamponade / pericardial effusion: fluid collects in the pericardium, putting pressure on the heart (increased intra-pericardial pressure) & inhibiting it from filling completely.
Pathologies – shock

A reduction in circulating blood volume, blood pressure and cardiac output, resulting in hypoxia of the tissues.

TYPES:

1. **Hypovolaemic shock**: blood volume is reduced by 15-25%. May be BLOOD or LIQUID loss due to haemorrhage, severe burn (loss of serum), vomiting, diarrhoea (loss of water and electrolytes), organ perforation – bleeding into a cavity.

2. **Cardiogenic shock**: heart muscle can’t maintain cardiac output - acute heart disease (e.g. MI).

3. **Septic shock**: infection causes an immune & inflammatory response causing vasodilatation & pooling of blood.

4. **Neurogenic shock**: loss of sympathetic control on blood vessels & increased parasympathetic stimulation of the heart – leads to dilation of blood vessels & bradycardia. This causes reduced cardiac output, blood pooling and fainting.

5. **Anaphylactic shock**: severe allergic response causing vasodilatation, bronchostriction, reduced venous return, reduced cardiac output & tissue hypoxia.
Pathologies – shock

SIGNs & SYMPTOMs:
Hypoxia; from Greek, hypo, low AND oxys, sharp, genein, to produce.
Hypoxia – cold, clammy, sweating, cyanosis (pale, blue skin & lips), faint, weak, drowsy, confusion, anxiety, tachycardia, weak pulse, shallow, rapid breathing, hypotension.

PHYSIOLOGICAL CHANGES:
The body attempts to counteract shock by: vasoconstriction, increased heart rate, water retention. If these are insufficient the following occurs: anaerobic respiration, lactic acid build up, acidosis, cellular damage / death.

TREATMENT:
A medical emergency! Lay the person flat, raise their legs (>25cm) to help restore blood pressure, stop any bleeding by applying direct pressure over the wound, or a tourniquet on extreme limb injuries, administer anaphylaxis treatment if necessary / available, loosen tight clothing, keep them warm with layers of blankets (not a hot water bottle), don't give them anything to eat or drink (vomiting).
Pathologies – chest pain

Differential diagnoses (DD\textsubscript{x}):

- Heart disease - angina, myocardial infarction
- Pericarditis
- Pulmonary embolism
- Oesophageal disease
- Pneumonia
- Pneumothorax
- Pleurisy

CLINICAL EXAMINATION:
Vital signs: temperature, pulse, blood pressure, respiratory rate, cyanosis, clubbing of nails, heart rhythm.
Activity 2

- Complete the **Cardiovascular Revision Quiz 2**.

- Complete **Cardiovascular System Quick Questions 2**.
ACTIVITY

Have a look at the **glossary** for the for this topic (on the student website).

Please also look at the **prefixes & suffixes** to help you understand the medical terminology used in this lecture.