

Embryology, cardiovascular, CNS

Embryonic period: first 8 week after fertilisation, 8-40 week is fetal period

- **Fertilisation:** fusion of haploid gametes - diplota zygote
- **Cleavage division:** Division without growth in size, up to 32 cell stage. Compaction at 16 cell stage
- **Blastomeres:** Cell specification into Trophoblasts and Inner Cell Mass (ICM).
- **Blastocyst:** Importing of Na ions into the center, water move in via osmosis - form blastocoel, structure become blastocyst
- **Implantation:** Trophoblast divide into syncytiotrophoblast and cytotrophoblast, syncytiotrophoblast invades the uterus lining, form blood filled lacunae,
- Hypoblast form yolk sac, epiblast form amnionic sac.
- Hypoblast secrete reticulum, material separating ICM from trophoblasts, form chorionic cavity. In mice and birds, mesoderm from gastrulation move into reticulum, extraembryonic mesoderm, give rise to placenta.
- Coelom form in the extraembryonic reticulum, surround the embryo, embryo connect to trophoblast via connecting stalk.

Gastrulation (Day 14)

- Ingression of epiblast on the bilaminar disc primitive streak, give rise to ecto/meso/endo dermal layers
- All three layers are formed from the ingressed cells of the epiblast, mesoderm migrate lateral-cranial, with midline mesoderm forming notochord from primitive node.
 - Two point of direct ecto/endoderm contact: rostral buccopharyngeal membrane, caudal cloacal membrane

Neurulation (day 18)

- Rostrally migrating mesoderm form notochord, induction of neuroectoderm, form neural plate
- Squamous - columnar cells, lateral cell rises, form neural fold, zippering of neural fold form the hindbrain, closing of rostral and caudal neuropore at D24 and D26.
- Somite formation 4-6 hours/pair (Form dermatome, myotome, sclerotome)

Ectoderm:

- Form outer skin tissue, and neural crests.
 - Neural crest cells migrate to form ganglions, myelin, adrenal glands, melanocytes, skull bones and heart tissues.

Mesoderm: (axial, paraxial(somite), intermediate, lateral (splanchnic somatic))

- Muscles and bones, kidneys and gonads, heart and blood vessel, smooth muscles.

Endoderm:

- Endothelium of digestive tracts, blood vessels. Gut derivative e.g. lungs, liver, pancreas, bladder

Abdominothoracic cavity formed by lateral plate mesoderm. Later divided by diaphragm.

Circulatory system

65% of blood in venus system, 30% in artery, 5% in capillary

Arteries: Thick elastic smooth muscle layer, no valve, high pressure oxygenated blood

Veins: Thin muscle wall, less elastic, valves, low pressure deoxygenated blood

Anastomosis: paired arteries/paired veins without capillary bed between, found at joints, keep oxygen supply at all times

End artery: Arteries that do not form anastomosis. E.g. retinal artery, renal and splanchnic artery.

Functional end artery: Can form anastomosis, but takes time to adjust e.g. coronary artery.

AORTA and major arteries:

Aortic arch (proximal - distal): Coronary, R brachiocephalic artery, right common carotid, right subclavian

• Paired:

- Carotid (Head)
- Subclavian (Arms, anterior wall)
- 9 pairs of thoracic posterior intercostal artery
- Renal (Kidneys)
- 4 pairs of lumbar segmental
- Gonadal
- Common Iliac (leg)

• Unpaired

- Coeliac trunk(Foregut, stomach, liver, pancreas, spleen)
- Superior Mesenteric (midgut)
- Inferior Mesenteric (Hindgut)

VEINS

- Most veins paired with arteries
- Capillary above the diaphragm drains into SVC, below the diaphragm drains into IVC.
- Unpaired hepatic portal vein drains deoxy blood from gut into the liver.
- External jugular vein drains blood from the head supplied by carotid artery, into subclavian veins
- Internal jugular vein drains straight into brachiocephalic vein

LYMPH

- Lymph enter lymph vessel from interstitial tissue fluid
- Lymph vessels contain valves, enter lymph node via narrow vessel, leaves via wider vessels.
- Joins the central thoracic duct which drains into the left subclavian vein

Oedema result from blocked lymph vessels

Caput medusa: Liver cirrosis - blocking of hepatic portal vein, redirect deoxygenated blood to the superficial veins.

Elephantiasis: blockage of lymph vessel by parasites

Central Nervous System

Cranial nerves: 12 pairs in total, originate from the cerebrum and brainstem

- CN I, II, VIII are sensory only
- CN III IV VI XI XII are motor only
- CN V VII IX X are mixed

Spinal nerves: 31 pairs originate from spinal cord, innervate body in dermatomes, correspond to somite numbers

- 8 cervical
- 12 Thoracic
- 5 Lumbar
- 5 Sacral
- 1 Coccygeal

- In cervix region SNs are above spinal column, in thorax SNs are below spinal column.

Nerves and the vertebral column:

- Dorsal root - Affarent sensory neurons
- Ventral root - Efferent motor neurons
- Spinal nerve entry/exit via the neuroforamen.
 - Spinal nerve divide upon exit:
 - Posterior ramus: innervate skin and muscle of the back
 - Anterior ramus: innervates skin and muscle of the front + side, and inner linings of the body wall

Plexus is the interwoven mass of nerves, required by arms and legs

- Cervical plexus: C2 - C5
- Brachial plexus C5 - T1
- Lumbar plexus T12 - L4
- Sacral plexus L5 - S4

Sensory and motor function subtype

- Sensory
 - Somatosensory: Muscle and skin
 - Visceral sensory: Organs e.g. bladder, heart, stomach
 - Special sensory: eyes, nose, ears
- Motor
 - Somatomotor: Muscles
 - Visceral motor: involuntary, smooth muscles, action via autonomic nervous system (PARA, SYM, ENS)

Autonomic nervous system

- Sympathetic: T1 - L2
 - Sympathetic ganglion chain on both sides of the vertebrate spanning from T1 - L12, pre ganglionic neurons can extend up to the neck and down to the sacrum within the chain ganglion
 - From the spinal nerve to ganglion chain - grey ramus communicantes.
 - From ganglion chain - spinal nerve - white ramus communicantes, myelinated.
 - short pre-ganglionic neuron, long post-ganglionic neuron

- Splanchnic nerved synapse in collateral ganglions located around lumbar aorta (preaortic ganglia), with synapse closer to the target organs. The splanchnic nerves run with blood vessels to the gut
 - Greater Splanchnic nerve: T5-T9
 - Lesser Splanchnic nerve: T10-T11
 - Least Splanchnic nerve: T12
- Parasympathetic: Cranial nerve 3/7/9/10 and Sacral spinal nerves S2-4.
 - Long pre-ganglionic neuron, close to target, short post-ganglionic neuron.

Autonomic reflex arc: involuntary response to a stimuli in the autonomic system, e.g. sharp pain trigger sympathetic nervous system via interneuron and ganglia synapses.

Referred pain: Both visceral and superficial structures are innervated by the same spinal nerve. Link in the sensory stimulus, pain from internal organs are reflected on the skin of its dermatome.

Embryonic period

Fertilisation - implantation

Gastrulation

Neurulation

Three germ layers

Distribution of blood

Artery connections and endings

Artery and vein characteristics

Major arteries 7 paired 3 unpaired

Aortic arch

Major veins SVC IVC unpaired

Lymphatic system

Conditions related to circulations

Cranial nerves OOOTAFVGVSH

Sensory, motor, mixed

Spinal, arrangement, plexus

SYM PARA characteristic, splanchnic

Referred pain