

TOPIC 1: ANATOMY

Embryology 1

Periods of Human Embryology

- Conceptus: fertilisation to end of 2nd week
- Embryo: beginning of 3rd week to end of 8th week
- Foetus: 3rd month to birth

Step 3. Cleavage

- With each cell division the cell gets smaller: so daughter cells are ½ the size of the cells before them
- Usually, there would be a growth phase of cells to keep them the same size. But cleavage has these unique divisions.

Step 4. Blastocyst

- Two types of cells
 - Outer epithelial layer (**trophoblast**)
 - Inner cell mass (**embryonic stem cells**)
- **Trophoblast** forms the **extraembryonic** structures
 - Part of **placenta**
- Between 5 and 10 days, the blastocyst **implants** into the uterine wall

Two germ layer stage:

- Inner cell mass splits
- Cavities form
- Forming an embryonic disk
- Epiblast—top
- Hypoblast—bottom

Gastrulation

- Begins with the formation of the **primitive streak** which defines all **major body axes**
 - On the upper surface of the bilaminar disk on the **epiblast** a line of thickened cells appear → **primitive streak**
 - The primitive streak **invaginates** to form the **primitive groove**
- Formation of the **three** germ layers: ectoderm, mesoderm, and endoderm
- Gives rise to distinct tissues in the adult

Three layer stage: trilaminar embryo

- Cells of the **epiblast** migrate **medially** and into the **primitive groove**
- The first cells move into the **hypoblast** and make the **embryonic endoderm**

- Later cells move into the space between the **epiblast** and the **endoderm** and becomes the **embryonic mesoderm**
- Cells that are left in the epiblast become the **embryonic ectoderm**

Left right asymmetry

- Nodes are important for setting up left-right asymmetry
- Cilia within a node rotate in one direction
 - Causing leftward fluid flow

Hypotheses for breaking symmetry

- Morphogen hypothesis and Nodal vesicular parcel hypothesis
 - Morphogen hypothesis: signalling molecules are present in the fluid and are pushed along with cells to the left side
 - Once on the left, they meet receptors so that the cells know they are left sided cells
 - Nodal vesicular: same, but the signalling molecules are in vesicles
- **Two cilia hypothesis**
 - Thought to be correct
 - There are cilia on cells at the bottom of the pit and the rim
 - The cilia at the bottom are motile
 - Those on both **sides** of the pit are non-motile, **sensory cilia** and can **detect movement**
 - So cilia on the left sense movement by being bet by the fluid coming from **right to left** → and they know they are **left sided cells**
 - And the cilia on the right do not sense anything, so they know that they are **right sided cells**

Situs invertus

- Organs are mirrored from their normal position
- Only some organs or partial: *situs ambiguus* or heteroaxis
 - This causes more problems because there might not be enough space for the foetus' organs and so it dies
 - **NB:** *situs solitus* is the normal position

Formation of the notochord

- Transient structure
- Cartilage-like
- Important for induction of the neural tube
- It has a cranial midline extension from the **primitive node** to form a **hollow tube**
- The tube grows in length as cells are added from the primitive node
- And the primitive streak regresses
- Primitive streak should disappear
- But sometimes the cells of the primitive streak are retained

- It is the most common tumour in newborns but it is benign and can be corrected by surgery

Formation of neural plate and neural tube

Neural plate

- Induced by notochord
- From cranial to primitive node
- Endodermal cells differentiate into a **thick plate** of pseudostratified, columnar neuroepithelial cells
 - Neuroectoderm

Neural tube

- Formation is called **neurulation**
- Invagination of neural plate: **neural groove**
- Closure

Teratomas from primitive streak

- Primitive streak should disappear
- But sometimes the cells of the primitive streak are retained
- This is the most common tumour in newborns
 - But it is benign and can be corrected by surgery
- Ectodermal cells above the notochord thicken and differentiate
- Extension and folding of the neural plate
- Convergence of the neural folds
- And neural tube closure

Neural crest gives rise to:

- Undergoes EMT
- Dorsal root ganglia
- Enteric ganglia
- Sympathetic and parasympathetic ganglia
- Schwann cells
- Melanocytes
- Face
- Dentine

Segmentation of neural tube

- The neural tube is initially one cell layer thick and hollow
- But then the **cranial end** starts to swell forming **vesicles**
- These vesicles give rise to the brain and the remainder of the spinal cord: CNS

