

Embryology

1. Describe lung development and be able to list & give a brief description of the stages of this development

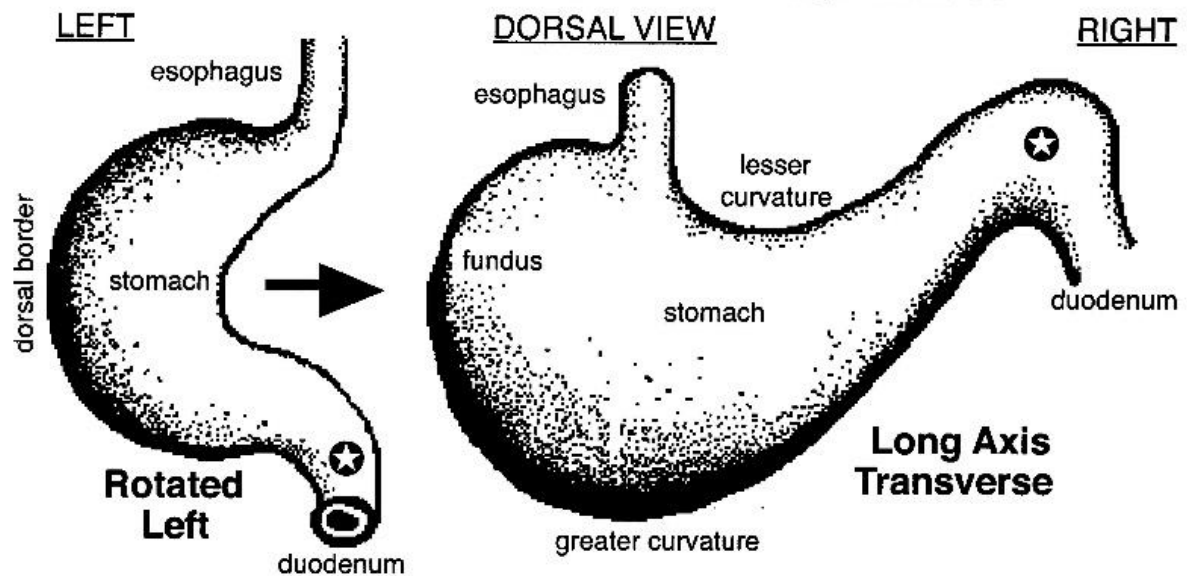
- Endoderm & splanchnic mesoderm form majority of conducting system & alveoli
 - Ectoderm will contribute to the neural innervation (nervous system)
 - Mesoderm also contributes to the supporting musculoskeletal components
- Lung development:
 - Defined at pharyngeal arch stage (3-4wks human gestation)
 - Outgrowth of primitive gut tube between 4th pair of pharyngeal arches, called the laryngotracheal groove (aka respiratory diverticulum)
 - Coincides with a wave of Retinoic Acid production in the ventral mesoderm
 - If RA blocked, lung buds will not form
 - Laryngotracheal tube = endodermal lining (inner) + splanchnic mesoderm (outer)
 - Regional specification = mesenchymal/epithelial interaction:
 - Cervical respiratory epithelium grows straight (tracheal formation)
 - Thoracic respiratory epithelium will branch to form bronchi & alveoli
 - Extends caudally & becomes separated from foregut by formation of two trachea-oesophageal grooves (one LHS, one RHS)
 - Grooves meet & fuse to form the trachea-oesophageal septum
 - Bifurcates to form the two bronchi & lungs
 - Bronchial buds enlarge, induced by FGF10, forming a L & R principle bronchus
 - L bronchus deviates from the midline laterally
 - R bronchi develops 2 secondary lobar bronchi:
 - Cranial
 - Caudal
 - R bronchus deviates to a lesser extent (therefore, more prone to inhalation infections)
 - R bronchi develops 4 secondary lobar bronchi:
 - Cranial
 - Middle
 - Accessory
 - Caudal
- 5 phases of prenatal lung development:
 - Embryonic
 - Pseudoglandular (tubule-acinous gland)
 - Development of bronchi, bronchioles & terminal bronchioles
 - Precursors of ciliated epithelium & secretory cells

- First alveoli cells appear
- Amniotic fluid produced
- Canalicular
 - Development of respiratory bronchioles
 - Vascular supply
 - Type II pneumocytes (surfactant production) differentiate into type I pneumocytes (gas exchange)
- Saccular (functional)
 - Development of alveolar ducts
 - Type II pneumocytes begin to secrete surfactant
- Alveolar (fully functional)
 - Development of alveolar sacs
 - Lung tissue continues to develop postnatally (up to 8yrs)
 - Capillaries, lymphatics & innervation completed
 - Foetal to postnatal respiration:
 - Foetal lungs = fluid-filled, not physiologically functional
 - At birth, fluid in upper respiratory tract is expired & fluid in alveoli is rapidly absorbed
 - Lung epithelia change from secretory (foetal) to absorptive (postnatal) function

2. Describe simple gut tube formation from the endoderm and then explain how a simple stomach forms

- Gut tube formation:
 - Folding of embryonic areas creates gut tube & formation of vitello-intestinal tract (yolk sac/gut connection)
 - Epithelium of digestive tract (lining of gut) from endoderm
 - Splanchnic mesoderm gives rise to smooth muscle & connective tissue
 - Closure of body wall results in tube formation with dorsal & ventral mesenteries
 - Ventral mesentery atrophies, forming the peritoneal cavity
 - Although hollow tube initially, many regions close and then reopen
- Simple stomach formation:
 - Two rotations occur:
 - 90° rotation → greater curvature shifts to left
 - Shortly after foregut formed
 - 2nd 90° rotation → caudal end shifts right & cranially
 - Occurs during foetal & postnatal period

SIMPLE STOMACH DEVELOPMENT



3. Describe the three stages of development of the kidneys

- Derived from the intermediate mesoderm (genital ridge)
- Pronephros:
 - Vestigial (degenerates)/non-functional
 - From intermediate mesoderm, form pronephric tubules → form pronephric duct → join to coelomic cavity → form internal glomeruli/tubules of primitive kidney
- Mesonephros:
 - May function transiently in embryonic life
 - End of somite stage, intermediate mesoderm in thoraco-lumbar region forms columns of tissue called the urogenital ridge
 - Later forms medial genital ridge & lateral genital ridge
 - Lateral to urinary ridge, the pronephric duct induces mesonephric tissue to form tubules & renal corpuscles
 - Development of mesonephric system causes pronephric tubules & cranial portion of pronephric duct to atrophy
 - Regression time depends upon species
- Metanephros (stage not present in fish or amphibians)
 - Definitive kidney
 - Form ureteric bud & metanephric blastema at caudal end of nephric ridge, about sacral region
 - Uretic bud extends cranially towards blastema & is surrounded by metanephric tissue
 - Dilated end forms pelvis & collecting ducts of definitive kidney
 - Collecting duct formation induces tissues to form metanephric tubules

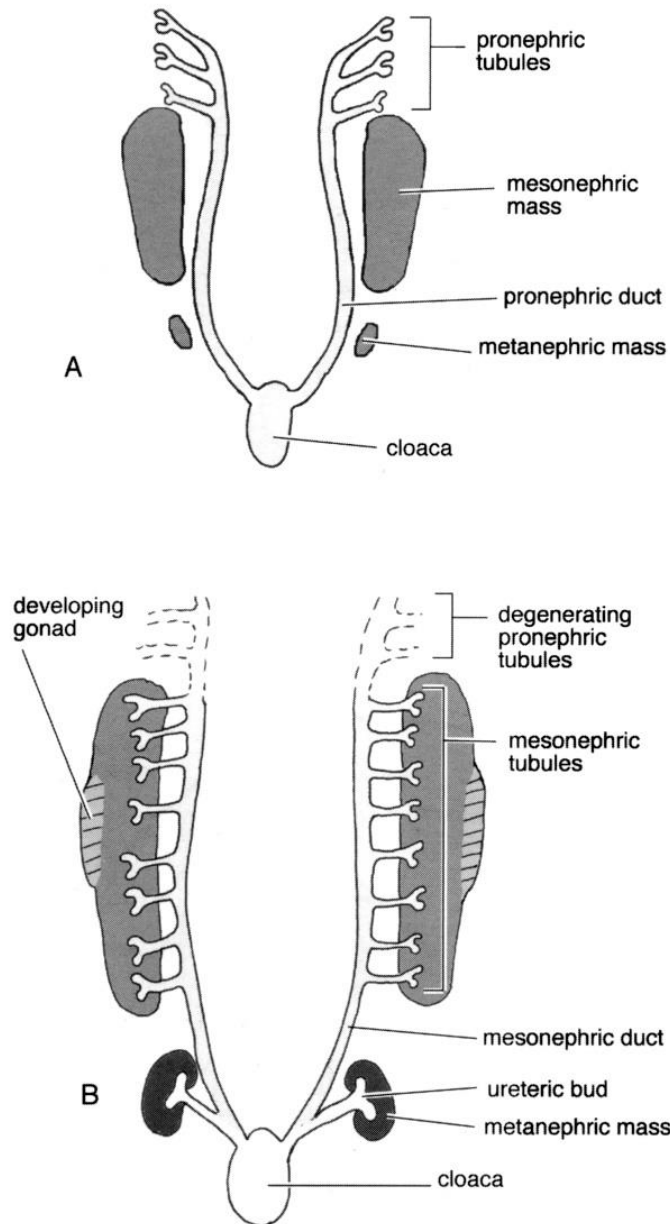


Figure 17.5 Dorsal views of the developing pronephros, mesonephros and metanephros.

4. Describe the development of the reproductive system from the early indifferent stage to development of either male or female gonads

- Primary sex determination, i.e. development of ovaries OR testis
 - Controlled by sex chromosomes (in mammals)
 - Gene directed
 - Both ovaries & testis formed from a common precursor, the bipotential gonad
- Early gonad development:
 - Origin: intermediate mesoderm, adjacent to mesonephric ridge
 - Most ventral aspect: genital ridge (epithelial layer)