



FORMS OF EMBRYONIC PRIMORDIA

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LEARNING OBJECTIVES



- ▶ **To recognise the different forms of embryonic primordia.**
- ▶ **To recognise the different derivatives of each of the different forms of embryonic primordia.**
- ▶ **To appreciate how organ-system development is closely related to understanding each of these Primordia.**

INTRODUCTION



- ▶ **Primordia are those primitive embryonic structures from which various structures of the body develop.**
- ▶ **They are primarily derivatives of the Trilaminar Embryonic Germ Disc layers i.e. Ectoderm, Mesoderm and Endoderm; which are one of the outcomes of Gastrulation**
- ▶ **Some are derived from one or two of the layer of the trilaminar germ disc, while some are derived from all the three layers of the embryonic disc.**

INTRODUCTION Cont'd



- ▶ **They can give rise to one, two or more structures; as the case may be.**
- ▶ **Those with capacity to give rise to multiple structures are described as “Pleuripotent”**
- ▶ **However, they all appear before the end of the second month (before end of the 8th week) post-fertilization**

INTRODUCTION Cont'd



- ▶ **One of the primordia (Somites) are useful in the determination of the *Embryonic Age* before the end of the 8th week post-fertilization.**
- ▶ **Some of these primordia are partitioned into subparts as they transform into various derivatives.**
- ▶ **The transformations are determined primarily by genetic or hormonal factors.**

The Various forms of Embryonic Primordia



- ▶ **TUBES**
- ▶ **BUDS**
- ▶ **PLACODES**
- ▶ **CAVITIES**
- ▶ **DIVERTICULA**

The Various forms Cont'd



- ▶ **CLOACA**
- ▶ **SWELLINGS/FOLDS**
- ▶ **DUCTS**
- ▶ **RIDGES**
- ▶ **SEPTUM TRANSVERSUM**

The Various forms Cont'd



- ▶ **TUBERCLE**
- ▶ **SINUS**
- ▶ **APPARATUS**
- ▶ **NEURAL CREST CELLS**
- ▶ **SOMITES**

AS “TUBES”



- ▶ **GUT TUBE** - Subdivided into Foregut, Midgut and Hind gut; and from it also, arises several embryonic buds.
- ▶ **HEART TUBE** –Derived from the fusion of the endocardial heart tubes
- ▶ **NEURAL TUBE** – Derived as a major outcome of neurulation

AS “BUDS”



- ▶ **Limb bud** –Derived from ectoderm and mesoderm gives rise to structures of the limbs
- ▶ **Dorsal and Ventral Pancreatic buds** – Derived from the foregut and gives rise to the Pancreas
- ▶ **Hepatic bud** – Derived from the foregut and gives rise to the biliary apparatus
- ▶ **Lung Bud** – Derived from the end of the Tracheo-Oesophageal diverticulum and gives rise to the Lungs

NOTES ON THE HEPATIC BUD



- ▶ The embryonic liver originates from the ventral foregut endoderm, which becomes the hepatic diverticulum, the first morphological sign of the embryonic liver.
- ▶ The anterior portion of the hepatic diverticulum gives rise to the liver and intrahepatic biliary tree, whereas the posterior portion forms the gall bladder and the extrahepatic bile ducts.
- ▶ At hepatoblasts delaminate from the anterior portion of the hepatic diverticulum and invade the adjacent septum transversum mesenchyme (STM) to form the **liver bud**

AS “BUDS” Cont’d



- ▶ **Ceacal bud** – Derived from the Mid-Gut and gives rise to the Caecum and Appendix
- ▶ **Ureteric bud** – also known as the metanephrogenic diverticulum, is a protrusion from the mesonephric duct and gives rise to a conduit for urine drainage i.e. Calyx, Collecting duct, Renal Pelvis, and Ureter

AS “PLACODES”



- ▶ Generally, Placodes are embryonic structures with developmental capacity to give rise to structures such as hair follicles, feathers and teeth.
- ▶ Those with capacity to give rise to neurons associated with Special senses and Cranial ganglia are called Nephrogenic Placodes which includes the Cranial placodes.
- ▶ Cranial Placodes are divided into *dorsolateral* placodes and the epibranchial or *epipharyngeal* placodes

The “Dorsolateral Placodes”



- ▶ **Trigeminal Placode** - gives rise to the cells of the Trigeminal ganglion
- ▶ **Otic Placode** - forms the Optic pit and the Otic vesicle giving rise eventually to organs of hearing and equilibrium

The “Epibranchial or Epipharyngeal Placodes”



- ▶ **GENICULATE PLACODE** – associated with the first branchial cleft and gives rise to the geniculate ganglion and distal parts of cranial nerve VII
- ▶ **PETROSSAL PLACODE** - associated with the second branchial cleft and gives rise to the glossopharyngeal ganglion and distal parts of cranial nerve IX.
- ▶ **NODOSAL PLACODE** - associated with the third branchial cleft and gives to the nodose ganglion and distal parts of cranial nerve X

OTHER PLACODES



- ▶ **OLFACTORY (OR NASAL) PLACODE** - gives rise to the olfactory epithelium of the nose
- ▶ **LENS PLACODE** – Influenced by the optic vesicle and gives rise to the lens of the eye.
- ▶ **ADENOHYPHYSAL PLACODE** – gives rise to the anterior lobe of the pituitary gland.
- ▶ **Note that some other Ectodermal Placodes** give rise to structures such as like the mammary gland, teeth and hair.

AS “CAVITIES” –COELOMIC CAVITY



- ▶ A derivative of the lateral plate mesoderm
- ▶ Formation is influenced by Lateral Embryonic folding
- ▶ Partitioned by the thoraco-abdominal diaphragm into Upper thoracic part and Lower abdomino-pelvic part (Peritoneal cavity)
- ▶ The Upper thoracic part is further partitioned into the Pericardial and Pleural cavities by the Pleuro-pericardial folds.

AS “DIVERTICULA”



- ▶ **Tracheo-oesophageal Diverticulum:** - A derivative of foregut that gives rise to the trachea and Oesophagus
- ▶ **Metanephrogenic diverticulum (also known as the Ureteric bud)** -a protrusion from the mesonephric duct and gives rise to a conduit for urine drainage i.e. Calyx, Collecting duct, Renal Pelvis, and Ureter
- ▶ **Hepatic diverticulum** (as described above)

AS “CLOACA”



- ▶ The terminal part of the hindgut ends in the CLOACA, which is an endoderm-lined chamber that contacts the surface ectoderm at the cloacal membrane and communicates with the allantois, which is a membranous sac that extends into the umbilicus alongside the vitelline duct.
- ▶ Partitioned into two –the Urogenital Sinus and Recto-anal canal by the Uro-rectal septum which divides the cloacal membrane into the urogenital and anal membrane parts

The “Cloaca” Cont’d



- ▶ Gives rise to structures of the Urogenital and Digestive system
- ▶ Urogenital Sinus –Give rise to the Urinary bladder, Urethra, parts of the Vagina (in females), Prostate (in males) and genital glands.
- ▶ Recto-anal canal –gives rise to the rectum and anal canal.

AS “SWELLINGS/FOLDS”



- ▶ The Labro-scrotal Swelling gives rise to the Labium Majora (in females) and the Scrotum (in males).
- ▶ The Urogenital folds forms the Labium Minora in females

AS “DUCTS” –the Genital Ducts



- ▶ **Mesonephric Ducts (also known as Wolffian duct)**
 - ▶ **In both male and female** -gives rise to the Urinary trigone of the Urinary bladder, efferent duct
 - ▶ In males, gives rise to the epididymis, vas deferens, seminal vesicle.
 - ▶ In female are its vestiges which include, epoophoron, Skene's gland and Gartner's duct
- ▶ **Paramesonephric Duct** –Gives rise to the Uterus, fallopian tube and part of Vagina

AS “RIDGES”



- ▶ The urogenital system arises from **intermediate mesoderm** which forms a **urogenital ridge** on either side of the aorta.
- ▶ The urogenital ridge develops into three sets of tubular nephric structures (from head to tail): the **pronephros**, the **mesonephros**, and the **metanephros**.
- ▶ The Gonadal or Genital ridge is the precursor of the Gonads (Testis and Ovary)

The “Metanephric blastema”



- ▶ A “renogenic” region within the intermediate mesoderm in the tail of the embryo.
- ▶ Secretes growth factors that induce growth of the **URETERIC BUD** from the caudal portion of the mesonephric duct.
- ▶ Forms:
 - ▶ Podocytes covering glomerular capillaries
 - ▶ Epithelial cells lining Bowman’s capsule

The “Metanephric blastema” Cont’d



- ▶ Proximal convoluted tubules
- ▶ Descending thick limbs of the loops of Henle
- ▶ Thin limbs of the loops of Henle
- ▶ Ascending thick limbs of the loop of Henle
- ▶ Distal convoluted tubules

AS “SEPTUM” –The Septum Transversum



- ▶ The **septum transversum** is a thick mass of cranial mesenchyme, formed in the embryo, that gives rise to parts of the thoracic diaphragm and the ventral mesentery of the foregut in the developed human being
- ▶ Gives rise to:
 - ▶ Central tendon of the Diaphragm
 - ▶ Ventral mesentery of the Foregut from which arise the lesser omentum, visceral peritoneum of liver, and the Falciform ligament.
 - ▶ Cells of the Liver

AS “TUBERCLE”



- ▶ Prominently the genital tubercle which transforms to form the phallus
- ▶ In males, under the metabolite of testosterone, Dihydrotestosterone (DHT), it elongates to form Penis
- ▶ In females with the absence of DHT, the phallus regresses and forms Clitoris

AS “SINUS”



- ▶ Prominently, the Urogenital Sinus as highlighted previously

AS AN “APPARATUS”



- ▶ Prominently the Branchial or Pharyngeal apparatus
- ▶ With component parts that include: Arches, Pouches, Clefts or grooves and Membranes
- ▶ Gives rise to most of the structures of the Head and Neck and as such can be said to be pluripotent
- ▶ Each persisting Arch is innervated by a designated Cranial nerve

THE NEURAL CREST CELLS



- ▶ Pleuripotent with capacity to give rise to several structures
- ▶ Derived from Ectoderm
- ▶ Some derivatives include:
 - ▶ Ganglia
 - ▶ Pigment cells
 - ▶ Meninges

AS “SOMITE”



- ▶ Subdivided in Dermomyotome and Sclerotome
- ▶ Dermomyotome gives rise to dermis of skin and muscles
- ▶ Sclerotome give rise to bones of the vertebral column
- ▶ With the Notochord, gives rise to the intervertebral disc.

REVISION QUESTIONS



- ▶ What are the forms of Embryonic Primordia?
- ▶ What are the derivatives of the different forms of embryonic primordia?
- ▶ Which of the primordia can be classified as pluripotent?
- ▶ Which of the primordia gives rise to one structure only?
- ▶ What influences the differentiation of the Phallus, Mesonephric duct and Paramesonephric duct in males and female?