Chapter 02: Embryogenesis

The Fourth Week of Embryonic Development

Introduction

The fourth week of embryonic development begins on the 21st day, immediately following the third week, which is marked by a fundamental event: **gastrulation**, leading to the formation of the trilaminar disc. This new stage is characterized by major processes such as embryo delimitation, neurulation, and the initiation of organogenesis. Additionally, the feto-placental circulation starts to establish itself, while limb buds gradually appear.

1. Embryo Delimitation

Embryo delimitation refers to its closure and progressive isolation from the extra-embryonic annexes, although it remains attached to the **embryonic pedicle** (future umbilical cord). This delimitation occurs along two axes:

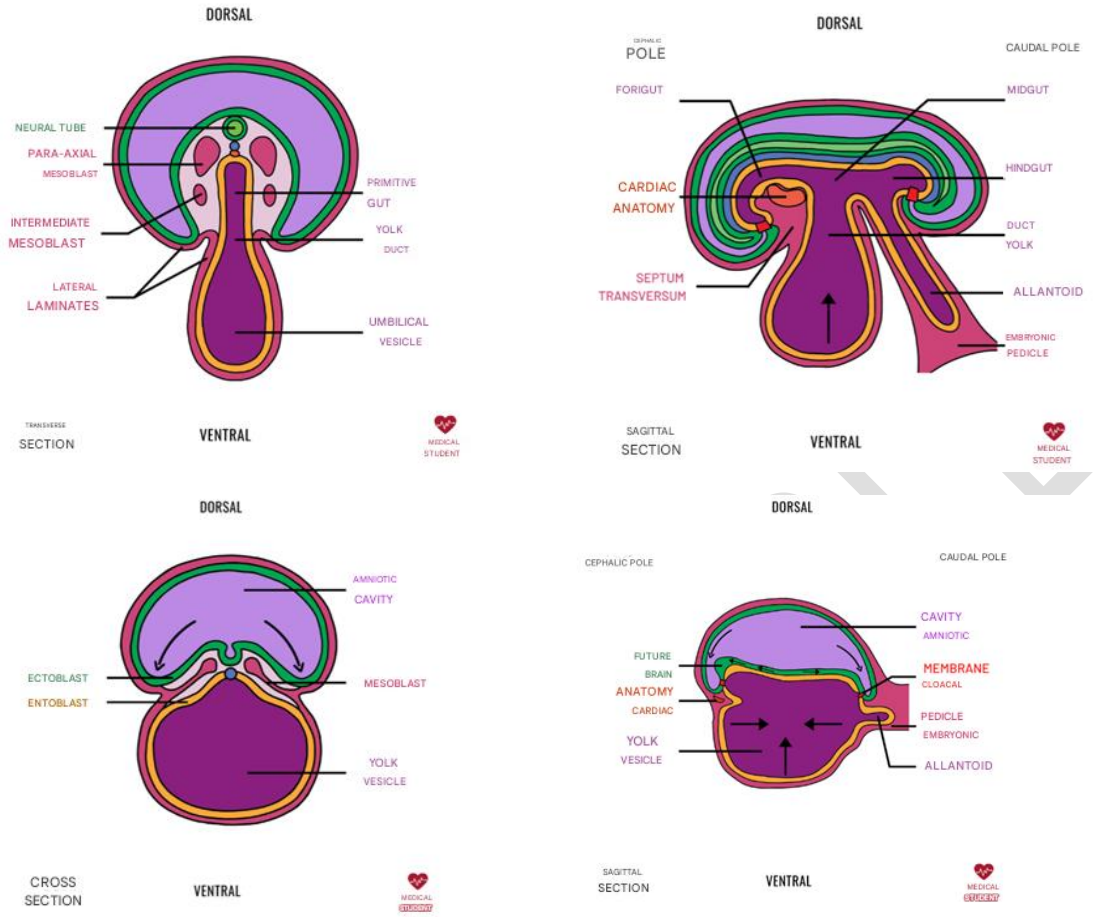
1.1 Longitudinal Delimitation

- The **expansion of the amniotic cavity** causes a fold in the caudal region.
- The order of structures is reversed: the allantois and cloaca move forward of the posterior end of the neural tube.
- The **cephalo-caudal folding** brings the cranial and caudal regions closer together, contributing to the definitive establishment of the embryonic structure.

1.2 Transversal Delimitation

- The rapid growth of the **amniotic cavity**, coupled with the stagnation of the **secondary yolk sac**, exerts pressure on the embryonic structures.
- The **chorionic sphere** develops more slowly, forcing the embryo and its annexes to fold upon themselves.
- The **edges of the embryonic disc** are gradually pushed towards the ventral face of the embryo, where they eventually fuse at the midline.
- The **somatic and splanchnic mesoblast** also fuses at the midline, isolating the **intra-embryonic coelom** from the **extra-embryonic coelom**.

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2. Formation of the Digestive Tube and Umbilical Cord

2.1 Formation of the Digestive Tube

- The **secondary yolk sac** gradually constricts, forming three distinct structures:
  - **The primitive intestine**, originating from the roof of the yolk sac.
  - **The vitelline duct**, a narrow canal crossing the ventral face of the embryo in the umbilical region.
  - **The umbilical vesicle**, a remnant of the primitive structure.
- The rotation of the cranial region, caused by the **rapid growth of the neuroectoderm**, results in a 180° tilt around the **septum transversum**, positioning the digestive structures correctly.

2.2 Formation of the Umbilical Cord

- The **expansion of the amniotic cavity** pushes the **extra-embryonic mesenchyme**, progressively erasing the extra-embryonic coelom.

- The **embryonic pedicle** is gradually moved towards the umbilical region.
- This constriction leads to the formation of the **umbilical cord**, which contains:
    - The **vitelline duct**.
    - The **allantoic duct**.
    - The **vessels connecting the embryo to the chorionic sphere**.

3. Neurulation and Organogenesis

3.1 Neurulation

- This process continues with the closure of the **neural tube**, initiated during the third week.
- The rapid growth of neural structures influences the morphogenesis of the embryo, impacting its position and connections with adjacent tissues.

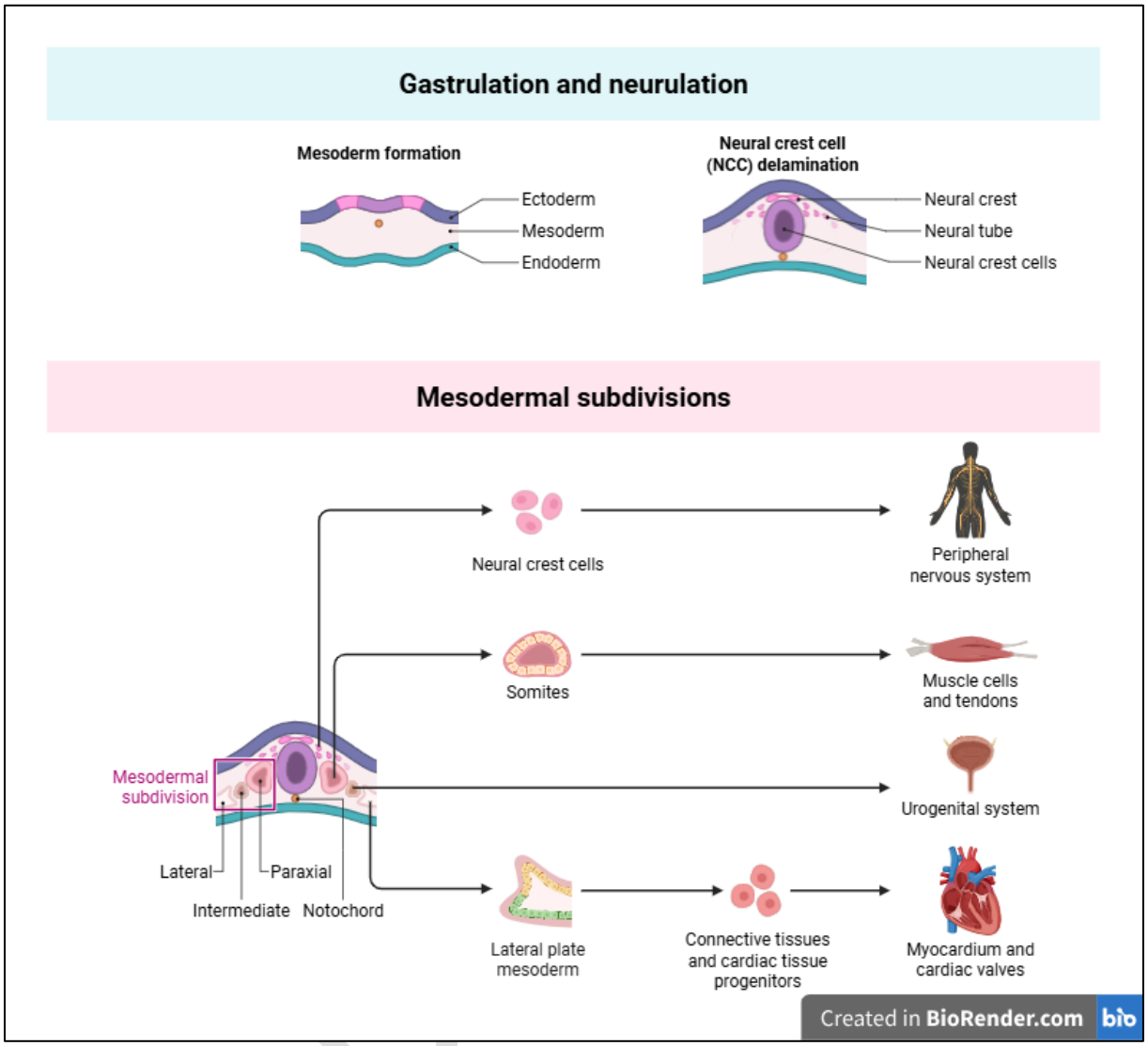
3.2 Beginning of Organogenesis

- The fourth week marks **the initiation of the development of major organs**.
- The **cardiovascular, nervous, and digestive systems** begin to take shape.
- The **limb buds appear**, initiating the formation of arms and legs.

4. Establishment of Feto-Placental Circulation

- During this week, the **establishment of embryonic blood circulation** is essential to support rapid growth.
- The embryonic heart begins to beat and ensures **the first exchanges between the embryo and the mother** via the placenta.
- The vessels connecting the embryo to the placenta develop rapidly, facilitating the transport of nutrients and oxygen.

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Conclusion

The fourth week of embryonic development represents a decisive transition during which the embryo acquires its definitive shape. **Embryonic delimitation**, **formation of the umbilical cord**, **development of the neural tube**, and the **organization of the first organs** are fundamental steps in embryogenesis. This period prepares the embryo for accelerated growth and the refinement of its internal structures in the following weeks.