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Chapter II. Stages of Embryonic Development

3. Third Week of Embryonic Development

3.1. Gastrulation

During the third week of embryonic development, **gastrulation** occurs within the embryonic disc. Gastrulation is the process of establishing the **third germ layer**, also known as the chordomesoblast. It is from these three primary germ layers that all tissues and organs of the embryo will be formed. During this stage, the circular embryonic disc becomes oval and elongates along the axis of the future embryo.

Gastrulation begins during implantation in rodents and primates (early-implantation species), whereas it occurs during the pre-implantation period in domestic mammals (late-implantation species).

3.1.1 .Main Stages of Gastrulation: Formation and Evolution of the Three Germ Layers

This process involves the establishment of the **ectoderm** (ectoblast), **endoderm** (endoblast), and **mesoderm** (mesoblast).

✓ **First Stage**

The first stage is characterized by the appearance of the **primitive streak** and **Hensen's node**.

The initially circular embryonic disc becomes oval-shaped and elongates following the longitudinal axis of the future embryo.

A small spot appears at the caudal (tail) end, resulting from the proliferation of ectoblast cells. These cells invaginate (move inward) between the endoblast and the remaining ectoblast cells. This spot elongates toward the middle of the embryonic primordium, forming the **primitive streak**. The cranial (head) end of the primitive streak thickens to form a highly active center of cell multiplication, creating a nodule known as **Hensen's node** (or the primitive node).

The appearance of the **primitive streak** and **Hensen's node** determines:

- The orientation of the **embryonic axis**.
- The **cranio-caudal** direction (head-to-tail).

✓ **The Second Stage**

This stage is characterized by: **mesoblastic migration**, the formation of the **notochordal process** (chordal process), and the establishment of the **allantoic diverticulum**. From a histological perspective, the **ectoblastic cells** (epiblast) develop migrating pseudopodia as they move through the primitive streak. During this process, they lose their intercellular connections.

This phenomenon of deep **invagination** characterizes **gastrulation** and results in the formation of the third germ layer, the **mesoblast** (mesoderm).

The **mesoblast** (mesoderm) separates the **ectoblast** (ectoderm) and the **endoblast** (endoderm) except in two locations: Ahead of the anterior tip of the **notochord**, which is the **buccopharyngeal membrane** (or pharyngeal membrane). Behind the **primitive streak**, which is the **cloacal membrane**. These two membranes mark the locations of the two ends of the future **digestive tract**.

Formation of the Allantoic Diverticulum

The **allantoic diverticulum** is simply a finger-like evagination (outpocketing) located behind the **cloacal membrane**, which extends into the **connecting stalk**. In humans, it is involved in early blood formation and contributes to the development of the urinary bladder.

Formation of the Notochordal Process (Chordal Process)

All ectophyll cells with chordal potential sink through **Hensen's node**, moving obliquely and axially toward the **pharyngeal membrane** while organizing into a **notochordal canal**. The floor of this canal rests on the endophyll, its flanks are in contact with the intra-embryonic mesoblast, and its roof is pressed against the inner surface of the ectophyll. Longitudinal fissures occur along the line of fusion between the endoblast and the notochordal canal.

As a result of this phenomenon, **amniotic fluid** passes into the **secondary yolk sac** (lecithocoele) through these fissures. The fissures affecting both the endoblast and the floor of the notched chordal canal extend along its entire length, such that the chordal material temporarily takes the form of an **inverted gutter** (reversed groove) from front to back.

The inverted chordal gutter flattens out into an elongated plate: the **notochordal plate**. It occupies the median region of the roof of the secondary yolk sac, while maintaining continuity with the endoblast. The notochordal plate then detaches from the endoblast and rolls up around a longitudinal axis to form the **notochordal rod** (notochord). As the chordal plate detaches, the endoblast restores its continuity. At the end of gastrulation, the dorsal rod occupies the embryo's axis between the pharyngeal and cloacal membranes.