Development of Amphioxus

Upto the formation of Coelom

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INTRODUCTION

Amphioxus, plural amphioxi, or amphioxuses, also called lancelet, any of certain members of the invertebrate subphylum Cephalochordata of the phylum Chordata. Amphioxus are small marine animals found widely in the coastal waters of the warmer parts of the world and less commonly in temperate waters. Both morphological and molecular evidence show them to be close relatives of the vertebrates.

- Development of amphioxus is indirect involving a larval stage.
- The early embryology of Amphioxus is simple and straightforward.
- The early development of Amphioxus is of great phylogenetic significance because it resembles with those of invertebrates like Echinodermates on one hand and vertebrates on other hand.
- Development of Amphioxus was described by many scientists viz., Hatscheck (1888), Wilson (1983), Cerfontaine (1906) and Conklin (1932).
- The work of Conklin is most recent and accepted one.
Fertilization

- Fertilization is external, taking place in the surrounding seawater where eggs and spermatozoa are shed.
- Before fertilization, the ovum has an outer thin vitelline membrane, enclosing a peripheral cytoplasmic layer, central yolky cytoplasm mainly towards the vegetal pole and a fluid filled germinal sac or nucleus towards the animal pole.
- During fertilization the sperm enters the egg near the vegetal pole.
Presumptive Area

Fig. 2. Branchiostoma. Presumptive areas of zygote in side view.
Cleavage and Blastulation

- The cleavage of eggs is **Holoblastic** and is of **Equaltype**.
- The first cleavage is **Meridional**, i.e. oriented along the median axis from animal to vegetal pole.
- The result of cleavage is the formation of two identical blastomeres establishing the bilateral symmetry of the adult animal.
- The Second cleavage is also oriented from animal to vegetal pole but at right angle to the first and divides the first two blastomeres into 4 equal sized cells.
• The **third cleavage** is horizontal (transverse) and slightly above the equatorial region. It divides each or four blastomeres in to one micromere and one macromere.

• Thus a total of 4 micromeres on the top and 4 macromeres at the bottom.

• The **fourth cleavage** is vertical. It divides each of eight blastomere into tow blastomeres, resulting in all 16 blastomeres. Out of these 16 blastomeres, eight are micromeres on the top and eight are macromeres at the bottom. Since the cleavage is not exactly through the middle, therefore the resulting blastomeres do not have equal sized partners.

• The cleaving zygote is not called **Morula**.
The **Fifth cleavage** is again horizontal (latitudinal) dividing the 16 blastomeres into 32 blastomeres arranged in four tiers of eight each, the upper two tiers consisting of micromeres and lower two tiers of macromeres.

The **Sixth cleavage** is vertical (longitudinal or meridional). It divides the 32 blastomere into 64 blastomeres. These blastomere are arranged in four tiers, one above the other and each tier is a ring of 16 blastomeres arranged side by side.

Further cleavage are irregular.
• Micromeres divide slightly faster than macromeres. This is probably because they have fewer yolk granules. A jelly filled cavity now appears in the center of morula to change it into blastula.

• It starts appearing at 16 blastomeres stage and becomes distinct by 64 blastomeres stage.

• The jelly starts absorbing water and enlarges in size. The blastomeres become arranged in single layer all around the blastocoel.

• The single layer is called blastoderm. At the completion of cleavage, there are about 9000 cells in the blastula of *Amphioxus*. 
GASTRULATION

- At the beginning of gastrulation the blastula has micromeres in upper part and macromeres at the lower part.
- The slower dividing macromeres are pushed by faster dividing micromeres from near the equatorial region and then micromeres start moving downwards (Epiboly).
- Now blastula looks like half sphere with flattened plate at the bottom.
Invagination

• The flattened macromere plate starts bending upwards (invagination).

• As invagination continues, the monoblastic blastula starts converting into a diploblastic gastrula.

• Later the gastrula has an appearance of a double walled inverted cup with the blastocoel as a compressed space between the two walls.

• The newly formed cavity surrounded by diploblastic walls is called Archenteron or Gastrocoel.

   The transformation of single walled blastula into double walled gastrula is called GASTRULATION.
ELONGATION

• Now the gastrula elongates in an antero-posteriordirection.

• The wide mouth of the archenteron gradually narrows into a triangular hole which is now situated at the posterior end of gastrula

• This hole is known as **Blastopore**.

• When the inner wall (hypoblast) of the gastrula touches the outer wall (epiblast), the original blastocoel disappears.

• As the gastrula elongates, the blastopore gradually becomes smaller.

• At this stage the gastrula is elongated structure with an upper flat surface and a lower ventrally bulging surface and is slightly compressed
FORMATION OF COELOM IN AMPHIOXUS

The presumptive mesoderm is present in the dorso-lateral walls of the archenteron. It surrounds the notochord on both the sides. From the wall of archenteron two folds arise in the form of grooves. They are divided into a series of segments by several transverse lines. Each segment is called coelomic pouch. These coelomic pouches separate from the archenteron and form a series of coelomic sacs in between the ectoderm and endoderm. The vail of the sacs forms the mesoderm. The coelomic sacs will grow in size and extend both upwards and downwards and occupy the space between ectoderm and endoderm.

Each coelomic sac are divided into two parts:

- The dorsal part is the myotome, and
- The ventral part is splanchnotome.
FORMATION OF COELOM IN AMPHIOXUS

1. **Myotome**: It contains a median muscular splanchnic portion and a laterally placed thin walled parietal portion. They surround the coelomic space or myocoel. The muscular part give dermatome which forms a thin sheet below the ectoderm of the skin. Scierotome gives rise to a sheath of notochord, and nerve cord. Muscle plate enlarges and forms the muscle bundles.

2. **Splanchnotome**: It is formed of two sheets separated by space, called splanchnocoel. It forms the coelome of the embryo. The outer wall of splanchnocoel present in contact with the ectoderm is called somatic layer of mesoderm. The inner wall of splanchnocoel which is in contact with The endoderm of archenteron is known as splanchnic mesoderm.

The origin of coelom in Amphioxus is called enterocoelic type, because it is derived from the archenteron.
Thank You