Origin and Significance of Coelom

Introduction

A space inside the body is called as body cavity, coelom is the true body cavity which is large and fluid filled. Coelom lies between the outer body wall and inner digestive tube. It contains most of the visceral organs. Coelom arises as a secondary body cavity between two embryonic layers of mesoderm. The term coelom was suggested by Haeckel in 1872.

Features of a True Coelom

It is a secondary body cavity formed by the splitting of mesoderm during embryonic development.
It is also bounded on all sides by a definite coelomic epithelium.
It consists of colorless coelomic fluid also the excretory organs open into it.
Reproductive organs arise from its walls.

Organization of Bilateria based on coelom

Acoelomata: Acoelomates do not have a coelom or body cavity. The space between the body wall and gut is filled up by mesenchyme and muscle fibres.
Eg: phylum Porifera, Coelenterata, Platyhelminthes and Nemertinea

Pseudocoelomata: The space between the body wall and gut encloses a fluid filled cavity which is not lined by mesodermal epithelial cells. It is known as pseudocoel or false coelom and the animals possessing it are known as pseudocoelomates.

Embryologically, the pseudocoelom is derived from the blastocoel of the embryo. The internal organs are free within the space, as there is no peritoneum bounding the cavity

Eg: phylum Nematoda, Acanthocephala, Entoprocta, Rotifera, and Gastrotricha

Coelomata: In rest of the bilateria, the body-cavity present between the body wall and gut is lined by a peritoneum. Peritoneum consists of epithelial cells derived by embryonic mesoderm. This type of cavity is known as true coelom and the animals possessing it are known as Eucoelomates

Eg: phylum Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata and Chordata.

The coelom is lined externally by a parietal epithelium and internally by a visceral or splanchnic epithelium. The peritoneum surrounds all the internal organs, including the alimentary canal. In other words, all the internal organs are present behind the peritoneum. Thus, coelom is also called as the

perivisceral cavity. Coelom is divided into fluid filled compartments by transverse partition called septa which extend from the annuli of the body wall to the alimentary canal. The wall of the septa is perforated, through which coelomic fluid communicates from one compartment to another. The coelom communicates with the exterior by two sets of ducts namely nephridia and coelomoduct. Nephridia are ectodermal tubes that remove water and excretory waste while coelomoduct are mesodermal tubes which usually open into the coelom at one end while the other end communicates with the exterior.

However, in some coelomates like arthropods and mollusks, the coelom is reduced or absent in adult, but is present in the embryo. The space containing blood and lymph is in the form of tubes through which fluid is made to circulate by the heart, and this space is called a haemocoel. The visceral organs are surrounded by the haemocoel. The haemocoel reduces the coelom to small cavities around the heart, gonads and kidney. In these animals, the haemocoel is called the primary body-cavity while the coelom is called the secondary body cavity.

Theories of origin and evolution of coelom

Schizocoel theory: According to this theory, the coelomates evolved from an ancestral acoelomate like flatworms by hollowing out of the parenchymal cells of the mesenchyme. Some of these cells formed the peritoneum. According to this theory, the acoelomate body plan is primary and ancestral to the coelomate plan.

The acoelomate flatworms, thus, form the basic group in the evolution of bilateral animals. The schizocoel mode of coelom formation in the embryonic development of annelids and mollusks would claim as supporting evidence of this theory. However, the evolution of coelom is not related to gonads or endodermal pouches of lower forms.

Enterocoel theory: This theory was first proposed by Lankester in 1875. This theory argues that the coelom evolved from the gastric pouches of some cnidarian ancestors such as anthozoans or scyphozoans. These gastric pouches separated out from the main gastric cavity to form the coelomic pouches.

This theory proposes that all bilateral animals are basically coelomate and that acoelomate forms like flatworms are secondarily derived from coelomate ancestors by the loss of the cavity. The enterocoelous mode of coelom formation in the embryogeny of echinoderms, hemichordates and chordates is the main supporting evidence of this theory.

Gonocoel theory

The theory was first enunciated by Bergh in 1885. It regards the coelom as the cavity of an expanded gonad and its origin is based on the common association between the gonads and the coelomic epithelium. Bergh believed that coelom initially arose in a segmented condition by enlargement and cavitation of the gonads after the release of gametes.

One of the main drawbacks of this theory is that it closely links the origin of coelom with the origin of metameric segmentation and hence it is difficult to account for the unsegmented coelomates. There is no evidence that the unsegmented coelomates have originated from the segmented ancestors. This theory has no embryological support because gonads do not arise before the coelom.

Nephrocoel theory

Proposed by Lankester in 1874. The coelom originated as an expanded nephridia. This theory however, was never taken seriously because protonephridia has been described in coelomates and also excretory organs are absent in some coelomates like echinoderms.

Functions of coelom

Coelom surrounds the internal organs and thus protects them from external shocks.
It serves as a hydrostatic skeleton to assist in locomotion and maintaining shape of the body.
It provides flexibility to the body. The internal organs in coelomate animals become large and are able to perform movements freely of their own.
It helps in removing excretory waste from the body.
Helps in the transportation of gases and nutritive materials from one part of the body to the other.
In some animals, it keeps the body wall moist to facilitate respiration and to destroy bacteria and other harmful micro-organisms.
Acts as a site for gamete maturation and brooding of embryos.