

AFFINITIES AND PHYLOGENY OF HEMICHODATA

INTRODUCTION

Hemichordata was till recently treated as the sub phylum of the phylum Chordate but is now regarded to be the independent phylum of invertebrates very close to the phylum Echinodermata. The peculiar characteristics of the animals belonging to Hemichordata are as follows,

- Enterocoelus coelom
- Pharyngeal gill slits
- Buccal diverticulum (earlier considered as notochord), now considered as a stomochord,
- Vermiform body divisible into three regions - proboscis, collar, trunk

The phylum hemichordate includes a small group of soft, primitive and marine chordates called as acron worms or tongue worms. Most familiar genus of this phylum is *Balanoglossus* which belongs to the class Enteropneusta. Other closely related genera are *Saccoglossus*, *Glossobalanus* etc.

The class Enteropneusta was established by Gegenbaur in 1870. Since then due to the peculiar anatomical organisation and embryology, Hemichordata have been considered closer to chordate as well as non-chordate phyla by different workers from time to time. The phylogenetic relationship and the taxonomic position of hemichordate are given below:

Affinities of the phylum Hemichordata

Affinities with Chordata

Zoologists proposed closer affinities between the phylum Chordata and Hemichordata. Their resemblance was based on the presence of three fundamental characteristics of Chordates in hemichordates,

- Notochord
- Dorsal hollow nerve chord
- Pharyngeal gill slits

Moreover the structure and functions of pharyngeal and branchial apparatus of Hemichordates is similar to that of Cephalochordates and Urochordates. Also the origin of coelom is enterocoelic type in the form of five pouches from the archenteron as in Brachiostoma. Due to all the above stated similarities Hemichordata was considered as sub-phylum of the phylum Chordata till recently

Objections:

Following are the objections which lead the establishment of Hemichordata as a separate phylum.

1. A true notochord does not exist in hemichordata. Unlike the notochord of Chordates, the so called notochord of hemichordates is very short, confined to proboscis and without any supporting function. Instead of being solid and made up of vacuolated cells, it is hollow and made up of epithelial cells. Instead of being called notochord, it is now referred to as Stomochord by Bateson and as buccal diverticulum by Hyman.
2. The nervous system is distinctly of invertebrate type being intra-epidermal in position and having a ventral nerve cord and circumcentric nerve ring which are absent in chordates.

3. Gill slits in hemichordates are numerous and dorsal in position where as they are 5 to 7 and laterally positioned in chordates.

Affinities with Echinodermata

The following are the resemblances of the adult hemichordates and echinoderms:

- Echinoderms and hemichordates are similar in having enterocoelus coelom which is divided into three different parts filled with sea water to serve hydraulic mechanism.
- Heart vesicle and glomerulus of hemichordates are considered homologous to dorsal sac and axial gland of echinoderms.
- Both have common habits, ecological niches and remarkable power of regeneration.

The following are the resemblances of the larval hemichordates and echinoderms.

- Larvae of both groups are small, pelagic, transparent and oval
- Similarity in the development of the coelom
- Blastopore becomes anus and digestive tract is complete with mouth, anus and same parts.
- Heart vesicle and glomerulus of **hemichordates** are considered homologous to dorsal sac and axial gland of echinoderms. Both have common habits, ecological niches and remarkable power of regeneration.

Objections:

- But Echinoderm larvae differ in lacking apical plate with sensory hair, eye spots and telotroch. Protocoel is single in hemichordate larva and paired in echinoderm larva

Systemic position of hemichordate

Earlier understanding

Peculiar anatomical organisation of hemichordata makes their phylogenetic position uncertain and controversial. Earlier workers placed hemichordates as a sub phylum under the phylum Chordata. But the only chordate feature shown by them is the presence of pharyngeal gill slits. Therefore, some recent workers like Van der Host, Marcus etc. have chosen to remove them as the sub phylum of phylum Chordata and treat them as an independent invertebrate phylum.

Since the hemichordate group consists of only 80 species, it is included in the category of minor phylum. The name Hemichordata suggests that they are half chordates.

The close affinities of Hemichordata with Echinodermata, Annelida, Pogonophora, Phoronida have led to the conclusion that they have arisen from a common ancestral stock. But many workers like Marcus, Berril and Hyman do not contribute to this view.

- According to Barrington, Echinodermata deviated greatly from the line of ancestral stock and formed a blind branch. Even hemichordata did not stand on the direct main line of chordate evolution. Hemichordates arose from the ancestral line after divergence of the ancient

echinoderms but before the rise of true chordates and hence they are often called as pre-chordates

Current understanding

The hemichordates are a small group of marine worms with an intriguing relationship with both the Echinodermata and our own phylum, the Chordata.

Hemichordates, as typical deuterostomes, cleavage is radial and the coelom forms through enterocoely, as three distinct compartments (protoel, mesocoel, and metacoel). Hemichordate traits, such as the presence of stomochord, collar neurochord, and gill slits also reinforced their phylogenetic proximity to chordates.

Bateson coined the present phylum name after recognizing similarities with chordate embryogeny, and for many years the hemichordates were actually ranked as a subphylum of Chordata.

Although hemichordates lack a notochord, excluding them from membership in the phylum Chordata, they do exhibit two other chordate characteristics: pharyngeal gill slits and, in some species, a dorsal, hollow nerve cord. However, current thinking is that only the gill slits and (probably) the neurochord can be homologized with those of chordates. Pharyngeal gill slits are used for filter feeding in the same way as protochordates.

Although some analyses have linked hemichordates to vertebrate chordates or to brachiopods and other "lophophorates," most molecular analyses indicate a closer link between hemichordates and echinoderms than between hemichordates and chordates.

Since their discovery, hemichordates have played a pivotal and controversial role in attempting to understand relationships among the three major

deuterostome phyla (echinoderms, hemichordates, and chordates), in the nature of the deuterostome ancestor, and in the search for the evolutionary origin of chordates.

Moreover, gene expression data supports the hypothesis that the gill slits were present in the putative common ancestor to hemichordates and chordates. On the other hand, a close relationship with echinoderms has also been proposed through characters such as the excretory heart-kidney system and the tornaria-dipleurula larvae. Currently, a sister-group relationship between hemichordates and echinoderms (a clade called Ambulacraria) is generally favored and fairly constantly supported by molecular phylogeny analyses.