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Acquisition of the dorsal structures in chordate amphioxus

Morov A., Ukizintambara T., Sabirov R., Yasui K.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2016 The Authors. Acquisition of dorsal structures, such as notochord and hollow nerve cord, is likely to have had a profound influence upon vertebrate evolution. Dorsal formation in chordate development thus has been intensively studied in vertebrates and ascidians. However, the present understanding does not explain how chordates acquired dorsal structures. Here we show that amphioxus retains a key clue to answer this question. In amphioxus embryos, maternal nodal mRNA distributes asymmetrically in accordance with the remodelling of the cortical cytoskeleton in the fertilized egg, and subsequently lefty is first expressed in a patch of blastomeres across the equator where *wnt8* is expressed circularly and which will become the margin of the blastopore. The lefty domain co-expresses zygotic nodal by the initial gastrula stage on the one side of the blastopore margin and induces the expression of gooseoid, not-like, chordin and brachyury1 genes in this region, as in the oral ectoderm of sea urchin embryos, which provides a basis for the formation of the dorsal structures. The striking similarity in the gene regulations and their respective expression domains when comparing dorsal formation in amphioxus and the determination of the oral ectoderm in sea urchin embryos suggests that chordates derived from an ambulacrarian-type blastula with dorsoventral inversion.

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Keywords

Chordate origin, Deuterostomes, Dorsal formation, Dorsoventral inversion, Lancelet