若手イニシアティブセミナー

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下田臨海実験センター第一研究棟３階セミナー室

Mechansim of specification of the neurogenic animal pole domain of the sea urchin embryo

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Early patterning of sea urchin embryo ectoderm into neural and epidermal ectoderm relies on interactions between transcription factors expressed in the initial neurogenic region (the Animal Pole Domain; APD) and the outputs from Nodal (anterior or oral) and Wnt (vegetal) signaling pathways. The initial expression of APD regulatory genes throughout the presumptive ectoderm is progressively restricted to a small patch of neurogenic ectoderm at the animal pole during late cleavage stages by a canonical Wnt signaling-dependent process that may work through the Frizzled 5/8 Wnt receptor expressed in early ectoderm. When Wnt signaling is blocked by microinjecting mRNAs encoding either Dcadherin, dnFzl5/8 or Dkk1, a large fraction of the embryo differentiates as an expanded APD, driven by greatly expanded expression of APD regulatory genes. We exploited this phenotype to identify many additional APD regulatory genes using microarrays designed in our lab to include all predicted coding sequences in the sea urchin genome. One key APD factor, FoxQ2, prevents *nodal* autoregulation and therefore secondary axis specification. The FoxQ2 pathway thus serves as a checkpoint to coordinate developmental programs along the primary and secondary axes. A second factor, Six3, plays a multifaceted, cardinal role in APD specification, being required for the expression of nearly all early APD transcription factor-encoding genes and putative Wnt antagonists, which are critical for determining the borders of the APD. Furthermore, misexpression of Six3 is sufficient to convert most of the embryo to a correctly patterned APD, likely as a result, at least in part, of its ability to suppress Wnt signaling. *Six3* and *foxQ2*, as well as that of another very early zygotic gene, *homeobrain* (*Hbn*), are all required to specify the APD as a territory conducive for neurogenesis. These three factors define three concentric, partially overlapping subregions that emerge during mesenchyme blastula and gastrula stages. At the same time, individual cells begin to express various combinations of regulatory genes at different times and in different regions of the APD, as revealed by two-color in situ hybridization and immunostaining. Within the sea urchin APD regulatory repertoire are many orthologs of genes expressed in the anterior neurectoderm of vertebrate embryos, suggesting that the common deuterostome ancestor used a conserved core gene regulatory network for early steps in specifying their neurogenic domains.

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