CDB SEMINAR

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16:00-17:00 C1F CDB Auditorium

The developmental basis for the recurrent evolution of deuterostomy and protostomy

Summary

Generations of biology students learn that all bilaterally symmetrical animals (e.g. humans and flies) belong to either Deuterostomia or Protostomia, a fundamental grouping that was originally based on whether the primary embryonic opening, called the blastopore, becomes the mouth or the anus of the adult. This division has prevailed for over 100 years, and has influenced nearly all views on animal evolution. However, gastrulation in Protostomia is vastly variable. For instance, penis and horsehair worms, as well as some spiralian lineages, exhibit deuterostomic development. To identify the mechanisms underlying the recurrent evolution of these two embryonic patterns, we compared the development of two related species of brachiopods that have similar ecological and reproductive strategies, but surprisingly display deuterostomic and protostomic development respectively. The investigation of the establishment of the axial polarity and fate identity during embryogenesis demonstrated that the protostomic species undergoes an extensive re-patterning of the blastoporal rim that relates to the cooption of the blastoporal orifice into the mouth opening. The differential deployment of Wnt signaling around the vegetal pole, together with the timing and location of mesoderm formation, is sufficient to influence the differential behavior and fate of the blastopore in these two species of brachiopods. Importantly, we demonstrate that similar developmental principles may act during gastrulation in the protostomic annelid Owenia fusiformis and might also account for the variability of blastoporal behaviors seen in this animal group. Our findings leverage the current knowledge of animal embryogenesis to mechanistically explain the evolution of deuterostomy and protostomy, demonstrating that these are recurrently appeared developmental by-products (i.e. ‘spandrels’). Our study thus challenges the long-standing evolutionary emphasis on extant blastoporal behaviors to explain the origin and diversification of bilaterian animals.

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