PLENARY SPEAKER

ANALYSIS OF COLLECTIVE CELL BEHAVIOURS UNDERLYING PRIMITIVE STREAK FORMATION IN THE CHICK EMBRYO

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ABSTRACT

How dynamic cell behaviours such as differentiation, division, cell shape change and movement are integrated at the tissue, organ and organism level is a key question in biology. This is particularly important during gastrulation, a key process during the early embryonic development of all higher organisms involving large scale tissue deformations and cell movements. During gastrulation the three germlayers, the ectoderm, mesoderm and endoderm take up their correct topological positions in the embryo. In amniotes including humans the mesendoderm precursors are formed from a single layered epithelial sheet of cells, the epiblast. During gastrulation these mesoderm and endoderm precursors ingress through a structure known as the primitive streak to form the inner layers of the embryo [1]. The mesendoderm precursor cells in the epiblast move in two large scale vortex flows towards and along the midline of the embryo to form the primitive streak [2]. We investigate the cellular mechanisms that drive these large scale tissue flows in the chick embryo, as well as the mechanisms that integrate these cell behaviours during streak formation on an embryo wide scale. Using a dedicated lightsheet microscope we are able to follow detailed cell behaviours such as cell division, ingression, cell-shape change and cell-cell intercalations of over 200.000 cells in the chick embryo epiblast. Our experiment have shown that the large scale epiblast tissue cortex flows resulting in the formation the primitive streak are driven by localised anisotropic pulling forces generated by mesendoderm cells. These forces appear to be generated by two main cellular mechanisms: directional cell-cell intercalation and apical contraction followed by ingression of mesendoderm cells [3]. We currently investigate the interplay between mechanical and chemical cell-cell signalling mechanisms that integrate these key behaviours at the tissue scale, using a combination of experimentation and cell based and continuous modelling approaches [4]. Specifically we test the hypothesis that junctional Myosin II accumulation resulting in apical contraction and cell-cell intercalation is a tension sensitive process and that this mechanosensitive process is a key part of the mechanism of tissue wide integration of cell behaviours during primitive streak formation.

References

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