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Hydraulic fracturing and active coarsening position the lumen of the mouse blastocyst

We investigate the role of cell contractility and molecular adhesion in the formation of the blastocoel during early mouse embryo development, a fluid-filled lumen that positions the first axis of symmetry of the embryo. We show that hundreds of micron-sized fluid filled cavities appear throughout the entire embryo on basolateral (adhesive) sides of cells, fracking cell-cell contacts. Via a process akin to Ostwald ripening, these microlumens exchange fluid, such that a single dominant lumen emerges. We build a model to study the coarsening of the network of microlumens, reproducing the features of the dynamics and positioning of the blastocoel. Our results suggest that the lumen forms at the Trophectoderm-ICM interface, corresponding to the lowest contractile cell-cell interface.

Field

Biophysics, Modeling, Morphogenesis, Embryogenesis

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