Center for Stem Cell Biology and Regenerative Medicine

Division of Mammalian Embryology
再生発生学分野

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Our lab aims to understand mechanisms underlying the cell fate decisions in early mammalian embryos and to apply their principle for future reproductive and regenerative medicine. In particular, we use pluripotent stem cells and early embryos from various mammals, which will enable us to investigate conserved mechanisms among the mammals and to develop novel technology by the use of species-specific features.

1. Induction of primordial germ cell-like cells from rat pluripotent stem cells

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In vitro induction of primordial germ cell like-cells (PGCLCs) from pluripotent stem cells (PSCs) is a robust method that will contribute to understanding the fundamentals of cell fate decisions, animal breeding, and future reproductive medicine. We develop a stepwise protocol to induce epiblast-like cells and subsequent PGCLCs via the formation of spherical aggregates from rat PSCs. We also develop a protocol to mature these PGCLCs from specified/migratory- to the gonadal stage by aggregation with female gonadal somatic cells. We summarize the detailed protocols above in a book chapter.

2. Transcription factor-mediated germ cell induction in rats

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The specification of primordial germ cells (PGCs) marks a crucial branch point in early embryonic development. Studying the molecular mechanisms underlying this process is key to gaining insights into reproduction and evolution. Here, we identify transcription factors essential for PGC specification in rats using an *in vitro* system to induce PGC-like cells (PG-

CLCs) from pluripotent cells. Overexpression of a key mesodermal factor activating the germ cell program in epiblast-like cells induces functional rat PGCLCs, similar to mice. However, unlike in mice, overexpression of the PGC specifiers alone is not sufficient in rats, additional signals are necessary for PGCLC induction. Through a candidate screen, we identified a transcription factor acting cooperatively with the PGC specifiers. Our study provides insight into the mechanism behind germline segregation in mammals and underscores the importance of using the rat model in addition to mice.

Publications

1. Oikawa M, Hirabayashi M, Kobayashi T.
    Induction of Primordial Germ Cell-Like Cells from Rat Pluripotent Stem Cells.
    Methods Mol Biol. 2770:99-111, 2024.
2. Irie N, Kobayashi T, Azim Surani M.
    Human Primordial Germ Cell-Like Cell Induction from Pluripotent Stem Cells by SOX17 and PRDM1 Expression.
    Methods Mol Biol. 2770:87-97, 2024.