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J Stem Cells Dev. 2023;1(1):17-18.

Journal of Stem Cells and Development Commentary

Creating an Ovarian Environment for the Generation of Mouse and Human Oocytes from Stem Cells

Helena J Teede[1*], Marie L Misso[2]

National Health and Medical Research Council Centre for Research Excellence in PCOS, Monash University, Melbourne, Australia

Correspondence to: Helena J Teede, National Health and Medical Research Council Centre for Research Excellence in PCOS, Monash University, Melbourne, Australia. E-mail: helena.teede11@monash.edu

Received: May 07, 2023; **Accepted**: May 23, 2023; **Published**: June 02, 2023

Citation: Teede HJ, Misso ML. Creating an Ovarian Environment for the Generation of Mouse and Human Oocytes from Stem Cells. J Stem Cells Dev. 2023;1(1):17-18.

INTRODUCTION

Efforts to reconstruct the ovarian environment for the generation of mouse and human oocytes from stem cells represent a pivotal frontier in reproductive science and medicine. Recent research conducted at Kyushu University has demonstrated remarkable progress in this area, offering promising insights into infertility treatment and conservation efforts for endangered species. Led by Professor Katsuhiko Hayashi from Kyushu University's Faculty of Medical Sciences, the research team has delved into the intricate mechanisms governing oocyte formation—a critical aspect of reproductive biology. Understanding the differentiation process of stem cells into specialized cells, such as oocytes, is fundamental to stem cell research and its potential applications.

While significant strides have been made in generating oocytes from mouse and human stem cells, a crucial challenge remains in establishing the necessary support system for their maturation. In natural physiology, oocytes mature with the assistance of surrounding cells within the ovarian follicle. First author Takashi Yoshino, an assistant professor at the Faculty of Medical Sciences, emphasizes the need to develop a self-sustaining support system derived from stem cells to advance our understanding of oocyte development and expand its applications to wildlife conservation and human fertility.

The research journey began with a comprehensive investigation into the genetic pathways underlying the

development of gonadal somatic cells in mice. This exploration laid the groundwork for the generation of foetal ovarian somatic cell–like cells (FOSLCs) from mouse stem cells, mirroring the characteristics of natural somatic cells. By integrating FOSLCs with stem-cell-derived primordial germ cells, the research team observed the formation of follicular structures around the developing oocytes—an essential step towards oocyte maturation. Subsequent fertilization of these oocytes resulted in successful pup production, highlighting the potential for large-scale oocyte generation without reliance on host animals.

Professor Hayashi underscores the significance of this breakthrough in advancing our understanding of ovarian follicle development and reproductive biology. While the application of this technology to humans holds promise, ethical considerations and technological refinements are paramount due to the genetic and epigenetic complexities associated with in vitro gamete production. Moving forward, the research team remains committed to unraveling the intricate mechanisms underlying this transformative process, paving the way for innovative solutions in reproductive medicine and conservation biology.