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Spindle Formation-related Proteins Responsible for Oocyte Quality

Yumi Hoshino
Laboratory of Animal Reproduction, Graduate School of Agricultural Science,
Tohoku University, 1-1 Tsutsumidori Amamiya-machi,
Aoba, Sendai, 981-8555, Japan

Increasingly, *in vitro* maturation (IVM) is being applied to cases of human infertility, especially to help patients with polycystic ovarian syndrome and ovarian hyperstimulation syndrome. To improve the application of IVM oocytes for embryo production and the efficiency of IVM oocytes to result in live birth, oocyte quality control and realization of the most suitable fertilization conditions are important. Therefore, the details of the mechanism underlying oocyte maturation need to be clarified. If oocyte maturation is understood in detail, high-quality oocytes can be produced and selected based on 'markers' that predict successful nuclear and cytoplasmic maturation, allowing for IVM optimization.

Oocyte maturation involves cytoplasmic and nuclear maturation, a process that involves chromosome alignment and spindle formation. Even though chromosome segregation following spindle formation is an important step in oocyte maturation, the details of the molecular mechanisms underlying these processes remain to be elucidated.

The spindle ensures normal distribution of chromosomes to daughter cells. Therefore, it is important that this structure functions properly so that chromosomes segregate normally. The mechanism of meiotic spindle formation differs greatly from that which occurs during mitosis. In somatic cells, the centrosome is a crucial organelle for mitotic spindle assembly during cell division. Although metaphase II (MII) spindles in mouse oocytes possess centrosomal material at both meiotic poles, formed by the assembly of multiple small asters, they lack centrioles. Vertebrate oocytes possess acentriolar microtubule organizing centers (MTOCs) instead of centrosomes during spindle assembly. However, the molecular basis and underlying mechanisms of spindle formation and chromosome segregation remain unknown.

Akt and mammalian target of rapamycin (mTOR) have been implicated in many cellular processes. These proteins localize to the spindle in mouse oocytes in unique distributions and contribute to meiotic resumption and completion. The occurrence rate of chromosomal abnormalities in oocytes is known to increase with aging, and abnormalities in spindle checkpoints cause chromosomal aneuploidy. Therefore, in future studies,

we will focus on precisely understanding spindle formation, chromosome segregation, and their underlying mechanisms during meiosis.

At this symposium, I will be speaking about spindle formation-related proteins that are involved in oocyte maturation and early embryo development.