MEIOC prevents continued mitotic cycling prior to meiotic entry during mouse oogenesis

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In multicellular organisms, the germ cell's transformation into a haploid gamete requires that it transitions from mitosis to meiosis, whereby it stops mitotic cycling and enters the meiotic cell cycle. In mammals, the decision to enter the meiotic cell cycle by undergoing the G1-to-meiotic S phase transition is triggered by transcriptional activator STRA8-MEIOSIN. However, what prevents continued mitotic cycling before entering the meiotic cell cycle remains unclear. Here, we demonstrate that the transition from mitosis to meiosis in mouse ovarian germ cells occurs as two molecularly distinct steps: first, during premeiotic G1 phase, germ cells are prevented from re-entering the mitotic cell cycle; then, they transition from premeiotic G1 to meiotic S phase to enter the meiotic cell cycle. We demonstrate that MEIOC, previously shown to repress the mitotic program after germ cells have entered meiosis by destabilizing mRNA, prevents re-entry into the mitotic cell cycle during premeiotic G1 phase. Furthermore, MEOIC supports the G1-to-meiotic S phase transition by indirectly increasing *Meiosin* transcript abundance and thereby activating the STRA8-MEIOSIN transcription factor. We conclude that, in mouse oogonia, MEIOC's post-transcriptional control of mRNA promotes the transition from mitosis to meiosis by preventing continued mitotic cycling and promoting entry into the meiotic cell cycle.