Abstract

Fully grown oocytes undergo their further development in the absence of transcription. Completion of meiosis and early embryo development rely on the maternal mRNAs synthetized and stored during earlier development. Thus, the regulation of gene expression in oocytes during that period is controlled almost exclusively at the level of mRNA stabilization and translation. In the same vein, any mRNA metabolism could play a critical function at this stage of development.

RNA localization followed by a local translation is a mechanism responsible for the control of spatial and temporal gene expression in the cell. We focused on visualization of mRNA and *in situ* translation in the mammalian oogenesis and embryogenesis. We characterized localization of global RNA population in the oocyte and early embryo nucleus together with RNA binding proteins. Additionally we visualized specific ribosomal proteins that contribute to translation in the oocyte and embryo. We have shown that the key player of cap-dependent translation mTOR becomes highly active post nuclear envelope breakdown (NEBD) and in turn its substrate, translational repressor 4E-BP1 becomes inactive. Precise localization of inactivated 4E-BP1 at the newly forming spindle of the oocyte indicates the ongoing translation in this area.

Furthermore, from our RNA sequencing database we selected specific candidate transcript, *Ankyrin 2* (*Ank2*). We identified that only *Ank2.3* variant is present in the mouse oocyte and becomes translated after NEBD. *Ank2.3* mRNA is localized in high quantity in the oocyte nucleus and at the newly forming spindle. Moreover, *Ank2.3* has an oligopirimidine motive which indicates translational regulation thru mTOR/4E-BP1 axis. ANK2 protein also colocalizes with inactivated translational repressor 4E-BP1 suggesting the ongoing translation of *Ank2.3* in the area of newly forming spindle. Furthermore, suppression of *Ank2.3* mRNA translation results in aberrant meiotic progression of oocytes. Here we showed that translation of subset transcripts in the right time and place is crucial for normal oocyte development.

Next, we studied influence of external factors on translation in the oocyte and early embryo. We found that the presence of the follicle stimulating hormone (FSH) in the cultivation media significantly decreased the incorporation of methionine and homopropargylglycine (amino acid analogue) into *de novo* synthetized proteins in oocytes of various mammalian species and mouse early embryos. In connection we found that FSH-receptor is expressed at mRNA and protein levels in cumulus-free mammalian oocytes. We proposed that decreased uptake of amino acids is influenced thru FSH-receptor and effects oocytes and early embryos development.

Taken together our results unveil various mechanisms of influencing mRNA translation which plays a significant role in physiological processes which are essential for development of healthy offspring in various mammalian species including human.