Assisted reproductive technology (ART) refers to fertility treatments and procedures that can help with difficulties or an inability to conceive children. ART use is increasing, and around 8 million children have been conceived by ART since the first baby tube was born in 1978. ART methods continue to develop and one of the perspective methods is *in vitro* maturation (IVM). For the first time IVM in humans was introduced into clinical practice as an alternative treatment for patients with polycystic ovary syndrome, who had severe ovarian hyperstimulation due to extracorporeal fertilization procedures. However, in recent years, indications for IVM expanded. Among them are polycystic ovaries, previous failed IVF attempts, problems with physiological *in vivo* oocyte maturation, poor responders upon hormonal ovarian stimulation. The development of oocytes' in IVM methods could also increase the number of good quality oocytes at metaphase II stage which leads to increasing number of available embryos for transfer into uterus and consequently increase the pregnancy rate. The European Society of Human Reproduction and Embryology presents several strategies for maintaining fertility in women using oocyte IVM. In case of emergency for female fertility preservation (FFP) prior gonadotoxic treatment immature oocytes could be retrieved with subsequent IVM and oocyte/embryo vitrification or IVM could be performed for oocytes retrieved from cryopreserved ovarian tissue. Among the advantages of using IVM and cryopreservation methods for FFP are avoiding metastasis, possibility of using for women of different age, independence of menstrual cycle phase and application in case of urgency of gonadotoxic treatment or surgery which could impact fertility. However efficiency of IVM and cryopreservation protocols for immature oocytes is not still satisfied and should be improved.

The development of the vitrification method has become a real breakthrough for cryopreservation of human and other mammalian oocytes. **However, the use of this method for mature and immature cumulus oocyte complexes (COCs) leads to a significant decrease in the number of viable cells cumulus cells (CCs) and disruption of intercellular contacts**. **CCs play an important role in oocyte maturation holding the oocytes under meiotic arrest, causing meiosis to restore, and maintaining cytoplasmic maturation**. The regulatory influence of CCs is exerted through tight intercellular contacts with oocytes and specific metabolic properties. Gap junctions (intercellular proteins) between oocytes and CCs are considered necessary for rapid transfer of small metabolites and regulation of oocyte meiosis resumption. Therefore, it is necessary to develop approaches that will restore connections CCs and oocytes after cryopreservation to achieve oocyte competence for successful FFP using immature oocytes.

However not only cryopreservation leads to disruption of intercellular contacts. After controlled ovarian stimulation approximately 20% of oocytes obtained can be nuclear immature. It is possible to assess the oocyte maturity degree only after removing cumulus and granulose cells by denudation prior fertilization by intracellular sperm injection. In this case, the intercellular contacts between the cumulus cells and the oocyte are also broken**. Therefore, the problem of restoring intercellular contacts between CCs and oocytes is a key point in the performing IVM for denuded oocytes and cryopreserved COCs.**

Various hormones and growth factors are in the process of intercellular communication for oocyte development. The main hormones controlling follicle maturation and oocyte maturation are FSH and LH. They mediate their effects through expression of certain genes and synthesis of other regulatory proteins, as well as through the intracellular signaling system. Among the elements of intracellular signaling is Ca^{2+} which induces through intercellular contacts maturation, fertilization and embryonic development.One of the key factors that largely stimulate the biological activity of follicle stimulating hormone and luteinizing hormone are insulin like growth factor (IGF-1) and epidermal growth factor (EGF), the actions of which are not fully understood. **We proposed that using of combination of EGF and IGF-1 for IVM medium may have a positive effect on the restoration of gap junction between CCs and oocytes and inducing Ca^{2+} signals after denudation or cryopreservation and that could leads to meiosis resumption, improving of quantity and quality of mature oocytes and embryo development.** The results of these studies will give new insights into the functioning of CCs and oocytes gap junctions and their ability to recover after oocyte denudation and COCs cryopreservation. In addition, the results obtained will form the basis for modifying the maturation medium in order to increase the IVM efficiency. We assume that the use of two different methods of cryopreservation of cumulus cells and oocytes, followed by the restoration of intercellular contacts for maturation of oocytes, can significantly improve the IVM outcomes of cryopreserved oocytes. This approach has additional benefits to use not only autologous but also donor CCs for oocyte maturation in the co-culture system in case of patients with oocyte maturation failure. Such developments will help to greatly increase the chances of FFP, especially for cancer patient who can preserve their fertility until successful recovery to have chances of future motherhood.