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CoQ10 and Female Fertility Overview with References

The data offered here represent a brief and selective review of the published medical literature in regards to coenzyme Q10 (CoQ10) supplementation in women. While CoQ10 has been extensively studied in relation to sperm production and sperm quality in males, its effects on oocyte quality and female fertility have only recently come under investigation*. This overview has been prepared by Robert F. Casper, MD, Senior Investigator at the Samuel Lunenfeld Research Institute of Mount Sinai Hospital in Toronto, Canada, one of the forerunners of research into CoQ10's potentially beneficial effects on female fertility*. This overview is distributed by Fertility Nutraceuticals, LLC, with permission from Dr. Casper.

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Age-related decline in mitochondrial function

The mitochondrion is the "energy factory" of cells, supplying the essential metabolic energy to cells in the form of ATP. Age-related natural decline in mitochondrial function and accumulation of mitochondrial DNA (mtDNA) damage have been well documented in various types of cells, both in humans and animals, including in the context of reproduction[1,2,3]. For example, a mouse study found concomitant decline in fertility rates and reduction in mitochondrial abundance within oocytes[1]. The same study also showed distinct, age-associated changes in the structure of mitochondria[1]. mtDNA damage accumulates possibly as a result of continuous exposure to reactive oxygen species (ROS), generated through normal metabolism.

Role of mitochondria in oocyte maturation and fertilization

Oocytes contain the largest number of mitochondria and mtDNA in any cells, at least an order of magnitude higher than somatic cells[4]. Just like somatic cells, oocytes rely on mitochondria for energy supply. Immature oocytes already rely on ATP from mitochondria for energy; however, as oocytes move through the maturation process and fertilization, the energy demand of oocytes increases significantly[5]. Especially during meiosis, physical separation of chromosome pairs by the meiotic spindle requires a significant amount of energy.

This intense energy demand of oocytes during these critical developmental processes raises the possibility that the age-related decline in mitochondrial function leads to problems in oocyte maturation[5]. Specifically, it has been suggested that energy deficiency may lead to malformation of meiotic spindles, which then can result in embryo anueploidy[5,6,7]. Since most aneuploid embryos fail to implant or, if they do, end in miscarriages, this may be a factor in the typical reproductive difficulties experienced by older women[5].

Supplementation with mitochondrial nutrients

Based on these observations, researchers have suggested that supplementation with mitochondrial nutrients may be able to reduce the risk of embryo aneuploidy in older women through better energy availability for meiosis*[5,8]. CoQ10 is one such mitochondrial nutrient. CoQ10 is considered one of the most promising by many experts, because it plays an important role of electron transfer in the process of oxidative phosphorylation through which ATP is synthesized*[5,8].

CoQ10 also maintains mitochondrial membrane potential, and is a powerful cellular antioxidant*. These two functions of CoQ10 suggest the possibility that CoQ10 may also protect mtDNA from oxidative damage, supporting normal functions of mitochondria within gametes and somatic cells*[9,10].

CoQ10 supplementation to support healthy oocyte development and fertilization

A mouse study demonstrated that a moderate decline in CoQ10 levels, typical of an age-related decline, was associated with increased ROS production and cell death[11]. Studies in mice of older maternal ages have found similar results[12,13]. However, older mice, once supplemented with CoQ10, produced significantly more oocytes and their litter size was significantly larger than the control mice of the same age*[12,13].

In a study of bovine embryos, addition of non-crystalline CoQ10 to the culture media was found to support the development and viability of embryos*[14].

Based on these animal studies, a recent review hypothesized that some negative effects of reproductive aging may be overcome with supplementation with CoQ10*[15]. Supporting this hypothesis, a recent small-scale study in humans, measuring the levels of CoQ10 in follicular fluids of women undergoing IVF, found higher levels of CoQ10 in the follicular fluid in women with significantly higher rate of mature oocytes and higher grades of resulting embryos*[16].

Most of the studies of the beneficial effects of CoQ10 supplementation on oocyte quality, embryo ploidy and female fertility have been performed in animals, and application to humans requires caution*. A team of University of Toronto researchers led by Dr. Casper is currently planning a prospective, randomized, placebo-controlled trial to test the hypothesis in older women undergoing in vitro fertilization (IVF)[17].

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