Obesity-induced oocyte mitochondrial defects are partially prevented and rescued by supplementation with co-enzyme Q10 in a mouse model.

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STUDY QUESTION: Does supplementation with co-enzyme Q10 (CoQ10) improve the oocyte mitochondrial abnormalities associated with obesity in mice?

SUMMARY ANSWER: In an obese mouse model, CoQ10 improves the mitochondrial function of oocytes.

WHAT IS KNOWN ALREADY: Obesity impairs oocyte quality. Oocytes from mice fed a high-fat/high-sugar (HF/HS) diet have abnormalities in mitochondrial distribution and function and in meiotic progression.

STUDY DESIGN, SIZE, DURATION: Mice were randomly assigned to a normal, chow diet or an isocaloric HF/HS diet for 12 weeks. After 6 weeks on the diet, half of the mice receiving a normal diet and half of the mice receiving a HF/HS diet were randomly assigned to receive CoQ10 supplementation injections for the remaining 6 weeks.

PARTICIPANTS/MATERIALS, SETTING, METHODS: Dietary intervention was initiated on C57Bl6 female mice at 4 weeks of age, CoQ10 versus vehicle injections were assigned at 10 weeks, and assays were conducted at 16 weeks of age. Mice were super-ovulated, and oocytes were collected and stained to assess mitochondrial distribution, quantify reactive oxygen species (ROS), assess meiotic spindle formation, and measure metabolites. In vitro fertilization was performed, and blastocyst embryos were transferred into control mice. Oocyte number, fertilization rate, blastulation rate and implantation rate were compared between the four cohorts. Bivariate statistics were performed appropriately.

MAIN RESULTS AND THE ROLE OF CHANCE: HF/HS mice weighed significantly more than normal diet mice (29 versus 22 g, P< 0.001). CoQ10 supplementation did not influence weight. Levels of ATP, citrate, and phosphocreatine were lower and ROS levels were higher in HF/HS mice than in controls (P< 0.001). CoQ10 supplementation significantly increased the levels of metabolites and decreased ROS levels in oocytes from normal diet mice but not in oocytes from HF/HS mice. However, CoQ10 completely prevented the mitochondrial distribution abnormalities observed in the HF/HS mice. Overall, CoQ10 supplementation significantly increased the percentage of normal spindle and chromosome alignment (92.3 versus 80.2%, P= 0.039). In the sub-analysis by diet, the difference did not reach statistical significance. When undergoing IVF, there were no statistically significant differences in the number of mature oocytes, the fertilization rate, blastocyst formation rates, implantation rates, resorption rates or litter size between HF/HS mice receiving CoQ10 or vehicle injections. Experiments were limited to one species and strain of mice. The majority of experiments were performed after ovulation induction, which may not represent natural cycle fertility.

WIDER IMPLICATIONS OF THE FINDINGS: Improvement in oocyte mitochondrial distribution and function of normal, chow-fed mice and HF/HS-fed mice demonstrates the importance of CoQ10 and the efficiency of the mitochondrial respiratory chain in oocyte competence. Clinical studies are now needed to evaluate the therapeutic potential of CoQ10 in women's reproductive health.

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