Nanoparticles and the ovary function: the negative effects on the follicular development and ovulation

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The continued increase in the application of nanoparticles (NPs) in many aspects of life is currently raising significant health concerns. Nowadays, NPs can be found not only in drug delivery systems and in clinical therapy but also in various daily used products such as cosmetics, clothes and food. Therefore, in addition to intentional application in medicine, the dermal, pulmonary, and gastrointestinal exposures are considered the three main exposure routes. The negative impact of NPs on human health depends among others from the properties of NPs such as shape, size, structure, dosage, material, surface-coating etc. [1]. It is well known that many types of NPs are able to pass certain biological barriers and exert toxic effects on various organs, such as the brain, liver, kidney and also ovary [2]. The recent evidences show that NP accumulation damages the physiology of the ovary by disrupting follicular development and ovulation process during the ovarian cycle [3]. The ovarian cycle is characterized by regularly repeating patterns of cellular proliferation, differentiation and transformation that accompanies follicular development, maturation and ovulation during the folliculo-luteal transition and corpus lutem formation [4,5]. Therefore any negative effect of NP in each of these physiological stages of ovarian function will cause irreparable damage to the reproductive processes, thus causing temporary or permanent infertility of various species. The possible molecular mechanisms of NTs cytotoxicity in the ovary tissue include inflammation, oxidative stress, apoptosis etc. [2]. There are evidences showing that NPs can enter both follicle cell types (theca and granulosa), affecting their normal function (steroid hormone production), particularly before ovulation [6]. In addition, there are clear evidences that exposure to specific NP can significantly alter levels of gonadotrophins (GnRH, LH, FSH) and steroid hormones (progesterone, testosterone, estradiol), that causes follicle atresia and anovulation, resulting in reduced fertility [7]. In conclusion this contribution will offer a comprehensive overview on the current state of knowledge regarding potential adverse effects of NPs on the ovary function. In addition, an improved understanding of the molecular mechanisms of NT toxicity during follicle development and ovulation has an obviously important implication for the reproductive health and regulation of fertility.

References

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