Summary

The influence of selected environmental pollutants on gametogenesis and early embryonic development

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Idiopatic infertility is a serious problem, which can be caused by exposure to endocrine disruptors, e.g. bisphenols. Bisphenol A, the most widely used bisphenol, is now being replaced in manufacturing processes due to its toxicity by its analogues, bisphenol S and F. While most of the scientific experiments examine the effect of toxic doses after direct exposure, this study provides results for exposure to real low doses after direct and indirect exposure. We assumed a negative effect of direct and indirect exposure to low doses of alternative bisphenols BPS and BPF on male and female reproduction at the level of gametes and embryos. The aim of this work is to evaluate the effect of direct exposure to mouse oocytes and sperm, to evaluate the effect of indirect exposure through breast milk to mouse oocytes, sperm, testicular tissue and the extent of damage to early embryonic development. Experimental ICR laboratory mice were exposed to low doses of bisphenols directly via drinking water or an oral gavage, or indirectly through the breast milk. Direct exposure to low doses of bisphenols affects the reproductive abilities of females mainly by malformations of the dividing spindle of oocytes, reduced genome stability and epigenetic modifications during meiotic maturation of oocytes. Similar manifestations are observed with indirect exposure via breast milk, such as increased oocyte's dividing spindle malformations, decreased markers of heterochromatin, and decreased developmental competence of oocytes. In males, direct exposure reduces sperm motility, increases protein acetylation and increases DNA double-stranded breaks in testicular tissue. Indirect exposure via breast milk increases the incidence of DNA double-stranded breaks in spermatozoa, and this damage is transmitted by fertilization to zygotes and subsequently to blastocysts. The results indicate that the possible mechanism of the negative effect is damage to the hemotesticular barrier and subsequently spermiogenesis. These results also indicate, that alternative bisphenols are not safe replacement and can be a cause of idiopathic infertility in both sexes. In addition, our work provides knowledge about the quality of gametes and the mechanisms that determine the success of early embryonic development.