Third Laureate
Applied Research

Project title: Impact of sperm DNA damage in induction of chromosomal abnormalities during fertilization and embryogenesis: Role of antioxidants

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Abstract:

Human sperm carry half of the genetic material to the next generation. Sperm abnormal DNA will be seen in the forms of premature condensation, strand breakage and chromosomal abnormalities. Deficient sperm nuclear materials can be considered for the growing male infertility expressed as decline in sperm counts and quality due to exposure to chemicals, air pollution and natural and manmade ionizing radiation. In this research, effects of defective sperm nuclear materials on failed fertilized oocytes, chromosomal variations in preimplantation embryos, rate of DNA damage and chromosomal aneuploidy in sperms of healthy controls and subfertile individuals, correlation of DNA damage in spermatogenesis cycle with transgenerational chromosomal abnormalities in laboratory animals was investigated. Also it has been shown that some antioxidants can reduce transgenerational genetic damages to embryos. To carry out these experiments, various cytogenetic techniques such as metaphase analysis, micronuclei assay, sperm chromosomal assay using zona free golden hamster oocyte, fluorescence in situ hybridization (FISH), primed in situ labeling (PRINS), comet assay for DNA damage and Tarkowski technique for oocyte chromosome preparation. DNA damage was induced using a cobalt-60 gamma generator at various stages of spermatogenesis cycle. Also, chemotherapy agents were used to induce DNA damage in sperms in vitro. Antioxidants used in this study were, vitamin C, vitamin E and famotidine; all have been shown to be potent radical scavengers. Results show that higher degree of DNA damage lead to higher frequency of chromosomal abnormalities during fertilization and embryogenesis. Use of antioxidants could improve sperm count and reduced frequency of transgenerational chromosomal abnormalities. Data indicates that the rate of DNA damage and chromosomal aneuploidy, more specifically sex chromosomes in sperms well correlates with the degree of subfertility of men. Therefore adapting strategies to reduce DNA damage in gametes, especially in sperms, could eventually lead to reduced genetic abnormalities and cancer incidence in population.