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JOURNAL ARTICLE

Evidence for increased lipid peroxidative damage and loss of superoxide dismutase activity as a mode of sublethal cryodamage to human sperm during cryopreservation

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Cryopreservation of human sperm, now generally required in donor insemination programs, adversely affects the sperm in terms of standard sperm evaluation parameters and fertilizing ability. The freeze-thaw process appears to produce sublethal damage that appears only after a delay. The authors hypothesized that cryopreservation enhanced peroxidation of sperm membrane lipids, based on previous studies of sperm lipid peroxidation, which showed that the effects of peroxidative damage became evident only after a delay, depending on the peroxidation rate. The effect of cryopreservation on the phospholipid content, the composition of the acyl moieties of the phospholipids, and the activities of the peroxidation protective enzymes, superoxide dismutase (SOD) and glutathione peroxidase plus reductase, in human sperm were examined to test the hypothesis. Parallel determinations were made of the percent motility, the average path velocity of the motile cells, and the time to loss of motility under specified aerobic incubation conditions, which gives a good estimate of the lipid peroxidation rate. The phospholipid content decreases after cryopreservation, with loss of phosphatidylcholine and phosphatidylethanolamine being the more pronounced. Polyunsaturated acyl moieties were also preferentially lost. This loss pattern is observed also from lipid peroxidation. The activities of glutathione peroxidase plus reductase remained unchanged. The sperm SOD activities varied widely between samples before cryopreservation. In all samples there was a decline in SOD activity after freeze-thaw, but the extent of the decline was also widely variable. The time to loss of motility declined in parallel with SOD activity, and a strong correlation (R2 greater than 0.9) between SOD activity and time to loss of motility was found for all samples, before and after freeze-thaw. The authors conclude that cryopreservation does enhance lipid peroxidation in human sperm, as hypothesized, and that this enhancement is mediated at least in part by the loss of SOD activity occurring during the process.

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