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## JOURNAL ARTICLE

# Reactive oxygen species and human spermatozoa. I. Effects on the motility of intact spermatozoa and on sperm axonemes

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Mammalian spermatozoa are sensitive to oxygen-induced damages mediated by lipid peroxidation of the cell membrane. The aim of this study was to evaluate whether reactive oxygen species (ROS) could also induce axonemal damage. When Percoll-separated spermatozoa were treated with hydrogen peroxide, or the combination xanthine and xanthine oxidase (X + XO), there was a progressive decrease, leading to a complete arrest, in sperm flagellar beat frequency. Once demembrated in a medium containing magnesium adenosine triphosphate (Mg.ATP), ROS-immobilized spermatozoa still reactivated motility; however, the percentage and duration of motility obtained in these tests gradually decreased to zero in the next hour. In 50% of the cases, motility of intact spermatozoa spontaneously reinitiated after 6 to 24 hours of immobilization due to ROS treatment, although with percentages and beat frequencies lower than those of untreated spermatozoa. Studies using ROS scavengers (such as catalase, superoxide dismutase, and dimethyl sulfoxide) indicated that hydrogen peroxide was the most toxic of the ROS involved, but that  $\cdot\text{O}_2^-$  and  $\cdot\text{OH}$  probably also played a role in immobilization of spermatozoa by ROS. The data suggest that ROS induce a chain of events leading to sperm immobilization, that axonemes are affected, and that limited endogenous repair mechanisms exist to reverse these damages.

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H. Tatemoto, N. Sakurai, and N. Muto

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