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Trisialoganglioside GT1b Prevents Increase in Sperm Membrane Molecular Ordering Induced by In Vitro Lipid Peroxidation

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The effect of various types of gangliosides, the sialic acid-containing glycosphingolipids, on human sperm membrane during lipid peroxidation induced by Fe²⁺/ascorbate ions was investigated. The monosialoganglioside (GM1), disialogangliosides (GD1a and GD1b), and trisialoganglioside (GT1b) were examined at a concentration of 100 μM, which was above their respective critical micellar concentrations. Lipid peroxidation was determined by quantification of malondialdehyde (MDA) concentration. The molecular orientational order in the membrane was assessed by fluorescence spectroscopy and electron paramagnetic resonance spectroscopy. Both approaches revealed a significant increase in membrane rigidity following oxidation, which correlated with an increase in the MDA level. The preincubation of spermatozoa with GM1 and GD1a did not have any effect on induced lipid peroxidation. In the presence of GD1b and GT1b, a reduced formation of MDA and a decrease in membrane rigidity was detected. The inhibitory effect of GT1b micelles toward membrane oxidation damage was found to be greater than that of GD1b. In conclusion, a direct relationship between the reduced content of the accumulated MDA and the longer preservation of the native-like membrane molecular ordering during sperm oxidation in the presence of GT1b suggests its protective effect. This phenomenon could be due to the specific GT1b conformation and its negative surface potential.

Key words: Membrane rigidity, gangliosides, spermatozoa

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