

Early steps of sperm-egg interactions during mammalian fertilization

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Abstract

Mammalian eggs are surrounded by two egg coats: the cumulus oophorus and the zona pellucida, which is an extracellular matrix composed of sulfated glycoproteins. The first association of the spermatozoon with the zona pellucida occurs between the zona glycoprotein, ZP3 and sperm receptors, located at the sperm plasma membrane, such as the 95kDa tyrosine kinase-protein. This association induces the acrosome reaction and exposes the proacrosin/acrosin system. Proacrosin transforms itself, by autoactivation, into the proteolytical active form: acrosin. This is a serine protease that has been shown to be involved in secondary binding of spermatozoa to the zona pellucida and in the penetration of mammalian spermatozoa through it. The zona pellucida is a specific and natural substrate for acrosin and its hydrolysis and fertilization can be inhibited by antiacrosin monoclonal antibodies. Moreover, *in vitro* fertilization experiments, trypsin inhibitors significantly inhibits fertilization. The use of the silver-enhanced immunogold technique has allowed immunolocalization of the proacrosin/acrosin system in spermatozoa after the occurrence of the acrosome reaction. This system remains associated to the surface of the inner acrosomal membrane for several hours in human, rabbit and guinea-pig spermatozoa while in the hamster it is rapidly lost. In the hamster, the loss of acrosin parallels the capability of the sperm to cross the zona pellucida. Rabbit perivitelline spermatozoa can fertilize freshly ovulated rabbit eggs and retain acrosin in the equatorial and postacrosomal region. These spermatozoa also show digestion halos on gelatin plates that can be inhibited by trypsin inhibitors. This evidence strongly suggests the involvement of acrosin in sperm penetration through the mammalian zona. Recently it was shown, however, that acrosin would not be essential for fertilization. It is likely, then, that such an important phenomenon in the mammalian reproductive cycle would be ensured though several alternative mechanisms.