The cation channel of sperm modulates boar sperm motility during capacitation

The male gamete, the spermatozoon, is a highly specialized cell with a trimmed shape, far from the original cells of origin in the testicles. Their primary function is to deliver the paternal gene component of the new embryo to the maternal gamete; the oocyte. These genes are highly packed in a tiny nucleus in the sperm head, so that they are protected during transport (or handling, including freezing of the cells) until they are unpacked at fertilization. Several other components are seen in these special cells, as a tail that warrants directional motility, mitochondria that provide energy for the cell, an acrosome that contains enzymes to debilitate the surrounding protein vestment of the oocyte (the zona pellucida, ZP) and a plasma membrane covering the entire cell. At ejaculation, spermatozoa that were quiet in the epididymis, start moving and reacting to the environments they find along their transport through the female genital tract (e.g from the vagina/cervix to the oviduct where fertilization occurs). These interactions with fluids and cells of the female prepare the spermatozoa for fertilization, via chemical processes called “capacitation” and the following encounter of the sperm membrane with the ZP, where the acrosome enzymes are delivered. Both processes are activated by salts: bicarbonate (HCO_3^-) and particularly calcium (Ca^{2+}) whose levels increase into the spermatozoon and cause the cell to change motility pattern from forward to hyperactivated (forceful) which will aid the spermatozoon to penetrate through the viscous fluids close to the oocyte and to mechanically penetrate the already enzyme-debilitated ZP.

Such relevant influx of Ca^{2+} into the sperm cell is regulated via the so-called Cation Channel of Sperm or “CatSper” the main membrane Ca^{2+} channel. The Catsper is composed by four subunits and in this study the presence, distribution and function of the four subunits of the CatSper were studied in ejaculated boar spermatozoa.

All four CatSper subunits were present, mostly localized over the sperm neck, tail and cytoplasmic droplets. The relation of the CatSper channel with sperm capacitation and sperm motility was studied in media containing different Ca^{2+} availability, exposed to bicarbonate, to progesterone or challenged by CatSper inhibitors (mibefradil and NNC 55-0396) at different concentration and exposure times and both dose-response and time effects were studied. The experiments showed that an increase in Ca^{2+} availability in the presence of bicarbonate appear to initiate sperm capacitation, hyperactivation and acrosome exocytosis. However, neither bicarbonate nor progesterone acted as specific CatSper inducers (agonists). On the other hand, mibefradil and NNC 55-0396 acted as specific CatSper antagonists effectively blocking the CatSper channel in capacitated spermatozoa.

In conclusion, the CatSper channel is present in boar spermatozoa being involved in the regulation of key processes for fertilization such us sperm capacitation, sperm motility and acrosomal exocytosis.

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