HyperSperm, a New Sperm Preparation Method for In Vitro Fertilization (IVF), Improves Sperm Capacitation, Increasing the Number of High-Quality Blastocysts in Mice.

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In vitro fertilization (IVF) treatments often result in low numbers of high-quality embryos, leading to the need for repeated treatments. While most approaches to improve IVF focus on oocytes and embryos, there is increasing evidence that sperm plays a fundamental role in embryo development. HyperSperm is a novel sperm preparation method based on biomimicking sperm capacitation, a process that naturally occurs inside the female reproductive tract.

This prospective experimental study aimed to test whether HyperSperm could provide improved capacitation parameters in semen samples from mice. Further, fertilization and embryo development were assessed both in vitro and in vivo in a mouse model of IVF, using 3-10 animals in each set of experiments.

Sperm were either incubated in control conditions (TYH-HEPES medium) or treated with HyperSperm. Sperm motility and kinematic parameters were assessed by Computer-Aided Sperm Analysis (CASA), and acrosome integrity by flow cytometry. Fertilized eggs from IVF experiments were cultured in KSOM, and resulting blastocysts were transferred to pseudo-pregnant females. The number of implanted fetuses at day 7 and of pups born were recorded. Statistical differences were determined by paired T-test, with significance set at $p<0.05$.

Hyperactivated motility, a key hallmark of capacitation, was significantly higher in HyperSperm group compared to Control (19.1±3.2% vs 8.8±0.2%; p=0.032; n=3). HyperSperm-treated sperm exhibited higher fertilization rates compared to Control, as the percentage of 2-cell embryos (162/215 vs 112/231 2-cell embryos/eggs; 71.9±6.4% vs 51.9±5.5%; p=0.032; n=10), and gave rise to higher embryo development rates (144/162 vs 75/112 blastocysts/fertilized eggs; 85.1±5.8% vs 65.1±6.2%; p=0.029; n=10). Once transferred, blastocysts derived from HyperSperm produced more implantation sites (31/43 vs 39/66 implantation sites at day 7/blastocysts transferred; 76.0±11.2% vs 48.7±10.3%; n=7), resulting in significantly higher litter sizes (16/39 vs 5/57 pups born/blastocysts transferred; 41.1±4.2% vs 8.3±5.4%; p=0.013; n=5). In terms of safety, HyperSperm treatment did not result in a decrease in sperm motility (83.5±1.1% vs 85.7±2.5%; p>0.05; n=3), and the percentage of sperm with intact acrosomes was similar between groups (37.8±4.6% vs 33.6±5.7%; p>0.05; n=3).

Overall, HyperSperm treatment enhances sperm capacitation, fertilizing ability, and embryo development, leading to an increased yield of term pups while maintaining a high safety profile. These findings underscore its potential to influence pre and post-implantation embryo development, and to improve IVF results on a per treatment basis.