REPRODUCTIVE SOLUTIONS

6 Physiological and Biochemical Assessment of a New Semen Collection Device

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OBJECTIVE

Semen quality is a key factor in determining the outcome of most infertility treatments. Previously, this lab demonstrated that a modification of the collection container, known as the device for improved semen collection (DISC), resulted in significant improvement in semen quality. Studies in two animal species suggested improved semen parameters and increased pregnancy rates. The objective of the study was to assess the effectiveness of a clinical-grade version of the DISC on sperm cell function and biochemistry prior to clinical trials.

DESIGN

A laboratory-based, controlled trial.

MATERIALS AND METHODS

Nine donors supplied three samples each collected in a standard specimen cup (SSC), the DISC, or the DISC with 1 mL of media. Following collection, each sample was processed using a simple sperm washing technique and then placed in culture for 24 hours. At predetermined intervals, aliquots were taken for standard semen analysis using an IVOS and biochemical assessment, including intactness of acrosomal membranes, lipid peroxidation level, mitochondrial membrane potential, and DNA fragmentation. Resulting data were subjected to ANOVA with repeated measures.

RESULTS

All parameters from semen collected in the DISC were either equivalent or superior to semen collected in the SSC. Specifically, samples collected in the DISC and/or DISC+ had higher rates of cell viability ($p < 0.005$), progressive velocity ($p < 0.05$) and motility index ($p < 0.034$) compared to the SSC and trended toward higher motility rates ($p = 0.066$) and path velocities ($p = 0.061$). Further, cells collected in the DISC had more intact acrosomes ($p < 0.017$) and retained higher mitochondrial membrane potential ($p < 0.004$) over the 24-hour period compared to the SSC.

CONCLUSIONS

Semen collected in the clinical-grade DISC appears to have superior physiological activity and biochemical stability compared to semen collected in the SSC. Clinical trials are ongoing to assess the usefulness of the DISC in the clinical environment.

SUPPORTED BY

TTU Office of Commercialization.

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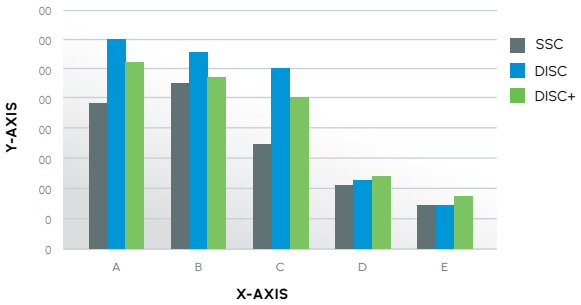
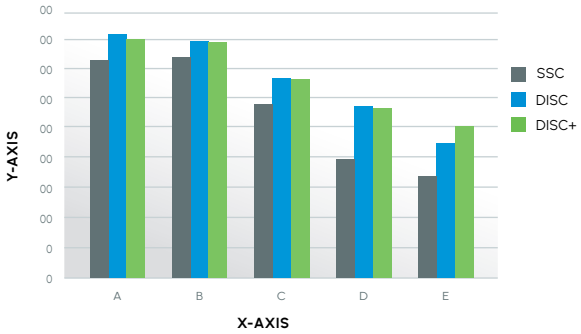
FIGURE 1 Motility Index Over Time



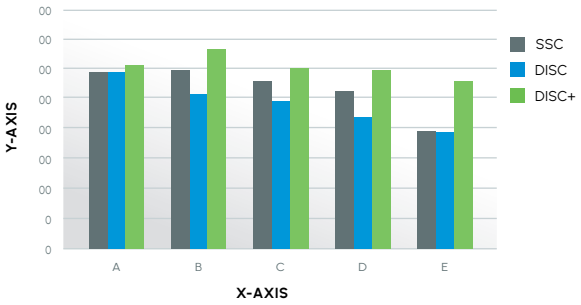
The motility index is a combination of the quantity of movement (motility) and quality of movement (Progressive velocity). The motility index was higher for spermatozoa collected in the DISC ($p < 0.034$) than for spermatozoa collected in the DISC+ ($p = 0.251$) or the SSC ($p = 0.662$)

FIGURE 2 Cell Viability Over Time



As would be expected, viability decreased over time ($p < 0.001$) in all treatments. More cells remained viable when collected in the DISC ($p < 0.005$) or the DISC+ ($p < 0.004$) in comparison to spermatozoa collected in the SSC. It is important to note that more cells were viable at all time points than the number of motile cells, indicating that there are a pool of viable cells present that are non-motile.

FIGURE 3 Mitochondrial Membrane Potential



Mitchondrial membrane potential would be another means to assess cellular health in ex vivo preparations of sperm cells post collection. Cells with the greatest membrane potential are equated to those being the healthiest in the preparation.

The number of cells with high mitochondrial membrane potential was greater in samples collection in the DISC+ ($p < 0.004$), than in the samples collected in either the DISC ($p = 0.121$) or in the SSC ($p = 0.385$)

INSIGHTS

While standard semen analysis parameters like motility are excellent indicators for sperm health, it can be misleading because motile sperm especially hyper-motile sperm are already going through the biochemical processes needed for fertilization while also going down a parallel path to apoptosis. It was necessary to evaluate sperm at a biochemical level, in this study sperm samples were collected in three treatments by human volunteers.

The three treatments were standard specimen cup, a dry ProteX, and a ProteX with 1 mL of sperm culture media, in this case Ham's F-10. Across 24 hours of incubation, the samples collected in ProteX with or without media had better biochemical health, as indicated by cellular and mitochondrial membrane integrity.