Review Article

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Sperm Selection in Assisted Reproduction Techniques: Short Review

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ABSTRACT

Quality of sperm is a critical factor to success in terms of pregnancy rates in assisted reproduction treatments (ART). There is an increasing interest in improving procedures of sperm selection before in vitro fertilization with or without intracytoplasmic sperm injection. And since DNA abnormalities are known to have negative correlation with ART outcomes, novel approaches in sperm laboratory techniques are involved in select cells with normal DNA.

Keywords: *Sperm Selection; Assisted Reproduction Techniques; DNA Damage; DNA Fragmentation; Apoptosis; in Vitro Fertilization*

Introduction

In the last two decades, assisted reproductive technologies (ART) have become the treatment of choice in many cases of infertility and, although the continuous development of these techniques has brought a significant improvement in the overall final outcome of reproductive medicine, there is still a significant number of unsuccessful cases in which repeated attempts are needed before pregnancy is achieved, or in which couples remain childless [1].

Studies of infertile couples have demonstrated that male factor plays a major role and that is the reason why the basic semen analysis is one of the most relevant test used in this evaluation. The quality of semen is mainly based on the assessment of sperm concentration, motility and morphology, according to World Health Organization (WHO) [2]. Nevertheless, WHO values for semen evaluation are just a reference and may fail, and this is the reason why a significant proportion of patients exhibiting normal semen parameters values have unexplained infertility.

Procedures that could improve sperm selection are needed.

Discussion

The main objective of laboratory techniques for sperm preparation is to obtain a suitable number of viable, motile, and functional spermatozoa. Currently, the most frequently used are swim-up and density gradient centrifugation. All of these techniques select sperm according to motility characteristics without taking into account their molecular features, despite several studies have demonstrated the relevance of certain molecular profiles for reproductive success [3].

Novel approaches such as electrophoretic separation and magnetic cell separation have demonstrated encouraging results for the isolation of spermatozoa with superior quality [4] although its mode of action does not include the identification of apoptotic markers in spermatozoa.

Another essential aspect in the study of sperm quality is evaluation of the spermatozoa DNA integrity. Intact human sperm DNA is necessary for successful fertilization, embryo development, full expression of male fertility potential and probability to achieve pregnancy in natural conception, as well as in ART [5].

It has not been easy to evaluate DNA integrity. For example, detection of DNA strand breaks or the level of protamination and compaction of the chromatin [6] are methods that destroy the sperm. Nevertheless, recent noninvasive methods have been developed to select sperm free of DNA damage for clinical use.

One example is the application of morphologically selected sperm (IMSI), which uses motile sperm organelle morphological examination (MSOME), and it has shown its effectiveness only in increasing the clinical pregnancy and live birth rates in cases of recurrent implantation failure [7].

Another technique described is isolation of mature sperm by detecting hyaluronic acid (HA) in sperm surface binding sites but this method has provided no clinical or embryological successes [8].

A new method for selection of spermatozoa has been proposed, Magnetic Activated Cell Sorting (MACS). This technique employs several types of nanobeads particles and magnetic microbeads conjugated to proteins or antibodies to tag cells of interest.

Key features of activated apoptosis are activation of caspase-3, increase abnormalities such as sperm DNA

fragmentation [9,10], disruption of the mitochondrial transmembrane potential, loss of membrane integrity and, finally, phospholipid phosphatidylserine (PS) externalization, all events directly linked to failure of fertilization, clinical pregnancy and pregnancy loss during assisted reproduction treatments

Increased levels of sperm cells that show apoptotic markers are detected in the ejaculate of infertile males, and suboptimal ART success rates have been attributed, at least in part, to the lack of in vivo sperm selection criteria that avoid or eliminate apoptotic spermatozoa [11, 12].

Conclusion

Unlike what happens with oocytes, the spermatozoa are usually present in tens of thousands or several millions per ejaculate, each one with different molecular characteristics that result from a complex process which involves a series of meiosis and mitosis, changes in cytoplasmic architecture, replacement of somatic cell histones with transition proteins, and the final addition of protamines. Alterations in the spermatogenic events result in the release of immature, abnormal spermatozoa in the ejaculate that can affect de outcomes in ART.

Accurate sperm selection should be considered as one of the essential steps to guarantee success in infertile couple's treatments.

References

1. Malizia BA, Hacker MR, Penzias AS. 2009. Cumulative live-birth rates after in vitro fertilization. N Engl J Med 360(3):236-43.
2. World Health Organization, Department of Reproductive Health and Research. 2010. WHO laboratory manual for the examination and processing of human semen.. (Fifth edition).
3. García-Herrero S, Garrido N, Martinez-Conejero JA, Remohi J, Pellicer A, Meseguer M. 2011. Differential transcriptomic profile in spermatozoa achieving pregnancy or not via ICSI. Reprod Biomed Online 22(1):25-36.
4. Ainsworth C, Nixon B, Aitken RJ. 2005. Development of a novel electrophoretic system for the isolation of human spermatozoa. Hum Reprod 20(8):2261-70.
5. Seli E, Gardner DK, Schoolcraft WB, Moffatt O, Sakkas D. 2004. Extent of nuclear DNA damage in ejaculated spermatozoa impacts on blastocyst development after in vitro fertilization. Fertil Steril 82(2):378-83.
6. Tavalaee M, Razavi S, Nasr-Esfahani MH. 2009. Influence of sperm chromatin anomalies on assisted reproductive technology outcome. Fertil Steril 91(4):1119-26
7. Boitrelle F, Guthauser B, Alter L, Bailly M, Bergere M, Wainer R, Vialard F, Albert M, Selva J. 2014. High-magnification selection of spermatozoa prior to oocyte injection: Confirmed and potential indications. Reprod Biomed Online 28(1):6-13.
8. Tarozzi N, Nadalini M, Bizzaro D, Serrao L, Fava L, Scaravelli G, Borini A. 2009. Sperm-hyaluronan-binding assay: Clinical value in conventional IVF under italian law. Reprod Biomed Online 19 Suppl 3:35-43.
9. Evenson DP, Larson KL, Jost LK. 2002. Sperm chromatin structure assay: Its clinical use for detecting sperm DNA fragmentation in male infertility and comparisons with other techniques. J Androl 23(1):25-43.
10. Tarozzi N, Bizzaro D, Flamigni C, Borini A. 2007. Clinical relevance of sperm DNA damage in assisted reproduction. Reprod Biomed Online 14(6):746-57.
11. Cayli S, Sakkas D, Vigue L, Demir R, Huszar G. 2004. Cellular maturity and apoptosis in human sperm: Creatine kinase, caspase-3 and bcl-XL levels in mature and diminished maturity sperm. Mol Hum Reprod 10(5):365-72.
12. Said TM, Agarwal A, Zborowski M, Grunewald S, Glander HJ, Paasch U. 2008. Utility of magnetic cell separation as a molecular sperm preparation technique. J Androl 29(2):134-42.

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