

APOPTOSIS IN SPERMATOZOA AND ITS ROLE IN MALE INFERTILITY

Jaxongirov Raxmatilla

Assistant, Department of Natural Sciences, Faculty of Medicine, Ma'mun University

Abstract: *This thesis analyzes the process of apoptosis in spermatozoa, its molecular mechanisms, and its role in male infertility. Apoptosis is a genetically programmed form of cell death that plays an important role in maintaining cellular homeostasis during spermatogenesis. Through this process, abnormal and DNA-damaged germ cells are eliminated. However, excessive apoptosis may negatively affect sperm quality and contribute to impaired male fertility.*

Keywords: *apoptosis, spermatozoa, spermatogenesis, DNA fragmentation, male infertility, oxidative stress.*

Introduction

Male infertility is considered one of the major reproductive health problems worldwide. In recent years, increasing attention has been given to the functional and genetic characteristics of spermatozoa. In this context, apoptosis is regarded as an important factor influencing sperm quality and male reproductive potential.

Main Part

Apoptosis plays a physiological role during spermatogenesis by eliminating excessive and abnormal germ cells and maintaining cellular homeostasis. The apoptotic process occurs mainly through two pathways: the intrinsic mitochondrial pathway and the extrinsic receptor-mediated pathway. In the intrinsic pathway, mitochondrial dysfunction leads to the release of cytochrome c, followed by activation of the caspase cascade. The extrinsic pathway is primarily mediated through death receptors, including Fas receptors, which initiate apoptotic signaling.

Under pathological conditions, including oxidative stress, varicocele, infections, hormonal disorders, smoking, alcohol consumption, and exposure to toxic substances, excessive apoptotic activity may occur. Increased apoptosis can be associated with sperm DNA fragmentation, mitochondrial dysfunction, and alterations in the sperm plasma membrane. Consequently, sperm motility, viability, and fertilization potential may be reduced.

Results and Discussion

Numerous studies have demonstrated an association between increased apoptosis-related changes in spermatozoa and male infertility. In particular, elevated sperm DNA fragmentation has been associated with reduced reproductive potential and may negatively influence the outcomes of assisted reproductive technologies. Oxidative stress is considered one of the important mechanisms contributing to sperm DNA damage and apoptosis-like changes in spermatozoa.

Therefore, assessment of apoptosis-related biomarkers and sperm DNA integrity may provide additional information for evaluating male reproductive function. Such approaches may be particularly useful in patients with unexplained infertility or abnormal semen parameters.

Conclusion

Although apoptosis is a physiologically necessary process during spermatogenesis, excessive apoptotic activity and apoptosis-associated cellular damage may contribute to male infertility. Evaluation of sperm apoptosis, mitochondrial function, and DNA integrity may therefore have important diagnostic and prognostic value in reproductive medicine. Further studies are needed to clarify the molecular mechanisms linking apoptosis, oxidative stress, and sperm dysfunction and to develop effective diagnostic and therapeutic strategies.

REFERENCES:

1. Agarwal A., et al. Role of oxidative stress in male infertility.
2. Sakkas D., Alvarez J.G. Sperm DNA fragmentation: mechanisms and clinical significance.
3. Aitken R.J., Baker M.A. Oxidative stress and male reproductive biology.
4. World Health Organization. WHO laboratory manual for the examination of human semen.
5. Shukla K.K., et al. *Apoptosis in human spermatozoa: molecular mechanisms and clinical significance*. Andrologia, 2018.
6. Smith R., et al. *DNA integrity in sperm and male fertility*. Human Reproduction Update, 2017.