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Commentary

Sperm DNA Fragmentation: An Analysis on its Occurrence and Infertility Risk

Sumati Paliwal*

Department of Pharmacy, The Maharaja Sayajirao University of Baroda, India

INTRODUCTION

Significance of sperm genetic health

The primary function of sperm is to transport genetic material (DNA) from one biological parent and mix it with genetic material present within the egg of the other biological parent, resulting in a unique genetic code for the offspring. Take a look at sperm's structure. The majority of the cell's space is devoted to its head, where chromosomes DNA molecules - are tightly coiled into a nucleus. The purpose of the neck and tail is to allow the sperm to transport its valuable "cargo" as efficiently as possible.

Because DNA contains all of the instructions for the development of an embryo, it's no surprise that sperm genetic integrity is a major factor in fertility. Damage to the DNA in sperm can make it difficult for the sperm to fertilize an egg or develop into a healthy, thriving embryo. The problem with sperm DNA fragmentation is just that [1].

Other semen characteristics and sperm quality metrics, such as sperm count, motility, and morphology, are less frequently tested and typically less well understood than sperm DNA fragmentation. However, as more study on the link between sperm DNA fragmentation and birth rates emerges, researchers are beginning to believe that sperm genetic integrity may be one of the most critical determinants in male fertility.

What is sperm DNA fragmentation and how does it happen?

To comprehend sperm DNA fragmentation, we must first comprehend the appropriate structure of DNA. A "double helix" is a lengthy, spiral staircase-like structure that organizes DNA. The steps of the staircase are built up of nucleotide pairs; the varied combinations of these base pairs are what give each organism its own genetic sequence. The nucleotides are linked together as well as to the long strands of sugars and phosphates that make up the staircase's "railings."

Chromosomes are structures that contain DNA. While the majority of human cells have 46 chromosomes, sex cells or "gametes" (eggs and sperm) only have 23. When they come together, they form a fully developed creature with the correct number of chromosomes [2].

A modification or loss of bases, or a break or split in one or both strands of DNA contained inside sperm, is referred to as sperm DNA fragmentation. This damage can happen at any moment during the sperm's life cycle: when it's being made in the testicles through a process called spermatogenesis, while it's in "storage" in the epididymis before to ejaculation, or even after ejaculation.

Natural repair of sperm DNA fragmentation

Although DNA damage is rather common in the human body, most cells are capable of detecting and correcting damage to their own genetic code. While immature sperm in the process of maturation may have some potential to repair their own DNA, mature sperm do not [3].

Eggs can compensate for this in some ways, and after fertilization, they have their own systems for repairing sperm DNA mistakes. However, if the damage is too severe - or if the egg is unable to repair it owing to age the harm can persist until the embryo stage. The embryo may fail to develop or implant, resulting in infertility, miscarriage (which may occur again), or genetic defects or sickness in the baby.

Male fertility and sperm DNA fragmentation

First and foremost, males with sperm DNA fragmentation can undoubtedly conceive. Researchers emphasize that full-term pregnancies have been produced even in studies that indicate lower pregnancy rates, longer time to conception, or greater miscarriage rates among males with a high DNA fragmentation index.

Men with high rates of sperm DNA fragmentation, however, are at an elevated risk of infertility, according to research. In one study, men who had been unable to conceive for a year or more presented for infertility evaluation had over twice as much sperm with DNA fragmentation than fertile males (27.6 percent vs. 13.3%) [4,5]. In another study, infertile or miscarrying couples were more likely to have a male partner with moderate or high levels of DNA fragmentation; the researchers found that “spermatozoa with denatured DNA... were the strongest predictor for whether a pair would not achieve pregnancy.”

***Correspondence to:** Sumati Paliwal, Department of Pharmacy, The Maharaja Sayajirao University of Baroda, India, E-mail: sumatipaliwal02@hotmail.com

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