Ultrastructural Changes in the Spermatozoa of Infertile Men"

İNFERTİL ERKEKLERİN SPERMATOZOONLARINDA İNCE YAPI DEĞİŞİKLİKLERİ

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Summary

Existence of a variety of spermatozoa defects and developmental abnormalities are the causes of male infertility which can not be always identifiable by conventional methods of semen analysis. The ability of sperm to perform functions that are essential for a positive reproductive outcome depends on the structural integrity of its organelles and therefore the ultrastructural examination of the semen for the diagnostic assessment will be necessary.

This study describes characteristic electron microscopic changes which were found in the spermatozoa often infertile men and illustrates the value of this technical approach in the evaluation of male infertility.

Key Words: Infertility, Spermatozoon, Ultrastructure

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Özet

Erkek infertilité nedenlerinden spennatozoa defeklleri ve gelişme bozuklukları konvansiyonel semen analizi metodlarıyla her zaman ortaya konulamayabilir. Üreme olayının tam olarak gerçekleşebilmesinde spermatozoonun fonksiyonlarım gösterebilmesi için organellerinin yapısal bütünlüğü çok önemlidir ve bu nedenle teşhis amacıyla semenin ince yapı düzeyinde incelenmesi gerekmektedir.

Bu çalışmada 10 tane infertil erkeğin spermatozoonlarında karakteristik olarak tespit edilen elektron mikroskobu değişiklikleri ve bu teknik yaklaşımın erkek infertilitesini değerlendirmedeki önemi tanımlanmaktadır.

Anahtar Kelimeler: infertilité, Spermatozoon, Ultrastrüktür

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Infertility affects up to 17% of the population (1). Since men express their fertility potential through the spermatozoa, analysis of semen continues to be the most important tool for the evaluation of the male fertility (2).

The assessment of the fine structure of spermatozoa is one of the most important parameters compared with the others (as spermatozoon concentration and motility) (3,4). The organization of subcellular elements of spennatozoa is an important component of the evaluation; so it is logical to study the fine structural details of spermatozoon as a cell. Under electron microscope spermatozoa were highly heterogeneous by their fine morphology as multiple abnormalities have been detected.

In this study the existence of different spermatozoa defects that were thought to be the cause of infertility and could not be identifiable by conventional methods were examined in the semen samples of ten infertile men by transmission electron microscope.

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Materials and Methods

Semen samples of ten men in which at least 70% of all spermatozoa showed structural abnormalities were referred to electron microscopic examination. Their age range was from 25 to 40 years (mean age 32 years).

Ejaculates were collected by masturbation after 3 days of abstinence. After liquefaction samples

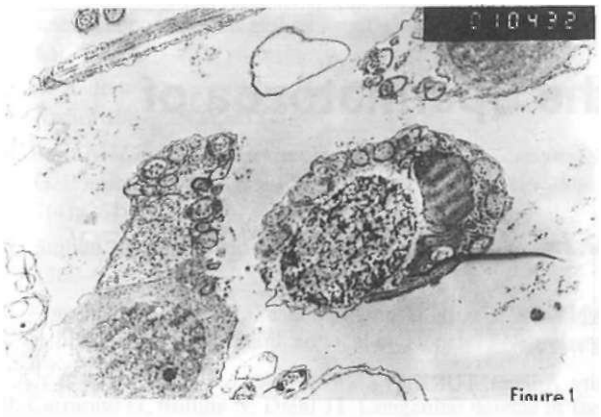

Figure 1. Two immature spermatozoa X 10000.

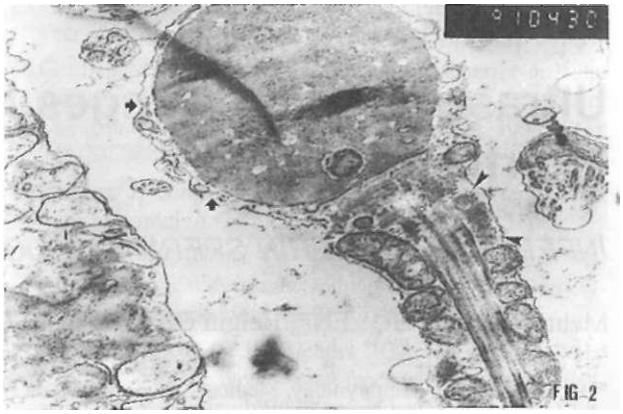

Figure 2. Absence of acrosome and postacrozomal sheath (arrow). Localized absence of mitochondria (arrow head) X 19000.

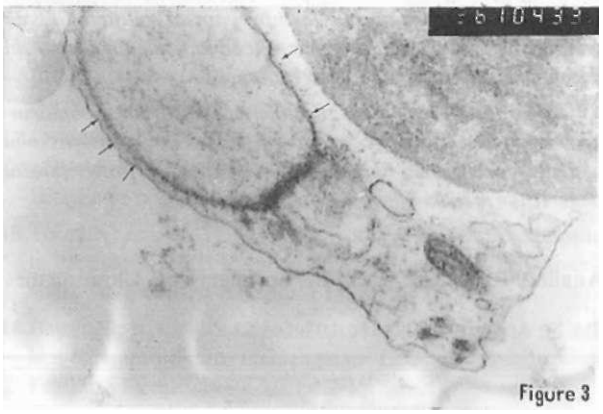

Figure 3. Large perinuclear vesicle (arrow) X 36000.

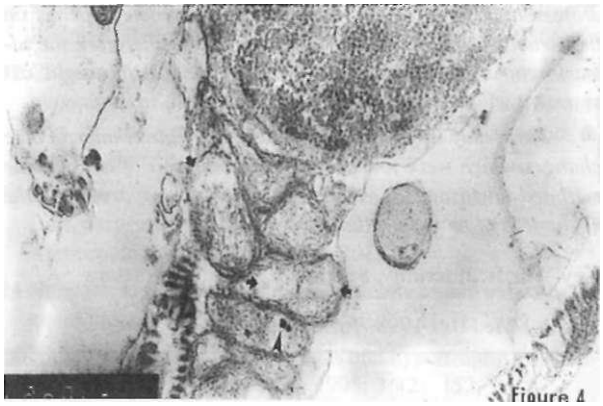

Figure 4. Disarrangement of cristae (arrow), electron dense granules in the mitochondria (arrow head) in the midpiece of a spermatozoon X 29000.

were fixed in 2% glutaraldehyde in a phosphate buffer (pH 7.2) and centrifuged at 1500 rpm. After rinsing in the buffer, materials were postfixed in 1% osmium tetroxide and subsequently dehydrated in graded ethyl alcohols. Araldite CY 212 was used for embedding. The sections were cut on L K B III ultratome, stained with uranyl acetate and lead citrate and then examined in a Jeol 100 Electron microscope.

Results

When examined with electron microscope the immature spermatozoa were in the great majority (Figure 1). The most striking abnormal feature was the absence of acrosome and the postacrozomal sheath (Figure 2). Some of the spermatozoa had large perinuclear vesicles (Figure 3). Nuclear defects and immaturity of the chromatin were seen in most of the cells (Figure 2, 4). In some of the cases, mitochondrial defects were observed. Most of the mitochondria were polymorph in size and shape (Figure 2, 4). In the midpiece of the spermatozoa; mitochondria showed lucent matrix, elecfron dense granules and disarrangement of cristae (Figure 4). Some of the mitochondria showed thickening in their membranes and parellellization of cristae (Figure 5). Local absence of mitochondria was observed in one case (Figure 2).

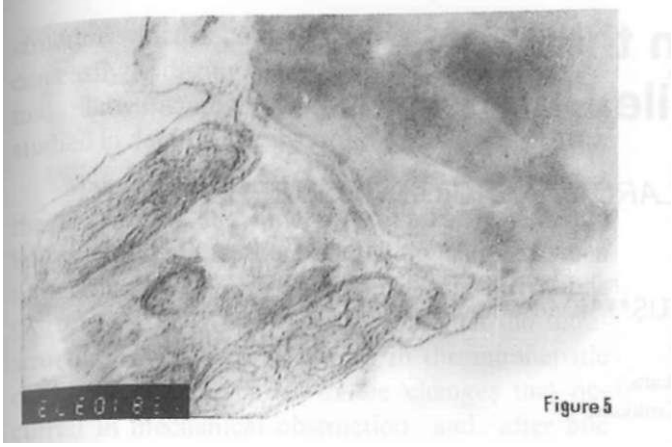

Figure 5. Thickening in the mitochondrial membrane and paralellization of mitochondrial cristae in the midpiece of a spermatozoon in a higher magnification X 58000.

Discussion

The ultrastructural pathology of human spermatozoa as one of the cause of infertility has been documented in the literature (3-5).

Ultrastructural evaluation of the spermatozoon confirmed the abnormalities such as absence of the acrosome (6), defects of mitochondrial organization (7,8), immaturity of chromatin in the nucleus (3,4,5), lack of fibrous sheath and disarrangement of the axonem (7).

Agenesis of acrosome is one of the major defects and frequently associated with a spherical shape of the spermatozoon nucleus and immature patterns of chromatin aggregation.

To achieve the fertilization of spermatozoa of all mammalian species it should undergo into the acrosome reaction (9). For this reason the spermatozoa which were devoid of acrosomes should be considered as a primary cause of male infertility.

In recent years increasing number of reports on mitochondrial dysfunctions have been published (8,10). The mitochondria showed increased matrices, thickening of membranes, parallellization of cristae and lipid inclusions which were characteristic for mitochondrial disorders. The reports indicated that mitochondrial dysfunction caused diminished spermatozoa motility in men (8). Abnormalities of mitochondrial organization have also been described. These abnormalities included local or total absence of mitochondria from the midpiece. Some of the reports mentioned that the midpiece, as defined by a mitochondrial sheath, was either absent or rudimentary (3-5,7,11).

As conclusion, in this article characteristic fine structural changes of the spermatozoa of ten infertile men were described. According to the results it could be decided that the acrosome, nucleus and mitochondrial organization defects should be the primary cause of male infertility in all of those cases.

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