ASSESSMENT OF FERTILIZING CAPACITY OF SPERMATOZOON

Essay
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BY

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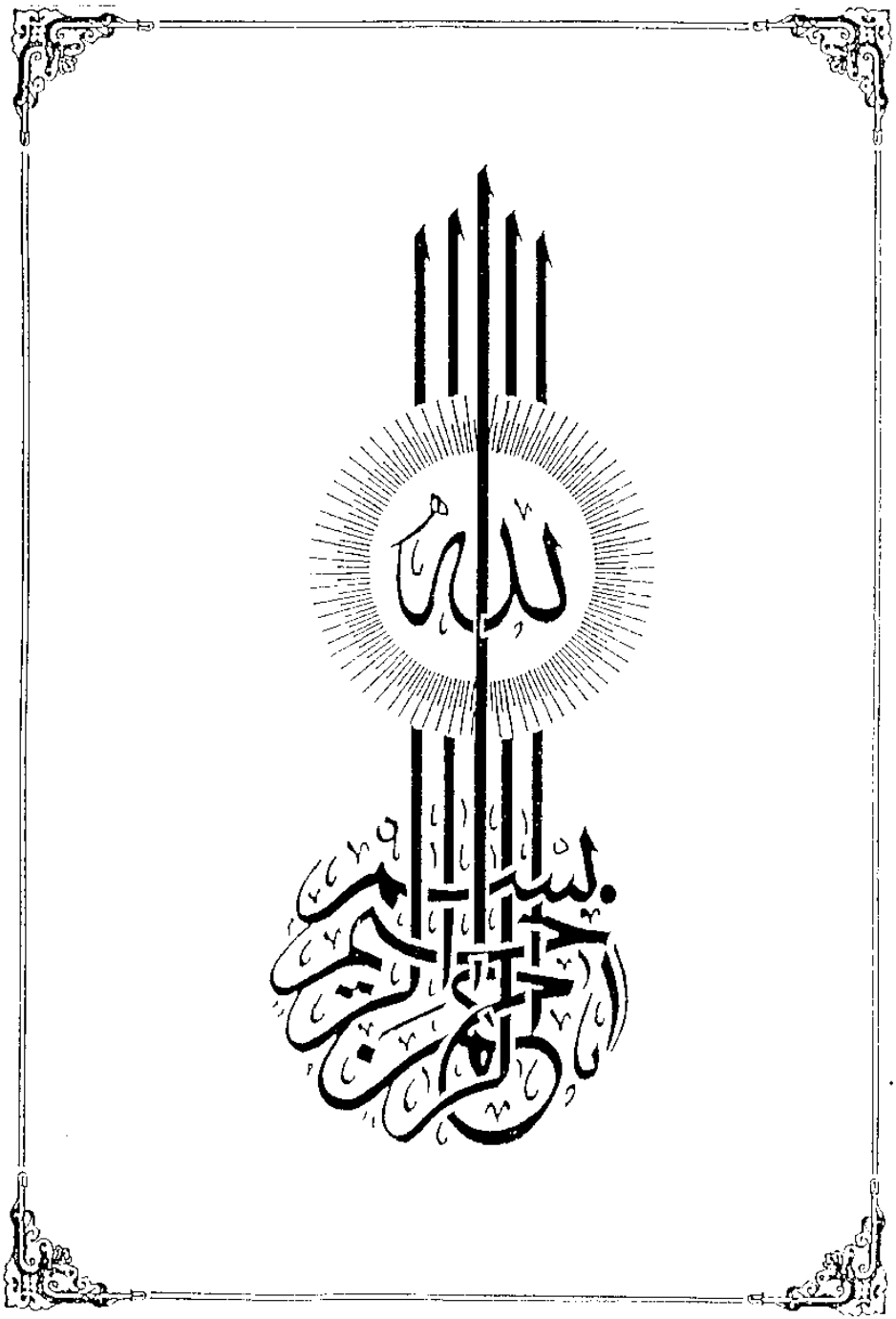

To

MY FAMILY

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CONTENTS

INTRODUCTION

&

AIM OF WORK

INTRODUCTION

In standard semen analysis, the volume, sperm concentration, percentage of motile sperm, percentage of abnormal sperm are used as parameters, but cases are sometimes encountered clinically in which these standard semen parameters are within a normal range while male infertility remains a problem. Conversely, men with oligozoospermia may be fertile. Therefore it is difficult to determine accurately the potential of sperm for fertilization on the basis of standard semen analysis **(Takahashi et al., 1990).**

Subfertility is generally defined as a sperm concentration of fewer than 10-20 X 10^6/ml, when the motility rate and normal sperm morphology rate are below 40%, but if such values are used it has been reported that more than 25% of men with children would be defined as subfertile **(Bostafte et al., 1984).** Moreover, if the correlation between fertility and the values obtained in the standard semen analysis is studied, it is found that the average fertility is extremely low, so that an extremely large number of subjects is needed to draw prospective conclusions **(Baker, 1986).**

In light of the insufficiencies of the standard semen test, the surest method of determining the fertility of human sperm would be to actually measure whether or not the sperm fertilize human oocytes, either in vitro or in vivo. After ejaculation various functions are known to occur: The physiological change known as capacitation, acrosome reaction, penetration the zona pellucida, entering the cytoplasm of the oocyte, and finally fertilization by means of the formation of pronucleus. There are a variety of functional tests to examine these stages of fertilization process **(Takahashi et al., 1990).**

As an direct means for knowing the capacitation potential of human sperm, there is zona-free hamster oocyte-sperm penetration test (the hamster test) using hamster oocytes in which the zona pellucida has been removed **(Yanagimachi et al., 1976).** Also there are many tests for measurements of acrosome status, acrosome reaction and acrosome activity **(Liu and Baker, 1992).** In view of the strong correlation between the ability of sperm to penetrate the zona pellucida and their ability to penetrate the cervical mucus by means the shearing force generated by sperm motility, there has also been developed sperm mucus penetration test **(Barratt et al., 1989; Pandya et al., 1986).**

It is possible that the proportion of sperm with immature nuclei may relate to fertilizing ability. Immature sperm nuclei can also be detected by staining with acidic aniline blue **(Liu and Baker, 1992).** Acridin oragne stain has also been used to distinguish between sperm contain normal or abnormal nuclear chromatin **(Tejada et al., 1984 and Ibrahim and Pedersen,1988).**As measures of the sperm membrane function there is eosin Y exclusion assay **(Liu et al., 1988a)** and hypo-osmotic swelling test **(Jeyendran et al., 1984).** More recently, analysis of sperm movement patterns using automated equipment has been done and a correlation between the fertility of human sperm and mean amplitude of lateral head displacement has been reported **(Jeulin et al., 1986; Boyers et al., 1989).**

So far, no single test of sperm function will predict fertility accurately where groups of tests are required and interpreted together to evaluate male fertility **(Liu and Baker, 1992).**

AIM OF WORK:

To review the different methods for assessment of fertilizing capacity of the spermatozoon.

REVIEW OF LITERATURE

STRUCTURAL AND ULTRASTRUCTURAL ANATOMY OF SPERMATOZOON

Introduction:

The spermatozoon had been disclosed in **1677** when **Leeuwenhoek** was able to observe the general form and swimming movement of spermatozoon, using a microscope with a single highly convex lens since that time. However, his belief that spermatozoa were normal constituents of semen and that they initiated and participated in the development of the eggs was not accorded general acceptance until two hundred years later.At that time **(1875),Hertwig** demonstrated sperm penetration and the union of the egg and sperm nuclei.

The progressive improvement in the light microscope and its resolving power in the 19^{th} century sharpened the images of external features of the spermatozoon but contributed little to the understanding of its internal structure. Indeed, most of what was learned from 1677 to 1950 about the spermatozoon concentrated on the external features and summarized the structure of spermatozoon in the following: The head (acrosomal cap and post acrosomal region) the neck, and tail (middle piece, principal piece and end piece) **(Fawcett, 1975).**

To express its fertility potential and fulfill its reproductive function, the spermatozoon must be viable and must posses the following:

(1) An efficient motor apparatus required to cover the relatively large distance separating the vagina from oviduct and overcome the formidable obstacles encountered a long the way, and to penetrate through the egg investments;

(2) An intact acrosome to acquire fertilizing competence through capacitation and acrosome reaction.

(3) An intact nucleus for the establishment of the genomic patrimony of embryo at syngamy **(Zamboni, 1987).**

The introduction of commercial electron microscope and of microtomes capable of cutting ultrathin section in 1950s, initiated an exciting and remarkably fruitful period of exploration of biological structure at magnifications up to half a million times and resolutions that have reached up to 4 to 5 angstroms (°A). In 1960s studies of the internal structures of spermatozoa with transmission electron microscope (TEM) have provided the ultrastructural basis for sliding microtubules theory of spermatozoon motility. Such studies clarified that nature of the acrosome reaction, and revealed details of sperm penetration and gamete fusion that were far beyond the reach of light microscope**(Fawcett,1975).**

The Spermatozoon:

The spermatozoon is composed of a head, neck and tail with their fine structures which are well illustrated by TEM (Fig.1). All Sperm parts are invested by a plasma membrane.

The Sperm Head:

The head of the sperm is flat and measures around 4-5 μm in length and 3 μm in width and is around 1-5 μm thick. The sperm head consists of acrosome, subacrosomal space, nucleus, postacrosomal region and nuclear envelope as well as basal plate **(Singer and Jordan, 1986a).**

The sperm nucleus acquires its shape while its chromatin is undergoing a remarkable condensation. There is a considerable variation in the degree of condensation of chromatin from man to man and also from ejaculate-to ejaculate from the same man. It has been suggested that the process of chromatin condensation does not proceed to completion in all members of sperm population **(Fawcett, 1975).** In some cells the chromatin is fully condensed with a dense,homogenous appearance **(Pedersen, 1974).** Furthermore, **Zamboni (1987)** described this chromatin as a uniformly compact keratinoid mass.

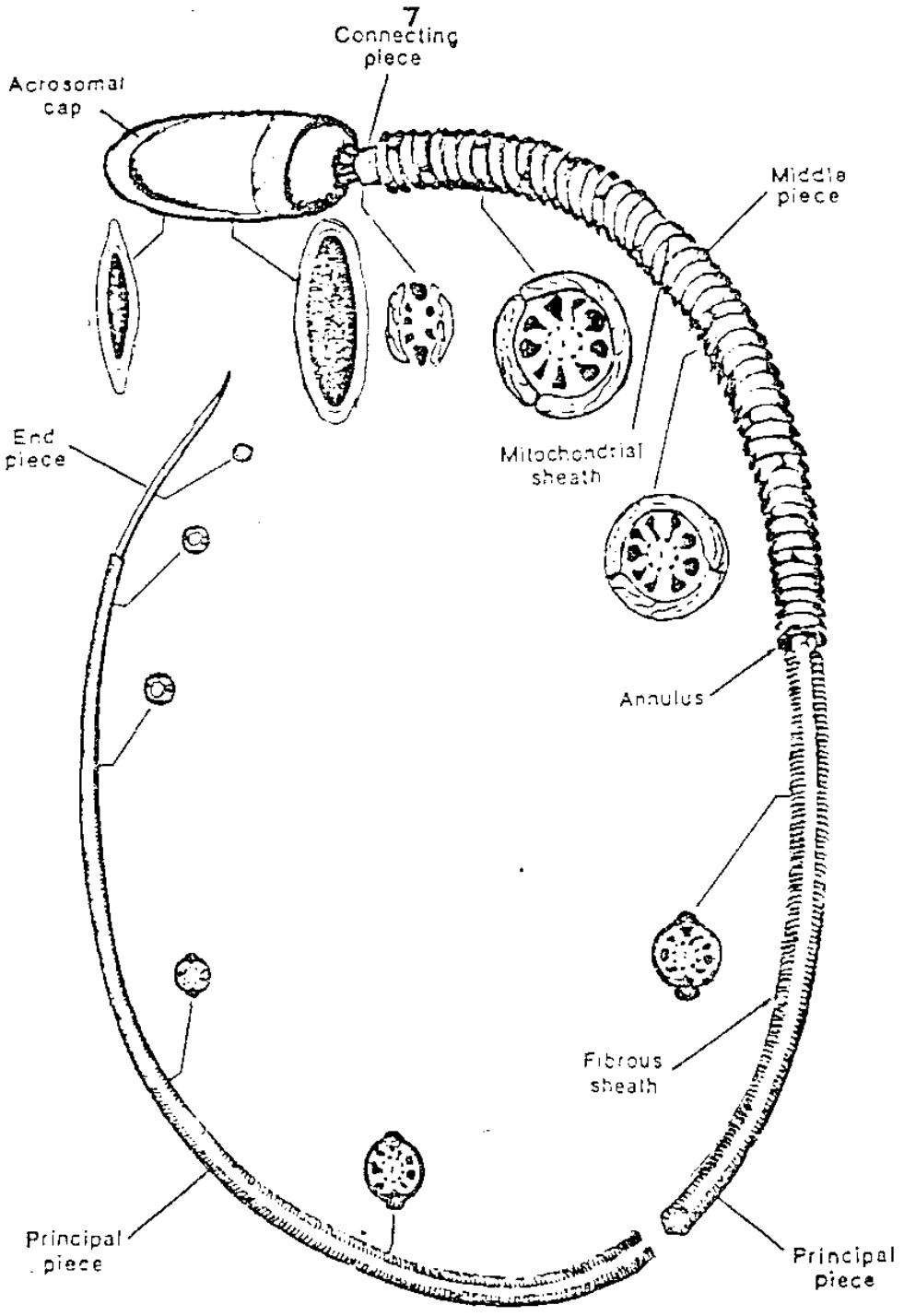

Fig. 1: Schematic representation of a typical spermatozoon as it would appear with the cell membrane removed to reveal the underlying structural components. Quoted from **Fawcett (1975).**