MORPHOLOGY OF THE SPERM
&
ITS RELATION TO FERTILITY

THESIS

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By

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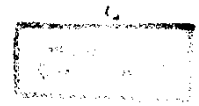

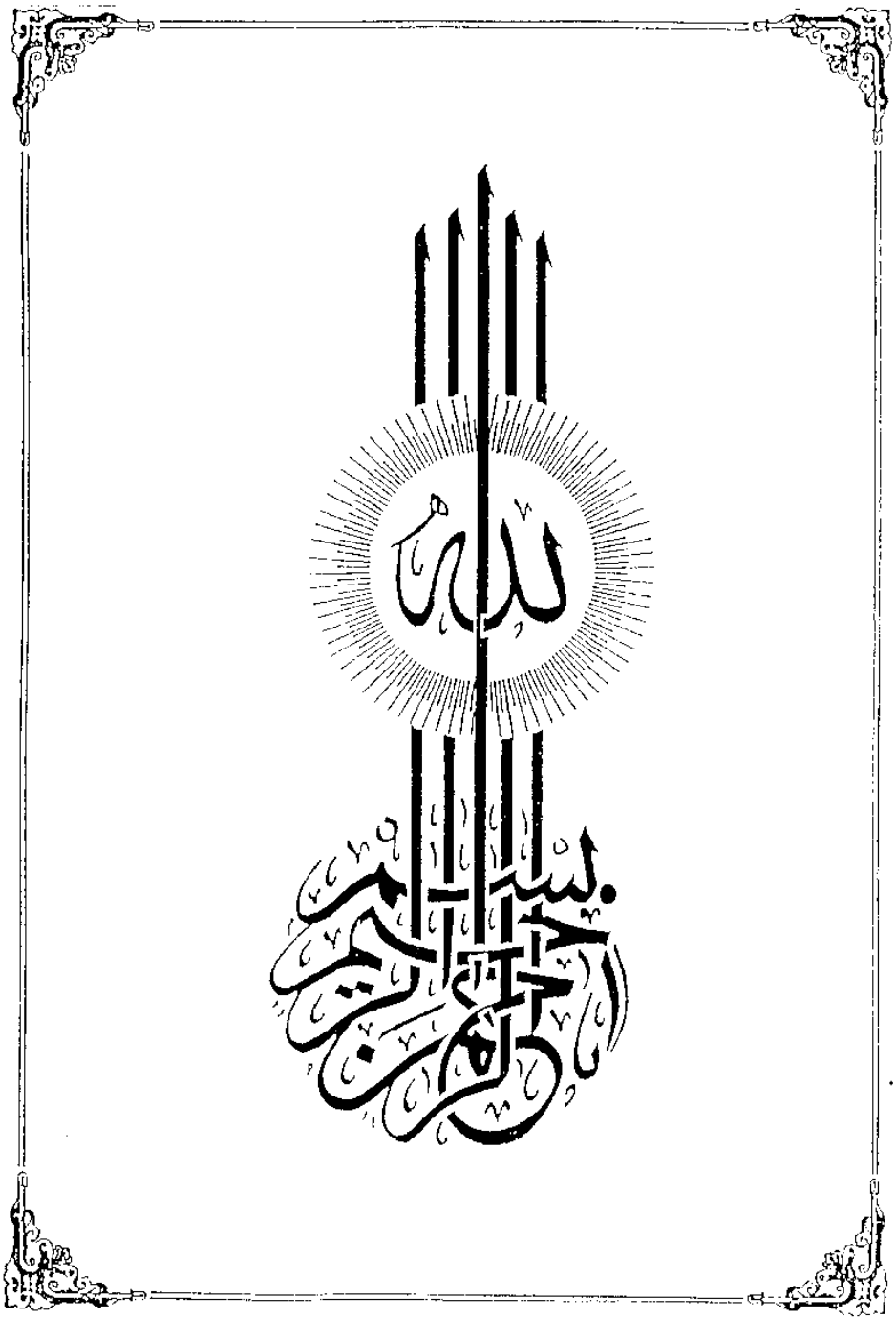

To my mother for her love and sympathy

To my father for his encouragement

To my wife and sons, my real motivators

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The first description of human spermatozoa was done by Leeuwnhoek in 1677. He saw "living animal cules in human semen, judging this to possess tails... Sometimes more than thousands were moving in size of a grain sand". Toward the end of the seventeenth century , other microscopists described spermatozoa as **"little men"** or homunculi.

The human spermatozoa are known to have a wide variety of heterogenecity in forms and , till now , no standardization has been made by different laboratories for what is normal.

Abnormalities of spermatozoa are many and all affect fertility either directly (acrosomal malfunction) or indirectly through motility (Tail anomalies).

The aim of this work is to introduce the different abnormalities of morphology in human spermatozoa in an attempt to identify what is normal. We shall also tackle the different ways of investigating the morphology and its effect on fertility.

MATURATION OF THE SPERM

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In the last decade, investigations of the human fetal testis have provided considerable informatin about the origin of human germ cells and their differentiation. However, the development of human spermatogonium during infancy and childhood has not been so extensively investigated. The studies performed on laboratory animals during the pre-pubertal period do not fill the gap, since the duration of the prepubertal period in these animals is very short in comparison with the 12-14 years between birth and puberty in man. Most of the studies have been carried out using only light microscope or small number of specimens which do not cover every age (Paniagua and Nistal, 1984).

Sroka (1965) discussed the process of maturation and he noted certain phases of spermatogensis e.g. the division of spermatogonium and other germ cells. Aside from spermatogensis, some phases of spermiogensis were also noted such as casting of protoplasm during spermatid - spermatozoa metamorphosis. Classically he divided the maturation process into spermatogensis and spermiogensis begin in the testis and further maturational steps occuring outside the testis.

A. Testicular Maturation of Spermatozoa:

Cell Division:

Three types of nuclear division occur. The first is the mitotic or direct one (the nucleus is randomly distributed to the resultant cells). In man this type is restricted to pathological condition. The other two types are more complex and referred to as the indirect division. They comprise, the mitotic and meiotic division. The mitotic occurs mainly in somatic cells giving identical copies, while the meiotic occurs only in gonads aiming at the production of Haploid gametes (Gray, 1973).

Spermatogensis:

Simply the spermatogensis consists of three phases. The first phase is a proliferative one in which the spermatogonium divide mitotically giving rise to primary and secondary spermatocytes. The second meiotic phase, the secondary spermatocytes, gives rise to the haploid gametes(spermatids). The third phase is concerned with spermatid-spermatozoa metamorphosis(Burger et al., 1976).

Holt and Moore (1984) classify the spermatogenic cycle of the marmoset monkey into nine distinctive cell associations. This method has advantage when applied to the marmoset, since the acrosome in this

species is small and unabortrusive. So they rely more on the association of cell types to define the spermatogenic stage. One notable feature of spermatocyte differentiation is the elaboration of the endoplasmic reticulum. Despite the similarity with the human spermatocyte, a special formation of endoplasmic reticulum, the "annulate Lamellae", has not been observed in the marmoset. This formation is characteristic of human spermatocytes and spermatids.

The spermatogonial proliferation was studied from day 13 until week 12 in rat. It appeared that, the numbers of stem cells spermatogonia increased almost to "10" fold after complete proliferation of Sertoli cells which suggest a function of sertoli cells in regulation of spermatogonial proliferation (Kluin et al., 1984).

A specific stage of topographical arrangement is established between sertoli cells and germ cells long before the first syndronous division of type A spermatogonia takes place. Ulvik (1983) defined a new term "Basal Endings" (BEs), which is the surface of the basement membrane of the sertoli sertoli interspaces and germ cells. He found that undifferentiated spermatogonia had contact with a very few BEs while differentiating type A spermatogonia seemed to be associated with a maximum of BEs.

A round body is found in male germ cells of rat. As long as the size of round body is increasing, the RNA is high and the opposite is true. So it may exert some control on nuclear activity in meiotic phase. This begins in late leptotene and during subsequent meiotic phase, it leaves the nuclear envelop and gradually increases in size. After each maturation division, the amount of round body material has decreased to about half the amount, presumably because the consistent proteins are dissociate at metaphase, distorted between the two cells at telophase. As spermiogenesis proceeds the round body shrinks gradually and disappears (Schultz et al., 1984).

a. First Phase of Spermatogensis:

Three types of the germ seeds cells i.e. spermatogonia, are present. Dark type A, pale type A and type B germ seed. The A spermatogonia are distinguished by their ovoid nucleus with nucleoli which are eccentric and attached to the inner aspect of the nuclear membrane. Dark type A is distinguished from pale type by its dark nucleoplasm and a large pale staining vacuole. Type B have a more constantly spherical nucleus with central nucleolus (Girgis and Hafez, 1977).