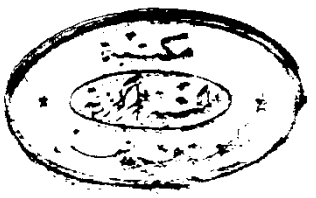
STUDY OF THE ANATOMY AND HISTOLOGY OF THE VAS DEFERENS&SEMINAL VESICLE OF THE ADULT ALBINO RAT



THESIS

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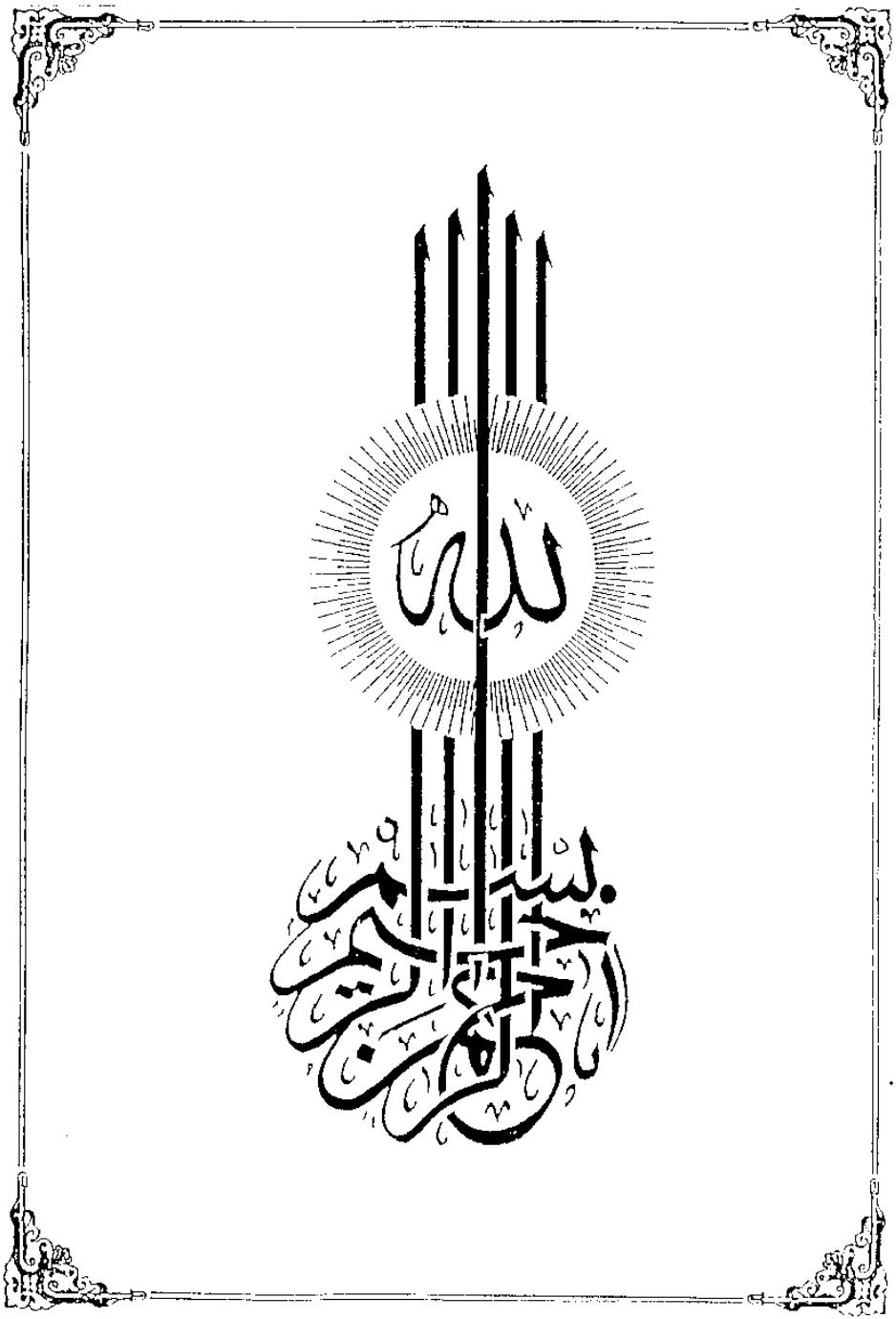

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It was generally accepted that the excurent male ducts were not merely passive conduits for sperm passage but represented a dynamic system that influenced if not the sperm directly , at least the environment within which the sperm existed. Although some studies described the ultrastructural aspects of the vas deferens (Niemi, 1965 ; Hamilton et al., 1969 ; Flickinger, 1973 ; Kennedy and Heidger, 1979) yet , its epithelial cells received less attention , as compared to that focused on the structure and histochemistry of the duct epithelium of the epididymis .

Accordingly, the general histology of the rat vas deferens and its seminal vesicle were reinvestigated and special attention was focused on the morphology of their epithelium lining from certain histochemical aspects . Moreover, the pattern of the intrinsic innervation of both vas deferens and seminal vesicle was attempted by such histochemical techniques .

I - THE VAS DEFERENS

Farris and Griffith (1949) mentioned that in the rat , the vas deferens , accompanied by the deferential blood vessels , extended from the cauda epididymis through the inguinal canal to end in the urethra after crossing the ureter . They further added that the prostate glands were in the form of two pairs, one was ventral and the other was dorsal to the terminal part of the vas deferens . They identified the seminal vesicles as two hook shaped glands with the coagulating glands lying along their concavities.

Nonidez and Windle (1949) mentioned that , in man, at the lower pole of the testis the epididymis gradually changed in structure where it turned upwards to become the ductus deferens . The epithelium of the vas deferens changed from pseudostratified to tall simple columnar, and toward the ejaculatory duct, it became stratified . It was thrown into longitudinal folds and had a little connective tissue beneath it forming a lamina propria and a basement membrane . The rest of the wall was principally smooth muscle arranged in inner and outer longitudinal layers with a circular layer inbetween . The lumen was noticed to be wider than that of the epididymis and widened even more at the lower end to form the ampulla. They described the ampulla of the vas deferens as a dilatation , in which the longitudinal folds of mucosa were exaggerated and intervening depressions formed deep valleys as

well as diverticulae . Some of the lining epithelium appeared to be secretory . Furthermore, the investigators added that , surrounding the vas deferens was a great deal of areolar connective tissue containing lymphatics, an extensive venous plexus, the spermatic artery, nerves and bundles of skeletal muscle (cremaster) together with the pampiniform veins .

Leblond (1950) reported that the seminal vesicles of the adult albino rat showed little reaction in the epithelium except occasionally for a few cells containing stained granules . The worker added that the secretion material contained in the lumen reacted with a variable intensity . On the other hand , the epithelium of the vas deferens was poorly stained in contrast to the well stained stereucilia .

Shaver (1954) in his study on the rat epididymis, identified that the epithelium of the caput epididymis was actively engaged in the transport of material from the lumen of the duct by means of steriocilia . The investigator suggested that the presence of stereocilia increased the surface area of the duct cells , so that the cell surface was differentiated toward the active uptake of fluid by the mechanism of pinocytosis .

Richardson (1962) in his study on the fine structure of autonomic nerve endings in smooth muscle of the rat vas deferens , described the muscle tissue in the wall of the vas deferens being very closely packed, with little intervening stroma even between

the separate muscle coats. The dense crowding of the muscle fibres influenced the distribution of the nerves . Thus the large bundles entering the vas deferens gave off numerous very fine branches at intervals within the muscle, rather than repeatedly bifurcating into pairs of smaller bundles of approximately equal diameter . In other words the spaces between the muscle fibres were so narrow that only very thin nerve bundles and ultimately single neurites would ramify within them . At higher magnification, some neurites or small bundles were characteristically kinked and persued a tortuous course with respect to the contour of each muscle fibre. Nowhere did they appear to terminate abruptly in an enlarged bead or ring-like ending . Nowhere they beaded along their length .

Green (1963) added that in the rat the testes had descended in the 30-40th days of age through the inguinal canal that remained open and wide throughout life, as is usual in rodents, and during sexually inactive periods the testis might be withdrawn into the abdominal cavity .

Falck, Owman and Sjöstrand (1965) described dense plexuses of intense green-fluorescent varicose nerve terminals within both the circular and longitudinal muscle layers of the vas deferens of the guinea pig. The nerve plexuses in the proximal part of the vas deferens were relatively less dense . In the peripheral parts , and just outside the vas deferens, nerve bundles extended parallel to the vas deferens branching off small fascicles, which penetrated

the wall to ramify in the organ . Small radial bundles issued from the outer longitudinal layer into the circular one, where they contributed to the circular plexus . In a similar manner the inner longitudinal layer received its supply from the circular layer . Only rarely were fluorescent terminals seen in the mucosa and those present appeared to accompany minute vessels rather than serving the mucosal cells. Regarding the distribution pattern of fluorescent nerves in the seminal vesicle , the workers demonstrated that it was similar to that of the vas deferens, although it was not so extensively innervated . Furthermore , nerve cells of varying degress of fluorescence , were dispersed over a rather wide area in the vicinity of the accessory male genital glands , and were regularly seen in the walls of the prostate and coagulating glands, but could not be found within the vas deferens or the seminal vesicles .

Niemi (1965) recognized the epithelium of the vas deferens of the adult rat to be composed of tall columnar cells together with flattened basal cells. He noticed that there were no differences between the columnar cells in ordinary sections . However, when sections cut for electron microscopy from material fixed in 2% osmium tetroxide were examined with the light microscope, some cells were heavily blackened by osmium and he described them as pencil-shaped cells . Stereocilia which were microvillus projections of the luminal border of columnar cells , were identified to be strongly PAS-positive rather than the cytoplasm which was lightly stained and with no

visible VAS-positive granules. Furthermore, the investigator observed that mitochondrial dehydrogenase activities were concentrated on the apical cytoplasm of the columnar cells.

Leeson and Leeson (1968) found that in man, the epithelium of the vas deferens was pseudostratified and many of the tall cells beared streocilia . Numerous elastic fibres were present in the thin lamina propria beneath the epithelium . They described the mucosa to be thrown into longitudinal folds that were responsible for the stellate outline seen in cross sections . An ill defined submucosa , containing numerous blood vessesls , separated the mucosa from the muscular coat . The latter was recognized to be arranged in three layers . The inner layer was relatively thin and longitudinally disposed , the middle layer was markedly robust and arranged circularly whereas the outer layer was longitudinally oriented. Surrounding the muscular coat, was a fibrous adventitia blending with that of adjoining tissues . The authors mentioned that the ampulla of the vas deferens was a terminal dilatation of the vas where the lumen appeared wider and the mucosa was much more folded. Many of the epithelial folds branched and fused with each other producing a number of pocket-like recesses . The simple epithelium might show evidence of secretion . They added that the musculature was much less regularly arranged than in the rest of the vas deferens. Usually only the external longitudinal layer retained its identity.

Clementi , Naimzada and Mantegazza (1969) in their study of the nerve endings in the vas deferens and seminal vesicle of the guinea pig found that, from a pharmacological point of view it appeared that cholinesterase inhibition potentiated in both organs the contraction elicited by stimulation of the hypogastric nerve. That potentiation was present even in preparations obtained from animals pretreated with reserpine or alpha-methyltyrosine and prevented or abolished by atropine. On the basis of electron microscopic studies , they were able to distinguish two types of nerve terminals, adrenergic and cholinergic . They interpreted these results as supporting the concept that the hypogastric nerve carried to the vas deferens and to the seminal vesicle , fibres of adrenergic and cholinergic type .

Bell and McLean (1970) studied the distribution of cholinergic and adrenergic nerve fibres in the vas deferens of the dog. They noticed that at the testicular end of the vas deferens, a dense plexus of noradrenergic nerves was found at the base of the mucosal epithelium, the nerve fibres of which were running parallel to the longitudinal axis of the tissue . Other noradrenaline containing nerves were scattered relatively sparsely through the muscle coats . In contrast , they found that at the urethral end of the vas deferens, the smooth muscle coats contained noradrenergic nerves, yet here was no evidence of a submucosal nerve plexus . On the other hand, fibres exhibiting high acetylcholinesterase activity were also found throughout the muscle coats but no concentration of staining fibres was observed in the

submucosa at the testicular end of the organ. So, they concluded that the smooth muscles of the vas deferens of the dog may recieve innervation from separate adrenergic and cholinergic fibres.

McKeaver (1970) recognized the vas deferens of the rat to be the continuation of the canal of the epididymis that extended parallel to the corpus epididymis , then passed through the inguinal canal, looped around the ureter and finally opened into the urethra .Near its junction with the urethra the author identified the ampullary glands of the vas deferens to form two distinct lobes. Beyond the ampullary glands, an evagination, the seminal vesicles was formed and the short, straight section of the vas just distal to its junction with the seminal vesicle was the ejaculatory duct. On the other hand the seminal vesicles were recognized as sac-like structures with the coagulating glands attached to their ventral curvature .

Dixon and Gosling (1972) investigated the distribution of the dual innervation of the musculature of the rat vas deferens , using light microscopic histochemical techniques and electron microscopy. The catecholamine containing nerves were uniformly arranged throughout the length of the vas. They formed an exceedingly rich plexus of highly fluorescent nerves throughout the thickness of the muscle coat. On the other hand, the distribution of acetylcholinesterase containing fibres showed regional variations along the length of the vas deferens . In the testicular region, large acetylcholinesterase containing nerves run in the adventitia and gave branches which

penetrated the relatively thin muscle coat . These nerves were of variable size and formed a branched network amongst the smooth muscle cells. This plexus was particularly well defined on the inner aspect of the muscle coat adjacent to submucosa . No ganglion cells could be observed. Following the vas deferens towards its urethral end, a gradual reduction in the density of acetylcholinesterase positive nerves was evident . However, along the whole length of the vas, numerous nerves were related to the inner aspect of the muscle coat. Close to the urethra, large adventitial nerves together with, occasional groups of acetylcholinesterase containing ganglion cells were identified . The activity of the enzyme pseudocholinesterase was evident in the smooth muscle cells in all portions of the vas deferens . This activity was evently distributed throughout the muscle coat.

Furness and Iwayama (1972) studied the arrangement and neuromuscular relationships of adrenergic and cholinergic nerves in the longitudinal and circular muscle coats of the adult guinea-pig vas deferens . Light microscopic studies showed that there was a dense adrenergic innervation of both layers but suggested that most of the cholinergic nerves supplied the circular muscle . Together with their ultrastructural studies, they suggested that acetylcholine did not participate in transmission to the longitudinal muscle of the vas deferens and that the motor innervaion of the longitudinal muscle was probably exclusively adrenergic .