CHAPTER VI

EXPERIMENTAL CRYPTORCHIDISM IN THE SLENDER LORIS

INTRODUCTION:

Spermatogenesis in the vast majority of mammals is known to require, in addition to the trophic influences exerted by one or more hormones of the anterior hypophysis, the relatively cool environment provided by the scrotum. It is now generally believed that the undescended testis is usually incapable of continued production of spermatozoa. In mammalian species, including man, cryptorchidism is associated with either greatly reduced or complete absence of spermatogenesis, (Robinson and Engle, 1954; Charney, 1960; Scott, 1962; Cummins and Glover, 1970; Davies and Firlit, 1966; Giarola, 1967; Albescu et al 1971, Atkinson, 1973 a,b). Because histological damage to the germinal epithelium seems to far outstrip the damage done to the interstitial tissue in both naturally occurring and experimental cryptorchidism, (Sohval, 1954; Mancini et al, 1965; Leeson and Leeson, 1970; Altwein and Gittes, 1972) the artificially cryptorchid mammal has been used as a tool to explore the possible hormonal feedback relationship between the anterior pituitary and the germinal epithelium.
Studies of artificial cryptorchidism in rats have tended to concentrate on histological observations, (Moore and Oslund, 1924; Nelson, 1951; Clegg, 1960, 1963 a,b, 1965 a,b; Davies and Firlit, 1966; Chowdhury and Steinberger, 1972). Although naturally occurring cryptorchidism with its profound effect upon the testis has been recognized both in man and the lower mammals for many years, the changes which it produces in the accessory reproductive system are less well known. Many workers consider that these organs are but little affected, but others have found changes of varying degrees in artificial cryptorchid animals, (Nelson, 1934, 1937, Moore, 1944). In most experimental studies on surgically induced cryptorchidism the size and histology of sex accessory glands have been used as indicators of male hormone function, (Korennchensky, 1930; Nelson, 1937; Antliff and Young, 1957). Others have used cytology of seminal vesicles and prostate glands of rat (Moore and Gallagher, 1930; Jeffries, 1931) as indicators of hormonal activity of the testis. In recent studies Clegg (1960) used measurement of citric acid secretion by the seminal vesicles and fructose elaboration by the coagulating glands to indicate androgen levels in rats rendered cryptorchid. In the present
investigation an attempt has been made to determine
the effect of cryptorchidism in slender loris upon
the secretion of the accessory organs and hence upon
the production of androgenic hormone by the crypto-
orchid testis. The implication of these histological
and biochemical findings on the testis and accessory
organs following different treatments of crypto-
orchidism are discussed.

MATERIAL AND METHOD:

The animals were rendered cryptorchid as
described in chapter III. The cryptorchid animals
were divided into the following groups, 5 animals in
each group.

Group I: served as normal control

Group II: animals were rendered cryptorchid
and left for 30 days.

Group III: animals were rendered cryptorchid
and left for 15 days.

Group IV: animals were rendered cryptorchid
and left for 15 days after which
200μgs of Testosterone propionato
per day was injected for seven days.
Group V: animals were rendered cryptorchid and left for 15 days after which olive oil was injected for seven days serving as controls for group IV.

OBSERVATIONS:

The absolute weight and relative weights of the testis of the 30-day cryptorchid, 15-day cryptorchid and testosterone propionate-treated are illustrated in Table I. It is seen that the cryptorchid testis maintained in the abdomen for 30 days was characterised by its small size, flabbiness, in its appearance giving the testis a degenerative look and with poor vascular supply. The blood supply to the testis and its vascularity is hardly visible. The combined testicular weight of the 30-day cryptorchid testis was only 219.4 mg (relative weight) when compared to the normal which was about 622.0 mg, thereby showing almost a threefold decrease. Histological studies on the cryptorchid testis showed a total absence of the active spermatogenic tissue. The testis appears distinctly cyanotic. Almost all the tubular sections showed considerable disorganisation of the germinal epithelium (Fig.1). The tubules show much shrinkage,
the diameter being reduced to about 82µ when compared to the normal adult which is about 150µ, resulting in an almost 50% decrease. Due to this shrinkage of the tubules, there appears a lot of intertubular space giving the testis a disorganised look. The only cells that are recognisable are the Sertoli cells and the spermatogonia which are arranged towards the basement membrane forming more or less a single row, (Fig.2). There is a complete absence of spermatocytes and spermatids. In addition to Sertoli cells and spermatogonia, there are also present a large number of multinucleate cells along with other pyknotic cells filling the lumen of the tubules (Fig.3). These multinucleate cells are formed as a result of coalescence of the desquamated cells. These cells are generally the spermatids in the Golgi or cap phase which cease to differentiate further and instead get segregated to give rise to multinucleate cytoplasmic masses. Such abnormal cells are characteristic of only the cryptorchid testis. The spermatogonial cells are as a whole, less affected than the spermatocytes which in turn are less affected than the spermatids. The spermatids disappear completely after the twenty second day of experimental cryptorchidism.
Due to the shrinkage of the tubules, large spaces are left between the tubules. This results in giving the testis a degenerative and flabby look. Leydig cells appear to have increased in numbers and grouped together. They are more or less spindle shaped, (Fig. 4). The secretory appearance of the Leydig cells as seen in the normal testis is not present in the cryptorchid testis. In the 15-day cryptorchid condition, the testis does not appear to be much affected. The loss of weight in the testis is comparatively less being about 456.6 mg, whereas the normal weight is about 622.0 mg (relative weight). Hence it is seen that not much of damage is done to the testis during this short duration of 15 days. The testis morphologically does not seem to be much affected.

Histological studies show that even within the tubules damage is not much (Fig. 5). The diameter of the tubule is about 140μ when compared to the normal which is about 150μ. In most cases the tubular sections present an almost uniform appearance. The tubules are lined by Sertoli cells, spermatogonial cells, the spermatocytes and finally the spermatids in the different stages of spermiogenesis. The
germinal epithelium shows however, that all spermatozoa and spermatids in the final stages have completely disappeared (Fig.6). Some sections of tubules contain only pachytene spermatocytes, being the most differentiated germ cells. These seem to lie free in the lumen. The Leydig cells of the 15-day cryptorchid testis do not show much change in shape but appear to be less secretory, (Fig.7).

Besides the testis being affected, the epididymis and the accessory sex glands are also seen to be affected by the abdominal retention of the testis for 30 days. There is a 50% decrease in the weights of the epididymis, from 263.3 mg in the normal adult, to about 120.3 mg in the 30-day cryptorchid animal (Tables II and III). Histological studies of the epididymis of 30-day cryptorchid loris show the complete absence of sperms in the lumina of both the caput and the cauda epididymis, (Figs.8,9,10). The tubules have decreased considerably in diameter. They are about 80μ when compared to the normal adult which has an average diameter of 160μ. The caput epididymis does not show septa which are characteristic of the normal adult epididymis. The connective tissue layer surrounding the ducts is thickened forming a thick covering. Thus the space formed by the shrinkage of the tubule is filled with thick connective tissue. Ciliation
which is another characteristic of the normal epididymis is once again completely absent in the cryptorchid epididymis. The epithelial cells show vacuoles towards their basal region. The cauda epididymis also shows similar changes. There is a complete absence of sperms in the lumen, a considerable decrease in the size of the lumen and formation of thick connective tissue covering the tubules, (Fig.10).

In the 15-day cryptorchid animal, the epididymis is seen to have decreased in weight being about 155.0 mg when compared to the normal epididymis which is about 263.3 mg. (Tables II and III). Histological sections of the cryptorchid epididymis maintained for 15 days in the abdomen are almost similar to those of normal epididymis. The diameter of the cryptorchid epididymis is about 125μ and the lumen is about 80μ. A characteristic feature of the 15-day cryptorchid epididymis is the presence of large masses of eosinophilic material in the epididymal lumen besides spermatozoa and large exfoliated cells (Fig.11). Ciliation is not affected, but in the caudal portion of the epididymis, the epithelium instead of being low cuboidal becomes pseudostratified with the nuclei being elliptical or oval in shape. Thus an increase
in cell height is seen (Fig. 12). There is a formation of a distinct connective tissue covering over each tubule. The lumen shows the presence of sperms intermingled with a large number of exfoliated cells. The diameter of the caudal tubule is about 100μ and the lumen about 80μ when compared to the normal which has a diameter of about 400μ and lumen of about 300μ. There is very little connective tissue around each tubule of the normal adult animal when compared to the 15-day cryptorchid which has a thick connective tissue covering. This indicates that the caudal epididymis is beginning to be affected by the retention of the testis in the abdomen for 15 days.

As in the case of the epididymis, the accesso- ries of the 30-day cryptorchid also show considerable decrease in size. There is almost a two-fold decrease in all the weights of the accessories as shown in the Tables II and III and Fig. 13. The vas deferens shows less folding of the epithelium. The cell heights are increased while there is a reduction in the muscle layers in the sub-epithelial region (Fig. 14). The section of the seminal vesicles shows a reduction in the lumen which appears to be devoid of its content (Fig. 15). The epithelial height is decreased and
cells are low and columnar (Fig. 16). There is a slight thickening of the wall of the vesicle due to an increase in the connective tissue. The Cowper's gland and the prostate gland also show a decrease in their luminal size and contents. Cell heights are reduced and there appears to be an increase in connective tissue surrounding each gland, (Fig. 17, 18). There is a simultaneous reduction in the glandular nature of the epithelial cells resulting in a decrease of secretory activity.

The accessory sex glands of the 15-day cryptorchid loris, do not show much change in their weight as also in histological nature. There is a slight decrease in the weight, (Tables II and III), of the accessory glands, which is due to the lumina being devoid of most of their contents. There is not much of connective tissue around each gland and the epithelium is also not much affected.

Biochemical studies of these accessory glands reveal their true secretory nature, (Tables IV, V and Figs. 19, 20). Estimation of fructose in the accessory glands of the 30-day cryptorchid when compared to the normal showed that in the seminal vesicles there was a 50% decrease but the prostate and Cowper's
glands showed only a slight decrease in the concentration of fructose. In the 15-day cryptorchid, the seminal vesicles and Cowper's glands showed a decrease in their fructose content when compared with the control values but there was an increase when compared with the 30-day cryptorchid condition. The prostate gland on the other hand showed an increase in the 15-day cryptorchid above the normal.

Citric acid concentration also showed a 50% decrease in the seminal vesicles and Cowper's glands of the 30-day cryptorchid animal and a three fold decrease in the prostate gland when compared to the normal, (Table V and Fig. 20). Concentration of the citric acid in the 15-day cryptorchid animal showed a slight increase when compared to the 30-day cryptorchid but was considerably less when compared to the normal.

In the lorises to which testosterone propionate was injected, the glands showed an increase in the weight, (Tables 2,3) as well as in their secretory activity. The histological sections of the hormone-treated cryptorchid testis reveal that a complete destruction of the cell types has not occurred because of the exogenous androgen. All the cell types and
the sperms are seen in the sections of the testis of the 15-day cryptorchid animals which have been treated with testosterone propionate (Fig. 21). Obviously the spermatids are not completely destroyed but are maintained by the hormone injection. On the other hand there is a complete destruction of the spermatocytes and spermatids in the control group which was treated with olive oil instead of the hormone (Fig. 22). It is seen that there is a sloughing of the degenerating cells in the lumen in the olive oil-treated loris. The interstitial cells of the testosterone propionate-treated animals look almost normal (Fig. 23) being large and secretory.

The accessory ducts and glands of the hormone treated group show a slight increase in their weights when compared with those of the 15-day cryptorchid animals. The epididymis shows the presence of sperms in the caput and cauda epididymis. The caput epididymis has a diameter of 130μ and the lumen is not considerably decreased and is seen with sperms as well as several eosinophilic cells, (Fig. 24, 25). In the caudal region although the epithelial cells seem to be pseudostratified with increasing cell height, the lumen is not considerably reduced and is seen to
be filled with sperm plus a large number of cells of doubtful identity. These may be the exfoliated epithelial cells (Fig. 25). There is an increase in the connective tissue covering of the tubules (Fig. 26). The accessory glands of the hormone-treated group do not show much change in weight as well as in their histological nature when compared to the normal group in spite of the retention of the glands in the abdomen. Thus it would appear that the accessory glands are maintained by the exogenous androgen. Fructose and citric acid concentrations also show an increase when compared to the untreated 15-day cryptorchid glands and reach almost the control values in the treated animals.

**DISCUSSION**

It is clear that inducing bilateral cryptorchidism in the rat and several species of laboratory animals leads to a prompt disorganisation of germinal epithelium (Steinberger and Nelson, 1955; Clegg, 1965 a,b; Cummins and Glover, 1970; Ploen, 1972; Jones et al, 1977). The reversibility of the changes has been shown to be dependent upon the length of time allowed to lapse before reposition of the testis back in the scrotum, (Atkinson, 1973 a,b; Hagen, 1971).
In the present studies the extent of germinal epithelium disruption is time dependent. The longer the testis remains in the abdomen, the more curtailed is spermatogenesis and the disruption of the epithelium. A similar observation is made in a study by Chowdury and Steinborger (1972) who reported that the cryptorchid milieu could support some degree of spermatogenesis in the rat, but with time, spermatogenesis ceased. The results in slender loris indicate that the cryptorchidism results in a phased degeneration of the germinal epithelium which reaches a maximal degree at about 30 days after operation. Cellular output is gradually reduced and ultimately halted so that the partially enlarged tubule appears relatively empty. With further progression, hylanization and sclerosis become prominent and many tubules become shrunken and fibrosed. The loss of germ cells during the degenerative phase appears to be roughly proportional to the degree of differentiation. Thus the spermatogonia as a whole are less affected than the spermatocytes which in turn are less affected than the spermatids. The spermatids disappear completely during the 15th - 22nd days of cryptorchid condition. The presence of multinucleate cells in
in the seminiferous tubules is an indication that tubular damage is occurring or has recently occurred. As the products of degeneration of germ cells become cleared from the tubules the nuclei of Sertoli cells generally become elongated with their long axis at right angles to the membrana propria. Towards the end of the experimental period (30-days), many tubular cross sections show complete obliteration of lumina by masses of Sertoli cell cytoplasms. The mechanism responsible for the increase in the number of Sertoli cells remains uncertain. It appears therefore that Sertoli cells react in an active manner to their abdominal environment increasing in number and in many instances moving away from the membrana propria of the seminiferous tubule. Much work has been done by Clegg (1963 a,b) in rats as also by Nelson (1951) in man and Moore (1924 a). Pearlman (1950), considered that the main block to spermatogenesis in crypto-orchidism, occurred between the primary and secondary spermatocyte stages and the present investigation shows that the block does occur between the early and late forms of the primary spermatocytes in the slender loris. The abdominal retention for 15-days resulted in the disappearance of most of the spermatids. When maintained for a month, spermatocytes
failed to differentiate and degenerated. When present, the spermatogenic cells are irregular in shape and poorly stained. Variable amounts of hylanisation and sclerosis of the membrana propria are seen. Similar results are seen in rat by Steinberger and Nelson (1955) and Clegg (1963). Jones et al (1977) have noted that in rat cryptorchidism leads to severe damage of the spermatogenic process and rapid degeneration of the seminiferous epithelium. It is also known that certain cell types do not degenerate in cryptorchidism, although morphological alteration in these cells have been noticed. Thus spermatogonia, Sertoli cells, Leydig cells are reported to remain intact. There is some disagreement concerning the type of cells showing the earliest morphologic changes after exposure to intra-abdominal milieu, (Steinberger and Nelson, 1955; Payne, 1956; Davies and Firlit, 1966). It has been demonstrated (Steinberger and Nelson, 1955; Davies and Firlit, 1966) that the spermatocytes show the earliest changes. Even in ram, (Blackshaw and Samisoni, 1967), the abdominal testis of mature cryptorchid animal was characterised by its small size and complete absence of active spermatogenic tissue. In guinea-pig (Blackshaw and Samisoni, 1966),
the gross evidence of atrophy was paralleled by histological evidence of tubular degeneration and shrinkage. In man the undescended testis showed fewer germ cells than were found in the scrotal testis. In addition the peritubular connective tissue showed a tendency to increase. Both these factors, reduction of germ cells and peritubular fibrosis are considered as factors which interfere seriously with normal spermatogenesis. In the undescended testis the process probably progresses until the condition may affect virtually the entire organ (Nelson, 1951).

The cellular changes in the seminiferous epithelium of the cryptorchid testis have been the topic of numerous investigators in various mammalian species, (Griffits, 1893; Moore, 1924 a,b; Nelson, 1951; Payne, 1956; Davies and Firlit, 1966; Glover, 1960; Ludwig, 1963; Clogg, 1963 b; Hicsni and Kormono, 1965 c). In general, all investigators agree that prolonged residence of the testis within the abdominal cavity results in progressive degeneration of the germinal epithelial cells, ultimately including the spermatogonia.

The mechanism by which the elevation of temperature produces epithelial damage are unclear. The
changed environment imposes some stress upon the testis which is capable of damaging spermatogenesis. It is generally assumed that the increased environmental temperature of the abdominal testis is responsible for the typical degenerative changes which occur (Moor, 1924), but the manner in which it acts is obscure (Clegg, 1963).

The effect of cryptorchidism on the Leydig cell function is not as clearly defined as on spermatogenesis. On the basis of morphologic studies, it has been suggested that Leydig cell remains unaffected, (Nelson, 1937; Collins and Lacy, 1969). Using histologic indicators, Clegg (1960) demonstrated a complicated pattern of changes in androgen function of the cryptorchid testis.

In the slender loris, the interstitial tissue did not atrophy, but remained intact throughout the experimental period. There appears to be an increase in its volume, which could be either due to the hypertrophy of Leydig cells or an actual increase in number of Leydig cells. The loss of tubular volume also might have constituted to this condition. The results in the slender loris agreed to some extent
with those of the previous workers who have concluded that the interstitial tissue increases in the cryptorchid animals (Bouins and Ancel, 1905; Blackshaw and Samisoni, 1967). However since this rise is so transient, the results are also not contrary to the view that the interstitial tissue is probably not affected by cryptorchidism (Moore, 1924, 1944). These authors attribute the apparent prominence of the interstitial tissue to the clumping of cells produced by the shrinkage of the testis and the divergence of these views from those of others cited above may be due to the fact that as the present investigation shows an increase in the number of cells can be expected only over a short period. Hooker (1948) was able to correlate the amount of testicular androgen in the bull with the number of vacuolated Leydig cells and it has been shown that the androgen content of the abdominal testis is less than that of the normal or scrotal testis. It is apparent however that in the cryptorchid testis, the interstitial tissue is incapable of producing an adequate amount of androgen presumably as a result of damage to the cells by their raised environmental temperature.
Many workers consider that the accessory reproductive organs are but little affected by cryptorchidism, (Jeffries, 1931), but others have found changes of varying degrees in artificially rendered cryptorchid animals, (Nelson, 1934, 1937; Moore, 1944). Previous workers have relied solely on weights and histological appearances of the accessory organs. More recently however the secretion of citric acid and fructose by the accessory reproductive organs has come to be regarded as a more sensitive index of testicular activity (Mann and Davies, 1949; Clegg, 1960). In the present investigation in the slender loris an attempt has been made to determine the effect of cryptorchidism upon the secretion of the substances by the accessory organs and hence upon the production of the androgenic hormone by the testis. All the particular features of the accessory organs which were examined in the present investigation namely organ weight, citric acid and fructose content and to a lesser extent cell-height indicate that during a limited period of the cryptorchid state (15–days) there is an increased output of the hormone and it decreases during a prolonged period (30–day) to below normal levels. This finding is in agreement with several other authors who consider that testicular hormone
output is diminished in cryptorchid animals (Nelson, 1937; Moore, 1944; Clegg, 1960). Engborg (1949) using androgen excretion in the urine as an index of its circulating levels came to similar conclusion. Glover (1956) described a rise in the level of the seminal fructose in ram, subsequent to scrotal insulation. Clegg (1960) has indicated the initial increase in the output of testicular hormone remained high during the experiment and gradually returned to normal after its termination. It was considered that this increase was the result of an increased production of male sex hormone. Although scrotal insulation cannot be strictly compared with cryptorchidism and although the experimental animals used differ greatly it would seem that increase in the testicular temperature a feature common to scrotal insulation and cryptorchidism may under certain circumstances produce a rise in the amount of circulating androgens. It has been known for many years that heat severely damages spermatogenic tissue, (Moore 1924a,b, 1944) and it is generally held that the cause of the severe damage in the cryptorchid animal is the elevated environmental temperature of the testis, (Moore, 1924, 1944). The rise in organ weight, citric acid and fructose
levels seen between the 10th and 15th day in the accessory sex glands of the cryptorchid slender loris confirm that androgen levels are increased during this period. A similar condition was noticed by Clegg, (1960) in rat.

The cryptorchid epididymis although appears relatively normal, histologically was empty of spermatozoa and the tubular diameter was about two thirds that of the normal. In the 15-day cryptorchid condition, histological sections showed the tubules of the epididymis to be distended, although in most cases the epithelium appeared to be relatively unchanged. In all animals examined after 30 days the epididymis appeared to be virtually empty of spermatozoa. This has been noticed by Clegg, (1960) in rat and Glover (1962) in rabbit.

Ludwig (1950) has demonstrated that maintenance of spermatogenesis by high doses of testosterone is secondary to a direct stimulating effect of this steroid, on spermatogenesis, which occurs in spite of the markedly diminished gonadotrophic levels. It should be reemphasised however, that testosterone only partially maintains the spermatogenic process.
Quantitative studies revealed that only 60 to 80% of the normal number of type A spermatogonia are available for further differentiation, thus resulting in diminution of the absolute number of mature germ cells produced by the testis (Clermont and Harvey, 1967). Elfwing (1955) showed that infertility in rats induced by the application of heat to the scrotum could be delayed by the administration of testosterone propionate.

Thus it could be that the dosage of testosterone propionate given to the 15-day cryptorchid loris is capable of maintaining the damaged testis although not at a control level. The administration of exogenous androgen prevents further damage to the testis. As it is already a well known fact that androgens stimulate the accessory ducts and glands, it is seen that even in a cryptorchid milieu, the exogenous androgen together with the androgens produced by the Leydig cells, returns the ducts to the normal levels, sperms are seen in the epididymis and the weights of the accessory glands seem to be almost similar to the control values. Regarding the secretory activity of the accessory glands it is seen that fructose concentration of the treated cryptorchid group is
almost that of the control or even more. However citric acid is considerably less than the control. It may be that the androgen threshold for fructose is more than that for citric acid.

Since a reciprocal relationship exists between gonad and the pituitary, a diminution in the testicular hormone output will result in an increased gonadotrophic output by the pituitary and vice versa. The testis affected by the increase in temperature will be less capable of response than a normal one and this capacity will diminish the longer the animal remains cryptorchid. Ultimately a stage will be reached when the testicular damage is maximal. However in the cryptorchid animal the capacity of the testis to produce hormone will diminish with time and ultimately a steady state will be reached, when increased production of gonadotrophin prevents further testicular damage but is insufficient to restore the testis to normal.
TABLE I

Changes in the weight of the testis following different period of cryptorchidism.

\[
\text{MEAN} \pm \text{S.E.}
\]

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>DURATION TREATMENT</th>
<th>BODY WT. (gms)</th>
<th>ABS. WT. (gms)</th>
<th>RELATIVE WT. (mg/s)</th>
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<tbody>
<tr>
<td>Group I</td>
<td>Normal</td>
<td>250±12.2</td>
<td>1.557±10.8</td>
<td>622.0±11.2</td>
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<tr>
<td>Group II</td>
<td>30 days</td>
<td>260±8.7</td>
<td>0.579±20.2*</td>
<td>219.4±30.8*</td>
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<tr>
<td>Group III</td>
<td>15 days</td>
<td>259±6.9</td>
<td>1.189±20.1*</td>
<td>456.6±20.2*</td>
</tr>
<tr>
<td>Group IV</td>
<td>15 days+ T.P.*</td>
<td>283.3±13.2</td>
<td>1.459±0.14</td>
<td>510.0±0.04</td>
</tr>
<tr>
<td>Group V</td>
<td>15 days+ oil. oil</td>
<td>260±10.0</td>
<td>1.072±1.8</td>
<td>412.0±30.1</td>
</tr>
</tbody>
</table>

* P > .001 when compared to the normal.
\(\circ\) P > .05 when compared to the normal.

\(^*\text{T.P.}\): testosterone propionate 200µgs/day for one week.
TABLE II

Changes in the absolute weight of epididymis, vas deferens and accessory glands in loris following different treatment.

MEAN ± S.E.

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>DURATION OF TREATMENT</th>
<th>BODY WT.</th>
<th>EPIDIDYMYIS</th>
<th>VAS.DEF.</th>
<th>SEM.VES.</th>
<th>PROS.GL.</th>
<th>GOWP.GL.</th>
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<td></td>
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<tr>
<td>Group I</td>
<td>Normal</td>
<td>250±6.1</td>
<td>658.4±10.6</td>
<td>117.5±5.8</td>
<td>901.0±60.1</td>
<td>238.2±30.9</td>
<td>830.3±18.3</td>
</tr>
<tr>
<td>Group II</td>
<td>30 days</td>
<td>260±8.7</td>
<td>317.5±20.2*</td>
<td>75.2±10.6</td>
<td>452.8±88.8*</td>
<td>114.0±30.9*</td>
<td>156.8±42.4*</td>
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<tr>
<td>Group III</td>
<td>15 days</td>
<td>259±6.4</td>
<td>403.9±18.1*</td>
<td>89.6±7.3</td>
<td>516.6±80.0*</td>
<td>163.8±10.1*</td>
<td>171.1±17.6*</td>
</tr>
<tr>
<td>Group IV</td>
<td>15 days+ T.P.*</td>
<td>283±13.2</td>
<td>541.4±28.5</td>
<td>110.8±10.9</td>
<td>1114.0±313.0</td>
<td>148.2±18.3</td>
<td>262.6±39.6</td>
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<tr>
<td>Group V</td>
<td>15 days+ ol. oil</td>
<td>260±10.7</td>
<td>367.4±10.2*</td>
<td>105.9±9.9</td>
<td>681.0±34.6</td>
<td>129.9±10.4</td>
<td>252.3±20.8</td>
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* P >.05 when compared to the normal

* T.P.: Testosterone propionate, 200μgs/day for one week
**TABLE III**

Changes in the relative weight of epididymis, vas deferens and accessory glands in the slender loris following different treatment.

**MEAN + S.E.**

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>DURATION OF TREATMENT</th>
<th>EPIDIDYMIS mgs</th>
<th>VAS.DEF. mgs</th>
<th>SEM. VES. mgs</th>
<th>PROS.GL. mgs</th>
<th>COVP.GL. mgs</th>
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<tbody>
<tr>
<td>Group I</td>
<td>Normal</td>
<td>263.3±6.8</td>
<td>47.0±1.8</td>
<td>360.5±30.1</td>
<td>95.2±1.8</td>
<td>132.1±10.1</td>
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<tr>
<td>Group II</td>
<td>30 days</td>
<td>120.3±5.1*</td>
<td>33.5±2.6*</td>
<td>170.9±35.0*</td>
<td>43.4±11.9*</td>
<td>59.7±16.6*</td>
</tr>
<tr>
<td>Group III</td>
<td>15 days</td>
<td>155.1±11.9*</td>
<td>34.4±8.8</td>
<td>203.9±17.8</td>
<td>39.7±10.8</td>
<td>65.9±18.8</td>
</tr>
<tr>
<td>Group IV</td>
<td>15 days + T.P.*</td>
<td>181.1±6.4</td>
<td>38.9±2.5</td>
<td>301.7±89.9</td>
<td>51.8±4.2</td>
<td>87.2±5.2</td>
</tr>
<tr>
<td>Group V</td>
<td>15 days + ol. oil</td>
<td>141.2±9.9</td>
<td>40.7±1.5</td>
<td>254.0±30.0</td>
<td>49.9±9.8</td>
<td>97.0±11.9</td>
</tr>
</tbody>
</table>

* P > .05 when compared to the control (Group I)

* T.P.: Testosterone propionate, 200µgs/day for one week.
### TABLE IV

Changes in the concentration (mgs/100mgs) of fructose in the Seminal Vesicles, Prostate Glands, Cowper's Glands following different treatment.

**MEAN ± S.E.**

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>DURATION OF TREATMENT</th>
<th>SEM. VES. mgs/100mgs</th>
<th>PROS. GLAND mgs/100mgs</th>
<th>COWP. GLANDS mgs/100mgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>Normal</td>
<td>114.7±20.2</td>
<td>94.9±30.1</td>
<td>69.8±8.2</td>
</tr>
<tr>
<td>Group II</td>
<td>30 days</td>
<td>52.7±22.1</td>
<td>70.2±34.1</td>
<td>52.7±4.0</td>
</tr>
<tr>
<td>Group III</td>
<td>15 days</td>
<td>92.1±8.9</td>
<td>109.1±40.1</td>
<td>61.5±12.7</td>
</tr>
<tr>
<td>Group IV</td>
<td>15 days + T.P.T.</td>
<td>112.5±25.1</td>
<td>116.7±31.2</td>
<td>67.1±13.3</td>
</tr>
<tr>
<td>Group V</td>
<td>15 days + ol. oil</td>
<td>58.6±12.8</td>
<td>22.2±4.9*</td>
<td>18.7±4.3*</td>
</tr>
</tbody>
</table>

* P > .05 when compared to group IV

* T.P.: testosterone propionate, 200μgs/day for one week.
**TABLE V**

Changes in the concentration (mgs/100mgs) of citric acid in the seminal vesicles, prostate glands and Cowper's glands of loris following different treatment.

**MEAN ± S.E.**

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>DURATION OF TREATMENT</th>
<th>SEM. VES. mgs/100mgs</th>
<th>PROS. GLAND mgs/100mgs</th>
<th>COWP. GLANDS mgs/100mgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>Normal</td>
<td>69.8±4.7</td>
<td>137.8±8.6</td>
<td>58.5±5.7</td>
</tr>
<tr>
<td>Group II</td>
<td>30 days</td>
<td>30.2±8.1*</td>
<td>43.8±14.5*</td>
<td>32.7±6.5*</td>
</tr>
<tr>
<td>Group III</td>
<td>15 days</td>
<td>40.6±16.3</td>
<td>47.1±30.8*</td>
<td>44.8±24.6</td>
</tr>
<tr>
<td>Group IV</td>
<td>15 days + T.P.</td>
<td>38.9±16.8</td>
<td>75.4±20.1</td>
<td>49.1±14.4</td>
</tr>
<tr>
<td>Group V</td>
<td>15 days + oil. oil</td>
<td>26.7±8.9</td>
<td>31.7±6.5</td>
<td>25.3±7.3</td>
</tr>
</tbody>
</table>

* P > .05 when compared to intact control

* T.P.: testosterone propionate, 200μg/day for one week.
Fig. 1: Photomicrograph of the section of the 30-day cryptorchid testis showing the degenerative epithelium. X 125.

Fig. 2: Photomicrograph of the section of the 30-day cryptorchid testis under higher magnification to show the Sertoli cell (SE) and spermatogonial cells (SPG) which are the only cell type present. X 540.
Fig. 3: Photomicrograph of the 30-day cryptorchid testis section to show the presence of large multinucleate giant cells (MNC) in the lumen. X 540.

Fig. 4: Photomicrograph of the 30-day cryptorchid testis section to show the interstitial tissue with spindle shaped interstitial cells. X 540.
Fig. 5: Photomicrograph of the transverse section of 15-day cryptorchid testis which shows not much of a damage within the tubule. X 125.

Fig. 6: Photomicrograph of a 15-day cryptorchid testis section under high magnification to show the absence of spermatids in the final stages of spermiogenesis. X 540.
Fig. 7: Photomicrograph of the cross section of the 15-day cryptorchid testis to show the interstitial tissue with Leydig cells. X 540.

Fig. 8: Photomicrograph of the cross section of the 30-day cryptorchid caput epididymis to show the absence of sperms in the lumen and also the absence of septa characteristic of the normal adult caput epididymis. X 35.
Fig. 9: Photomicrograph of the 30-day cryptorchid caput epididymis section. X 125.

Fig. 10: Photomicrograph of the 30-day cryptorchid cauda epididymis section to show the absence of sperms in the lumen, decrease in the size of the lumen and the presence of thick connective tissue covering around each tubule. X 125.
Fig. 11: Photomicrograph of the 15-day cryptorchid caput epididymis section to show the presence of large masses of exfoliated cells and spermatosoa in the epididymal lumen. X 540.

Fig. 12: Photomicrograph of the cross section of the 15-day cryptorchid cauda epididymis to show the pseudostratified nature of the epithelium. X 540.
Fig. 13: Changes in the relative weights of the accessory ducts and glands (in mg.) in the control, 30-day cryptorchid, 15-day cryptorchid and 15-day cryptorchid plus testosterone treated.
Fig. 14: Photomicrograph of the cross section of the 30-day cryptorchid vas deferens to show the absence of sperms in the lumen and increased cell height of the epithelium. X 35.

Fig. 15: Photomicrograph of the cross section of the 30-day cryptorchid seminal vesicle to show the reduction in the size of the lumen and also absence of secretion in the lumen. X 35.
Fig. 16: Photomicrograph of the transverse section of the 30-day cryptorchid seminal vesicle under high power to show the decrease in the cell height of the epithelium which appears non-secretory and low columnar. X 125.

Fig. 17: Photomicrograph of the transverse section of the 30-day cryptorchid prostate gland to show the non-secretory glandular region and the ducts devoid of secretion. The ducts of the seminal vesicle and vas deferens are also seen. X 35. (Pu—prostate gland, VD—vas deferens, VdD—ducts of the seminal vesicle).
Fig. 18: Photomicrograph of the transverse section of the 30-day cryptorchid Cowper’s glands to show the decrease in cell height and complete absence of contents. X 35.
Fig. 13: Fructose concentration (mg/100 gm.weight) in the seminal vesicle, prostate gland and Cowper's gland of the control, 30-day cryptorchid, 15-day cryptorchid and 15-day cryptorchid plus treated groups.
FIG. 19

Fructose concentration (mgs/100 gm weight)

- **Control**
- **30 day cryptorchid**
- **15 day cryptorchid**
- **15 day cryptorchid + treated**

Glands:
- Seminal vesicle
- Prostate gland
- Cowper's gland
Fig. 20: Citric acid concentration (mg/100 gm. weight) in the seminal vesicle, prostate gland and Cowper's gland of the control, 30-day cryptorchid, 15-day cryptorchid and 15-day cryptorchid plus treated group.
Citric acid concentration (mgs/100 gm weight)

- Control
- 30 day cryptorchid
- 15 day cryptorchid
- 15 day cryptorchid treated

Seminal vesicle, Prostate gland, Cowper's gland

FIG. 20
Fig. 21: Photomicrograph of the transverse section of the 15-day cryptorchid plus testosterone propionate treated testis to show the presence of all the cell types in the tubule. X 540.

Fig. 22: Photomicrograph of the transverse section of the 15-day cryptorchid testis plus olive oil treated control testis to show the destruction of the spermatocyte and spermatids and formation of multinucleate giant cells (MNC). X 540.
Fig. 23: Photomicrograph of the transverse section of the 15-day cryptorchid plus testosterone propionate treated testis to show the relatively interstitial cells which appear normal and secretory. X 540.

Fig. 24: Photomicrograph of the hormone treated cryptorchid epididymis section to show the presence of sperms in the lumen and increased diameter of the tubule. X 125.
**Fig. 25:** High power magnification of the testosterone treated cryptorchid caput epididymis section to show the presence of sperms and exfoliated cells in the lumen. X 540.

**Fig. 26:** Photomicrograph of the transverse section of the 15-day cryptorchid plus testosterone propionate treated cauda epididymis to show the lumen filled with sperms and exfoliated cells. X 540.