8-1953

The Effects of Testosterone Propionate on the Testes, Seminal Vesicles and Prostate of Intact and Castrate Rats

Sherman H. Jackson Jr.
Prairie View A&M College

THE EFFECTS OF TESTOSTERONE PROPIONATE ON THE TESTES, SEMINAL VESICLES AND PROSTATE OF INTACT AND CASTRATE RATS

JACKSON

1953

THE EFFECTS OF TESTOSTERONE PROPIONATE ON THE TESTES, SEMINAL VESICLES AND PROSTATE OF INTACT AND CASTRATE RATS

By

Sherman H. Jackson, Jr.

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of

Master of Science

In The

Graduate Division

of

Prairie View Agricultural and Mechanical College
Prairie View, Texas

August, 1953

BIOGRAPHICAL SKETCH

Sherman Hawley Jackson, Jr. was born September 8, 1925 in Yoakum, Texas. He attended both grade school and high school in Yoakum, Texas, and was graduated from Yoakum High School in May, 1942. He entered Prairie View A. and M. College in September, 1942. He was called to serve in the United States Army in November, 1943. After being honorably discharged from the Army in February, 1946, he returned to Prairie View A. and M. College to pursue the B. S. degree in Biology. In August, 1948, he was graduated from Prairie View A. and M. College with the Bachelor of Science Degree. In June, 1949, he entered graduate school at Prairie View A. and M. College to pursue the M. S. Degree in Biology. In September, 1949, he was employed on the staff of Peabody High School, Hillsboro, Texas, where he is now teaching in the field of science.

ACKNOWLEDGMENT

The writer is deeply indebted to Mr. Charles H. Nicholas for his inspiration, encouragement and kind guidance throughout the course of this research.

DEDICATION

This Thesis is Lovingly Dedicated

To My Wife

Mrs. Carrie H. Jackson

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

A review of progress on the male hormone is as follows: (a) the demonstration by Berthol, in 1849, of an internal secretory action by the testis; (b) emphasis directed towards hormone secretion and its function between 1900-1920; (c) the first successful extraction of the hormone from the testicular tissue in 1927 by McGee; (d) the crystallization of a male hormone, androsterone, from human urine by Butenandt in 1931; (e) the preparation in 1934 by Ruzicha of androsterone, by synthetic means from cholesterol; (f) the preparation in 1935 of a crystalline male hormone, testosterone, from fresh testicular tissue by David, Dingemange, Freud and Laqueur; (g) the preparation by synthetic means of testosterone in 1935, Butenandt and Hanish.

Moore and Gallagher (14) 1929, presented the facts relating to the development of several methods for detecting the presence of testicular hormone and the successful replacement of the hormone in the castrated mammal. It has been necessary to develop several methods for hormone detection in the mammal in order to study effects of testis extracts that have shown activity on injection into the capon.

Since 1929, the capon or chick comb method has been used for the assay of androgens. From a practical point of view it is not very desirable, for it is difficult and expensive to maintain a large flock of birds under conditions necessary for assay work. Research in this field of investigations has been confined lately to the rat. The work of Green and Burrill (4) 1940, 1941 describes a method for the assay of androgens using immature rats, a technique which has been used by many investigators.

The effects of testosterone propionate is recognized to cause changes in the morphological and histological mechanism of the sex organs' tissues. The rat and guinea pig (4) have been used as the experimental animal, and the tests were both morphological and histological in character. All tests have shown that the substance injected has the same effect as the internal secretion of the testis.

Numerous studies have shown that the functional state of the prostate and seminal vesicles of the rat is dependent on the male hormone. Gross size and secretory activity are conditional, and regression is rapid after castration.

The use of the accessory sex organs as the criterion of response for the biological assay of androgens has been described by Korenchevsky 1932, Callow and Deanesly 1938, Green and Burrill 1940, 1941, Hays and Mathieson 1945, and

Moore and Price 1946 (5).

In 1945, Steadman and Krischesky (20) observed that in castrate and intact rats treated with testosterone propionate, the response of the prostate gland and its various lobe was similar in both castrate and intact animals. In the case of seminal vesicles, there was a marked difference in response in the castrate rats to that in the intact animals. In the former, the seminal vesicles responded by a continuous and uninterrupted hypertrophy, while the intact animals reached a maximum, followed by regression.

Heckel (6) 1940, observed that in hypophysectomized rats, testosterone propionate will maintain but not initiate spermatogenesis. It will maintain the accessory reproductive organs in castrate animals, and produce marked changes in the testis of young normal growing animals.

Krohn and Zuckerman (10) 1940, demonstrated experimentally, that the increase in testicular activity after androgen injection, was either due to stimulation of the pituitary, or to a direct effect of androgen on the testis. They observed that the long term suppressive treatment with oestrogen, however, could hardly be due to any change in pituitary, and probably was due to a direct effect of the testicular hormone. It would seem reasonable to suppose therefore, that the effect of androgen is also direct.

The work done by Krischesky, Benjamin, Belt and

Schwartz in 1941 (8) indicated that testosterone propionate injections into completely prostatectomized rabbits produced a rapid increase in intraocular prostatic implants, which reached a peak in from 10 to 16 days, and was then followed by regression to the preinjection level in 6 to 8 weeks.

Korenchevsky, Hall and Ross in 1939 (9) observed that testosterone propionate produces complete restoration of the atrophied sexual organ, or with large dosage, a super normal development of the seminal vesicles and prostate.

Willis and Rampton (23) 1948, observed that the maximum response of testosterone propionate administered is obtained at approximately 72 hours after injection. Except for the first two weeks after castration, the sensitivity of rats castrated at 28 days of age to testosterone propionate does not change significantly.

Green and Burrill (4) 1941, noted weight increase in the seminal vesicles 24 hours after administration of testosterone propionate, and that variations in the prostate gland are due to the amount of hormone produced by the testes, and that the transformation at puberty is a manifestation of testicular production.

Moore and Price (15) 1937, found that the prostate and seminal vesicles of sexually mature rats show cytological involution changes within 2 to 5 days after

castration; that castration changes progress rapidly to a typical low level within approximately 2 weeks, and that bull extract prevented involution changes.

Much work has been done upon the response of immature rats' testes and accessories to male hormones. The treatments in general have been over a long period of time. In this research, the effects of testosterone propionate on the testes and accessories were observed after injection of testosterone propionate for a period of 14 days. The objectives being:

I. To study the normal condition of the testes and accessory sex organs of the rat which may be compared with modifications of these organs in experimental animals.

II. To observe the responses that the male testes and accessories make after the injection of testosterone propionate into 22 days of age rats for a period of 14 days.

III. To determine if the effects of testosterone propionate are parallel to the effects of the male hormone secreted by the testes.

IV. To show how castration affect the accessory sex organs, and find out if testosterone propionate injection will prevent the appearance of castrate characteristics.

CHAPTER II

MATERIALS AND METHODS

Rats Used. The rats used in this research problem were white albino rats of a strain propogated for approximately twenty years at A. and M. College, College Station, Texas. The experiment included twenty male rats which were divided as follows: five served as intact control. This group enabled one to determine whether the testes, seminal vesicles, and prostate had remained in the normal condition. Five rats served as castrate control, and the remaining ten rats were injected with testosterone propionate. A group of five was intact experimental, and the other group of five was castrate experimental. The age of the rats at the beginning of the experiment was 22 days. The average body weight of these animals prior to castration was 45 grams.

Care of Rats. Each group of rats was kept in a cage, 9"x 9"x 15" in the Prairie View A. and M. College Biology Research Laboratory. In order that the rats could eat and drink freely, they were constantly supplied with water and a diet consisting of Purina Dog Chow.

The humidity and temperature of the room were not kept constant, and the animals suffered from excessive heat during the course of the experiment.

Castration. All animals except the intact control

and the intact experimental were castrated when 22 days old. Under ether anesthesia, the scrotum was opened by a mid-distal incision, and the testes removed. All wounds healed without infection.

Injection. Testosterone propionate was injected after castration intramuscularly for a period of 14 days, with a 10 c. c. syringe graduated to 1 c. c. carrying a 22 gauge needle. The needle was inserted full length to prevent leakage of the doses of testosterone propionate, which was prepared in a diluent of physiological saline containing 1 mg. of testosterone propionate per c. c. of saline.

Autopsy. The rats were sacrificed at the beginning of the 15th day, and the testes and accessory sex organs removed.

Removal of Testes and Accessory Sex Organs. At autopsy, the ventral surface of the abdominal cavity was opened to expose the testes and accessory sex organs. The seminal vesicles and ventral lobe of the prostate were removed by incising at a point near the base of the bladder. The organs were placed immediately in Bouin's fluid, and then fresh weights were taken. Samples of the testes, seminal vesicles and prostate were preserved for histological study in Bouin's fixative, then stained in Harris's Hematoxylin and counterstained in eosin. The testes were sectioned at 7 microns and the seminal vesicles and prostate at 4 microns for the histological study.

CHAPTER III

EXPERIMENTS AND RESULTS

Study of normal condition. The normal condition of 5 intact control rats (Group A) 36 days old was studied at the end of the experimental period of 14 days. Three rats of this group were used for the morphological study, and two were used for the histological study of the testes, seminal vesicles and ventral lobe of the prostate. The study of the normal condition was made to observe the characteristics of the testes and accessory sex organs of 36 day old rats, in order that comparisons could be made with other groups of this experiment. Consequently, the rats of this group did not receive daily injections of testosterone propionate, but were cared for otherwise as all other groups.

Results. The fresh average weights of the testes in pairs of 3 intact control rats were found to be 0.8675 gram recorded in Table I. Histological normality of the testes consisted of well developed seminiferous tubules characterized by germinal epithelium cells with densely stained nuclear material. The phases of spermatogenesis in these cells could not be distinguished (Figure 11). The average diameter of 20 tubules in Table III was 157.5 microns.

In Table I is shown the data of the seminal vesicles

TABLE I. WEIGHTS OF TESTES, SEMINAL VESICLES AND PROSTATE OF INTACT CONTROL AND INTACT EXPERIMENTAL RATS

	INTACT CONTROL (GROUP A)				INTACT EXPERIMENTAL* (GROUP B)			
No. of rats	Final body wts.(gm)	Testes** wts.(gm)	Seminal vesicles** wts.(mg)	Ventral prostate wts.(mg)	Final body wts.(gm)	Testes** wts.(gm)	Seminal vesicles** wts.(mg)	Ventral prostate wts.(mg)
1	78	0.9750	10.0	15.0	71	0.9558	89.7	57.3
2	74	0.8622	19.2	15.9	77	0.8508	83.9	58.5
3	71	0.7615	10.3	16.7	73	0.7576	86.3	50.0
Av.	74 $\pm$ -0.7515	0.8675 $\pm$ -0.026	13.2 $\pm$ -0.2905	15.7 $\pm$ -0.1224	73 $\pm$ -0.8333	0.8544 $\pm$ -0.7200	86.6 $\pm$ -0.2157	51.9 $\pm$ -0.3122***

* Intact experimental rats received 14 injections of testosterone propionate.
**Organs weighed in pairs.

***The standard error of mean = $\frac{(x-x')^2}{n(n-1)}$ where x = individual value, x' = group mean, n = number of individuals.

and prostate. From microscopic study, the seminal vesicles of the intact control rats presented a granular lining epithelium; one cell in thickness of a tall columnar variety averaging 16.2 microns, as shown in Table III. The cells were resting upon a basement membrane which was outlined distinctly when stained in Harris's hematoxylin. The most conspicious feature in the cytoplasm was the presence of secretory granules between the basal nuclei and the distal end of the cells.

The histological structures of the ventral lobe of the prostate were very distinct, revealing a lining epithelium of a single layer of high columnar cells averaging 29.9 microns as shown in Table III. Secretory activity was characterized by well defined light areas near the lumen. These general features of the prostate were observed when the prepared slides were studied microscopically of the intact control rats.

Effects of testosterone propionate on intact rats. Five rats designated as intact experimental (Group B) were given daily injections of 1 mg. of testosterone propionate, to determine the effects testosterone propionate would have on the intact rats. The morphology of 3 rats of this group is expected to show some characteristics of the testes, seminal vesicles and prostate after testosterone propionate injections. From the histological study of prepared slides the conditions of the cells will be expected to give a clearer view of the effects.

TABLE II. WEIGHTS OF SEMINAL VESICLES AND PROSTATE OF CASTRATE CONTROL AND CASTRATE EXPERIMENTAL RATS

	CASTRATE CONTROL (GROUP C)			CASTRATE EXPERIMENTAL* (GROUP D)		
No. of rats	Final body wts.(gm)	Seminal vesicles** wts.(mg)	Ventral prostate wts.(mg)	Final body wts.(gm)	Seminal vesicles** wts.(mg)	Ventral prostate wts.(mg)
1	84	10.6	14.0	75	66.3	47.0
2	77	16.1	13.0	74	70.1	47.2
3	82	11.0	15.3	78	67.9	51.9
Av.	81 ≠ -0.8494	12.6 ≠ -0.1389	14.1 ≠ -0.1905	76 ≠ -0.5000	68.1 ≠ -4.5000	48.7 ≠ -0.0169***

*Castrate experimental rats received 14 injections of testosterone propionate.
***Organs weighed in pairs.
***S. E. M.

TABLE III. AVERAGE TUBULAR DIAMETER, AND CELL HEIGHTS OF THE TESTES, SEMINAL VESICLES AND PROSTATE OF CONTROL AND EXPERIMENTAL RATS

	TESTES		SEMINAL VESICLES		PROSTATE	
No. of rats	Intact control tubular diam. (microns)	Intact experimental tub. diam.	Cell heights (microns) control	castrate	Cell heights (microns) control	castrate
1	150.0	142.5	15.0	14.5	29.7	21.1
2	165.0	130.0	17.5	13.2	30.1	14.0
Av.	157.5	136.2	16.2	13.8	29.9	17.5

TABLE IV. BODY WEIGHTS IN GRAMS OF INTACT AND CASTRATE* RATS

	No. of rats	Intact control	Intact exper.	Castrate control	Castrate exper.	Av.
Initial body wts.	5	48	45	51	49	48
Final body wts.	5	74	73	78	76	75

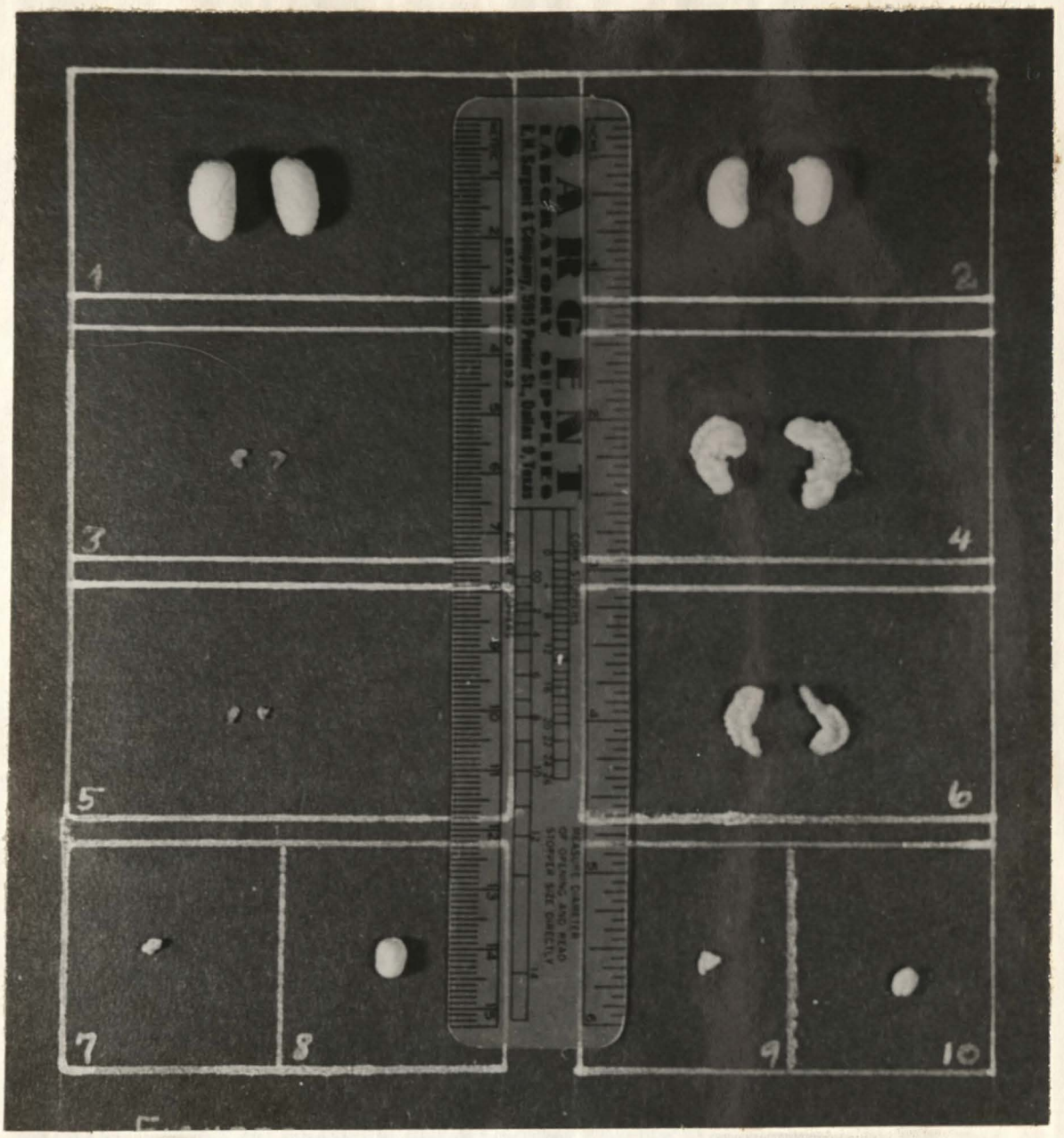
*Castration was performed at 22 days of age, initial weights were taken before castration and final weights were taken 15 days later.

Results. From Table IV, it was observed that neither initial nor final body weights differed materially between the intact experimental and the intact control groups.

In intact normal rats, Moore and Price (15) 1938 observed that secretion of the testes started about the 35th or 40th day of life. Therefore, the changes observed in this experiment of the testes and accessory sex organs are considered to be caused by 14 injections of 1 mg. of testosterone propionate.

The intact experimental rats possessed testes lighter than the intact control rats (Table I). It is seen from Figures 1 and 2 that the size of intact experimental rats were smaller than the intact control rats. The photomicrograph (Figure 12) of the testis of an intact experimental rat provided no evidence of testosterone propionate stimulating or retarding spermatogenesis. Study of the seminiferous tubules showed smaller tubular diameters determined by the average of 20 tubules (Table III). From an observation of (Figures 11 and 12) the effects of daily injections of 1 mg. of testosterone propionate on the intact experimental rats can be seen.

The seminal vesicles and prostate became enlarged significantly in the intact experimental rats when compared with the intact control rats. The administration of 1 mg. of testosterone propionate for 14 days into the intact experimental rats increased the gross size of the



Figures 1-10. Morphologic appearance of the testes, seminal vesicles and prostate of a 22 day old rat. 1. testes of intact control; 2. testes of intact experimental; 3. seminal vesicles of intact control; 4. seminal vesicles of intact experimental; 5. seminal vesicles of castrate control; 6. seminal vesicles of castrate experimental; 7. prostate of intact control; 8. prostate of intact experimental; 9. prostate of castrate control; 10. prostate of castrate experimental.

Figure 11. Testis of a control 36 day old rat. (C.S.)

Figure 12. Testis of an experimental 36 day old rat, castrated at 22 days of age. (C.S.)

testes and accessory sex organs when compared with the intact control rats (Figures 1, 2, 3, 4, 7 and 8). In Table I, the weights of the accessory organs of the intact experimental group were greater than the intact control group. Microscopic studies of the seminal vesicles of intact experimental rats after intramuscular injection of 1 mg. of testosterone propionate, showed that the epithelial cells had been increased to a height greater than the cells in the intact controls. The secretory activity was observed and found to have been increased, characterized by larger light areas. After injections the prostate showed that the cells had been increased to a height higher than the intact control group.

Experimental method of modifying the accessory sex organs by castration. Five rats designated as castrate control (Group C) were castrated at 22 days of age to study the effects of the absence of the testicular hormone upon the accessory sex organs of the male rats. Without the presence of the testicular hormone, and a lack of testosterone propionate injections, the conditions of the seminal vesicles and prostate are expected to show some changes in morphological and histological appearances, since, according to the literature (12, 13), the hormone secreted by the testes influence the growth and secretory activity of the accessory sex organs.

Results. The record of 3 rats in Table II showed

that the seminal vesicles and prostate weighed less after castration when compared with the weights of the accessory sex organs of the control group (Table I). Following castration the secretory granules of the seminal vesicles were not distinct and a decrease in the cell height took place. In the prostate, the light areas near the lumen had disappeared and there was a loss in epithelial height. These changes were observed from the study of the slides and from photomicrographs (Figures 13, 14, 15 and 16), which compared the castrate control group with the castrate experimental group.

Effects of testosterone propionate injections after castration. The castrate experimental rats (Group D) were used to determine the effects of testosterone propionate on the seminal vesicles and prostate. Five rats were castrated at 22 days old and daily injections made of testosterone propionate for a period of 14 days. After this period of time the effects of testosterone propionate were observed. Morphological and histological characteristics of the seminal vesicles and prostate were compared with the castrate control group and the intact control group.

Results. The data from the castrate control group revealed that the seminal vesicles and prostate had been changed from the normal condition. Three rats of the castrate experimental group were used to show the effects

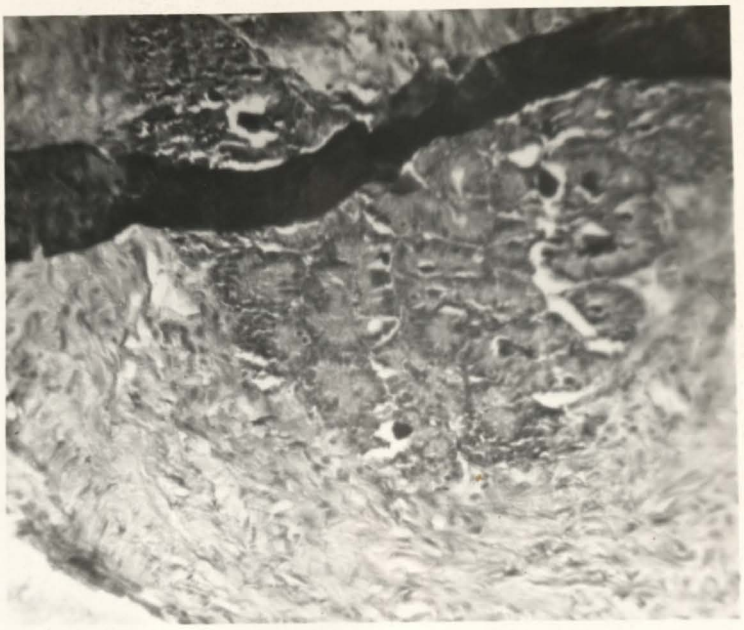


Figure 13. Seminal vesicle of a castrate control 36 day old rat. (C. S.)

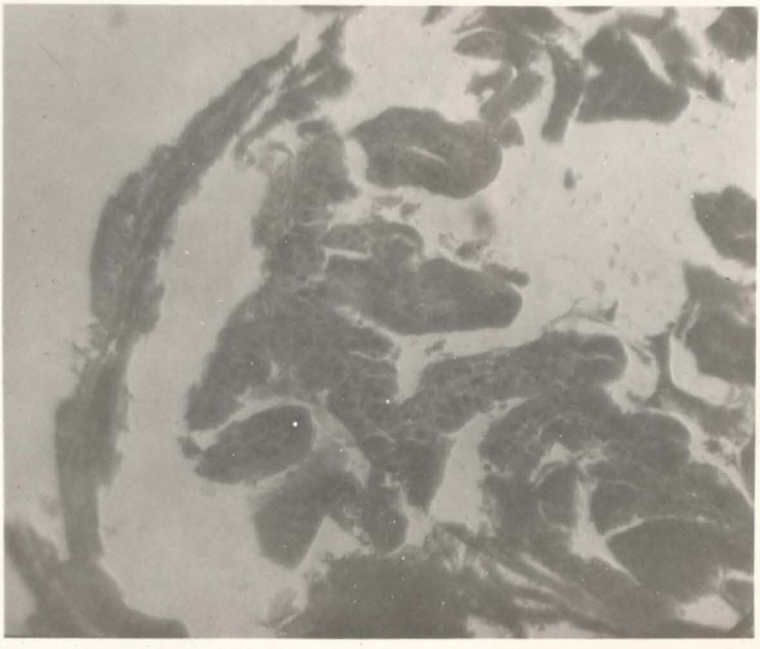


Figure 14. Seminal vesicle of a castrate experimental 36 day old rat, castrated at 22 days of age. (C.S)

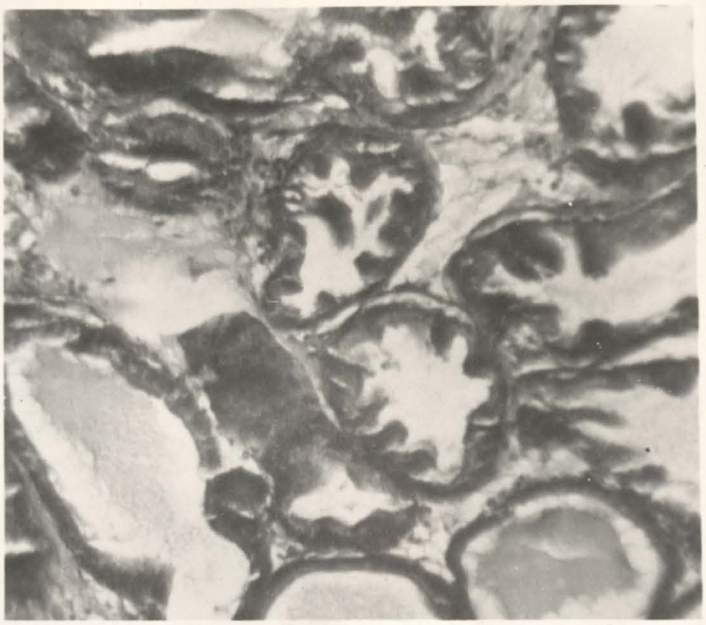


Figure 15. Prostate of a castrate control 36 day old rat. (C.S.)

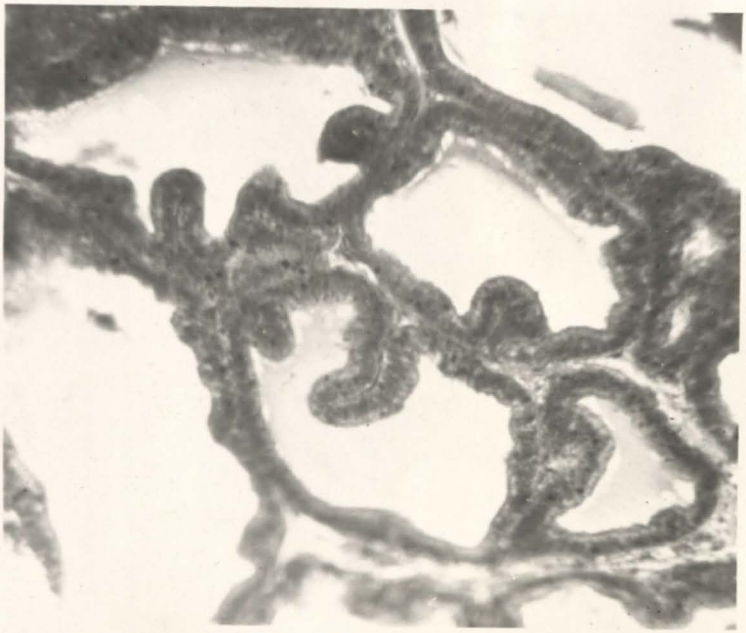


Figure 16. Prostate of a castrate experimental 36 day old rat, castrated at 22 days of age. (C.S)

testosterone propionate injections caused after the experimental period of 14 days.

The seminal vesicles of castrate rats injected daily with 1 mg. of testosterone propionate were found to be higher developed in secretory activity than those of the castrate control group (Figures 13 and 14). Comparisons of fresh weights (Table II) of the seminal vesicles revealed that those of the castrate experimental were greater than those of the castrate control group.

In the prostate, histological studies presented evidence of higher secretory activity in the castrate experimental compared to the activity in the castrate control group. The epithelium of the castrate experimental group had increased highly over the castrate control group as seen from Figures 15 and 16. The gross size of the prostate can be observed in Figures 9 and 10 of a castrate experimental rat and a castrate control rat. From comparison of fresh weights, the prostate of the castrate experimental group weighed more than the prostate of the castrate control group as seen in Table II.

CHAPTER IV

DISCUSSION OF RESULTS

The effects of testosterone propionate on the testes, seminal vesicles and prostate of intact and castrate rats have been studied, after the injections of 1 mg. of this hormone for 14 days. The effects produced by this hormone were recognized in this experiment, from a morphological and histological study of these glands.

The effects caused by the daily injections of 1 mg. of testosterone propionate were as follows: (1) an atrophy of the testes in weight and size in the intact experimental group, and an increase of the seminal vesicles and prostate; and (2) an increase in size, weight and secretory activity of the seminal vesicles and prostate of the castrate group.

From a comparison between the intact experimental rats and the intact control rats, it was found that the testes of the intact experimental rats were smaller than the testes of the control group, the seminiferous tubules were seen to possess tubular diameters of a smaller size and the accessory sex organs were greater than the intact control group.

Moore and Price (15) in calling attention to the atrophic effect of androgens on the testes attributed it to a reduction of gonadotrophin. This has been showm by Korenchensky and Hall (7), who gave daily doses of androgen

to rats. The same results were obtained by Wells(22) in 1943 on the squirrel. It was found by Moore and Price (15) that the testes of young rats atrophied when small doses of testosterone propionate have a depressive effect upon the anterior hypophyses (11) and that this in turn causes depressive effects in the testes of the intact experimental animals. However, Krohn and Zuckerman (10) 1940 were of the opinion that these results were due to a direct effect of testicular hormone on the testis.

In this experiment the spermatogenic process was not shown to have been stimulated in the intact experimental rats, but in comparison with the intact control group testosterone propionate maintained spermatogenesis.

According to Rudolph and Menely (19) after the injection of testosterone propionate intramuscularly into intact experimental rats for 56 days spermatogenesis was maintained. Nelson and Gaunt (16) using hypophysectomized rats found that the action of testosterone propionate maintained spermatogenesis. They were of the opinion that spermatogenesis in the rat is, to some extent at least independent of any direct hormone stimulation, and that after removal of the hypophysis the action of testosterone propionate is largely the result of keeping the testes in the scrotum. The evidences show that the administration of testosterone propionate depresses the gonadotrophic level (18) and that a mutual regulation exists between gonadotrophin and testicular production.

The results of this experiment on the intact experimental rats seem to coincide with the findings in the above experiments. It seems reasonable to attribute the atrophy of the testes and the maintainance of spermatogenesis to the amount of excess hormone present after the 14 daily injections of testosterone propionate.

The seminal vesicles and prostate in this experiment hypertrophied in the intact experimental rats. After injections of 1 mg. of testosterone propionate for 14 days, these glands were larger than in the castrate control rats.

Krohn and Zuckerman (10) 1949, in the course of their experiment observed, that testosterone propionate injections produced a continuous increase in size and secretory activity of the seminal vesicles and prostate.

Brovsin and Korenchevsky (2) observed that seminal vesicles and prostate hypertrophy could be caused by an excessive production of androgen by the testes. They joined two male rats in parabiosis and castrated one of them; the result was that these accessory sex organs of the non-castrated rat became hypertrophied because its testicles were stimulated to produce and excess of androgen owing to the increased supply of pituitary gonadotrophin derived from its partner.

Further evidence of the part played by androgens in intact rats have been produced by Callow and Deanesly (3) who showed that androgen caused a general hypertrophy in

size and in the secretory function of the epithelium in both the seminal vesicles and prostate.

These various experiments show that the main effects of androgens are on the seminal vesicles and prostate of intact rats confined to the epithelial structures, which become hypertrophied and functionally active. In view of known effects, it seems reasonable to suppose, that in this experiment the hypertrophied condition of the accessory sex organs was caused by the daily injections of 1 mg. of testosterone propionate, which was in excessive amount when compared with the amount and effects produced in the intact control rats.

Removal of the testes in this experiment produced marked changes in morphological and histological structures of the seminal vesicles and prostate within the experimental period of 14 days. The changes most apparent in this experiment were decreased in size of the seminal vesicles and prostate; a loss of secretory granules; and an involution of the secretory epithelium.

Korenchevsky and Ross (9) demonstrated the atrophic action of castration by castrating rats and observing the appearance of the seminal vesicles and prostate. They found that atrophied characteristics appeared 2 or 3 days following castration due to a lack of the testicular hormone and a suppressive effect on the hypophysis.

Castration effects over a longer period of time have been studied by Blyth and Dodds (1) who observed that after

castration the accessory sex organs atrophied to a typical low level within approximately 2 weeks. The atrophied effects were characterized by a decrease in size of the organs and loss of secretory cell height.

In this experiment, the effects of castration were observed 14 days after castration, and seemed to have been parallel to the findings of investigators mentioned.

Testosterone propionate injected into castrate rats produced a definite effect on the weights and histological characteristics of the seminal vesicles and prostate. It was observed that daily injections of 1 mg. of testosterone propionate into castrate rats prevented castration characteristics of the seminal vesicles and prostate, but stimulated the glands to greater than normal.

Moore and Gallagher (14) 1929, injected lipoid extracts of bulls into castrated guinea-pigs and by this means maintained the secretory activity of the accessory sex organs and stimulated growth. In castrated rats, these glands became atrophied in the absence of the testes.

Walsh, Parker and McCullagh (21) removed the hypophysis of rats, thus causing atrophy of the accessory sex organs. In such rats, they found that atrophy of the seminal vesicles and prostate could be prevented by daily injections of androsterone. Callow and Deanesly (3) performed a similar experiment showing that the seminal vesicles and prostate could be maintained in a functional state after castration in rats, mice and guinea-pigs by

a daily administration of androsterone.

Zuckerman and Parker (24) in 1938, treated a castrated rhesus monkey with injections of testosterone propionate and at the end of 91 days, the seminal vesicles and prostate were found to be of normal size and in full secretory activity.

In view of these investigators' findings, the results in this experiment can be supported as being similar to them. The effects of 1 mg. of testosterone propionate injection for a period of 14 days seemed to have been due to an excess of the hormone and its similarity to the testicular hormone.

CHAPTER V

SUMMARY

The morphological and histological effects of testosterone propionate on the testes, seminal vesicles and prostate have been studied after daily injections for a period of 14 days.

Testosterone propionate injections into intact rats caused a decrease in the diameter of the seminiferous tubules; and an increase in the size, weight and secretory activity of the seminal vesicles and prostate. These glands were more developed in the intact experimental rats than in the intact control rats, and the development was probably caused by an excess of testicular hormone.

In the castrate rats, the characteristics of castration were prevented by the daily injections of testosterone propionate. The hormone produced stimulating effects on the seminal vesicles and prostate. The increase in size, weight and secretory activity in the castrate rats seem to have been caused by an excess amount of the substance containing the testicular hormone.

Castration effects were observed to occur in the castrate control rats. The seminal vesicles and prostate were less developed than in the intact control rats. This decrease was probably due to the lack of testosterone propionate.

BIBLIOGRAPHY

1. Blyth, J. S. S. and E. C. Dodds. "Observation on the Assay of the Effects of Castration on Rats." Jour. Physiol., 73:136-140, 1931.

2. Brovsin, I. and V. M. Korenchevsky. "The Assay and the Effects of Testosterone Propionate on Rats Compared with those of other Sexual Hormones." Biochem. Jour., 31:1434-1441, 1937.

3. Callow, Robert K. and Ruth Deanesly. "Effects of Androsterone and Male Hormone Concentrations on the Accessory Reproductive Organs of Castrated Rats, Mice and Guinea Pigs." Biochem. Jour., 29:1424-1426, 1939.

4. Green, R. R. and M. W. Burrill. "Twenty-four Hour Response to Androgens in the Immature Rat." Proc. Soc. Exper. Biol. and Med., 45:780-783, 1940.

5. Hays, Harry W. and Donald R. Mathieson. "Effects of Testosterone Propionate on the Seminal Vesicles of Juvenile and Castrate Male Rats." Endocrinol., 37: 266-274, 1945.

6. Heckel, N. J. "The Effects of Testosterone Propionate on the Accessory Reproductive Organs in Castrated Rats." Jour. of Urol., 43:286-293, 1940.

7. Korenchevsky, Vladimir. "Castrated Rats for the Assay of Testicular Hormone." Biochem. Jour., 26:1300-1305, 1932.

8. Korenchevsky, V., J. A. Benjamin, E. Belt and M. Schwartz. "Changes Produced by Testicular Hormone in Castrated Rats." Jour. of Urol., 46:303-310, 1941.

9. Korenchevsky, V. M., M. A. Ross and K. Hall. "Effects of Sex Hormones on Rats." Biochem. Jour., 33:213-228, 1939.

10. Krohn, P. L. and S. Zuckerman. "The Response of the Accessory Sex Organs in Castrate Rats to Testosterone Propionate." Jour. of Endocrinol., 6:256-258, 1949.

11. Leathem, James H. "Influence of Testosterone Propionate on the Adrenals and Testes of Hypophysectomized Rats." Anat. Rec., 89:155-160, 1944.

12. Melamphy, R. M. and J. C. Porter. "Effects of Testosterone Propionate on Rat Seminal Vesicles." Fed. Proc., 11:105-107, 1952.

13. Moore, C. R. "Treatment of Testicular Deficiency with Testosterone Propionate." Jour. Clin. Endocrinol., 3:389-393, 1943.

14. Moore, Carl R. and T. F. Gallagher. "The Prevention of Castration Effects in Mammals by Testes Extract Injection." Amer. Jour. Physiol., 89:384-388, 1929.

15. Moore, Carl R. and Dorothy Price. "Some Effects of Testosterone and Testosterone Propionate in Rats." Anat. Rec., 71:59-65, 1938.

16. Nelson, W. O. and R. Gaunt. "Some Effects of Castration on the Growth of Rats." Amer. Jour. Physiol., 84:461-469, 1928.

17. Price, Dorothy. "Normal Development of the Prostate and Seminal Vesicles of the Rat with a Study of Experimental Post-natal Modifications." Amer. Jour. Anat., 60:79-124, 1937.

18. Rubinstein, H. S. and M. C. Solomon. "Growth Stimulating Effects of Testosterone Propionate." Jour. Urol., 51:89-93, 1944.

19. Rudolph, G. and George Menely. "Early Effects of Testosterone Propionate on the Accessory Organs of Castrate Rats." Fed. Proc., 10:240-241, 1951.

20. Steadman, F. H., I. Brovsin and B. Krischesky. "Prostate and Seminal Vesicles Response to Testosterone Propionate in Intact and Castrate Rats." Endocrinol., 37:89-95, 1945.

21. Walsh, C. L., A. S. Parker and D. R. McCullagh. "Influence of Testosterone Propionate upon Prostatic Hypertrophy and Spermatogenesis." Amer. Jour. Physiol., 107:508-512, 1934.

22. Wells, L. J. "Effects of Synthetic Androgen on Accessory Reproductive Organs of the Male Ground Squirrel." Proc. Soc. Exper. Biol. and Med., 34: 89-90, 1949.

23. Wills, C. G., S. E. Rampton and L. I. Pugsley. "Variables Affecting the Assay of Testosterone Propionate Using the Seminal Vesicles Response of Juvenile Castrated Male Rats." Endocrinol., 44:251-258, 1949.

24. Zuckerman, S. and A. S. Parker. "Androgen Action in Rats." Jour. Anat., 72:277-284, 1938.