

Testosterone Effect on Growth, Feed Intake and Composition of the Plasma in Rats^b

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흰쥐의 성장과 사료섭취 및 혈장내 성분에 대한 테스토스테론의 영향

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Summary

To investigate the effect of testosterone upon the body weight, feed intake, and creatinine and cholesterol content in the blood plasma, thirty rats which were three months old, were assigned into 6 groups of 5 rats. Those groups included one control group and 5 castrated groups which injected 0 to 4 mg of testosterone each.

The body weight gain in the control showed relatively higher value than the castrated, showing no significant effect between the groups. Also no significant effect in the feed intake between the groups, due to the amount of testosterone injection, was found.

The creatinine content in the plasma showed a highly significant effect between the groups, giving a lower concentration in the castrated group compared with the control while the content in the hormone treated groups increased with increasing amount of testosterone injection.

Otherwise the cholesterol concentration in the plasma was inversely proportional to the creatinine in each group.

Introduction

The principal hormones produced by the testes are androgens, steroid hormones that cause pronounced changes in body metabolism. Androgens stimulate the growth of muscles. They increase the rate of protein synthesis, resulting in increased

body weight. The increased protein synthesis in skeletal muscles is accompanied by a decrease in fat deposition. Muscle located in the forequarter of the male, especially those in the neck and crest region, show greater development than in females and castrates. The effects of androgens explain this characteristic growth pattern.

Nimni and Geiger^{a)} reported the androgen

1) 本研究은 1982年度 文敎部 學術研究助成費에 依해 遂行된 것임.

injection caused to increase in the body weight of rats, and Branning¹¹ and Park¹² applied that study to the steer to bring the result that the bull, compared to the steer, makes more rapid and efficient gains of the body weight. There were many reports which show the fact that the castration to male rats made the body weight decrease^{2,5,8,12}

However Turton¹⁴ and Rostoccev⁹ asserted that there was no difference in the gain of the body weight between the castrated and normal male rats as well as the case of Shin et al¹³ and Chung et al³. In recent Rowland¹⁰ reported the body weight of mature male rats taken the genital gland out was increased rapidly when treated with testosterone. Thus the objective of the present study is to investigate the body weight, feed intake, and creatinine and cholesterol contents affected by various levels of testosterone injections in the castrated and normal rats.

Materials and Methods

Thirty rats which were three month old were assigned into 6 groups of 5 rats

each, and after one month, each of 5 groups was castrated and injected testosterone propionate of 0, 1, 2, 3, and 4 mg, respectively, into the femoral muscle with every 3 days interval for 36 days, while a remained group was used as reference without any treatment (Table 1).

Every group was fed *ad libitum*, and the amount of feed intake and body weight were measured every 6 days each. The blood for creatinine and cholesterol was extracted from heart to put the test tube containing EDTA to prevent the coagulation and kept at -20°C after centrifuging. The creatinine content of the blood plasma was analyzed with Spectronic-20 by the Experimental Methods (1973) published by the Korean Biochemistry Society, and the analysis of the cholesterol followed AOAC (1980).

Results and Discussion

The influences of castration and testosterone treatment on the body weight are shown in Table 2. When compared with the control the body weight gain was similar in each of the testosterone treated

Table 1. Experimental design

| Group | Treatment |
|-------|---|
| A | Control |
| B | Castrated |
| C | Castrated & injected 1 mg testosterone propionate |
| D | 2 mg |
| E | 3 mg |
| F | 4 mg |

groups, giving a lower value in the castrated, of which result is consistent with the study by Chung et al.² instead of Rowland¹⁰ who reported that the high increase of the body weight was obtained in the testosterone treated male rats which the genital gland was cut out. Also there was not significantly different in the body weight between the hormone treated groups but the group with 3 mg testosterone showed the higher figure, 31.28g (Table 2)

In general the body weight of the hormone treated groups showed increasing rate while just the castrated group did not affect by the days on feed so much throughout the experiment, in agreement with earlier study of Ramirez and McCann⁸

Comparison of feed intake revealed that the castrated group without and with the hormone injection were not so different in the amount of feed intake (Table 3).

Table 2. Change of body weight affected by castration and T.P^z administration in male rats

| Day | Treatment ^y | | | | | | Duncan's M. R. test (P < 0.05) |
|-----|------------------------|--------|--------|--------|--------|--------|--------------------------------|
| | A | B | C | D | E | F | |
| | g | | | | | | |
| 0 | 288.88 | 277.46 | 279.54 | 282.14 | 279.58 | 272.24 | N S |
| 6 | 291.28 | 284.34 | 300.88 | 306.02 | 301.74 | 293.96 | N S |
| 12 | 306.94 | 291.64 | 304.00 | 301.00 | 307.82 | 299.76 | N S |
| 18 | 306.92 | 285.94 | 307.32 | 298.22 | 310.66 | 295.3 | N S |
| 24 | 313.18 | 284.88 | 302.18 | 298.64 | 302.60 | 292.8 | N S |
| 30 | 314.08 | 296.18 | 305.44 | 307.20 | 308.10 | 296.94 | N S |
| 36 | 319.78 | 302.20 | 308.02 | 312.00 | 310.86 | 301.00 | N S |

z) Testosterone propionate

y) A: Control

B: Castrated

C: Castrated & injected 1 mg T. P.

D: Castrated & injected 2 mg T. P.

E: Castrated & injected 3 mg T. P.

F: " 4 mg T. P.

Table 3. Change of feed intake affected by castration and T. P^z administration in male rats

| Day | Treatment ^y | | | | | | Duncan's M. R. test (P < 0.05) |
|-----|------------------------|--------|--------|--------|--------|--------|--------------------------------|
| | A | B | C | D | E | F | |
| | g | | | | | | |
| 6 | 155.80 | 157.40 | 151.60 | 164.40 | 152.80 | 158.20 | N S |
| 12 | 166.60 | 153.20 | 164.40 | 170.00 | 159.40 | 155.60 | N S |
| 18 | 166.40 | 167.20 | 163.00 | 168.00 | 161.80 | 167.20 | N S |
| 24 | 159.88 | 166.92 | 159.54 | 174.18 | 159.36 | 169.06 | N S |
| 30 | 198.66 | 210.92 | 183.84 | 185.14 | 186.16 | 207.74 | N S |
| 36 | 200.1 | 181.32 | 178.16 | 196.52 | 176.82 | 202.88 | N S |

z) Testosterone propionate

A: Control

B: Castrated

C: Castrated & injected 1 mg T. P.

D: Castrated & injected 2 mg T. P.

E: " 3 mg T. P.

F: " 4 mg T. P.

The feed intake did not always affect the body weight which might be influenced by the complex metabolic factors including feed intake as well.

The creatinine content of the blood plasma showed a highly significant difference between the treatments as shown in Table 4.

Table 4. Creatinine content in the blood plasma in rats fed for 5 months

| Treatment ²⁾ | Replication | | | | | Mean & DMRT ^Y |
|-------------------------|-------------|------|------|------|------|--------------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| | mg/100 ml | | | | | |
| A | 2.40 | 3.00 | 2.88 | 3.30 | 2.90 | 2.90 |
| B | 6.60 | 2.10 | 2.70 | 2.10 | 2.40 | 3.18 |
| C | 2.90 | 2.46 | 2.55 | 3.60 | 3.00 | 2.90 |
| D | 3.00 | 2.40 | 3.00 | 4.20 | 2.85 | 3.09 |
| E | 3.60 | 3.11 | 3.00 | 2.55 | 3.30 | 3.11 |
| F | 5.40 | 8.10 | 7.50 | 2.10 | 7.80 | 6.18 |

Z) A: Control

B) Castrated :

C: Castrated & injected 1 mg T.P.

D: " 2 mg T.P.

E: Castrated & injected 3 mg T.P.

F: " 4 mg T.P.

Y) Duncan's M. R. test.

Table 5. Cholesterol content in the blood plasma in rats fed for 5 months

| Treatment ²⁾ | Replication | | | | | Mean & DMRT ^Y |
|-------------------------|-------------|-------|-------|-------|-------|--------------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| | mg/ml | | | | | |
| A | 0.075 | 0.070 | 0.076 | 0.074 | 0.096 | 0.080 |
| B | 0.096 | 0.104 | 0.114 | 0.080 | 0.104 | 0.100 |
| C | 0.080 | 0.104 | 0.078 | 0.070 | 0.100 | 0.090 |
| D | 0.024 | 0.044 | 0.040 | 0.036 | 0.040 | 0.040 |
| E | 0.044 | 0.046 | 0.048 | 0.046 | 0.044 | 0.0456 |
| F | 0.046 | 0.030 | 0.056 | 0.040 | 0.056 | 0.0456 |

2) A: Control

B: Castrated

C: Castrated & injected 1 mg T.P.

D: Castrated & injected 2 mg T.P.

E: 3 mg T.P.

F: " 4 mg T.P.

Y) Duncan's M. R. test.

The increasing levels of creatinine in the castrated group which injected the testosterone from 1 to 4 mg was an expected fact with reference to the results of Nimni and Geiger⁶⁾, Thompson and King¹³⁾

and Loring et al¹⁾ The reason for the rapid increase of creatinine content from 3.11mg in the 3 mg hormone treated to 6.18mg in the 4 mg hormone treated group

remains to be elucidated. Thompson and King³⁾ reported that the administration of androgen to the castrated rats caused to the increase of muscle weight by the increase of proteins, amino acids and creatinine in the blood, and Loring et al.⁴⁾ presented the result which the testosterone injection to the castrated rats made ATP and l-keto acid production high. It is assumed ATP production by creatine phosphate and ADP contributes to the high content of creatinine.

The concentration of cholesterol in the plasma showed a highly significant difference between the treatments (Table 5).

The cholesterol content in the castrated group showed the decreasing rate with the increasing amount of testosterone injection treated especially from 1 to 2mg testosterone group. West and Todd⁵⁾ explains the increase of cholesterol in the plasma is because the shortage of androgen which occurs by the diminish of exercise and inhibition of nutrient oxidation. Thus it is a logical conclusion to get the increased cholesterol content with the falling exercise in the testosterone treated groups.

적 요

Testosterone propionate가 体成長 사료섭취량 및 plasma내의 Creatinine 과 cholesterol에 미치는 영향을 구명하기 위해 생후 3개월령된 숫 흰쥐 30마리를 대조구 거세구 거세한 후 1mg, 2mg, 3mg, 4mg으로 각기 호르몬을 투여한 처리구로 나누어 각 5마리씩 배치하여 체중측정과 사료섭취량은 6일간격으로 testosterone주입은 3일 간격으로 처리하고 심장穿刺 채혈하여 plasma를 분리해 내어 분석했다. 체중의 변화는 거세구가 대조구와 다른 testosterone처리구에 비해

증체가 둔화되었으나 전체적으로 볼 때 각 처리구간에 유의성은 없었다. 사료섭취량은 전체적으로 유의성이 없었으며 사료섭취량의 증감과 증체량을 비교했을 때 부분적으로 평행하는 경향을 보였다. Creatinine의 Plasma내 함량은 처리구간에 고도의 유의성을 나타내었고 ($P < 0.01$) 대조구와 비교해 볼 때 거세구는 감소했고 testosterone처리구에서는 2mg이상의 처리구에서 상승치를 보였으며 특히 4mg을 처리한 구에서는 큰 증가를 나타내었다. Cholesterol의 Plasma내 함량은 처리구간에 고도의 유의성을 나타내었으며 ($P < 0.01$) 대조구와 비교해 볼 때 거세구는 증가했고 testosterone처리구에서는 1mg 처리시 동일했으며 그 이상의 hormone 처리에서는 상당히 감소했다.

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