1.

Type II

1.1.1.

Glucocorticoid [Czerniske et al., 1987; Rannels & Jefferson, 1980] or other Type II steroid (Falduto, Young & Hickson, 1992a; Hickson et al., 1981, 1984, 1986; Seene & Viru, 1982; Choe & Hong, 2001).

When the steroid is glucocorticoid (Czerniske et al., 1987) or another glucocorticoid (Falduto, Young & Hickson, 1992a; Hickson et al., 1981, 1984, 1986; Seene & Viru, 1982; Choe & Hong, 2001), it is referred to as Type II steroid.


2. Materials

Glucocorticoid dexamethasone Type II. Type II muscle.

Type II muscle dexamethasone saline

1. Study

Sprague-Dawley rats (N = 36, Wt. = 102.5 ± 4.98g) were utilized. The circadian rhythm was 12h:12h. The figures are means ± SEM.

2. Design

<table>
<thead>
<tr>
<th>Control</th>
<th>Saline</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexa</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(n = 8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control + Sedentary</td>
<td>Saline</td>
<td>Sedentary</td>
</tr>
<tr>
<td>(n = 6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control + Exercise</td>
<td>Saline</td>
<td>Exercise</td>
</tr>
<tr>
<td>(n = 5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexa + Sedentary</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(n = 5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexa + Exercise</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(n = 7)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* : Muscle Dissection

*Figure 1* Experimental design
1) Dexamethasone

Choe, Choi & Shin, 1997

2) Saline

Dexamethasone saline 5 Kg 10m/min

3) Dexamethasone

kg 50 Kg 10m/min

4) Dexamethasone saline rat digital balance

Pentobarbital sodium (50mg/kg i.p.)

microbalance

6) Dexamethasone (myofibrillar protein)

39mM borate, 25mM KCl, 1mM phenylmethylsulfonyl fluoride, 5mM EGTA, 0.01M borate-KCl buffer (pH 7.0)

2000rpm 15°C

Percoll (1% TritonX-100) membrane bound protein 0.1M KCl, 2mM MgCl, 2mM EGTA, 0.01M Tris-maleate (pH 7.0), 10mM

Kruskal-Wallis test

Mann-Whitney U test p<0.05

III. Results

(C), Dexa (D), saline(C+S), saline(C+Ex), Dexamethasone saline(R), Dexamethasone saline (C+S), saline(R)

104.50±2.02g, saline(R) 101.50±3.50g, dexamethasone saline 99.50±6.54g, saline(R) 101.93±1.69g, dexamethasone saline 132.73±3.13g.
Table 1> Pre and Post body weight of Control(C), Dexa(D), Sedentary after Control(C+S), Exercise after Control(C+Ex), Sedentary after Dexa(D+S), and Exercise after Dexa(D+Ex) rats.

<table>
<thead>
<tr>
<th></th>
<th>Prewt. (g)</th>
<th>Postwt. (g)</th>
<th>Post/ Prewt (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C (n = 5)</td>
<td>110.11±0.00</td>
<td>132.73±3.13*</td>
<td>120.54</td>
</tr>
<tr>
<td>D (n = 8)</td>
<td>104.50±2.02</td>
<td>86.81±4.65*#</td>
<td>83.07</td>
</tr>
<tr>
<td>C+S (n = 6)</td>
<td>99.50±6.54</td>
<td>146.86±5.23*</td>
<td>147.60</td>
</tr>
<tr>
<td>C+Ex (n = 5)</td>
<td>107.34±4.50</td>
<td>153.78±11.39*</td>
<td>143.26</td>
</tr>
<tr>
<td>D+S (n = 5)</td>
<td>101.50±3.50</td>
<td>121.31±22.65*</td>
<td>119.52</td>
</tr>
<tr>
<td>D+Ex (n = 7)</td>
<td>101.93±1.69</td>
<td>117.74±7.69*#</td>
<td>115.51</td>
</tr>
</tbody>
</table>

Values are mean±SD (g); n: number of animals
pseud.: body weight, at the start of experiment, postwt.: body weight before dissection
* Significantly different between prewt. and postwt. value (p<0.05)
# Significantly different between C and D (p<0.01)
@ Significantly different between C+S and D+Ex (p<0.001)
& Significantly different between C+Ex and D+Ex (p<0.001)

<Table 2 > Wet weight of hindlimb muscles in Control(C), Dexa(D), Sedentary after Control(C+S), Exercise after Control(C+Ex), Sedentary after Dexa(D+S), and Exercise after Dexa(D+Ex) rats.

<table>
<thead>
<tr>
<th></th>
<th>Plantaris (mg)</th>
<th>Gastrocnemius (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C (n = 5)</td>
<td>123.90±8.01</td>
<td>632.80±50.59</td>
</tr>
<tr>
<td>D (n = 8)</td>
<td>83.93±7.65*</td>
<td>424.25±42.60*</td>
</tr>
<tr>
<td>C+S (n = 6)</td>
<td>163.36±19.80@</td>
<td>798.93±62.84@</td>
</tr>
<tr>
<td>C+Ex (n = 5)</td>
<td>159.50±19.19&amp;</td>
<td>829.14±76.76&amp;</td>
</tr>
<tr>
<td>D+S (n = 5)</td>
<td>118.70±18.83</td>
<td>585.40±70.70</td>
</tr>
<tr>
<td>D+Ex (n = 7)</td>
<td>121.21±13.93#</td>
<td>600.79±48.41#</td>
</tr>
</tbody>
</table>

Values are mean±SD (mg); n: number of animals
* Significantly different between C and D (p<0.001)
# Significantly different between C+S and D+Ex (p<0.001)
@ Significantly different between D+S and C+S (p<0.001)
& Significantly different between C+Ex and D+Ex (p<0.001)
3. Type II muscle fibers

7.21 % Type II fibers in D after 36.73 % in Control. The Type II fiber content increased significantly from 0.93 ± 0.06 in D to 1.03 ± 0.07 in saline (p = 0.001), from 1.11 ± 0.07 in D to 1.03 ± 0.06 in D (p = 0.06), and from 1.03 ± 0.06 to 1.03 ± 0.67 in saline (p = 0.006). The Type II fibers in D increased significantly from 4.13 % in saline to 11.72 % in D (p = 0.006), from 11.72 % in saline to 4.86 % in D (p = 0.001), and from 11.72 % in saline to 7.21 % in D (p = 0.001).

4. Type II myofibrillar protein (myofibrillar protein)

7.21 % Type II fibers in D after 36.73 % in Control. The Type II fiber content increased significantly from 0.93 ± 0.06 in D to 1.03 ± 0.07 in saline (p = 0.001), from 1.11 ± 0.07 in D to 1.03 ± 0.06 in D (p = 0.06), and from 1.03 ± 0.06 to 1.03 ± 0.67 in saline (p = 0.006). The Type II fibers in D increased significantly from 4.13 % in saline to 11.72 % in D (p = 0.006), from 11.72 % in saline to 4.86 % in D (p = 0.001), and from 11.72 % in saline to 7.21 % in D (p = 0.001).

<table>
<thead>
<tr>
<th>Plantaris (mg/g)</th>
<th>Gastrocnemius (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(n = 5)</td>
<td>0.93 ± 0.06</td>
</tr>
<tr>
<td>D(n = 8)</td>
<td>0.97 ± 0.07</td>
</tr>
<tr>
<td>C+S(n = 6)</td>
<td>1.11 ± 0.12</td>
</tr>
<tr>
<td>C+Ex(n = 5)</td>
<td>1.03 ± 0.07</td>
</tr>
<tr>
<td>D+S(n = 5)</td>
<td>0.98 ± 0.06</td>
</tr>
<tr>
<td>D+Ex(n = 7)</td>
<td>1.03 ± 0.67</td>
</tr>
</tbody>
</table>

Values are mean ± SD (mg/g) n; number of animals
# Significantly different between C+S and D+Ex (p<0.01)
@ Significantly different between C+S and D+S (p<0.01)
**Table 4** Myofibrillar protein content of hindlimb muscles in Control (C), Dexa (D), Sedentary after Control (C+S), Exercise after Control (C+Ex), Sedentary after Dexa (D+S), and Exercise after Dexa (D+Ex) rats

<table>
<thead>
<tr>
<th></th>
<th>Plantaris (mg/g)</th>
<th>Gastrocnemius (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C (n=5)</td>
<td>76.11±11.34</td>
<td>82.15±5.56</td>
</tr>
<tr>
<td>D (n=8)</td>
<td>72.71±4.90</td>
<td>62.19±15.89</td>
</tr>
<tr>
<td>C+S (n=6)</td>
<td>150.67±49.64</td>
<td>106.62±5.30</td>
</tr>
<tr>
<td>C+Ex (n=5)</td>
<td>84.60±23.97</td>
<td>62.37±7.21</td>
</tr>
<tr>
<td>D+S (n=5)</td>
<td>52.32±42.84</td>
<td>66.28±21.81</td>
</tr>
<tr>
<td>D+Ex (n=7)</td>
<td>84.64±13.13</td>
<td>86.65±12.02#</td>
</tr>
</tbody>
</table>

Values are mean±SD (mg/g muscle weight) n: number of animals

# Significantly different between D+S (G) and D+Ex (G) (p<0.05)

saline - 21.8% Type II

 dexa - 12% Type II

dexa has on e 28.19 % Type II

saline has on e 43.83% Type II

Dexamethasone 82.15±5.56mg/g, Dexa has on e 62.19±15.89mg/g, saline has on e 106.62±5.30mg/g, saline has on e 62.37±7.21mg/g, dexa has on e 66.28±21.81mg/g, dexa has on e 86.65±12.02mg/g.

Dexamethasone 24.30%

saline 18.74% saline

saline 18.74% dexa

dexa 18.74% dexa

dexa 23.51%

(p=0.036), saline has on e 18.74%, dexa has on e 18.74%, saline has on e 18.74%

Dexamethasone 12%

cortisone acetate 12%

Hickson (1984). Type II cortisone acetate 12%

dexamethasone (Hickson & Davis, 1981; Czerwinski et al, 1987), glucocorticoid 12%

dexamethasone (Rannels & Jefferson, 1980). Dexamethasone 12%

cortisone acetate 12%

dexamethasone 12%

cortisone acetate 12%

dexamethasone (Goth, 1981) dexamethasone 12%

cortisone acetate 12%

dexamethasone 12%

cortisone acetate 12%

Dexamethasone 12%

cortisone acetate 12%

dexamethasone 12%

cortisone acetate 12%

Dexamethasone 12%

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cortisone acetate 12%

Dexamethasone 12%

cortisone acetate 12%

dexamethasone 12%

cortisone acetate 12%
Type II muscle fibers are generally resistant to glucocorticoids, whereas Type I muscle fibers are more sensitive. Dexamethasone can be used to affect Type II muscle fibers in a fast-twitch manner (Czerwinski et al., 1987). In contrast, cortisol can affect Type II muscle fibers more slowly (Choe et al., 1982). Glucocorticoids are known to affect heavy chain isoform profile (Seene & Alev, 1985) cortisol acetate can affect Type II muscle fibers in a fast-twitch manner (Czerwinski et al., 1987).

Dexamethasone can be used to affect Type II muscle fibers in a fast-twitch manner (Czerwinski et al., 1987). In contrast, cortisol can affect Type II muscle fibers more slowly (Choe et al., 1982). Glucocorticoids are known to affect heavy chain isoform profile (Seene & Alev, 1985) cortisol acetate can affect Type II muscle fibers in a fast-twitch manner (Czerwinski et al., 1987).

V. Results

Glucocorticoids dexamethasone 1 kg 5mg kg 1g 10m/min 2002 8
References


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**Effect of Regular Exercise during Recovery Period Following Steroid Treatment on the Atrophied Type II Muscles Induced by Steroid in Young Rats**

*Choe, Myoung-Ae* * Shin, Gi-Soo **

*An, Gyeong-Ju* * Choi, Jung-An* *

*Lee, Yoon-Kyong*

**Purpose:** This study was conducted to determine whether low intensity regular exercise following dexamethasone treatment could attenuate steroid-induced muscle atrophy.

**Method:** 36 Wistar-rats (90-110g) were divided into six groups: control group (C), dexamethasone treatment group (D), sedentary group after normal sedentary period (C+S), sedentary group after dexamethasone treatment period (D+S), exercise group after normal sedentary period (C+E), and exercise group after dexamethasone treatment period (D+E). D, D+S, and D+E groups received dexamethasone injection (5mg/Kg) for seven days whereas C, C+S, and C+E groups

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* College of Nursing, Seoul National University
** Red Cross College of Nursing
received normal saline injection. Both C+E and D+E groups ran on a treadmill for 60 minutes/day (20 minutes/4 hours) at 15 m/min and a 10° grade for seven recovery days.

Result: Post-weight (body weight before muscle dissection) of D group significantly decreased by 16.03%, and that of D+E group significantly increased by 15.51% compared with pre-weight (body weight before steroid treatment). Type I muscle (plantaris and gastrocnemius) weights of D group were significantly lower than those of C group. Myofibrillar protein contents of type I muscles of D group tended to decrease comparing with C group. In D+E groups, body weights and relative weights of type I muscles (muscle weight (g)/post-weight (g)) tended to increase comparing with D+S group.

Conclusion: It is suggested that steroid-induced muscle atrophy can be ameliorated through low intensity regular exercise after dexamethasone treatment.

Key words: Exercise, Steroid, Fast-twitch muscle fibers