JOURNAL OF APPLIED PHYSIOLOGY
Vol. 32, No. 6, June 1972. *Printed in U.S.A.*

Effect of anabolic steroids on reflex components

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ARIEL, GIDEON, AND WILLIAM SAVILLE. *Effect of anabolic steroids on reflex components*. J. Appl. Physiol. 32(6): 795–797. 1972.—The purpose of this study was to investigate the effect of anabolic steroid on the nervous system by measuring the various reflex components of the knee jerk reflex. A double-blind technique was used to examine the effect of methandrostenolone (Dianabol) on the knee reflex of six male subjects. The anabolic steroid had a significant effect upon these reflex components. Significantly faster motor times and significantly slower latencies were obtained. From these results it can be concluded that the anabolic steroid acted upon the central nervous system and the biochemical processes involved in the reflex.

methandrostenolone; latencies; motor times; total reflex times

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THE WORK OF KOCHAKIAN AND MURLIN (3) provides the basis for the use of anabolic steroids. The pharmacological properties of these steroids has proved of clinical value in the treatment of conditions where protein synthesis and reduced nitrogen loss is desired. Their use has been extended by "power event" athletes who have attempted to develop increased muscular contractile force. The use of anabolic steroids for this purpose is reported to be widespread.

The effects of anabolic steroids upon the nervous system are still unclear. The purpose of this study was to investigate the effect of anabolic steroid (methandrostenolone) on the nervous system by measuring the knee jerk reflex. This reflex arc which is initiated by striking the ligamentum patella has been subdivided into three components, the reflex latency, the motor time, and the total reflex time. The latency and the motor time components of the total reflex time are derived from the nomenclature of Weiss (6) who named the premotor time and motor time components of total reaction time. In general, the subdivisions used by Weiss (6) and Botwinick and Thompson (2), to fractionate reaction time, were used in the present study to fractionate reflex time. Therefore, the reflex latency is the time from mechanical stimulation of the ligamentum patella to the appearance of an action potential at the motor point of the rectus femoris muscle. The motor time is the period from the appearance of an action potential at the motor point to the mechanical movement of the leg by the muscle. The total reflex time is from the mechanical stimulation of the tendon to the mechanical movement of the leg. Kroll (4) has postulated the relative independence of these components. This independence suggests different mechanisms.

The effect of anabolic steroids on the afferent-efferent nervous pathways and their effect upon the electrobiochemical exchange period was examined. The time taken for the conduction of the nervous impulse from the receptor site back to the muscle motor point, via the ventral horn cells, and the time for the conversion of this electrical phenomenon into a chemically mediated response of the muscle were measured. Changes in the neurological component and the linking of this component with the biochemical processes of contraction in the muscle should supplement the established literature that has already shown consistent changes in the biochemical parameters.

METHODS

Six male university students, aged 18–22 years, served as subjects in this study. Their height averaged 182 cm with a mean weight of 97 kg. The experiment was conducted during an 8-week period. To minimize the effect of diurnal variation, testing was conducted between 8 PM and 10 PM.

Testing was conducted weekly on 2 successive days. All the subjects were varsity athletes who had experienced 2 years of weight training. For a period of 4 months prior to the beginning of the test procedures all the subjects lifted for 5 days and were tested on the 6th and 7th days. This procedure was followed for the 8-week study period. On the 2nd, 3rd, and 4th weeks of the study all the subjects were given placebo pills daily and informed they contained 10 mg of Dianabol (methandrostenolone), an oral anabolic steroid. From the 4th to the 8th weeks a double-blind technique was used. Three of the subjects received 10 mg of the oral anabolic steroid and the remaining three subjects continued to receive the placebo. The oral anabolic steroid and the placebo were assigned to the subjects by code by the University Health Service and the investigators were not informed which subject received the steroid until after the 8-week testing period.

Total patellar reflex time and reflex latency were obtained on the right limb. A Lafayette knee reflex apparatus was used. An adjustable hammer was used to deliver a strike to the ligamentum patella. The hammer was released at 60 degrees. The heel of the subject was held relaxed against a plate depressing a microswitch. The recording was started when the microswitch in the hammer was activated by the strike. The microswitch closed the circuit, causing an electric Hunter clock counter to start when contact was made by the hammer head with the ligamentum patella. As soon as the reflex arc was completed, a mechanical movement of the limb caused the subject's heel to raise the heel plate which again opened the circuit and stopped the electric clock. The time elapsed is the total reflex time.

The subject was seated on a specially constructed knee reflex apparatus. A movable backrest was adjusted until

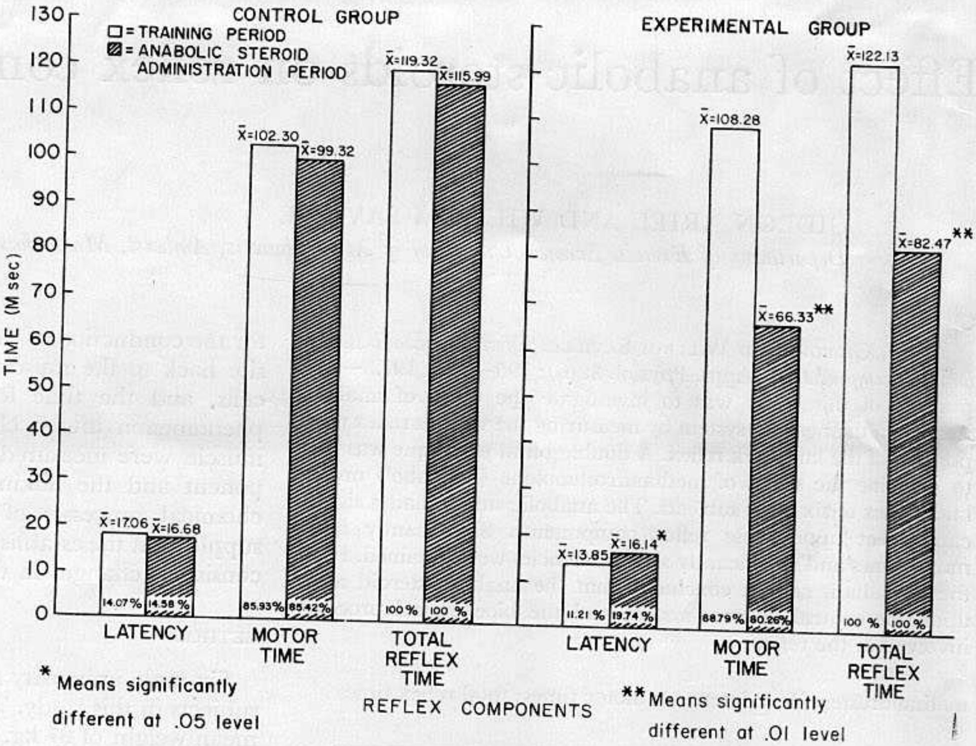

FIG. 1. Means and relative percentage of reflex components.

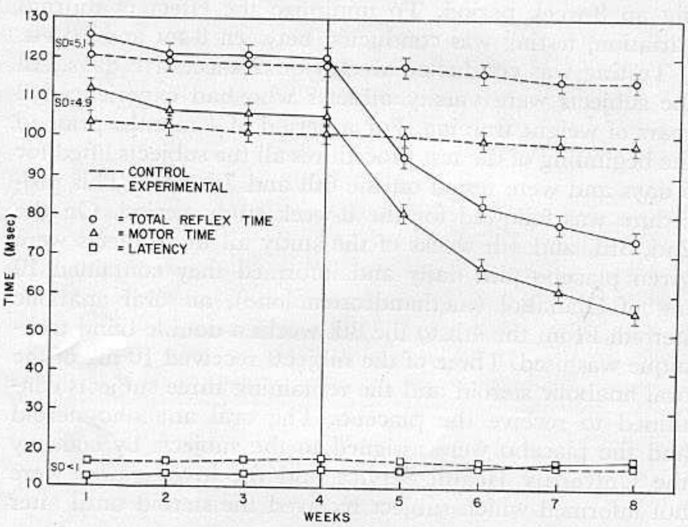

FIG. 2. Reflex components in training and anabolic periods.

the subject was comfortably seated with his heel against the adjustable heel plate. Electrodes were placed directly over the rectus femoris motor point which was located by the standard procedures indicated in the TECA operator's manual (5) for the variable-pulse generator and chronaximeter model CH3. The electrodes were connected to the TECA electromyograph model B2 oscilloscope. A the time when the hammer struck the ligamentum patella, a beam swept across the oscilloscope, and as the nerve impulse reached the motor point electrodes, a spike potential was displayed on the oscilloscope. This time interval was the latency. Ten reflex trials were consecutively taken on each subject at each testing session.

Data are reported for the control (placebo) and the experimental groups (Dianabol), and comparisons between the training period (first 4 weeks) and the anabolic steroid period (last 4 weeks) have been statistically tested.

TABLE 1. *A slope analysis of regression lines representing reflex components between training period and anabolic steroid period and between control and experimental groups*

	Reg Coef		df	MS	F Ratio	
Control group	*TP*	*AP*				
Latencies	(0.049)	(−0.267)	1	0.333	16.27*	(1, 6)
Motor times	(−0.641)	(−0.849)	1	0.144	0.07	(1, 6)
Total reflex	(−0.614	(−1.130	1	0.888	2.93	(1, 6)
Experimental group						
Latencies	(0.141)	(0.961)	1	2.266	25.64*	(1, 6)
Motor times	(−0.626)	(−12.005)	1	359.079	9.15†	(1, 6)
Total reflex	(−1.491)	(−11.041)	1	304.008	7.30†	(1, 6)
Training period	*C*	*E*				
Latencies	(0.049)	(0.141)	1	0.021	1.00	(1, 6)
Motor times	(−0.641)	(−1.626)	1	2.426	1.56	(1, 6)
Total reflex	(−0.614)	(−1.491)	1	1.923	1.11	(1, 6)
Anabolic steroid period						
Latencies	(−0.261)	(0.961)	1	7.466	96.22*	(1, 6)
Motor times	(−0.849)	(−12.005)	1	722.282	22.20*	(1, 6)
Total reflex	(−1.300)	(−11.041)	1	499.140	14.53*	(1, 6)

Reg coef = regression coefficients; df = degrees of freedom; MS = mean square; TP = training period; AP = anabolic steroid period; C = control group; E = experimental group. * F ratio significant at the 0.01 level of confidence. † F ratio significant at the 0.05 level of confidence.

RESULTS

Figure 1 presents the means and the relative percentages of each reflex component in the training and anabolic steroid periods for both the control and the experimental groups. Figure 2 presents the variability of the means and the changes in the reflex components for both control and experimental groups for the same two periods. A slope analysis for regression lines between the training period and the anabolic steroid period and of regression lines between the experimental and the control groups is presented in Table 1.

In Fig. 1, only slight changes are seen between the percentages of the different components for the control group and the mean differences were not statistically significant. However, the effect of the anabolic steroid on the experimental group is marked and statistically significant. The reflex latency of 11.21% changed to 19.74% during the anabolic steroid period; the motor time component decreased from 88.79 to 80.26% of the total reflex time during the same period. These changes in the motor time produced a greatly reduced total reflex time. The mean motor time of 108.28 msec was reduced to 66.33 msec (significantly different at the 0.01 level of confidence). Figure 2 serves to show that there was an increase in the length of the reflex latency component of the experimental group during the anabolic steroid period. This lengthening of the latency component was statistically significant despite the small mean difference (0.05 level of confidence). The faster motor time and its effect on the total reflex time are clearly seen to be more marked for the experimental group who received the anabolic steroid during this period.

A comparison of regression lines between the training and the anabolic steroid periods yields the following results (Table 1). The control and the experimental groups demonstrated significant differences at the 0.01 level of confidence between the slopes of the regression lines for latencies (Table 1; 1, 4). The regression slopes were significantly different, at the 0.05 level of confidence, between the training and the anabolic steroid periods in the motor and total reflex times for the experimental group (Table 1; 10–12).

DISCUSSION

Clearly, the anabolic steroid had a significant effect on the components of the knee jerk reflex. This was achieved by reducing the time of execution of the portion of the reflex from the electrobiochemical coupling to the mechanical expression of movement. The time of the neural component (the latency) was slower under the experimental conditions. The specific biochemical changes that facilitate this faster motor time and slower latency need to be further examined. Possible contributing factors are permeability changes in membranes that permit an altered rate of exchange of the increased calcium and potassium concentrations that have been reported (1). Anabolically active 17-alpha-alkylated steroids have been shown to enhance creatine synthesis and excretion; the phosphocreatine content of muscle after treatment with steroids should be determined. The indication of an anabolic steroid effect on the neurological component of reflex time which is different from the subsequent reflex components supports the early postulate of different mechanisms.

This study was supported by Public Health Services Biomedical Sciences Support Grant FR07048-05 (to Dr. Benjamin Ricci).

Received for publication 12 October 1971.

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