Anabolic Steroids in Athletics: Crossover Double-blind Trial on Weightlifters

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Summary

Thirteen experienced male weightlifters taking high-protein diets and regular exercise took part in a double-blind crossover trial of methandienone 10 or 25 mg/day to see if the drug improved athletic performance. Their improvements were significantly greater on methandienone than on placebo; their body weights rose (though this seemed to be associated with water retention); and systolic blood pressure rose significantly. Methandienone caused many side effects, and three men had to withdraw because of them. All side effects disappeared after the drug was stopped. Anabolic steroids are effective only when given in combination with exercise and high-protein diet. We deprecate their use in athletics but can suggest no way of stopping it.

Introduction

Orally active anabolic steroids, which are reputed to have an anabolic: androgen ratio 10 times that of methyltestosterone,[1] became available in the 1960s for senile debility, anorexia, asthenia, and convalescence.[2] Then athletes began to use them in the hope of achieving prowess unattainable by conventional training and dieting. The pressure on top-class athletes is ruthless, and by 1969, when we became interested in the problem, anabolic steroids were easily available through unofficial channels at several gymnasia in northern England. Their use is now probably universal among male international athletes, certainly in the "heavy" events and possibly also in the speed and stamina events. There is evidence that women also use them.[3]

Doctors have generally been reluctant to prescribe steroids for athletes,[4] both for ethical reasons and because of their side effects; they interfere with liver metabolism,[5] have androgenic effects,[6] disturb cortisol metabolism,[7] and possibly cause hypercholesterolaemia[8] and testicular atrophy.[9]

Objective evidence of improved athletic performance is sparse and contradictory. Androstenolone 20 mg/day in a double-blind trial among a group of students of mixed athletic habits produced no significant improvements in performance,[10] whereas methandienone 5 mg/day did produce improvement in a group of experienced weightlifters in a non-double-blind trial.[11] Other reports[12-15] have added to the confusion; Ariel and Saville[15] gave placebo tablets to six highly trained athletes, who believed them to contain methandienone, and significantly improved performances resulted.

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Our trial was designed to determine (*a*) whether anabolic steroids benefit athletic performance and (*b*) their side effects. Over our four-year trial we became acquainted with many of the national heavy athletes and their coaches and accumulated much anecdotal lore concerning the use of anabolic steroids, and our results may be seen in better perspective against this background.

Subjects

Between Spring 1971 and Summer 1973 we were approached by several athletes from whom we selected those studied. We gave steroids only to men because of probable virilization in women and only to postpubertal men because of the danger of premature epiphyseal fusion.[16]

Those we selected had to be experienced athletes who had been weight training for at least a year; all possessed records of performance and were on high-protein diets—that is, 1 pint (0·57 l) of milk and 1 lb (0·45 kg) of lean meat a day. Because of their discipline they needed little supervision during the trial. We insisted on previous weight training because an initial upsurge of strength occurs in any normal man when he starts such training, and we expected drug-induced gains to be more modest. We also suspected that trained muscles might respond to steroids differently from untrained ones.

The athletes' general health was assessed by routine clinical interview and examination, including blood pressure measurement. One of us (A.J.B.) volunteered for the trial since he fulfilled all the selection criteria.

Motives and Ethics.—Most of the men agreed to co-operate in the trial in exchange for a legal supply of anabolic steroids and were aware of the advantages of medical supervision. All had already resolved to use the drugs, and were not prompted by us into doing so. If we were approached simply for advice we discouraged the practice.

Methods

A double-blind crossover trial was designed. Athletes chose a low-dose (10 mg methandienone daily) or a high-dose (25 mg/day) regimen, and were treated for two consecutive six-week periods with methandienone or placebo in random order; anecdotal lore indicates that the effect of steroids wears off after six weeks even though treatment continues. This "wearing-off" effect has been described with respect to nitrogen-balance studies.[17]

Before the trial each athlete reported his current performance in four to six standard strength exercises—for example, standing press, bench press, squat. Supine blood pressure, subscapular skinfold thickness, and body weight were recorded and blood taken for cholesterol and alanine transaminase (SGPT) estimation. The athlete was then given his supply of tablets (labelled A and B) and two copies of a statement listing the aims and methods of the trial and the side effects of anabolic steroids. He signed this statement to the effect that he had read and understood it and kept one copy. It was emphasized that he could withdraw from the trial at any time.

For 12 weeks each athlete trained as usual and took his tablets. Every fortnight the athlete's SGPT, cholesterol, blood-pressure, body weight, skinfold thickness, and athletic performance were recorded along with any side effects noted by athlete or observer. Before the code was broken each man was challenged to predict his sequence of steroid and placebo.

Results

Of the 13 men (aged 18-30 years) chosen for study six opted for the low-dose regimen (0·12–0·15 mg/kg) and seven for the high (0·25–

0·46 mg/kg). Seven took methandienone first, while six started with placebo. All 13 forecast correctly what the code would be when broken.

Of the seven who started on methandienone one athlete gave us no data on performance but claimed "fantastic improvements," two realized immediately that they were on the active treatment and disappeared from our ken once their steroid supply was exhausted, and one withdrew from the trial because of side effects. Of the six starting on placebo two became discouraged and gave us no usable results and of the other four two withdrew during active treatment because of side effects. We record these failures without embarrassment since highly-tuned athletes are rather "prima-donna-ish." Bearing in mind the incompleteness of these data all the measurements made were examined, using Student's *t* test to assess significance where appropriate.

Performance was measured as maximum poundage lifted on each visit, expressed as a percentage of pretrial maximum poundage (fig. 1) or maximum poundage reported on the previous visit (fig. 2). When a man produced records of more than one standard lift (as most did) his percentage improvements were averaged. Raw data on performance are not given as these would allow the athletes to be identified. The men who started on methandienone showed much greater improvements than those who started on placebo. After the changeover to methandienone all except one of the men who had started on placebo gave greatly improved performances. The three who switched to placebo maintained or even continued their improvement. There was no obvious difference between low-dose and high-dose groups. Using the data shown in fig. 2 an average percentage improvement was calculated for each man for each treatment period. The 10 data for the methandienone period showed improvements of 0·3%–13·0%; the likelihood of this happening by chance is 1 in 500 (binomial test). Of the eight placebo data five showed improvements (0·3%–2·3%); the likelihood of this occurring by chance is greater than 1 in 10.

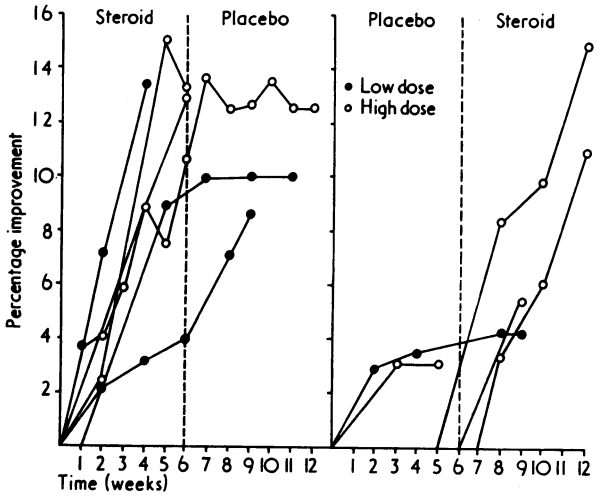

FIG. 1—Average athletic performance as percentage of pretrial performance.

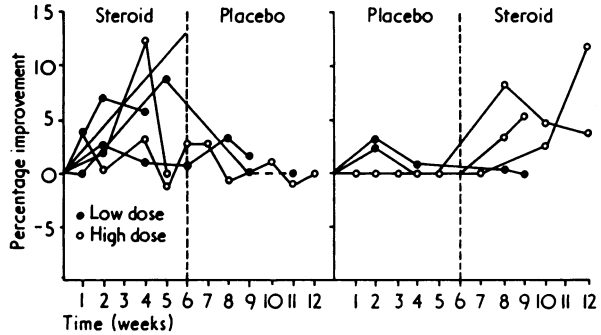

FIG. 2—Average athletic performance as percentage of performance reported on previous visit. Any point greater than zero means that improvement has continued since then.

Body weight increased significantly on methandienone (fig. 3; $P<0·001$) but on starting placebo weight tended to return quickly to initial levels (though strength was usually maintained).

Blood pressure increased slightly on methandienone (fig. 3). This was significant for systolic pressures ($P<0·05$) but not for diastolic pressures.

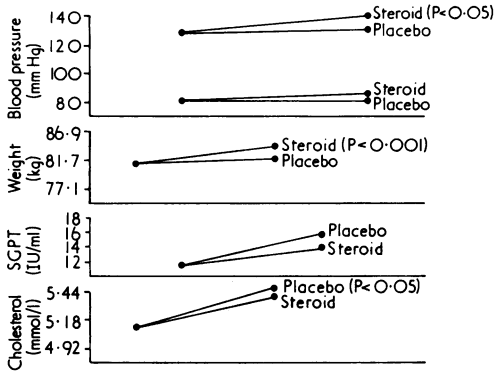

FIG. 3—Mean changes in weight, blood pressure, and biochemical values during trial.
Conversion: SI to Traditional Units—Cholesterol: 1 mmol/l=38·7 mg/100 ml.

Cholesterol showed a slight tendency to rise throughout the trial period which was independent of the treatment sequence (fig. 3). (Blood specimens were randomly taken without attempting to control recent food intake; meat and milk form much of weightlifters' diets; therefore these measurements are of little value.)

Most *SGPT levels* remained within normal limits throughout. In one patient SGPT rose from less than 10 IU/ml to 35 IU/ml; treatment was continued and SGPT fell spontaneously to 20 IU/ml. In another patient the level rose from 10 IU/ml to 75 IU/ml, and treatment was stopped. Both rises occurred on methandienone and both levels had returned to normal two weeks later.

Skinfold thickness did not change in any man.

No *side effects* were seen on placebo. Three patients withdrew because of side effects on methandienone. One man on a low-dose regimen had acne and after he had fainted during lifting was found to have a blood pressure of 150/110 mm Hg, which took several hours to return to normal. This man had tended to be hypertensive on the drug (125/85–130/105 mm Hg) and withdrew after this episode. Two men on high-dose regimens withdrew, one because of headache and muzziness, the other because of "urethritis." Other side effects were reduced sexual activity (in one man on 25 mg/day methandienone); acne (one man on 25 mg, one on 10 mg); and headache, dizziness, and nausea (one man on 25 mg, one on 10 mg). All side effects disappeared within two weeks of stopping the drug.

Discussion

The answers to our questions are (*a*) methandienone does increase athletic performance under conditions of diet and exercise very close to those of actual competition preparation, and (*b*) there are side effects though none that we saw persisted.

The drug caused weight gain but this was not maintained after its withdrawal in spite of persisting athletic improvement, which suggests that the gain may have been due more to water retention than to increased muscle mass. Casner *et al.*[14] showed that while the net body weight rose on stanozolol total body specific gravity remained about the same, and total body water increased. Both we and others[11] have found that skinfold thickness is unaffected, thus excluding a significant increase in body fat.

Our suspicion that anabolic steroids are effective only in "trained" men, which is what athletes themselves believe, seems to be confirmed. Studies which found improved performances with steroids were all carried out in men in training on high-protein diets using methandienone,[12 13] whereas those

which found no effect on athletic performance studied untrained men and used androstenolone[10] or stanozolol.[14]

To avoid the pitfalls suggested by Ariel and Saville's[15] finding that placebo produced significant improvements in performance, each of our athletes acted as his own control.

We found more side effects than others have reported; in particular acne has never been reported under these conditions though it is a recognized complication of androgen therapy, nor have we seen reports of "urethritis." The occasional high SGPT levels were unassociated with symptoms or signs and might have reflected enzyme induction rather than liver damage.[18]

Anecdotal Lore.—We have heard of doses of up to 300 mg/day being taken for months or even years, but the consensus of opinion is that huge doses are no more useful than the moderate doses we used. As might be expected from nitrogen balance studies[17] the effect of anabolic steroids seems to wane after about six weeks in spite of continuing treatment. The gains are usually maintained for some weeks after stopping the drug, but then follows a period of relative weakness which may last for several weeks. On steroids athletes generally become less susceptible to fatigue, which allows longer, more frequent, and harder training sessions. Injuries to muscles, tendons, and ligaments occur less often in weight training, and when they do occur they heal more quickly than usual. These two features might provide a clue to the mechanism of these drugs. Among side effects of steroids we have heard of jaundice, hypertension, urethritis, gastrointestinal haemorrhage, increased and decreased libido, and oligospermia. Inevitably many of the correlations implied by these anecdotes are incidental. Acne and headache are so widely mentioned as to confirm our own findings.

Such anecdotal data are of little strict value, but we cannot mount the very large trial needed to test them objectively. Highly trained dedicated athletes are rare and few are interested in co-operating in such studies; this is especially true in Britain where top-class athletic training is unrewarding and often lonely, requiring of its practitioners a large degree of obsession.

ETHICAL CONSIDERATIONS

The taking of anabolic steroids by athletes, and thus our trial, may be criticized on the grounds that (*a*) these drugs give a competitor an unfair advantage over opponents not taking them; and (*b*) it is wrong to give a drug to a healthy person. On the other hand, anabolic steroids are reputed to be taken by almost all international heavy athletes, and if this is so then not to take them is to submit to an unfair disadvantage. We also felt justified in proceeding with our trial because the athletes would have obtained and taken the drugs even if we had not condoned it (some already had), and in that case it were better they did so under medical supervision.

Nevertheless, neither of these arguments detracts from the force of the ethical objections posed. It is wrong that athletes should be subjected to short-term competitive pressures which might damage their health in the long term, and we would support any measure to prevent this abuse of anabolic steroids. Enforcement of such a ban would mean, however, that contestants should have regular blood or urine tests for at least two months before a competition, and we doubt if this could be carried out internationally. Anabolic steroids are now rarely prescribed by doctors and there is a flourishing black market in them. Presumably they reach competitors in this country from abroad or via unscrupulous individuals in the chain of pharmaceutical distribution.

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Variations in Leucocyte Count during Menstrual Cycle

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Summary

The neutrophil counts of seven women, three taking oral contraceptives and four not taking them, showed cyclical variations during the menstrual cycle, most consistently a fall in the neutrophil count at menstruation. The neutrophil count in women not taking oral contraceptives rose to a peak twice during each cycle.

One woman not taking oral contraceptives was studied in detail over eight consecutive menstrual cycles. She showed two neutrophil peaks per cycle and a similar variation in the monocyte count. The eosinophil count showed a reciprocal relation with the neutrophil count and the basophil count fell in mid-cycle. The changes in her neutrophil count seemed to follow changes in oestrogen level with a delay of one to two days. Oestrogen probably promotes release of neutrophils from the bone marrow rather than from the marginated pool.

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Introduction

Women have significantly higher neutrophil counts than men,[1]