EFFECT OF TESTOSTERONE ON ANTLER GROWTH IN YEARLING MALE REINDEER

Virkning av testosteron på gevirvekst hos ettårige reinsbukker

MORTEN RYG, Institute of Zoophysiology, P.O.Box 1051 Blindern, Oslo 3 - Norway

Abstract:

1. The effect of exogenous testosterone on antler growth in yearling male reindeer *(Rangifer tarandus tarandus)* was tested.
2. Testosterone (33 mg/kg) inhibited antler growth, and in one animal induced cleaning and subsequent casting of the antlers. This animal grew a new set of antlers, which were cleaned at the normal time.
3. During treatment, there was an inverse relationship between peak testosterone levels and antler growth rate.
4. There was no effect of treatment on body weight or food intake.
5. It is concluded that the effects of testosterone on antler growth are qualitatively the same in reindeer as in other deer. However, because high testosterone doses were necessary to produce effects, it is questionable whether this hormone normally is responsible for the cessation of antler growth in reindeer.

Key words: Testosterone antler reindeer.

***Rangifer** 3 (2): 6—9*

RYG, M. 1983. Virkningen av testosteron på gevirvekst hos ettårige reinbukker.

Sammendrag:

1. Virkningen av testosteron på gevirvekst hos ett-ärige reinbukker *(Rangifer tarandus tarandus)* ble undersøkt.
2. Testosteron (33 mg/kg) hemmet gevirveksten, og hos ett dyr førte behandlingen til at geviret ble feiet og deretter felt. Deretter vokste det ut ett nytt gevir, som ble feiet til vanlig tid.
3. Det var en negativ korrelasjon mellom maksimale testosteronnivåer og gevirvekst under behandlingen.
4. Det var ingen effekt på fôrinntak eller vektutvikling.
5. Det blir konkludert med at virkningen av testosteron på gevirvekst er kvalitativt den samme hos rein som hos andre hjortedyr. Det er likevel tvilsomt om testosteron normalt er ansvarlig for avslutningen av gevirvekst hos rein, fordi store testosterondoser måtte til for å få noen virkning.

Kodeord: Testosteron gevir rein.

***Rangifer** 3 (2): 6—9*

RYG, M. 1983. Testosteronin vaikutus vuodenikäisten urosporojen sarvien kasvuun.

Tiivistelmä:

1. Tutkimuksessa seurattiin ruiskeena annetun testosteronin vaikutusta vuodenikäisten urosporojen *(Rangifer tarandus tarandus)* sarvien kasvuun.
2. Testosteroni (33 mg/kg) hidasti sarvien kasvua, aiheuttaen yhdessä eläimessä sarvien kelomisen ja pudottamisen. Tälle eläimelle kasvoi uudestaan sarvet, jotka se keloi normaaliin aikaan.
3. Testosteronin huipputaso veressä oli käsittelyaikana kääntäen verrannollinen sarvien kasvunopeuteen.
4. Käsittely ei vaikuttanut eläinten ruumiinpainoon eikä niiden ruokahaluun.
5. Voidaan päätellä testosteronin vaikutuksien sarvien kasvuun olevan porossa laadullisesti yhtäläiset kuin muissakin hirvieläimissä. Koska vaikutuksen aikaansaamiseksi vaadittiin korkeita testosteroniannoksia, voidaan kuitenkin pitää kyseenalaisena, onko kyseinen hormoni normaalisti vastuussa poronsarven kasvun keskeytymisestä.

Avainsanat: Testosteroni sarvi poro.

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INTRODUCTION

The calcification of deer antlers, and the shedding of the velvet, is thought to be controlled by the increasing concentrations of testosterone during late summer and autumn. However, in reindeer it is believed that the antler cycle is not affected by testosterone because both sexes carry antlers, the first set of antlers develop prepubertally, and castrates regularly cast the old antlers and grow a new set every year (Bubenik 1966). However, this view has been challenged by Leader-Williams (1979). He suggested that although there may excist other factors inducing calcification in females and castrates, in the males the effects of these factors are normally overridden by the presence of testosterone.

If this view is correct, exogenous testosterone should retard antler growth, induce calcification of the antler and shedding of the velvet, in reindeer as in other deer. This paper reports the effect of exogenous testosterone on antler growth in yearling male reindeer.

MATERIALS AND METHODS

All animals used in this study were yearling male reindeer from herds of semidomestic reindeer. The animals were kept at the Norwegian State Reindeer Research on Hinnøya (68°25'N). They were kept in individual pens and fed å reindeer feed concentrate (RF 71). The composition of RF 71 is given by Jacobsen and Skjenneberg (1979). Daily food intake was recorded.

In the first experiment, three animals weighing 75 ± 3 kg were given 100 mg testosterone propionate intramuscularly daily for six days starting on 6 June. On the sixth day, each animal also received 1g testosterone propionate subcutanously. Thereafter, each animal received 0.5 g testosterone propionate an the 10th and 14th day after the start of the experiment. The hormone was given as a slurry of crystals in physiological saline. Three animals received physiological saline at the same schedule.

In a second experiment, four animals (body weight not recorded) received 500 mg testosterone enantate (Primoteston-Depot, Schering AG) and 100 mg testosterone propionate (Sigma T-1875) intramuscularly on 22 June. Four animals serving as control received sterile olive oil.

The animals were weighed once or twice every month from the end of May to the end of August. Simultanously, the length of all antler beams and tines were measured, and blood samples were taken by jugular puncture. The blood was allowed to clot, the serum was separated by sentrifugation, and divided into several aliquots that were stored at -20°C until assayed for testosterone, using a

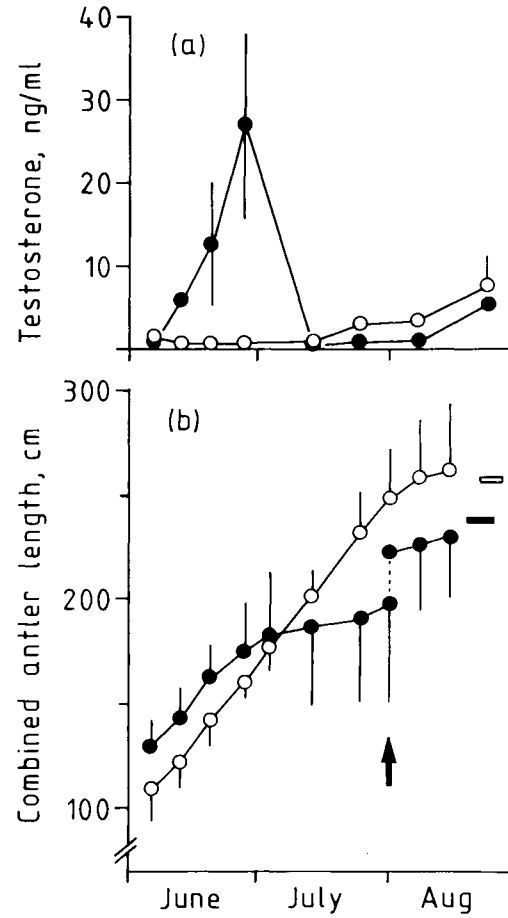

Figure 1. Effect to testosterone propionate on (a) serum testosterone and (b) antler growth in yearling male reindeer. ● : testosterone-treated animals; ○ : control animals. One experimental animal cast his antlers as indicated by the arrow. Horizontal bars indicate start of antler cleaning.

Virkning av testosteron propionat på (a) serum testosteron og (b) gevirvekst hos ettårige reinbukker. ● : testosteronbehandlete dyr; ○ : kontrolldyr. Pilen viser hvor ett av de hormonbehandlede dyrene mistet geviret før tiden. Starten av gevirfellingen er markert med horisontale rektangler.

radioimmunoassay as described by Sanwal et al. (1974) and modified by Sundby et al. (1975).

Significance of differences between groups were tested with a 2-way ANOVA, using p=0.05 as level of significance.

RESULTS

In the first experiment, testosterone levels in the experimental animals rose gradually to peak levels (15 to 37 ng/ml) one week after the last injection. At the next sampling (13 July) testosterone levels were lower in the animals which had previously received testosterone than in the controls (Fig. 1a).

There was a significant reduction in the rate of antler growth in the testosterone-treated animals (Fig. 1b). There was no significant reduction in antler growth rate during the two weeks before the last injection. The animal with highest recorded testosterone levels during treatment (37 ng/ml), cleaned the antlers during the end of July, and lost both antlers on 31 July. Subsequently, it grew a new set of small antlers, which were cleaned during the end of August, at the same time as in the other five animals.

In the second experiment, testosterone levels reached peak values (9.2 to 14.1 ng/ml) in the hormone-treated animals on the first sampling, one week after treatment. Thereafter, the testosterone levels stabilized at 2.1 to 6.4 ng/ml for 2 weeks. In this experiment, the antlers were badly broken in one control and two experimental animals. In one of the two remaining experimental animals, antler growth was extremely rapid before the treatment period, and ceased almost completely after the treatment. In the other, antler growth rate was not overtly different from the control animals. When all results are taken together, there appeared to be an inverse relation between antler growth rate and peak testosterone levels (Fig. 2).

There was no effect of the treatment on food intake or body weight.

DISCUSSION

The results of the first experiment indicate that the effect of testosterone on antler growth are qualititively the same in reindeer as in other species of deer. However, it is questionable whether testosterone normally plays a dominant part in the regulation of antler calcification and cleaning. Judging from the normal range of body weights in other species, the doses (as related to body weight) used in this investigation was probably more than

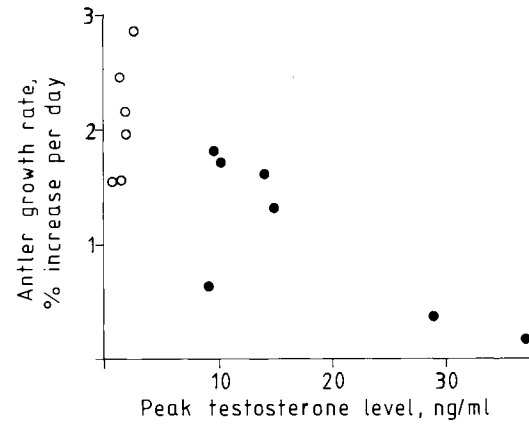

Figure 2. Relationship between maximum testosterone level and antler growth during treatment with testosterone propionate (19 June to 13 July and 22 June to 14 July in two experiments).

Sammenheng mellom maksimale testosteronnivåer og gevirvekst i perioder med testosteronbehandling (19. juni til 13. juli, og 22. juni til 14. juli i to eksperimenter).

twice those used in sika (Goss 1968), white-tailed (Wislocki et al. 1947), and red deer (Lincoln 1972), and so, reindeer antlers may be less sensitive than those of other deer to the effects of testosterone. This conclusion is also borne out by the relationship between antler growth and testosterone levels (Fig. 2). Although peak testosterone levels as high as 40 to 65 ng/ml have been reported (Whitehead & McEwan 1973, Ryg *in press*), peak levels are most often in the range 5 to 15 ng/ml (Ringberg Lund-Larsen 1977, Stokkan 1980, Ryg & Jacobsen 1982, Ryg *in press*), and in this range, testosterone would be expected to have only marginal effects.

In contrast to the effect on one of the animals in the present report, termination of testosterone treatment did not cause antler casting in sika deer (Goss 1963) or red deer (Lincoln et al. 1972). This does not necessarily imply a species difference; the seemingly different results could depend on differences in the doses employed, or on differences in the endogenous testosterone production in the posttreatment period. The immediate onset of new antler growth after casting in July, as compared to the normal lag of 2 to 3 months between casting and regrowth suggests the existence of an antler growth stimulation factor that is present in summer but absent in winter. Alternatively, there may be an inhibiting factor

that is present in winter but absent in summer.

In summary, the effects of testosterone on antler growth are qualitatively much the same in reindeer as in other deer. However, the sensitivity to testosterone is low, and it is doubtful whether testosterone normally is responsible for the inhibition of antler growth in reindeer. The present data, therefore, support the classical view.

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