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# THE EFFECTS OF BARBITURATE ANESTHESIA AND LAPAROTOMY ON TESTIS AND PLASMA TESTOSTERONE IN RATS

JAN-ERIK DAMBER, HANS CARSTENSEN and STAFFAN LINDGREN
Department of Physiology, Umeå University, S-901 87 Umeå, Sweden

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SUMMARY

Plasma and testis testosterone concentrations were measured in rats 2.5 and 24 h after barbiturate (thiomebumal) anesthesia and 24 h after laparotomy. The testicular concentration of testosterone was significantly reduced after barbiturate treatment but plasma testosterone concentration was not significantly affected. Laparotomy did not cause any effect on plasma or testis testosterone concentrations.

## INTRODUCTION

The effects of anesthesia and surgical stress on testosterone secretion is of great interest in experimental work on male gonadal function. Bardin and Peterson [1] showed that a short period of ether anesthesia reduces the testicular blood level of testosterone in rats. This is in agreement with the work of Farriss *et al.* [2] who found a reduction of testicular testosterone concentration in rats given ether anesthesia, occurring within 2 min and maintained for at least 24 h. Recently, in a work by Moor and Younglai [3], it was shown that barbiturate anesthesia in male rabbits caused an increase in plasma LH that was followed by elevation of plasma testosterone. Species differences may be important since Carstensen *et al.* [4] showed a pronounced decrease of plasma testosterone concentration in dogs in response to barbiturate anesthesia.

Surgical stress in the human male reduced plasma testosterone [5, 6] and the rate of decrease seemed to be related to the severity of surgical stress including the anesthesia [5]. This reduction of plasma testosterone was also observed in dogs after laparotomy with maximal effect 24 h after the operation [4].

The present study was undertaken to examine the effects of barbiturate anesthesia and laparotomy on testis and plasma testosterone in rats.

## MATERIALS AND METHODS

Male rats of the Sprague Dawley strain (Möllegaard-Hansen, Ejby, Denmark), weighing between 300 and 400 g, were kept in a controlled environment at least 14 days prior to the experiment. Food and water were available *ad libitum*. Fifteen rats were anesthetized by giving 35 mg of Thiopentone sodium (Intraval natrium®, Pharma Rhodia) i.p. as a single injection. In a control group 13 rats were injected with saline and 5 rats were untreated and included in the control group since saline injected animals did not differ from uninjected. After 2.5 h the animals were sacrificed.

An additional group of 30 rats were anesthetized with 15 mg of Thiopentone sodium, which is a dose large enough to maintain anesthesia. Laparotomy was performed on 15 rats and the rest of the group was used as controls. Twenty-four h later the animals were killed. All rats were killed by decapitation. Blood was collected into heparin tubes for determination of plasma testosterone. For testis testosterone analysis the entire testis was homogenized in 0.9% NaCl and a sample corresponding to 0.1 g tissue extracted. Testosterone was measured using a competitive protein binding assay employing paper chromatography [6].

Statistical analysis was performed using Wilcoxon's non-parametric two-sample *t*-test based on range.

## RESULTS

*Anesthesia.* A significant effect on testis testosterone concentration was observed 2.5 and 24 h after barbiturate anesthesia when compared to the control group (Table 1). Plasma testosterone concentration was not significantly affected under these conditions (Table 2).

*Laparotomy.* Plasma testosterone concentration was unaffected and no further decrease of the testis testosterone content was found 24 h after laparotomy in addition to barbiturate anesthesia (Tables 1 and 2).

## DISCUSSION

Our results clearly show that the male rat reacts to barbiturate anesthesia with a decreased testis testosterone concentration. Although, there was a tendency to decreased plasma testosterone concentration also, no significant change was observed. However, the effect, if any, may be concealed by the large fluctuations in plasma testosterone known to occur in rats [7]. The variance in this experiment was also

Table 1. Testis testosterone concentration of rats, ng per g of decapsulated organ

| Group | Experiment | $n$ | mean | S.E.M. | Comparison | Significance ($P$ level in parenthesis) |
|---|---|---|---|---|---|---|
| I | Controls | 14 | 232 | 21 | | |
| II | 2.5 h after Thiomebumal-Na 35 mg | 15 | 142 | 21 | I | S (0.01) |
| III | 24 h after Thiomebumal-Na 15 mg | 15 | 128 | 19 | I | S (0.02) |
| | | | | | II | NS |
| IV | 24 h after Thiomebumal-Na 15 mg + laparotomy | 15 | 170 | 15 | I | S (0.05) |
| | | | | | III | NS |

Table 2. Plasma testosterone concentration of rats, ng per 100 ml

| Group | Experiment | $n$ | mean | S.E.M. | Comparison | Significance ($P$ level in parenthesis) |
|---|---|---|---|---|---|---|
| I | Controls | 18 | 311 | 62 | | |
| II | 2.5 h after Thiomebumal-Na 35 mg | 15 | 245 | 63 | I | NS |
| III | 24 h after Thiomebumal-Na 15 mg | 15 | 203 | 32 | I | NS |
| | | | | | II | NS |
| IV | 24 h after Thiomebumal-Na 15 mg + laparotomy | 15 | 226 | 32 | I | NS |
| | | | | | III | NS |

much greater for plasma testosterone than for testis testosterone concentrations. This indicates that testis testosterone is more directly related to production rate than plasma testosterone.

The effect of barbiturate on testis testosterone may be mediated by a decrease in the microcirculation, since it is known that barbiturate lowers the tissue $pO_2$ [8] and the central and testis arterial blood pressure in rats [9]. It is known from the work by Eik-Nes [10] that perfusion rate is of paramount importance for testosterone secretion. However, our own results in dogs give no support for this view since barbiturate anesthesia did not affect testicular microcirculation measured by $^{133}$Xenon washout technique, although the concentration of testosterone in plasma was significantly decreased [11]. Another possible explanation for the effect on the testis testosterone concentration is a central inhibition of LH secretion [12].

Surgical trauma, such as laparotomy, did not result in a decrease of plasma or testis testosterone concentrations in the rats. The lower testicular testosterone concentration in this group as compared to controls can be fully explained by the effect of barbiturate. This is in contrast to the effect of surgery on plasma testosterone levels previously demonstrated in male humans [5, 6] and male dogs [4].

In light of our findings we conclude that barbiturate anesthesia does affect testosterone secretion in rats but that surgical trauma has no effect. This must be considered in studies on testosterone secretion *in vivo* in rats during barbiturate anesthesia. However, the effect is less than the one obtained by using ether anesthesia [2].

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