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# Arterial blood pressure and blood gas composition of white rhinoceroses under etorphine anaesthesia

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Arterial blood pressure and blood gas composition were investigated in white rhinoceroses immobilized with either etorphine/fentanyl ($n$ = 6) or etorphine/azaperone ($n$ = 6) mixtures. In the etorphine/fentanyl group, arterial pressure was higher (183 ± 16 mm Hg) than the mean value observed in the latter group (141 ± 24 mm Hg). In both groups, anaesthesia was accompanied by hypoxaemia and hypercapnia. Assuming that such effects could contribute to post-capture morbidity and/or mortality, either oxygen supplementation or the administration of a respiratory stimulant as soon as possible after recumbency is indicated. In addition, the use of azaperone may alleviate possible blood pressure elevation in these animals during immobilization.

Arteriële bloeddruk en bloedgassamestelling is ondersoek in witrenosters wat met mengsels van òf etorfien/fentaniel ($n$ = 6) òf etorfien/asaperoon ($n$ = 6) geïmmobiliseer is. Die arteriële bloeddruk van die etorfien/fentanielgroep (183 ± 16 mm Hg) was hoër as die gemiddelde waarde (141 ± 24 mm Hg) van die ander groep. In beide groepe het narkose met hipoksemie en hiperkapnie gepaard gegaan. Indien aanvaar word dat hierdie uitwerking tot morbiditeit en/of mortaliteit na die vangs mag bydra, sou dit gerade wees om suurstof of 'n asemhalingstimulant so gou moontlik nadat die dier gaan lê het, toe te dien. Die gebruik van asaperoon mag bydra tot die verligting van moontlike bloeddrukverhoging tydens immobilisasie.

**Keywords:** Anaesthesia, blood gas composition, blood pressure, rhinoceros

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## Introduction

Immobilization of black *Diceros bicornis* and white *Ceratotherium simum* rhinoceroses using etorphine in combination with various other drugs such as fentanyl is routinely carried out in southern African national parks. However, capture, confinement and translocation procedures are not without complications and, while these animals appear to be relatively resistant to peracute and acute capture stress, the incidence of postcapture mortality remains unacceptably high (Kock, Du Toit, Kock, Morton, Foggin & Paul 1990; Kock 1985). The successful immobilization of rhinoceroses using etorphine is well described, yet its effects on cardiopulmonary function in these animals are not well described, despite the fact that the use of etorphine has been associated with adverse side effects such as hypertension, hypoxaemia and hypercapnia in the white rhinoceros (Heard, Olsen & Stover 1992; Kock 1985; LeBlanc, Eicker, Curtis & Beehler 1987).

The importance of investigating physiological responses to immobilizing drugs or drug combinations becomes evident if one considers the possibility that certain of these responses may contribute to postcapture morbidity and/or mortality. The purpose of this study was to report on arterial blood pressure and blood gas composition in white rhinoceroses immobilized with etorphine/fentanyl and etorphine/azaperone mixtures.

## Method

### Animals

Adult white rhinoceroses (7 male and 5 female), immobilized in the Kruger National Park during the period June to September 1992 for translocation to other reserves, were used in this study. One group ($n$ = 6) was darted with a mixture of 2,0 mg etorphine HCl (M99, HMC Manufacturing Chemists Ltd., Dundee, Scotland) and 30 mg fentanyl (Janssen Pharmaceutica, Beerse, Belgium). A second group ($n$ = 6) received a mixture of 3,0 mg etorphine and 25 mg azaperone (Stresnil, Janssen Pharmaceutica, Beerse, Belgium). All immobilizations took place in the early morning by approaching the rhinoceroses in a helicopter and darting them from the air. The animals were not weighed but body masses were estimated at about 1600 kg.

### Blood sampling and arterial pressure measurement

As soon as possible after recumbency, which in most cases was within 10 min of darting, a 20-gauge arterial catheter (Jelco, Critikon RSA, Johnson & Johnson (Pty) Ltd., RSA) was placed into an auricular artery. A sample of arterial blood from each animal was then collected anaerobically into heparinized 1-ml syringes and immediately placed on ice. These samples were used for subsequent analysis of oxygen and carbon dioxide content using a Radiometer PHM 71 analyser and BMS 3 MK2 blood microsystem. The arterial catheter, still in position within the artery, was then attached to a pressure transducer using a 0,9% heparinized saline-filled pressure line. The pressure transducer was zeroed to atmospheric pressure and connected to a multichannel oscillograph (Harvard Universal), which was calibrated against a mercury manometer prior to recording.

**Table 1** Mean arterial blood pressure and arterial $PO_2$ and $PCO_2$ of white rhinoceroses immobilized with etorphine/fentanyl ($n$ = 6) and etorphine/azaperone ($n$ = 6) mixtures

| | Etorphine/fentanyl | Etorphine/azaperone |
|---|---|---|
| Arterial pressure (mm Hg) | 183 ± 16 | 141 ± 24 |
| Arterial $PO_2$ (mm Hg) | 38 ± 6 | 57 ± 16 |
| Arterial $PCO_2$ (mm Hg) | 73 ± 16 | 68 ± 18 |

Mean arterial pressure was then monitored for 2–3 min during the period of recumbency.

## Results

Mean arterial pressure and arterial $PO_2$ and $PCO_2$ (mean and standard deviation), obtained as soon as possible after recumbency for groups of animals immobilized with etorphine/fentanyl and etorphine/azaperone mixtures, are presented in Table 1. Blood pressure values represent an average of several recordings for each animal obtained in the 2–3 min after the arterial catheter was in position within the vessel. In rhinoceroses receiving an etorphine/fentanyl mixture, mean arterial pressure ranged between 160 and 200 mm Hg, while in those animals given an etorphine/azaperone mixture, the recorded range was lower (100–160 mm Hg). In the former group, arterial $PO_2$ was lower and $PCO_2$ higher than the respective values obtained in the latter group.

## Discussion

Published data regarding arterial pressure measurements in etorphine-anaesthetized white rhinoceroses exist as case reports with observations on single, captive animals. In one study, mean arterial pressure was monitored during prolonged anaesthesia and ranged between 107 and 168 mm Hg (Heard *et al.* 1992). Another study reports a mean arterial pressure of 280 mm Hg 15 min after recumbency, which subsequently stabilized at 210 mm Hg (LeBlanc *et al.* 1987). These results, as well as the range of mean arterial pressures obtained for anaesthetized rhinoceroses in this study, are difficult to interpret in the absence of control blood pressure data obtained from conscious animals under resting conditions, although etorphine-induced hypertension is suspected. Increased blood pressure associated with etorphine anaesthesia has also been documented in the horse (Lees & Hillidge 1975; Bogan, MacKenzie & Snow 1978) and, although the causative agents are at present uncertain, accompanying increased sympathetic nervous system activity (Daniel & Ling 1972; Bogan *et al.* 1978), peripheral vasoconstriction and hypoxia (Heard *et al.* 1992) have been suggested as contributing factors.

Of interest in this study was the fact that rhinoceroses immobilized with etorphine/azaperone mixtures displayed lower blood pressures immediately after recumbency than those given etorphine/fentanyl mixtures. A higher dose of etorphine was used to anaesthetize animals in the former group since, in the absence of fentanyl, it was not certain whether a 2-mg etorphine dose would be sufficient for successful immobilization. Given that etorphine may be responsible for elevating blood pressure in animals anaesthetized with this drug, the lower blood pressure in the group receiving a higher dose of etorphine is surprising. It is possible that the azaperone itself is responsible for this effect although further research is required to substantiate such a suggestion. Azaperone has antagonistic peripheral $\alpha_1$ adrenergic receptor properties (Meltzer & Swan 1988) and was therefore considered suitable for use in this study to overcome possible blood pressure elevation during immobilization.

Etorphine/fentanyl and etorphine/azaperone anaesthesia in rhinoceroses was accompanied by hypoxaemia and hypercapnia (Table 1). A similar, less severe change in arterial $PO_2$ (which improved with oxygen supplementation) was observed by Heard *et al.* (1992) in an etorphine-anaesthetized white rhinoceros. Hypoxaemia and hypercapnia are probably a direct result of etorphine-induced respiratory depression which is a recognized action of this drug in many species (Alford, Burkhart & Johnson 1974). The more favourable $PO_2$ observed in the etorphine/azaperone group in spite of the higher etorphine dosage used may be related to the absence of fentanyl which is also reported to suppress respiration when used alone (Harthoorn 1973). Although such a suggestion requires confirmation, the results obtained here support the recommendation by Heard *et al.* (1992) that the management of anaesthesia in etorphine-immobilized rhinoceroses should include oxygen supplementation.

Kock *et al.* (1990) suggested that certain physiological responses to capture in the initial period of management may predispose the animals to adverse effects of further stress, resulting in mortalities one week to two months after capture. It is also possible that increased blood pressure, hypoxaemia and hypercapnia, whether induced by drugs, stress and/or postural changes during immobilization, may contribute to the post-capture morbidity and/or mortality reported in rhinoceroses. This study was a preliminary investigation and the need for further research into the effects observed is imperative. The results obtained above suggest that the addition of azaperone to immobilization mixtures may alleviate possible blood pressure elevation during immobilization. Secondly, either oxygen supplementation or the administration of a respiratory stimulant (such as doxapram) as soon as possible after recumbency to improve blood gas status is indicated.

## Acknowledgements

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