Anaesthesia of gemsbok (Oryx gazella) with a combination of A3080, medetomidine and ketamine

D Grobler\(^a\), M Bush\(^b\), D Jessup\(^c\) and W Lance\(^d\)

**ABSTRACT**

An effective anaesthesia protocol was developed for adult free-ranging gemsbok (Oryx gazella) using a combination of A3080, medetomidine and ketamine. A short induction time, good muscle relaxation, adequate oxygenation and stable heart rate and respiration rate characterised this anaesthetic regime. Equal doses of A3080 and medetomidine (22–45 µg/kg) plus 200 mg of ketamine were administered to each animal. The anaesthesia was rapidly and completely reversed by intramuscular naloxone at a dose of \( X = 0.9 \pm 0.2 \text{mg/kg} \) and atipamezole at a dose of \( X = 90 \pm 20 \mu\text{g/kg} \). No mortality or morbidity occurred with this protocol.

**Key words:** A3080, anaesthesia, atipamezole, gemsbok, ketamine, medetomidine, naloxone, Oryx gazella, oxygen saturation.


**INTRODUCTION**

The gemsbok is a popular and economically important species on game farms and is a flagship animal in certain South African National Parks. Their preferred habitat is open grasslands, but they can also be found in open woodlands. Gemsbok are considered to be nervous and highly aggressive and less tractable than roan or sable antelope. They resist handling when semi-immobilised and their strength and long sharp horns make them very dangerous unless properly anaesthetised\(^2,3\). Safe and reliable anaesthesia of gemsbok has been difficult with currently available anaesthetics. Most anaesthetic protocols use either etorphine (60–100 mg) or xylazine (3–7 mg) or fentanyl (50–60 mg) anaesthetic protocols use either etorphine and ketamine (KET) or naltrexone, medetomidine and ketamine. Ketamine has a synergistic effect compared with MED in cervids by 26–65%\(^1,6\). Medetomidine combined with KET has been demonstrated to be effective in a broad range of non-domestic ungulates\(^6\). Ketamine has a synergistic effect combined with MED in cervids\(^6\) and has been observed to potentiate synthetic opiates in bovids\(^1,11\). Medetomidine combined with KET has been demonstrated to be effective in a broad range of non-domestic ungulates\(^6\). Ketamine has a synergistic effect combined with MED in cervids\(^6\) and has been observed to potentiate synthetic opiates in bovids\(^1,11\).

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Table 1: Summary of the doses of the anaesthetic and reversal drugs and their effects on gemsbok.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass (kg)</td>
<td>198 ± 24</td>
<td>138–240</td>
</tr>
<tr>
<td>MED and A3080 (µg/kg)</td>
<td>29 ± 7</td>
<td>22–45</td>
</tr>
<tr>
<td>KET (mg/kg)</td>
<td>1.0 ± 0.1</td>
<td>0.8–1.5</td>
</tr>
<tr>
<td>Initial signs</td>
<td>1.31 ± 0.19</td>
<td>0.50–2.06</td>
</tr>
<tr>
<td>Recumbency</td>
<td>3.18 ± 1.04</td>
<td>1.40–5.20</td>
</tr>
<tr>
<td>ATP (µg/kg)</td>
<td>90 ± 0.2</td>
<td>60–140</td>
</tr>
<tr>
<td>NAL (mg/kg)</td>
<td>2.5 ± 0.2</td>
<td>0.6–1.4</td>
</tr>
<tr>
<td>Standing (min)</td>
<td>5.25 ± 1.50</td>
<td>2.45–9.13</td>
</tr>
</tbody>
</table>

Table 2: Physiological data over 15 minutes of monitoring for 18 gemsbok that received A3080, medetomidine and ketamine.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>0 min</th>
<th>5 min</th>
<th>10 min</th>
<th>20 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiration rate (min)</td>
<td>73 ± 31</td>
<td>72 ± 23</td>
<td>70 ± 21</td>
<td>73 ± 23</td>
</tr>
<tr>
<td>Heart rate (min)</td>
<td>79 ± 16</td>
<td>82 ± 15</td>
<td>71 ± 18</td>
<td>66 ± 15</td>
</tr>
<tr>
<td>O₂ saturation (%)</td>
<td>86 ± 6</td>
<td>82 ± 15</td>
<td>84 ± 13</td>
<td>85 ± 6</td>
</tr>
<tr>
<td>Rectal temperature (°C)</td>
<td>39.4 ± 1.0</td>
<td>39.6 ± 1.0</td>
<td>39.7 ± 1.0</td>
<td>39.7 ± 1.0</td>
</tr>
</tbody>
</table>

Arabian oryx with good results. When prolonged anaesthesia was desired (3 h) for relocation of Arabian oryx, MED was combined with etorphine. Atipamezole (AP) (Antisedan, Orion Corp., Orion-Farmos) is a potent and selective alpha₂-adrenoceptor that antagonises the effects of MED.

The objective of this study was to determine whether the rapid induction potential of A3080 could be combined with the potent selective alpha₂-agonist effects of MED and the dual synergistic effect of KET to result in a predictable rapid balanced anaesthesia in free-ranging gemsbok. The hypothesis was that the protocol would ensure adequate muscle relaxation for safe handling for both animals and personnel under field conditions.

During anaesthesia the physiological parameters for cardiovascular and respiratory function should be maintained within an acceptable range. The chosen anaesthetics should be reversible to facilitate the immediate release of the animal back into its environment with no post-anesthetic sedation or complications.

MATERIALS AND METHODS

The gemsbok in this study were free-ranging in the Vaalbos National Park, South Africa, during June 1999. The animals included both subadult and adult males and females. They were in good physical condition and their pelage was considered to be good for the season and available indigenous vegetation.

Anaesthetics used in this study were A3080 (10 mg/m), MED (20 mg/m) and KET (200 mg/m) formulated as sterile injectable solutions in multidose vials. The drugs were delivered by a CO₂-powered remote injection device delivering a 3-ml plastic air-pressurised dart with a 40-mm collared needle (Dan-Inject SA) to insure a deep intra-muscular (i.m.) injection.

Group 1 consisted of 2 adult male gemsbok chased by helicopter into a boma before darting. The doses of A3080 given were (32 and 36 µg/kg) plus 200 mg KET per animal (1.1 and 1.4 mg/kg). Group 2 consisted of 18 free-ranging gemsbok (8 males, 10 females) that received equal doses of A3080 and MED (22–45 µg/kg) plus 200 mg KET (0.8–1.0 mg/kg). The dose of A3080 and MED was adjusted according to a visual evaluation of the animal's mass and the success of previous anaesthetic procedures. The gemsbok were darted from a helicopter.

Initial data collected included time from dart delivery to first signs of drug effect and the time until the animal became recumbent. Physiological data collected once the animal could be handled included heart rate, respiration rate, oxygen saturation by pulse oximetry (Nellcor N-200, Nellcor Incorp.) and rectal temperature. The degree of muscle relaxation and response to ear and eye stimulation were subjectively evaluated. The physiological data were collected at 5 min intervals for 15 min. The gemsbok were weighed before reversal of the anaesthetics.

The anaesthetic effect A3080 and MED was reversed using i.m. injections of NAL and AP. The time interval to standing and the completeness of the reversal were recorded.

RESULTS

The 2 males in Group 1 that received A3080 and KET developed initial signs in less than 1:30 (min:sec) and were recumbent in less than 2:30. The quality of anaesthesia was considered to be poor, since the animals were struggling, responsive to noise, difficult to restrain and dangerous to handle. Limited physiological data were obtained on these animals and included respiration rates of 40–48/min, heart rates of 120 and 208/min, oxygen saturation of 80–83% and rectal temperatures of 41.9–42.1 °C. These gemsbok weighed 138 and 186 kg respectively. Owing to the poor response the procedure was aborted by giving i.m. NAL (1.0 mg/kg). The gemsbok were standing within 1:35 and rapidly returned to their normal state.

The responses of the gemsbok in Group 2 that received the A3080, MED and KET combination were presented in Table 1, which indicates their body mass. The time to initial signs was also rapid at X = 1.8 ± 0.49, with recumbency occurring at X = 3.18 ± 1.04 following a brief period of progressive and marked ataxia. Neither the onset nor time to recumbency were affected by increasing the dose of the A3080/MED combination. All animals went down in sternal recumbency in a controlled manner and maintained it if left alone for 5 min. During this remote observation period we monitored respiratory rate and depth to ensure that the animal was not apnoeic or hypoventilating. If an animal was approached too soon after recumbency it would often attempt to rise and then fall onto its side. The quality of the anaesthesia was considered to be fair to good based on the degree of muscle relaxation and ease of handling. When approached after going down, most animals would undergo a brief period of teeth grinding and vocalisation for up to 5 min. These responses ceased as the anaesthesia deepened over time. The improved quality of the anaesthesia was subjectively correlated with the administration of increasing doses of A3080/MED. Minimal salivation was noted.

The physiological data recorded over the 15 min monitoring period from gemsbok in Group 2 are summarised in Table 2. The oxygen saturation, respiration and heart rates remained constant.
throughout the monitoring period. The rectal temperature was 39.4 ± 0.3 °C, and rose only slightly to 39.7 ± 0.9 °C at the end of the monitoring period.

The anaesthetic procedure was rated as good in 16 gemsbok. It was rated as fair in 2 animals because of an increase in muscle tone. All animals failed to respond to tactile stimulation of the eyes and ears suggesting that a level of anaesthesia was present.

The rates and characteristics of the recovery were comparable. Following i.m. injection of the antagonists (NAL and AP) the recovery time to standing averaged 5:19 ± 1:51. Recovery was rapid and smooth, with the animals first gaining control of their head in a sternal position, followed by a rapid rise to a standing position and then moving off within 30 sec with little to no noticeable ataxia.

**DISCUSSION**

Ketamine was administered at a constant total dose of 200 mg/animal. Ketamine has synergistic properties with MED\(^6\), which we also noted in the pilot study in the Karoo in 1998 where KET supplements allowed safe manipulation of the gemsbok. Synergism with opioids has been reported to improve the quality of the anaesthesia and decrease the amount of opioid required in bovids\(^{13,14}\). No residual sedation was seen that could be attributed to the dosage of KET following the reversal of A3080 and MED.

The animals in Group 1 showed rapid onset of anaesthesia and short time to recumbency, but the quality of the anaesthesia was very poor owing to the extreme muscle rigidity and struggling. In Group 2 the rigidity induced by the opioid A3080 was effectively reduced by addition of MED to the combination. During induction the animals rapidly progressed through the trotting gait phase as the anaesthetic took effect. They ran only 300-500 m before becoming sterna recumbent. The MED addition had the net effect of maintaining a rapid onset leading to sternal recumbency combined with a relaxed and manageable animal.

The physiological parameters measured during this study were within acceptable ranges (Table 2). All animals exhibited an initial increased panting respiration, which was attributed to the effect of MED, as noted in some species such as markhor\(^*\). The \(O_2\) saturations were marginally low but tidal volume and respiratory rate appeared adequate. The \(O_2\) saturation recorded by pulse oximetry may have been artificially low owing to the peripheral vasoconstriction effect of MED\(^4\). The heart rate was also stable during monitoring. Our dose rates for MED and A3080 covered a 2-fold range, yet the induction times and the physiological parameters remained stable with similar ranges and ranges. This stabilization of physiological parameters was also reported in impala with increasing dosages of A3080\(^4\).

The antagonists NAL and AP were given i.m. in all animals and resulted in a controlled, rapid and complete reversal. When these drugs were given intravenously in other species the reversal was very rapid, with the animal having a tendency to stumble or crash into fixed objects immediately upon rising.

The safety of this protocol is demonstrated by acceptable physiological parameters seen over the wide effective dose range of A3080 and MED of 22-45 mg/kg. This is useful when the exact mass of the free-ranging animal may be difficult to estimate. Another characteristic of this anaesthesia was that the gemsbok in this study group did not experience the elevated temperature that can occur during opioid anaesthesia.

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