Detomidine Sedation of Sokoto Red Goats under Different Ambient Temperatures

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\section{1. Introduction}
In the last two decades there has been an increased interest in drugs that act via the interaction with the \( \alpha_2 \)-adrenoceptors with particular reference to their applications in human and veterinary anaesthesia (Gertler \textit{et al.}, 2001). The full clinical potential of these drugs is made available by the availability of specific antagonists such as yohimbine or atipamezole, for prompt reversal of their effects. Detomidine (DET) is one of the relatively new \( \alpha_2 \)-adrenoceptor agonist compared to xylazine. It is an imidazoline derivative and structurally related to clonidine, xylazine and medetomidine (Virtanen \textit{et al.}, 1988). It has greater affinity on \( \alpha_2 \)-adrenoceptors than xylazine thus in the same species smaller doses are usually required to produce similar effects (Virtanen and MacDonald, 1985).

The influence of the prevailing ambient temperature on the response of animals to certain chemicals has been documented (Gordon, 1996; Malberg and Seiden, 1998). It has also been reported that high ambient temperature will cause a pronounced and prolong response to xylazine in cattle (Fayed \textit{et al.}, 1989). The influence of ambient temperature on the effects of DET has not been previously reported.

The objective of the present study was to investigate the response of Sokoto red goats to sedative doses of detomidine under climate-induced different ranges of ambient air temperatures.

\section{2. Materials and Methods}

\subsection{2.1 Animals}
Twelve clinically healthy Sokoto red goats of both sexes aged between 2 and 3 years and weighing 24.3\( \pm \)6.5kg (mean\( \pm \)SD) were used for this study. The goats were allowed free access to groundnut hay, beans offals, wheat bran and fresh water.

\subsection{2.2 Drugs}

Abstract
Evaluation of detomidine-induced sedation under different ambient temperature was studied in male Sokoto red goats. The study was carried out in two phases namely, low ambient temperatures (LAT) at \( \leq 15^\circ \text{C} \) and high ambient temperatures (HAT) at \( \geq 39^\circ \text{C} \). Two sedative doses of detomidine 20 and 40 µg/kg were administered IM at two different periods of the year with identical humidity. The indices of sedation/recovery as well as rectal temperature (RT), heart rates (HR), respiratory rates (RR) and rate of ruminal movements (RRM) were monitored with time till full recovery. The results indicated that similar doses of detomidine administered under these two different ranges of ambient temperatures produced significantly different quantitative effects. Duration of sedation and period of recovery were significantly longer in LAT compared to HAT. Significant hypothermia was consistently observed in LAT. The depressed RT, HR, RR, and RRM reverted to baseline values by 24 hours in both LAT and HAT experiments. We concluded that the prevailing ambient temperature should be considered among other factors to determine the appropriate sedative doses of detomidine needed in goats. The apparent discrepancies in some previous reports concerning the influence of this drug on rectal temperature in this species may be due to investigators not considering the ambient temperature as an important variable.

Key words: Detomidine, Goats, Sedation, Ambient temperatures, Physiological parameters.
Detomidine (Domosedan®) 1mg/ml veterinary injection (Orion Pharma Corporation Animal Health, Turku, Finland) was used for this study.

2.3 Study Design

The study was conducted in two phases, the harmattan season of the year with ambient temperature below 15.0 °C (Low ambient temperature - LAT) and the hot season with temperature higher than 39 °C (High ambient temperature - HAT). Six goats equally divided between the sexes were used for each phase. Detomidine 20 or 40µg/kg was administered intramuscularly. Each of the six goats for each phase was treated with the two doses separated by at least seven days washout period. The treatment groups are – treatment 1- LAT 20µg/kg, treatment 2 - HAT 20 µg/kg, treatment 3- LAT 40 µg/kg, treatment 4- HAT 40µg/kg.

2.4 Monitoring

The time from drug injection to the manifestations of the first signs of sedation, sternal and lateral recumbencies were recorded. The heart rate, respiratory rate, rectal temperature and rate of ruminal movements were monitored at specific intervals (0, 15, 30, 45, 60, 90, 120, 180, 240, 300, 360 minutes) and at 24 hours post drug administration. The monitoring of these parameters was with the aid of stethoscope, clinical thermometer and stopwatch.

2.5 Statistics

Data were analyzed, using ANOVA, and pairwise comparisons were made, using least-significant difference multiple comparison test. All data are presented as mean ±SD and P<0.05 was considered significant

3. Results

The results are summarized in Fig 1-5. The mean induction time following DET sedation under low ambient temperature (LAT) was significantly (P<0.05) lower than the value obtained under high ambient temperature (HAT) with a dose of either 20 or 40 µg/kg, (Fig 1). Onset of sternal recumbency (SR) or lateral recumbency (LR) following 20 or 40 µg/kg DET was significantly shorter (P<0.05) under LAT than under HAT. The mean head-up time, on-feet time and time to full recovery following both doses of DET were significantly longer (P<0.05) under LAT than the corresponding values under HAT.

There were significant decreases (P<0.05) in the mean rectal temperature (RT) over some time points following DET sedation with the two doses under LAT (Fig 2). This was not observed with the two doses of DET under HAT. The mean heart rates (HR) decreased significantly (P<0.05) at many time points during DET sedation under both LAT and HAT (Fig 3). The mean respiratory rate (RR) decreased significantly (P<0.05) from the baseline values at many time points following DET sedation in the LAT and HAT experiments (Fig 4). The mean rate of ruminal movement (RRM) decreased significantly following DET administration at both dose rates under LAT and HAT (Fig 5). The RRM was zero and bloat was evident in the goats in all treatment groups at some time points during sedation and the recovery period. At 24 hours following DET under both LAT and HAT and with the two doses used in this study the mean RT, HR, RR, and RRM were not significantly different from the baseline values obtained before drug administration. Unlike the smooth and uneventful recovery from sedation in HAT, the recovery in LAT was characterized by at least two failed attempts at regaining standing posture before success by the goats, followed by persistent vigorous shivering for between thirty minutes to one hour.

4. Discussion

The prevailing ambient temperature significantly influenced the sedative and other effects of DET in this study. The higher dose 40 µg/kg induced significantly more profound sedation than the lower doses 20 µg/kg under both LAT and HAT. This is in support of earlier reports in goats (Singh et al., 1991; Clark et al., 1993; Kumar et al., 1997) which indicated that effects of this drug in goat are dose-dependent. The alteration of vital signs in the sedated goats also followed the same pattern. The 20 µg/kg or the 40 µg/kg IM DET produced sedation of greater depth and longer duration in LAT than in HAT. Suggesting that DET- induced sedation is also strongly influenced by prevailing ambient temperature. This clearly disagree with an earlier report that xylazine induced more pronounced and prolonged sedation in cattle under HAT (Fayed et al., 1989). Species variation, differences in climate or geographical locations and other factors may account for this disparity. The smooth recovery from the sedative effects of DET by the goats in HAT is in support of earlier reports in other breeds of goat (Tiwari et al., 1991; Fayed et al., 1997; Mahmood and Mohammad, 2000; Mpanduji et al., 2000).

Our result showed clearly that under LAT, DET induced-sedation is accompanied by hypothermia. Similar results in goats following detomidine administration has been reported (Singh et al., 1991; Dilipkumar et al., 1998). The result is however not consistent with previous report that medetomidine, a similar drug, produced variable effects on rectal temperature in goats (Mpanduji et al., 2000). This
hypothermia may also contribute to the prolong effect and recovery from sedation in LAT since the enzymes involved in biotransformation functions at the optimum only at a narrow range of body temperatures. Hypothermia following $\alpha_2$- adrenoceptor agonists has been demonstrated in many other species (Scheinin et al., 1988; Nishimura et al., 1992; Sakaguchi et al., 1992). It has been reported that the $\alpha_2$- adrenoceptor agonist, romifidine induced more pronounced hypothermia than detomidine or medetomidine in dwarf goats (Van Miert et al., 1994). It has been demonstrated that atipamezole effectively prevented the hypothermic effects caused by $\alpha_2$- adrenoceptor agonists (Scheinin et al., 1988; Nishimura et al., 1992; Van Miet et al., 1994).

Fig 1: Time in minutes (mean±SD) elapsing before the manifestation of sedative/recovery signs in sokoto red goats following administration of detomidine under high and low ambient temperatures.

Fig 2: Rectal temperature in °C (mean±SD) with time following detomidine administration in Sokoto red goats under low and high ambient temperatures.
Atipamezole reversal of detomidine-induced hypothermia was however not investigated in this study. Certain precautions to enhance the safe applications of DET in LAT may have to be taken. Lower doses than would have been needed in HAT should be administered. The reversal of DET-induced sedation with atipamezole or similar drugs could be employed to shorten the recovery period. The animal could be covered with a blanket or the temperature of the surgical theatre could be altered to facilitate recovery. The shivering during recovery period in LAT was the natural response to cold by the recovering animal.

**Fig 3:** Heart rates (beats/minute; mean±SD) with time following detomidine administration in Sokoto red goats under low and high ambient temperatures.

**Fig 4:** Respiratory rates (breaths/minute; mean±SD) following detomidine administration in Sokoto red goats under low and high ambient temperatures.
goats and meant to generate heat (shivering thermogenesis). The post-surgical shivering could lead to the loosening of sutures and delay healing, hence its duration should be as brief as practicable and some of the precautions mentioned could assist the surgeon to achieve this.

The transient nature of the alteration in physiological parameters such as RT, RR, HR and RRM as well as the smooth recovery from sedation especially in HAT, is an indication of the apparent safety of this drug in this breed of goat.

5. Conclusion
This study has established that qualitative and quantitative differences exist between detomidine administrations under LAT when compared with HAT using similar doses. Thus the prevailing temperatures at the time of administration influence the pharmacological and clinical effects of detomidine. At the doses used in this study physiological influences did not extend beyond 24 hours and full recoveries from drug effects were achieved. Taking appropriate precautions this study also established the safety of IM detomidine in Sokoto Red goats under LAT and HAT.

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References


