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A RETROSPECTIVE CLINICAL EVALUATION OF XYLAZINE-KETAMINE TOTAL INTRAVENOUS ANAESTHESIA (TIVA) IN DROMEDARY CAMELS

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ABSTRACT

Total intravenous anaesthesia using a combination of xylazine and ketamine was evaluated in 55 dromedary camels which underwent diverse major clinical surgeries. Preanaesthetic medication with xylazine was followed by induction and maintenance of anaesthesia by xylazine (0.16 - 0.2 mg kg^{-1}) and ketamine (0.8 mg kg^{-1}), intravenously. The mean anaesthetic time was 69.6 min, and a mean time interval between the injections was 20.96 ± 5.7 min. The heart and respiratory rates remained within the physiological limits during the anaesthesia. This combination has shown to produce safe and satisfactory anaesthesia in dromedary camels which under went major clinical surgeries.

Key words: Anaesthesia, camel, dromedary, ketamine, TIVA, xylazine

Intravenous drug administration to provide anaesthesia has evolved in the last decade to become a popular alternative to inhalational anaesthesia. This increasing popularity of Total intravenous anaesthesia (TIVA) is testament to its ease of use and perceived benefits (Campbell *et al,* 2001). Technical demands of gas anaesthesia and difficult intubation in camel has made the TIVA a favourable option for this species. Xylazine and ketamine can be employed as a component of a TIVA technique to provide quality anaesthesia. The synergistic action of these drugs results in smooth induction and recovery, muscle relaxation, enhanced analgesia and a decreased total dose of either drug compared to their use alone (Amend, 1972). This combination has successfully been used to produce short-term anaesthesia in the camel (White *et al,* 1987; Bolbol, 1991; Ramadan, 1994) and other animals (Waterman, 1981; Kerr *et al,* 2004; Mama *et al,* 2005). This research paper presents experience with use of xylazine/ketamine TIVA for longer duration in camels undergoing major surgeries or long procedures, and describes the characteristics of anaesthesia in terms of quality, duration, and changes to heart and respiratory rates.

Materials and Methods

Data were obtained from the anaesthetic records of 55 camels out of which 31 were females and 24 males, aged 6.7 ± 2.6 years (range 7 days-13 years) admitted to the Veterinary Teaching Hospital of the King Faisal University for general surgeries. Camels were of 2 breeds, e.g. Majaheem and Magateer and weighed 541.9 ± 177.9 kg (range 70-700 kg). The numbers and types of procedures carried out were 25 jaw fixations, 11 mastectomies, 7 tumour removal, 5 hernias, 4 femoral and tibial surgeries, and 3 soft tissue surgeries. Food, but not water, was withheld for 48-72 hours before surgery. Camels were secured in sternal recumbency before an initial physical examination was performed. Pre-anaesthetic medication was xylazine (Ilium-Xylazil-20, Troy Laboratories, Australia) at 0.16 - 0.2 mg kg^{-1} administered intravenously. Camels were then positioned as required for surgery and the skin was prepared for an aseptic surgery. Adequate level of sedation was thought to be obtained when a camel showed no signs of resistance. Anaesthesia was induced with ketamine (Ketamil, Troy Laboratories, Australia) @0.8 mg kg^{-1} and xylazine @0.16 - 0.2 mg kg^{-1} combined in the same syringe and administered IV as a single bolus. All camels were monitored for clinical signs of anaesthesia. Heart and respiratory rates were recorded before premedication and at every 10 minutes after induction of anaesthesia. Surgery started 2-6 minutes after induction of anaesthesia, and an appropriate level of anaesthesia was achieved when spontaneous movement and response (reflex) to surgical interference were abolished. Intravenous top-up of xylazine-ketamine of the same original doses was injected whenever

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required or when surgical stimulation provoked movement. Time intervals between the injections were recorded.

Anaesthesia was discontinued after surgery was completed. The camels were returned to the sternal position, and observed until the recovered. All data are listed as mean (± SD) unless otherwise indicated.

Results

Xylazine (0.16 - 0.2 mg kg^{-1}) made an adequate pre-operative sedation. Induction of anaesthesia with the combination of xylazine (0.16 - 0.2 mg kg^{-1}) and ketamine (0.8 mg kg^{-1}) was generally rapid and smooth. A surgically satisfactory anaesthesia was achieved and maintained in all camels by repeated injections of this combination at the same original dose, except in 5 camels where the injection dose was insufficient and a supplemental dose was required.

The mean anaesthetic time between the initial injection (induction) and the last injection was 69.6 min (range 28-132 min) and a mean time interval between the injections was 20.96 ± 5.7 (range 11-30 min) as shown in table 1. The values of heart rate ranged after the induction at 10 minutes from 49.3 beats/min to 57.3 beats/min at 60 minutes of anaesthesia, while mean respiratory rate ranged from 14.1 breath/min at 10 minutes after the induction to 13.9 breath/min at 60 minutes. The heart and respiratory rates remained within the physiological limits during the anaesthesia (Table 2).

Discussion

In animals of present study camels were with-held only food, not the water 48-72 hr before inducing anaesthesia. No complications were seen. White *et al* (1987) stated that xylazine and ketamine should never be given intravenously to camels on full feed as they may regurgitate copious quantities of stomach contents and there is a serious risk of aspiration.

Xylazine was used for pre-anaesthetic sedation in this study to facilitate handling, radiography, preoperative procedures, induction and to reduce the dose of xylazine-ketamine combination required for maintaining anaesthesia. The dose of xylazine used in this study (0.16 - 0.2 mg kg^{-1}) was sufficient in all cases and it was within a wide range of dose rates reported previously (White *et al,* 1987; Bolbol, 1991; Ramadan, 1994). Combinations of drugs are often used in anaesthesia to make use of their individual characteristics and to minimise the dose of each drug. This requires an understanding of each drug and its actions in combination with other agents (Nunes *et al,* 2004). Combination of xylazine with ketamine to produce general anaesthesia is a common practice. Xylazine causes bradycardia, reduced respiratory rate, hypotension, but induces good muscular relaxation, whereas, ketamine increases cardiac output, heart rate, mean arterial pressure and central venous pressure, but induces poor muscle relaxation (Clarke *et al,* 1982; Kim *et al,* 2004). This combination may exert a synergistic action on cardiopulmonary changes and muscle relaxation. These stimulating effects of ketamine compensated the depressing effects of xylazine in present this study, where heart and respiratory rates were stable in camels throughout the anaesthesia and were regarded as within the acceptable physiological range although individual variation occurred.

The anaesthesia in all camels was satisfactory and easy to maintain at a constant plane providing good muscle relaxation and lasting enough (69.6 min; range 28-132 min) to perform diverse major surgeries.

It is well-known that the maintenance of anaesthesia for greater than 1 hour with injectable anesthetic techniques is not usually recommended due to the potential cumulative drug effects, which in turn prolongs the recovery from anaesthesia and may negatively influence its quality (Muir *et al,* 1978; Mama *et al,* 1999; Mama, 2000; Mama *et al,* 2005). However, TIVA may be a more suitable option in the camel over inhalational anaesthesia owing to many disadvantages of inhalational systems together with

Table 1. Mean time intervals between the injections of xylazine-ketamine combinations.

	2nd Inj.	3rd Inj.	4th Inj.	5th Inj.	6th Inj.	7th Inj.	8th Inj.	9th Inj.
Time (min)	20.8	22.1	23.3	22.1	23.4	11	15	30
Camels No.	55	55	36	19	7	2	1	1

Table 2. Mean values of heart and respiratory rates before and during the anaesthesia.

Time (min)	0	10	20	30	40	50	60	70	80	90	100	110	120
RR/(min^{-1})	14.6	13.27	16.33	13.94	14.75	14.1	13.94	12.7	14.3	14.9	14. 3	14.1	13.1
HR/(min^{-1})	55.9	62.7	64.4	68.8	64.0	61	57.4	58.0	57.1	54.5	51.8	49.3	48.9

difficult intubation in this species because of their narrow oral cavities.

In conclusion, the use of the xylazine-ketamine TIVA has provided satisfactory anaesthesia in 55 Majaheem and Magateer camels underwent diverse major surgeries. This combination has also shown its safety and all camels were discharged after recovery.

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HYGIENIC STATUS OF CAMEL MILK IN DUBAI (UNITED ARAB EMIRATES) UNDER TWO DIFFERENT MILKING MANAGEMENT SYSTEM

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During a five month period the milk of 43 former racing camels in Dubai (UAE) was examined for total bacterial count (TBC), pathogenic bactersia, California mastitis test (CMT), somatic cell count (SCC), electrical conductivity (EC) and activity of indicator enzymes for heat treatment. The results of milk milked in the traditional way by hand (196 samples of 18 camels) were compared with milk of camels kept in intensive husbandry and milked by machine (260 samples of 25 camels). Additionally, 468 quarter milk samples of 25 camels mentioned above were examined. The geometric mean of TBC of the hand milked samples was 1.1×10^2 cfu/ml, of machine milk sample 9.2×10^2 cfu/ml and of quarter milk sample 9.2×10^2 cfu/ml. 100% of hand milk samples, 97.7% of machine milked and 81.8% of the quarter milk samples showed results lower than 5.0×10^3 cfu/ml and therefore amount only to 5% of the limit of 1×10^3 cfu/ml laid down by the European Union for raw cow milk. The prevalence of coagulase positive staphylococci (CPS) was 28.5% in machine milked samples, 5.4% in hand milked and 4.5% in quarter milk samples. CPS were the major udder pathogenic bacteria most often isolated in this study. In most samples coagulase negative staphylococci were determined. No effect of these minor pathogenic bacteria on udder health was detected. None of the hand milk samples showed positive results for *Bacillus cereus*. In 9 (3.1%, maximum 4.7×10^1cfu/ml) of the machine milked samples *B.cereus* was present. Quarter milk samples were not examined for *B. cereus*. In 17 (6.5%) of the machine milked samples coliforms were detected. 7 of these isolates (41.2%) were *Citrobacter freundii*, 2 (11.8%) *E.coli*, 4 (23.5%) *Enterobacter cloacae* and 4 (23.5%) *Klebsiella pneumoniae* 14 (8.3%) of the hand milked samples were positive for coliforms- all *Serratia marcescens*.

In quarter milk samples coliforms were not detected. Other (partly facultative) pathogenic bacteria found were *Streptococcus agalactiae, Streptococcus bovis, Corynebacterium striatum* and *Burkholderia cepacia.* All 47 samples had a negative result for salmomella species. Of the 61 samples tested for listeriae only one sample revealed a positive result for *Listeria welshimeri.* Besides pathogenic bacteria the adequacy of EC and CMT for mastitis screening was tested. No distinct correlation was found between EC and the presence of pathogenic bacteria. CMT results did not correlate distinctly with the above mentioned test results. Therefore, CMT is not considered adequate as a single mastitis screening method. For such a screening, CMT should be accompanied by other tests particularly by the determination of udder pathogenic bacteria. The geometric mean of SCC for a negative CMT was 6.3×10^4 cells/ml. It increased to 1.4×10^5 cells/ml with CMT +/-, 3.7×10^5 with CMT +, 8.4×10^5 at CMT ++ and 1.8×10^6 cells/ml with CMT +++. The activity of indicator enzymes peroxidase and alkaline phosphatase for the heat treatment of milk was determined after heat treatment at different temperatures and times. Both enzymes showed different inactivation temperatures than in cow milk. However, they could be suitable for the proof of pasteurisation (peroxidase) or for higher heat treatment (alkaline phosphatase) if combined with other heat sensible parameters. In addition to milk samples, 42 faecal samples of 22 camels were examined for the presence of vero verotoxinogenic *E.coli* by ELISA. All of them revealed a negative result. The study shows that all in all the milk from the camel herds examined was of good hygienic quality, fit for human consumption and quite comparable to the quality of cow milk. Moreover, the results of the present study showed that the microbiological criteria for cow milk regulated by law in the European Union are also applicable for camel milk.