SHORT COMMUNICATION

Epidural anesthesia in Egyptian water buffalo (*Bubalus bubalis*): a comparison of lidocaine, xylazine and a combination of lidocaine and xylazine

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Abstract

Objective To evaluate and compare the analgesic effects of a combination of lidocaine and xylazine to lidocaine or xylazine administered alone for epidural anesthesia in Egyptian water buffalo *(Bubalus bubalis)*.

Study design Prospective, randomized, 'blinded', crossover experimental study.

Animals A total of 12 female Egyptian water buffalo.

Methods Buffalo were randomly assigned to one of three epidural treatments administered through the sacrococcygeal joint: a local anesthetic (2% lidocaine, 0.22 mg kg^{-1}), an alpha-2-adrenergic agonist (xylazine, 0.1 mg kg^{-1}) or a combination of both drugs in a crossover fashion with a 14 day washout period. The total volume of each treatment was fixed at 7.0 mL by adding 0.9% NaCl. Onset, maximal effect, and duration of epidural anesthesia were recorded.

Results Caudal epidural anesthesia was easily performed, and all three treatments produced local anesthesia of the tail and perineal structures of standing buffalo. Onset of epidural anesthesia was faster ($p < 0.05$) with lidocaine (3.4 ± 0.9 minutes) than with xylazine (9.1 ± 1.1 minutes) or lidocaine-xylazine (6.4 ± 1.1 minutes). The maximal effect of epidural anesthesia was reached faster ($p < 0.05$) with lidocaine (5.9 ± 0.64 minutes) than xylazine (14.4 ± 1.1 minutes) or lidocaine-xylazine (12.9 ± 0.64 minutes). The duration of epidural anesthesia was longer ($p < 0.05$) with lidocaine-xylazine (145.8 ± 3.3 minutes) than either lidocaine (118.4 ± 2.7 minutes) or xylazine (102.1 ± 3.7 minutes) administered alone. None of the treatments produced ataxia.

Conclusions and clinical relevance Caudal epidural anesthesia was easily performed in Egyptian water buffalo by administering a local anesthetic, an alpha-2-adrenergic agonist or a combination of both drugs through the sacrococcygeal joint. Administering a combination of lidocaine and xylazine provided a longer duration of anesthesia than either drug used alone. Epidural xylazine provided a useful level of systemic sedation without ataxia.

Keywords anesthesia, *Bubalus bubalis*, egyptian buffalo, epidural, lidocaine, xylazine.

Introduction

The Water buffalo occupies an esteemed position in Egypt among food and farm animals and is of great economic importance as a source of milk, meat and hide. The ability to complete surgical and obstetrical procedures using epidural anesthesia eliminates the risk associated with general anesthesia in ruminants (Skarda 1996). Epidural anesthesia was historically produced using local anesthetic agents. Effective duration is limited when only short-acting local anesthetics are used (Hall et al. 2001). Local anesthetic agents indiscriminately block motor, sensory, and

sympathetic fibers, increasing the risk of hind limb weakness, ataxia, and in extreme cases, recumbency (Day & Skarda 1991). The combination of lidocaine and xylazine has been shown to provide rapid onset and prolonged duration of anesthesia in buffalo calves (Singh et al. 2009), cattle (Caron & LeBlanc 1989; Grubb et al. 2002), horses (LeBlanc et al. 1988), goats (Mpanduji et al. 1999), llamas (Grubb et al. 1993) and dogs (Bedder et al. 1986). The objective of the study was to evaluate and compare the analgesic effects of a combination of lidocaine and xylazine to either lidocaine and xylazine alone for epidural anesthesia in buffalo.

Materials and methods

Animals

The study was approved by the Institutional Animal Care and Use Committee of Cairo University (CU/II/F/38/2017). A total of 12 healthy nonpregnant female Egyptian buffalo (3–5 years old and weighing between 500 and 600 kg) from the university dairy farm were studied using a randomized, crossover design. Each buffalo was administered an epidural three times with a 14 day washout period. The animals were fasted for 12 hours prior to treatment.

The animals were assigned to one of three treatments using GraphPad Calcs software (GraphPad; Prizm Corp., CA, USA): 1) 0.22 mg kg^{-1} 2% lidocaine (Debocaine 2%; The Arab Company for Pharmaceuticals, Egypt); 2) 0.1 mg kg^{-1} xylazine (Xylaject 2%; Adwia, Egypt); and 3) 0.22 mg kg^{-1} 2% lidocaine combined with 0.1 mg kg^{-1} xylazine. The total volume administered for all treatments was fixed at 7.0 mL by adding 0.9% NaCl (normal saline 500 mL; Otsuka Pharmaceutical Company, Egypt).

Anatomy

The sacrum of the Egyptian water buffalo consists of five fused segments. The fused spinous processes create a median semicircular thickened crest, which terminates as a distinctive prolonged projection extending over the sacrococcygeal space (Fig. 1a). The spinal cord terminates at the level of the third sacral segment while the dural sheath extends to the third coccygeal space. The spinal canal slopes downwards more steeply and then diminishes towards the tail.

Technique

The animals were secured in a stanchion and the sacrococcygeal region was aseptically prepared. Epidural injections were administered through the sacrococcygeal space using an 18 gauge 3.7 cm long needle (El-Dawlia Co., Egypt) directed at an acute angle directly under the terminal projection of the sacrum (Fig. 1b). Minimal resistance to injection was used to confirm placement in the epidural space. Loss of sensation was defined as a lack of response to pinpricks and hemostat pressure in the perineal and sacrococcygeal regions. Observations were performed at 1 minute intervals until onset occurred and then at 5 minute intervals for the remainder of the study period. Onset, maximal effect and duration of anesthesia were recorded for each treatment. Onset was defined as the time from injection to tail flaccidity and loss of response in the perineal region (Fig. 1c). The maximum effect was defined as time from injection to loss of sensation in the inguinal, upper limb and lumbosacral regions. Duration of anesthesia was defined as the period of time between onset and the return of sensation in all regions. The presence of

Figure 1 (a) The sacrum of a water buffalo showing the terminal projection of the spinous process (black arrow); (b) site of needle insertion in the sacrococcygeal space; (c) testing for epidural anesthesia.

sedation or ataxia, as well as any changes in heart rate (HR), respiratory rate (f_R) and rumen motility were noted. Sedation was scored in the following manner: (0) absent; (1) mild (slight lowering of the head and/or protrusion of the lower lip); (2) moderate (protrusion of the third eyelid and ptyalism); or (3) severe (leaning on stanchion for support). Ataxia was scored in the following manner: (0) absent; (1) mild (slight stumbling but able to walk); (2) moderate (marked stumbling and ataxia); or (3) severe (recumbency). All observations were performed by a single observer who was unaware of treatment applied.

Statistical analysis

GraphPad Software (GraphPad-Prizm Corp.) was used for statistical analysis. All data concerning the onset, maximum effect and duration are expressed as mean ± standard deviation (SD). All data were analyzed using ANOVA for repeated measures for comparison of mean ± SD between different groups at different time intervals. Paired *t* test with Bonferroni correction was used for comparison with the normal base data. The differences were considered significant at $p < 0.05$.

Results

Caudal epidural injections were easily accomplished in all subjects. Onset of epidural anesthesia was significantly faster ($p < 0.05$) with lidocaine (3.4 ± 0.9 minutes) than with xylazine (9.1 ± 1.1 minutes) or lidocaine-xylazine (6.4 ± 1.1 minutes). The maximal effect of epidural anesthesia was reached faster ($p < 0.05$) with lidocaine (5.9 ± 0.6 minutes) than xylazine (14.4 ± 1.1 minutes) or lidocaine-xylazine (12.9 ± 0.6 minutes). Duration of epidural anesthesia was significantly longer ($p < 0.05$) with lidocaine-xylazine (145.8 ± 3.3 minutes) than either lidocaine (118.4 ± 2.7 minutes) or xylazine used alone (102.1 ± 3.7 minutes). Epidural anesthesia with xylazine provided a desirable level of sedation (ptyalism, drooping of the head, and protrusion of the third eyelid). None of the treatments produced ataxia. HR, f_R and rumen motility remained within normal limits.

Discussion

The first intercoccygeal space is routinely used for epidural administration in cattle (Caron & LeBlanc 1989) and buffalo calves (Singh et al. 2009). In this study, a novel approach was used for epidural injections to accommodate anatomic differences in the sacrococcygeal region of buffalo. Inserting the needle at an acute angle through the sacrococcygeal space just under the marked terminal projection of the sacral spine does not require manipulation of the tail and was found to be preferable to the first intercoccygeal space for epidural administration in buffalo.

Smaller epidural doses of xylazine (0.05 mg kg^{-1}) have been used in a variety of food animal species (Caron & LeBlanc 1989). The increased duration of epidural anesthesia produced by a combination of lidocaine and xylazine compared to either drug used alone is in agreement with previous studies in humans (Nishikawa & Dohi 1990), horses (LeBlanc et al. 1988), cattle (Caron & LeBlanc 1989), llamas (Grubb et al. 1993) and dogs (Bedder et al. 1986). Treatments that included xylazine produced a useful level of sedation with no apparent ataxia. This is in agreement with a previous study that used the same dose of xylazine (0.1 mg kg^{-1}) intramuscularly for chemical restraint of buffalo (Fouad and Shokry 1973). The HR, f_R and rumen motility remained within normal limits in all treatment groups. A significant reduction in HR, f_R and no reduction in ruminal movements were demonstrated after epidural xylazine (0.05 mg kg^{-1}) in Indian buffalo calves (Singh et al. 2009). Epidural xylazine (0.5–0.7 mg kg^{-1}) typically produces mild ataxia and mild bradycardia in cattle (personal communication) and more potent and longer lasting analgesia than lidocaine (Fikes et al. 1989). Xylazine, in addition to interacting with alpha-2-adrenoceptors in the spinal cord, possesses a local anesthetic effect characterized by blockage of action potentials and reduced nerve conduction velocity, which may enhance its epidural effects (Aziz & Martin 1978). The increased duration of epidural anesthesia produced by using a combination of lidocaine and xylazine provides more time to complete procedures and/or a longer period of post-procedure anesthesia. The sacrococcygeal approach makes epidural injection easier in buffalo and not having to manipulate the tail, allows both of the operator's hands to remain sterile. Since buffalo are very sensitive to alpha-2 agonists, adjusting the dose is crucial to minimize any undesirable effects such as ataxia or recumbency. Furthermore, epidural alpha-2 agonists should be avoided in pregnant buffalo.

In conclusion, epidural administration of lidocaine and xylazine combination provided a longer duration of anesthesia and a convenient level of systemic sedation without ataxia.

Authors' contributions

MMS: study design, statistical analysis and preparation of manuscript (first author). AHE: experimental implementation, data management and interpretation (co-author).

Conflict of interest statement

Authors declare no conflict of interest.

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Received 25 August 2017; accepted 26 March 2018.

Available online 19 May 2018

