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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Comparison of analgesia and cardio-pulmonary effects of epidural injection of pethidine and lidocaine in small East African goats

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Abstract

Analgesic and cardiopulmonary effects of epidural injections of 2% lidocaine (4mg/kg, n=6) and pethidine (2.5mg/kg, n=6) were compared in healthy goats weighing 18-25 kg. All drugs were injected at lumbosacral epidural space. Mean heart rate, respiration rate, rectal temperature, analgesia effect (response to pinprick stimuli), sedation and motor incoordination were determined. Results were recorded before and at various times (every 5 minutes for the first 10 minutes and every 10 minutes upto 2 hrs) after the epidural injection. Onset of analgesia was after 5 minutes following injection of either lidocaine or pethidine. Duration of analgesia was over 120 minutes and 60 minutes after epidural injection of lidocaine and pethidine respectively. Hind limb paralysis was observed in goats that received lidocaine while only mild incoordination was observed in pethidine treated goats except for one goat that remained recumbent for the entire observation period. Significant increase in body temperature was recorded in 10 minutes after pethidine injection but did not change following lidocaine injection. There was no significant change in heart rate following epidural injection of lidocaine but significantly decreased following pethidine injection. Respiration rate significantly increased in lidocaine group but did not change in pethidine treated goats. Results of this study indicate that epidural injection of pethidine at a dose of 2.5 mg/kg produce analgesia of a shorter duration compared to lidocaine, but is sufficient and safe for short duration surgeries of the perineal region in goats.

Keywords: Spinal analgesia; opiates; caprine; pain

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Introduction

Pethidine or Meperidine-HCL is a potent analgesic agent which belongs to a group of drugs called opioid. It acts at specific opioid receptors in the CNS to produce analgesia, euphoria and sedation.

Lidocaine is a local anesthetic agent commonly used to provide intra-operative and postoperative analgesia in animals. It is particularly useful in horses and farm animals for standing surgery, as an adjunct to general anaesthesia and for postoperative pain relief (Clarke, 2008).

The discovery of opiate receptors in the spinal cord has led to wide use of opiates intrathecally or epidurally mainly for post operative analgesia (Fitzgibbon and Ready, 1999) and for treatment of acute obstetrical and perineal surgery (Williams, 1998) in human. Reported method of delivery includes bolus injection, continuous infusion and patient controlled epidural analgesia (Ngan Kee, 1998). Pethidine exerts its analgesic effects by acting as an agonist at themμ-opioid receptor, same as morphine. Apart from its strong opiodergic and anticholinergic effects, pethidine has local anesthetic activity related to its interactions with sodium ion channels (Taylor et al., 2001).

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Epidurally administered opioids are very effective (Clarke, 2008). Epidural or intrathecal pethidine has been used in caesarean section (Kafle, 1993) and perianal surgery (Chaudhari et al., 1996) in humans. In animals, several researchers and clinicians have used pethidine for different surgical procedures in different species such as dogs (Lascelles et al., 1997), pigs (Hermansen, 1986), horses (Skarda and Muirr, 2001). However, lack of information exists regarding the sole use of this agent intra-operatively for goat (Mohammed, 1996). The present study was carried out in order to evaluate analgesia, sedation and cardio-pulmonary effects of epidurally injected pethidine and compared it with epidurally injected lidocaine in goats.

Materials and methods

Animals

Six adult healthy (ASA Risk Group 1) Small East African goats of either sex weighing from 18 to 25 (mean 20.8±1.9) were used in this study. Same animals were used for both treatments at 10 days interval. The animals were kept under uniform good husbandry conditions at the Faculty of Veterinary Medicine, Sokoine University of Agriculture throughout the period of the study. The animals were allowed to browse during the day and supplemented with maize bran in the evening.

Injection Technique

Epidural injection technique in the goats was adopted from Hall and Clarke (1991) and followed all routine antisepsia. During injection the animal was restrained in lateral recumbency with lumbosacral full flexed. The site for injection was located with left hand by placing the thumb and second finger on the ilial crest while with the index finger palpated the lumbosacral space immediately posterior to the spinous process of 7^{th} lumber vertebra (Lumb and Jones, 1984). An 18 gauge, 2.0 inch epidural needle was used for drug injection where a popping sensation was felt as the needle passed through the intervetebral ligament. A lack of resistance technique was used to ascertain the correct position of the epidural space. Attempts to aspirate cerebrospinal fluid into the syringe was done to check whether the dura had been punctured but there was no evidence of fluids or blood coming out in all goats. A syringe containing 5% pethidine at a dose of 2.5mg/kg (Mohammed, 1996) topped up with water for injection to make a total volume of 5ml or 2% lidocaine at a dose of 4mg/kg (Hall and Clarke, 1991) was attached to the needle and injection completed. The goat was then turned on to its back with the fore quarters elevated for two minutes to enable equal distribution of the drug into the lumbosacral epidural space.

Analgesia, Sedation and Cardiopulmonary Monitoring

After the drugs were injected the animals were left loose in a large room for observation. Animals were observed for the onset, extent and depth of analgesia, sedation and motor incoordination, heart rate, respiration rate and rectal temperature.

The heart and respiration rates were measured by thoracic auscultation using a regular stethoscope. Rectal temperature was monitored using digital thermometer (Citizen®, China) with the temperature probe placed deep into the rectum touching the rectal wall. These parameters were monitored at 0 (before injection), 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 and 110 min respectively post injection.

Analgesia was determined in a less restrained animal by observing response to pinprick stimuli. The onset and level of analgesia were recorded at the flank, ventral abdomen, hind limbs, perineum and the tail by recording the response to pinprick stimuli at these sites. During each test, superficial skin prick and deep muscular pricks were performed using a 2.54 cm, 23-gauge needle. To quantify the depth of analgesia, response to pinprick was graded as 0–no analgesia (strong response to superficial skin pinprick); 1–mild analgesia (no avoidance response to superficial skin pinprick); 2-moderate analgesia (no avoidance response to insertion of half the needle length) and 3–complete or profound analgesia (no avoidance response to insertion of the needle through the skin and underlying tissues, i.e. deep muscle pricks). The spread of analgesia to the thorax and forelimbs were also determined and recorded in a similar manner. Adequate analgesia was defined as a range between the mean analgesic score of 2 and 3. End of sensory blockade was taken as the time when the goat could react to pinprick.

The extent of motor blockade was recorded by observing incoordination of hind limbs where the grading was 0 for no incoordination (normal gait); 1 – mild incoordination (slight ataxia and incoordination of hind limbs); 2 – moderate incoordination (able to walk without support but with extreme difficulty); 3 – severe incoordination (unable to support its weight on hind limbs and attained sternal recumbency). A paired t-test was used to compare cardio-pulmonary values while a Wilcoxon test for matched pair (Fowler, Cohen and Jarvis (1998) was employed to compare differences in scores for analgesia and locomotion. A p-value of less than 0.05 was considered to be significant.

Results

Analgesia and Motor Blockade

The onset of analgesia of the flank and perineum was evident within 5 minutes following epidural

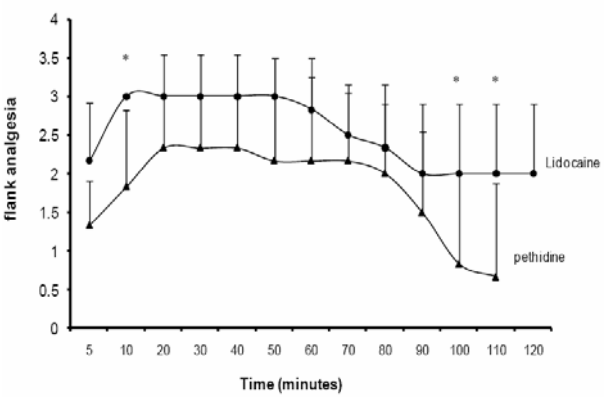

Fig. 1: Analgesia score of the flank after epidural injection of pethidine and lidocaine in goat. *Values significantly different are indicated

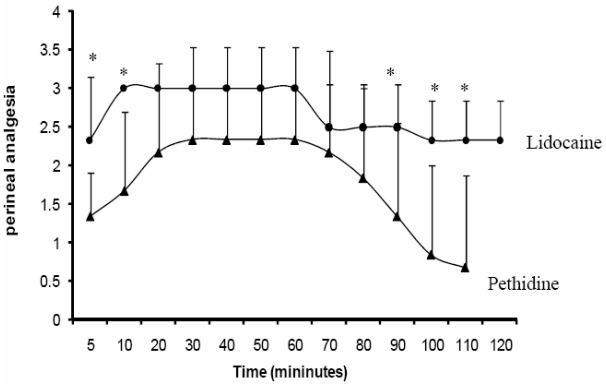

Fig. 2: Analgesia score of the perineal region after epidural injection of pethidine and licocaine in goat. *Values significantly different are indicated.

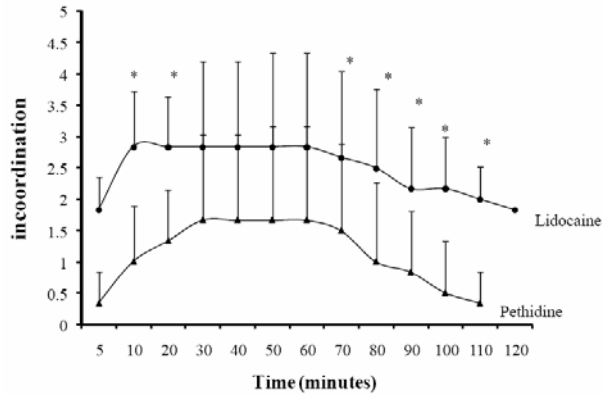

Fig. 3: Degree of motor blockade after epidural injection of pethidine and lidocaine in goat. *Values significantly different are indicated.

injection of lidocaine and pethidine and continued throughout the observation period (Figure 1). Profound analgesia of the flank was reached within 10 and 20 minutes respectively for the two drugs and continued for about 70 and 50 minutes for lidocaine and pethidine respectively and followed subsequently by a significant ($P<0.05$) decline on analgesia for pethidine treated animals but prolonged for lidocaine treated animals (Figure 1). Profound analgesia of perineum was reached in similar time as for flank (but the duration for lidocaine induced analgesia lasted for the entire observation period contrary to pethidine analgesia which lasted for about 60 minutes after which the levels decreased significantly (Figure 2). At all times, the level of analgesia following lidocaine epidural injection was above that observed following pethidine injection. Animals given lidocaine were fully alert but showed hind limb paralysis that persisted for the entire observation period. However, a variation on the level of incoordination was observed for pethidine treated animals. One animal showed intense sedation and remained recumbent for the entire observation period while others showed only mild degree of motor incoordination. The mean scores for the levels of motor incoordination are summarized in Figure 3.

Cardio-pulmonary dynamics

Epidural injection of lidocaine did not significantly change the body temperature in goats. However, pethidine caused significant increase 10 minutes after injection and the temperature remained above the pre-injection values throughout the observation period (Table 1). Pair wise comparison of rectal temperature showed significant higher values for pethidine treated goats during the 30^{th}, 60^{th}, 80^{th}, 90^{th} and 110^{th} minutes of observation. The heart rates were not affected by epidural injection of lidocaine but significantly decreased 10 minutes after pethidine injection, and fluctuated in decreasing order there after (Table 1). Respiration rates were however increased ($P<0.05$) in lidocaine but not in pethidine treated goats (Table 1).

Discussion

Pain management is a subject becoming popular daily both in human and veterinary medicine. Treating pain based upon observation of the painful state is less effective than anticipating and preemptively treating the pain (Cornick-Seahorn and Messonnier, 2001). Abdominal and perineal surgeries require excellent intraoperative and postoperative analgesia because postoperative pain following perineal surgery causes distress and suffering and can cause reflex inhibition of bladder evacuation with increase in sphincter tone. In this study, pethidine and lidocaine were studied and

compared for analgesic and cardiopulmonary effects after epidural injection in goats.

The mean onset of analgesia following epidural injection of pethidine in goat was 5 minutes similar to earlier reports by Chaudhari et al. (1996) and Acalovschi (1986) in human subject where the mean onset were 6.37 and 5.28 minutes respectively. In this study, pethidine at a dose of 2.5 mg/kg provided adequate analgesia of the flank and perineum region contrary to the earlier report by Mohammed (1996). Profound analgesia of the flank and perineum following pethidine injection lasted for 50 and 60 minutes respectively. This warrants the possibility of performing short surgeries such as castration and hernia repairs. On the other hand, lidocaine had prolonged and intense analgesic effect both at the flank and perineum contrary to reports from human patients (Kafle, 1993; Chaudhari et al., 1996) where pethidine appear to have superior effect. Chaudhari et al. (1996) reported duration of postoperative analgesia of 15.39 ± 5.14 hrs and 1.3 ± 0.53 hrs for intrathecal pethidine and lidocaine respectively in man.

Mean onset of motor blockade observed with pethidine was 10 min which correlates well with a study by Acalovschi (1986). Pethidine injection resulted in moderate motor incoordination with exception of one goat that showed intense sedation and was completely recumbent for the entire observation period. Motor blockade was generally more intense with lidocaine than with pethidine injection similar to what was observed by Kafle (1993). The duration of clinical effect of pethidine in this study as manifested by analgesia and motor blockade lasted for 70 to 90 minutes which is lower compared to 120-150min reported by Taylor et al. (2001).

There was no significant change in body temperature following lidocaine injection but pethidine caused a significant rise in body temperature that remained high throughout the observation period especially from the 30^{th} to 110^{th} minute. Heart and respiration rates remained unchanged from values recorded pre injections for both drugs although the rates recorded for pethidine were sometimes higher when compared to lidocaine. Parenteral administration of pethidine is sometimes associated with histamine release, and causes respiration depression, vagolytic and negative inotropic effects at clinical recommended dose (Plumb, 2002). In the present study, these effects were not observed in goat. The high lipophilic and hyperbaric nature of pethidine with respect to cerebrospinal fluid (Williams, 1998) probably limits systemic absorptions and the clinical effects observed are confined to those associated with stimulation of spinal opiate receptors and the local analgesic effects (Taylor et al., 2001) thus reducing the incidence of systemic side effects (Ngan Kee, 1998).

Latta et al. (2002) noted that the analgesic effects of pethidine is not pronounced and is complicated by side effects including serotonergic crisis and normeperidine toxicity (Taylor et al., 2001). This study has shown epidural pethidine to be safe and effective alternative technique in providing analgesia of the perineal region in goat. Profound analgesia and the lack of serious cardio-respiratory depression effects after epidural administration of pethidine make it a safe alternative technique for painful manipulations

Table 1: Comparison of the mean rectal temperature, heart rate and, respiration rate after epidural injection of lidocaine (n=6) and pethidine (n=6) in Small East African goats.

Time	Lidocaine			Pethidine		
	Rectal Temp.	Heart Rate	Resp. Rate	Rectal Temp.	Heart Rate	Resp. Rate
0	38.6±1.1	80±11[b]	15±4.7[c]	38.6±0.9	91.3±7.0[b]	21.2±3.7[c]
10	38.4±1.1	91±19	21±4.1[*]	39.4±0.7[*]	85.8±6.0[*]	22.7±4.3
20	38.4±1.3	85±11	19±3.8[*]	39.5±0.8[*]	82.7±11.8	21.5±6.7
30	38.2±1.2[a]	79±3.9	19±4.2[*]	39.5±0.7[a*]	83.8±7.4[*]	20.0±5.6
40	38.2±1.2	79±3.2	8±3.5	39.5±0.6[*]	82.3±9.8[*]	22.2±6.4
50	38.2±1.2	78±3.9	19±3.0[*]	39.6±0.6[*]	81.3±10.7[*]	21.5±5.5
60	38.3±1.3[a]	77±3.5	17±2.5[c]	39.6±0.6[a*]	81.7±9.5[*]	21.7±5.0[c]
70	38.4±1.4	76±5.6	17±2.5[c]	39.6±0.5[*]	82.3±7.5[*]	21.0±3.3[c]
80	38.3±1.4[a]	78±7.0	16±3.5	39.9±0.3[a*]	79.3±9.2	25.7±3.8
90	38.4±1.5[a]	78±9.9	18±3.4[*]	39.9±0.2[a*]	77.7±8.1[*]	25.3±4.1
100	38.4±1.2	77±9.7	18±2.6[*]	39.9±0.2	80.0±5.6[*]	23.0±1.4
110	38.5±1.2[a]	78±10	18±2.8[*]	39.8±0.3[a]	81.5±3.5[*]	22.0±2.8

[*]Values significantly ($P<0.05$) different from values recorded at base line (t = 0). Values significantly different between groups are indicated by same letters Rectal temp (a), Heart rate (b), and Resp. rate (c). All values expressed as Mean±sd. Recorded normal heart and respiration rates and rectal temperature values for goat are 70-80, 12-15 and 38.5-40.5 respectively (Blood and Rodostits, 1989, Grimley et al., 1998).

involving the flank and perineum in goat. However, its sole use for intra operative analgesia needs further evaluation. The present study concludes that epidural pethidne given at a dose of 2.5 mg/kg in goats offers profound analgesia of short duration, and comparatively makes it inferior to 4 mg/kg lignocaine injection. Epidural pethidine is thus limited for use in painful procedures of short duration in goat.

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