INTRODUCTION

One of the most useful applications of epidural analgesia is in the old dogs. When combined with effective sedation, epidural analgesia is definitely safer than general anaesthesia in old patients. Epidural analgesia can be routinely considered in all ages of dogs for caesarian section, hysterectomy, painful manipulation of the hind limbs and rectal, vaginal or perineal surgery (Booth, 1981).

The most frequently used epidural anaesthetic is lignocaine which is known to have excellent diffusion and penetrability, as well as produce rapid onset and establishment of surgical anaesthesia, but it does not produce prolonged sensory and motor blockade. Therefore, it is not a satisfactory agent for single dose technique for long duration surgical procedure (Adetunji et al., 2001). Epidural and intrathecal administration of ketamine produced analgesia in the dogs (Rao et al., 1999) and provide perineal analgesia in the horse, goat and cow (Gomez De Segura et al., 1998). Amarpal et al. (1999) demonstrated that ketamine given epidurally to dogs before fracture repair decreased post-operative pain for up to 15 days as compared to dogs receiving saline. Epidurally administered opioids have been shown to provide analgesia for both visceral and somatic pain that can persist in the dog for 10-24 hours (Torske and Dyson, 2000).

The available literature suggests that only sporadic research works have been conducted in the past on the spinal use of buprenorphine (Pasqualucci et al., 1987, Wolff et al., 1986). Buprenorphine is a derivative of the morphine alkaloid, thebaine. It is a powerful analgesic approximately 25-40 times as potent as morphine. Buprenorphine in combination with ketamine have been selected as epidural agents in the present study to exploit their potential in terms of their clinico-anaesthetic profile in dogs.

MATERIALS AND METHODS

The present research work was conducted on 10 clinically healthy male / female mongrel dogs of about one year of age. They were divided into two groups containing five dogs in each group. Each dog was subjected to two treatments of epidural analgesic administration at one week interval. The dogs were maintained in isomanage mental condition in the indoor ward of Ranchi Veterinary College clinics. The dog was kept off fed and withheld water for 12 and 6 hrs, respectively before the commencement of experiment.
The lumbo-sacral region was shaved and prepared aseptically and ketamine @ 3 mg/kg bwt was administered in group I and in combination with Buprenorphine@ 0.005 mg/kg bwt in group II. The dog so treated was supported in sternal recumbency for at least 2 min following drug injection to ensure that a bilateral rather than unilateral blockade is achieved. The dog was placed at an isolated corner without disturbance to monitor the development and progression of analgesia sequentially.

RT, RR and HR were carried out at the time intervals of 5, 15, 30, 60, and 120 min of following epidural administration of analgesic agents. Various reflexes like corneal, palpebral, pedal, anal and cutaneous were noticed.

The anaesthetic indices like onset of analgesia, duration of analgesia, time to recumbency and time to standing were noted in each treated dog on the basis of physical symptoms and reflexes.

The analgesia was scored using a 0-3 numerical rating scale to pin prick response as:
0 - No analgesia
1 - Mild
2 - Moderate
3 - Excellent

Sedation was judged by observing drowsiness and lowering of head and scored using a 0-3 numerical rating scale:
0 - Fully alert
1 - Alert but unable to walk
2 - Drowsy and unable to stand
3 - Heavily sedated/asleep

The data was statistically analysed by one way analysis of variance (ANOVA) as per method described by Snedecor and Cochran (1994).

### RESULTS AND DISCUSSION

The rectal temperature in group I showed an increasing trend up to 30 minutes of observation followed by a decreasing trend to reach to the pre injection level (Table 1). Ketamine causes tonic and clonic convulsion of limb muscles (Hall and Clark, 1991) which might be responsible for increase of temperature at initial intervals of observation in group-I animals which was in accordance with the findings of Aithal et al. (1998). Contrary to this, Kumar et al. (1979) and Amarpal et al. (1999) observed decreased rectal temperature following epidural administration of ketamine in dogs. The animals of group II manifested a non-significant fall (P> 0.05) in the rectal temperature through out the observation period. The decrease in rectal temperature may be due to inhibition of skeletal muscle movements, reduction in metabolic rate or depression of thermoregulatory centre as a result of epidural administration of drugs in dogs (Kumar et al., 1979). Hypothermia has also been observed by other workers following administration of butorphanol and ketamine in dogs (Atalan et al., 2002).

The respiratory frequency in group I showed a significant tachypnoea up to 60 minutes as compared to its base value following epidural administration of ketamine which simulates with the findings of Aithal et al. (1998). This was further supported with the findings of Amarpal et al. (1998) after epidural administration in dogs. The tachypnoea observed in the present case might be attributed to stimulatory action on the respiratory centre causing increase in respiration rate. The increase in respiration rate might also be due to its rapid absorption and systemic distribution (Aithal et al., 1998). The values recorded at 5 and 15 min.

### TABLE 1: Mean ± S.E. values of rectal temperature (°F), respiration rate (/min), Heart rate (beats/min) and analgesia in the animals of different groups before and after epidural administration.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups</th>
<th>Observation period (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>RectalTemp.</td>
<td>I</td>
<td>101.50±0.40&lt;sup&gt;AA&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>101.90±0.37&lt;sup&gt;AA&lt;/sup&gt;</td>
</tr>
<tr>
<td>Respiration rate</td>
<td>I</td>
<td>20.40±0.73&lt;sup&gt;AA&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>23.20±1.75&lt;sup&gt;aA&lt;/sup&gt;</td>
</tr>
<tr>
<td>Heart rate</td>
<td>I</td>
<td>92.40±1.46&lt;sup&gt;aA&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>91.80±0.52&lt;sup&gt;acA&lt;/sup&gt;</td>
</tr>
<tr>
<td>Analgesia</td>
<td>I</td>
<td>0.00±0.00&lt;sup&gt;aA&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>0.00±0.00&lt;sup&gt;aA&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values bearing similar superscript in a row with small letters and capital letters in a column did not differ significantly (P>0.05).
in group I was significantly higher as compared to the corresponding intervals in group II. A significant decrease in respiration rate after epidural administration of buprenorphine (Group II) in combination with ketamine might be ascribed to synergistic respiratory depressant activity of opioids and ketamine. Kappa-opioid agonists are less likely to induce respiratory depression as compared with \( \mu \)-opioid agonists (Pascoe, 2000; Hall and Clark, 1991). Buprenorphine is \( \mu \) opioid agonist. The opioids follow the slow passive circulation of CSF in the spinal subarachnoid space over 4-6 hours intervals to reach the cisterns of the brain and then reach the respiratory centre via the ventral pons. Opioid travelling cephalad in CSF may also stream against the rapid and active intracranial CSF circulation to gain retrograde access to the lower ventricle with subsequent rapid access to respiratory centre. Contrary to this, a significant increase in the respiration rate has been recorded from 5 to 300 minutes after epidural administration of ketamine and buprenorphine in dogs (Sharma et al., 2005). A non-significant change has been reported by De Rossi et al. (2004) in horse treated with epidural meperidine and in man treated with meperidine and pentazocine (Mohan et al., 1995).

The heart rate observed in both the groups, after epidural administration of analgesic drugs, manifested higher value at initial intervals of observation. The values recorded at 5 and 15 min of observation were significantly higher \((P<0.05)\) in group I and II as compared to base value. The enhancement in heart rate in group I was comparatively more with respect to group II. This increase in heart rate might be sequel to rapid absorption and systemic distribution of drugs from epidural space. A significant increase in heart rate after epidural administration of ketamine has also been reported by Aithal et al. (1998). A major feature that distinguishes ketamine from other intravenous anaesthetics is stimulation of the cardio vascular system (Lin, 1996). Ketamine causes increase in arterial pressure, heart rate and cardiac output in a man after intravenous infusion (Lin, 1996).

Ketamine has unusual pressure effects like increased blood pressure and heart rate at lower dose levels \((2.5 \text{ mg/kg})\) and at higher doses \((10-20 \text{ mg/kg})\) produces depressor effects more similar to those induced by other anaesthetic agents (Parker and Adams, 1978). Sharma et al. (2005) also recorded increased heart rate from 5 to 90 minutes after epidural administration of buprenorphine and ketamine in atropinized dog. Buprenorphine administration as an intravenously in rabbits increased arterial blood pressure and did not change the heart rate. Bradycardia occurring following opioids administration has been compensated and antagonized by epidural administration of ketamine causing tachycardia (Sharma et al., 2005). Non-significant change in heart rate has been reported in dog treated with buprenorphine and acepromazine (Stepien et al., 1995).

The animals of group I did not show any sign of sedation throughout the observation period which is similar to the findings of Aithal et al. (1996). The maximum sedation could be recorded at 5 minutes interval in groups II \((1.00 \pm 0.28 \text{ min})\), followed by group I. The level of sedation gradually decreased in group II at 15 minutes post induction and on the subsequent periods of observation, all the animals were absolutely free from the effect of sedation. Sedation was not appreciable in any group which simulates with the findings of Amarpal et al. (1998).

**Analgesia and anaesthetic indices (onset of analgesia, duration of analgesia, time of standing, time of recovery and time of recumbency)**

In group I, analgesia was noticed at 5 min which progressed upto 30 min. Whereas, in group II the analgesia persisted up to 60 min. Analgesia was absent in the animals of all the groups by 120 min. of observation. The onset of analgesia was noticed with faster rate in group II \((3.48 \pm 0.11 \text{ min})\) as compared to group I \((4.08 \pm 0.33 \text{ min})\). The duration of analgesia was significantly higher in group II \((27.80 \pm 0.77 \text{ min})\) followed by group I \((21.40 \pm 1.15 \text{ min})\). The time of standing and time of recovery were significantly enhanced in group II as compared to group I(Table.2). The duration of recumbency did not exhibit any significant variations among the groups. Buprenorphine induces analgesia of the same quality as morphine, however, without the outlasting sedation (Brodbelt et al., 1997). The duration of analgesia after intrathecal and epidural administration of opioids is dependent upon the
agent and its lipophilicity as well as the size of the dose employed (Consins and Mather, 1984).

The analgesic properties of ketamine appear to be mediated by action on a number of receptor systems. Ketamine will bind stereospecifically to opioid receptors (Forman, 1999) as well as cholinergic receptors (muscarinic and nicotinic) (Hustveit et al., 1995). Additionally, ketamine may activate the monoaminergic descending inhibitory system (Crisp et al., 1991) and produce local anaesthetic effects by blockade of sodium channels(Yaksh, 1996). Reduction in post incisional hyperalgesia could be observed for longer time in epidural administration of ketamine (Duque et al., 2004). Epidural ketamine alone may be insufficient for adequately reducing the pain state by removing the central facilitation alone (Wong et al., 1996). Opioids and ketamine combination can antagonize these two distinct components and provide adequate control of post operative pain. Schmid et al. (1999) reviewed the clinical trials in two studies of ketamine analgesia and concluded that small dose ketamine (4 mg/kg for the epidural route) may play an important role in post operative pain when used as an adjunct to local anaesthetics, opioids or other analgesics. The duration of analgesia was higher in buprenorphine treated animals which can be substantiated by the fact that the buprenorphine is retained at the opiate receptors situated in the spinal cord for a longer period and released slowly (Sharma et al., 2005). Amarpal et al. (2003) used ketamine and pethidine epidurally in dogs and confirmed synergistic interaction in increasing analgesia.

Nausea and vomiting was recorded in 20% of animal in group II. In contrary to this, Shah et al. (2006) reported 30% human patient suffered with nausea and vomiting after epidural administration of buprenorphine and ketamine, 30 min before skin incision. Shivering was common in groups II might be due depression of hypothalamus which produces hypothermia. There was no shivering in ketamine groups concurrent with findings of Aithal et al. (1998). There was no respiratory depression in groups II which is in accordance with the findings of Shah et al. (2006). Other unwanted symptoms dilatation of anal opening was also recorded in Group II might be due to prolongation of anal reflex. A variable degree of hallucination was observed in both the groups. Ketamine induced depression of the inferior colliculus and medial geniculate nucleus leading to misperception of auditory and visual stimuli may be responsible for the reaction (White et al., 1982). Chaney (1995) reported four side effects like pruritis, nausea, vomition, urinary retention and respiratory depression after epidural opioids. But in present study untoward reaction were occasionally noticed in both the groups. Therefore, opioids along with ketamine can be administered epidurally for effective analgesia in the dogs.

REFERENCES


