Effects of intraperitoneal bupivacaine and bupivacaine-dexmedetomidine for intra-operative and post-operative pain management in dogs

Saurav Debnath, Hitesh Bayan, Bedanga Konwar, Prava Mayengbam and Kalyan Sarma

Abstract

Pain management is difficult in animals due to their inability to verbalize the discomfort and adequacy of treatment. The study was aimed to evaluate the use intraperitoneal bupivacaine and bupivacaine-dexmedetomidine for intra-operative and post-operative pain management in dogs. Eighteen clinical cases of dogs requiring laparotomy were randomly divided into three groups viz. Group-B, BD and N comprising of six dogs in each. The animals were premedicated with glycopyrrolate, meloxicam and diazepam. Anaesthetic induction and maintenance was done by using propofol. Intrapertioneally bupivacaine, bupivacaine-dexmedetomidine and normal saline were infused in the three groups. Time for sedation, quality of sedation, time for induction, quality of induction, depth of anaesthesia, recovery time, quality of recovery and intra-operative analgesia, post-operative analgesia, heart rate, rectal temperature, respiratory rate and blood pressure were recorded. Intrapertioneal infusion of bupivacaine and bupivacaine-dexmedetomidine combination improved the intraoperative and postoperative analgesia. Clinical and cardiorespiratory changes following intraperitoneal bupivacaine and bupivacaine-dexmedetomidine combination were within physiological range.

Keywords: bupivacaine, dexmedetomidine, dogs, intraperitoneal

Introduction

Understanding as well as managing of pain in all animals is a challenging and often subjective task. It is important for animal health care professionals and researchers to consider different components that may affect the animal responses to pain, to assess any indication of pain in each of the components and tailor treatment simultaneously. Postoperative pain in animals is harmful to the patient as it can cause loss of appetite, behavioural changes, increase protein catabolism, cardiac dysrhythmias, depress respiratory function, central stimulation and may also lead to the chronic pain (Kim et al., 2012) [9]. Accordingly it increases the period of hospitalization and postoperative treatment cost (Guerrero et al., 2016) [10]. Systemic analgesics or local anaesthetics combinations are used for postoperative pain management (Hewson et al., 2006) [8]. Economical, easily accessible and relevant local anaesthetics have been commonly used intraperitoneally in veterinary as well as human medicine to avoid or alleviate pain (Korkmaz et al., 2019) [10]. Bupivacaine is a lipophilic long acting amino amide local anaesthetic commonly used for regional and infiltration anaesthesia of longer duration. Dexmedetomidine is an effective and well selective adrenoceptor α-2 agonist with analgesic and sedative properties (Sampaio et al., 2020) [16]. The present clinical study was conducted to evaluate the effectiveness the intraoperative and postoperative analgesia, clinical, cardiorespiratory changes following intraperitoneal bupivacaine and dexmedetomidine in dogs.

Materials and Methods

The study was conducted in the Teaching Veterinary Clinical Complex and Department of Veterinary Surgery and Radiology, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram in the year of 2020-2021. Eighteen clinical cases of dogs requiring laparotomy procedure were divided into 3 groups viz. Group-B, Group-BD and Group-N comprising of 6 dogs in each. All the animals were fasted for 12 hours for food and 4 hours for water. The animals were examined for physiological and haematobiochemical parameters prior to surgery and premedicated with glycopyrrolate @ 0.01 mg/kg b. wt and meloxicam @ 0.2 mg/kg b. wt through intramuscular route and after 10
minutes diazepam was administered @ 1 mg/kg b. wt intravenously. Induction was done by using propofol @ 5 mg/kg b. wt intravenously or till effect and the anaesthesia was maintained with incremental doses of propofol. After laparotomy incision intraperitoneally bupivacaine @ 2 mg/kg in Group B, bupivacine and dexmedetomidine combination @ 2 mg/kg and 1µg/kg in Group BD along with equal volume of normal saline and in Group N normal saline solution was administered. Time for sedation was recorded from the administration of diazepam till the animal showed the first sign of sedation. Quality of sedation was determined according to the method described by Amengual et al. (2013) [2]. Time for induction was determined from the administration of the induction agent till the loses reflexes. The quality of induction was assessed according to the method described by Amengual et al. (2013) [2]. The quality of intra-operative analgesia was assessed by pricking the inter-digital space of the hind foot with a needle, as described by Jimenez et al. (2012) [7]. Anaesthetic depth was assessed according to the method described by Ahmad et al. (2013) [11]. Recovery time was calculated from the time of discontinuation of anaesthesia till the animal’s ability to walk unassisted. The quality of recovery was determined as per the method described by Sams et al. (2008) [17]. The numerical pain scoring system Leibetseder et al., 2006 [11] was used to assess postoperative pain in at 0 min, 6 hrs, 12 hrs and 24 hrs of post recovery. Heart rate (beats/ minute), Rectal temperature (°C), Respiration rate (breaths/minute), Blood pressure (mm Hg) were recorded before premedication at 0 min (baseline), 30 min (after induction), 2 hrs and 24 hrs. The statistical package for social sciences (SPSS) version 25 was used to analyse the data. The data was analysed by using one-way analysis of variance (ANOVA) and a post-hoc test using Duncan’s multiple range tests. The data was displayed as Mean ± Standard Error and differences were considered statistically significant when P<0.05.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group-B</th>
<th>Group-BD</th>
<th>Group-N</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time for sedation(min)</td>
<td>1.66±0.33</td>
<td>1.83±0.30</td>
<td>1.50±0.22</td>
<td>0.721**</td>
</tr>
<tr>
<td>Quality of sedation</td>
<td>1.33±0.21</td>
<td>1.33±0.21</td>
<td>1.50±0.22</td>
<td>0.821**</td>
</tr>
<tr>
<td>Time for induction(sec)</td>
<td>36.00±2.39</td>
<td>31.16±1.70</td>
<td>34.33±1.66</td>
<td>0.237**</td>
</tr>
<tr>
<td>Quality of induction</td>
<td>0.50±0.22</td>
<td>0.33±0.21</td>
<td>0.50±0.22</td>
<td>0.821**</td>
</tr>
<tr>
<td>Intra-operative analgesia</td>
<td>0.33±0.21</td>
<td>0.33±0.21</td>
<td>0.50±0.22</td>
<td>0.821**</td>
</tr>
<tr>
<td>Depth of anaesthesia</td>
<td>2.66±0.21</td>
<td>2.83±0.16</td>
<td>2.16±0.16</td>
<td>0.052**</td>
</tr>
<tr>
<td>Time for recovery(min)</td>
<td>20.50±0.84a</td>
<td>25.50±1.11b</td>
<td>20.83±1.16a</td>
<td>0.007***</td>
</tr>
<tr>
<td>Quality of recovery</td>
<td>0.83±0.16abc</td>
<td>0.33±0.21a</td>
<td>1.50±0.22b</td>
<td>0.004***</td>
</tr>
</tbody>
</table>

*: P≤0.05, **: non-significant (NS) Values in the same row with different superscripts (small font) differ significantly

![Fig 1: Post operative analgesia in Group B, BD and N](image1.png)

![Fig 2: Heart rate in Group B, BD and N](image2.png)

![Fig 3: Rectal temperature in Group B, BD and N](image3.png)

![Fig 4: Respiration rate in Group B, BD and N](image4.png)
the duration and quality of analgesia through direct inhibition on the peripheral nerve endings, reserve of insulin secretion along with vasoconstriction caused by dexmedetomidine might delay the absorption of local anaesthetic and prolong the elimination period (Sampaio et al., 2020) [16]. There was no significant variation noticed among Group B, BD and N for depth of anaesthesia (Table 1). Animals in all the three groups showed no response to very slow and occasional palpebral reflex. Recovery time (Table 1) was significantly higher in Group BD than Group B and N. The longer recovery time in the animals of Group BD might be due to residual sedative action of dexmedetomidine. Similar findings were also reported by Nicacio et al. (2020) [14] after intraperitoneal administration of ropivacaine and dexmedetomidine in cats. The score for recovery quality (Table 1) was significantly higher in Group N followed by Group B and BD. In Group B and BD, all the animals exhibited a smooth-easy to uncomplicated recovery whereas the animals in Group N showed uncomplicated to difficult recovery. A significantly higher scoring observed in Group N might be due to more surgical stress or pain as compared to other two groups. Improved quality of recovery was also observed by Nicacio et al. (2020) [14] after intraperitoneal administration of ropivacaine and dexametomidine in cats.

The postoperative analgesia score differed significantly ($P<0.01$) among the groups at different observation period with a highest value in Group N and a lowest value in Group BD. Within the group, the mean postoperative analgesia score was lower at 0 min (after recovery) in all the groups followed by significant ($P<0.01$) increase at subsequent observation period with a highest value in Group N. The animals in Group BD exhibited a better postoperative analgesia as compared to Group B and Group N (Fig 1). Similar findings were also observed by Rapolu et al. (2016) [15] after intraperitoneal administration of bupivacaine and dexametomidine combination in human patients following laparoscopic cholecystectomy. The heart rate (Fig 2) increased non-significantly at 30 min followed by a non-significant decrease at 2 hrs and at 24 hrs in all the groups. At 2 hrs and 24 hrs of observation period the Group BD showed a slightly lower heart rate than Group B and N after intraperitoneal administration of drugs. Guerrero et al. (2016) [3] observed a decreased heart rate after intraperitoneal administration of bupivacaine in dogs and with bupivacaine and tramadol combination by Memis et al. (2005) [13]. The rectal temperature (Fig 3) decreased significantly at 30 min followed by significant increase at 2 hrs and 24 hrs interval in all the groups. The respiratory rate (Fig 4) decreased significantly at 30 min followed by significant increase at 2 hrs and 24 hrs. A slightly higher in respiratory rate was observed in Group N at 2 hrs and 24 hrs interval than the other two groups which might be indicative of more pain in Group N animals. The changes in the respiratory rate in the present study in support with the findings observed by Guerrero et al. (2016) [3]. The mean systolic pressure (Fig 5) decreased non-significantly at 30 min and thereafter increased non-significantly until the end of the observation period in Group B and BD but in Group N the subsequent increase in systolic pressure was significant. A slightly lower systolic pressure was observed after intraperitoneal administration in Group B and BD than Group N. A significantly lower blood pressure was observed by Guerrero et al. (2016) [3] following administration of bupivacaine intraperitoneally in dogs. Nicacio et al. (2020) [14] also noticed lower systolic pressure.

Results and Discussion

The mean body weight of the dogs included in the present study was 10.5±0.23 kg ranging from 9-12 kg and the mean age was 12.4±0.29 months ranging from 11-15 months. Dogs of different breeds and either sex were covered in this study. The sedation time and sedation quality (Table 1) recorded in all the three groups were similar and did not vary significantly. Mild sedation was observed in 4 animals in Group B, 5 animals in Group BD and 4 animals in Group N and rest of the animals showed moderate level of sedation. The induction was fast in all the groups and the induction time did not differ significantly among the groups. The faster induction might be due to the sedative effect of diazepam as a preanaesthetic. The level of sedation might reduce the induction time and anaesthetic dose as observed by Amengual et al. (2013) [2], Glowaski and Wetmore (1999) [4] and Ko et al. (2006) [8] also reported shorter induction time and reduction in induction dose of propofol after intravenous administration of diazepam as preanaesthetic in dogs. Induction quality (Table 1) did not differ significantly among all the three groups. All the animals in Group B, BD and N showed smooth transition with no paddling to intermittent slow paddling movements during induction. All the animals in Group B, BD and N showed no pain to mild pain and values did not show any statistically significant variation among the Group B, BD and N (Table 1). The lower pain response in all the groups might be due to the premedication with meloxicam and adequate anaesthetic depth during the surgical procedure. But in Group B and BD the lower intraoperative pain score was observed than the Group N. Local anaesthetics produces total sensory nerve fibres blockade and prevents central sensitization (Lemke and Dawson, 2000) [12]. The combination of local anaesthesia with α-2 adrenergic agonist like dexametomidine might enhance...
in cats after intraperitoneal administration of ropivacaine and
dexmedetomidine combination. Dexmedetomidine decreases
in mean arterial pressure due to stimulation of α-2A and α-2B
adrenergic receptors (Ahmad et al., 2013) [1]. The
intraperitoneal administration of bupivacaine might have lead
to stable haemodynamics owing to enhanced analgesia (Das
and Deshpande, 2017) [3]. The mean diastolic pressure (Fig 6)
decreased non-significantly at 30 min from baseline value and
thereafter increased slowly until the end of the study period in
all the groups. At 2 hrs and 24 hrs interval diastolic pressure
was found to be lowest in Group BD and highest in Group N.
Nicacio et al. (2020) [14] noticed lower diastolic pressure in
cats after intraperitoneal administration of ropivacaine and
dexmedetomidine combination.

Conclusion

Intraperitoneal infusion of bupivacaine and bupivacaine-
dexmedetomidine combination improved the intraoperative
and postoperative analgesia in dogs during laparotomy. The
clinical, cardiorespiratory changes following intraperitoneal
bupivacaine and bupivacaine-dexmedetomidine combination
in dogs were within physiological range. Better analgesia was
provided by bupivacaine-dexmedetomidine combination.

References

1. Ahmad RA, Kinjavedkar P, Amarpal, Aithal HP, Pawde
AM, Kumar R. Potential use of dexmedetomidine for
different levels of sedation, analgesia and anaesthesia in
2. Amengual M, Flaherty D, Auckburally A, Bell AM, Scott
EM, Pawson, P. An evaluation of anaesthetic induction in
healthy dogs using rapid intravenous injection of
propofol or alfaxalone. Veterinary anaesthesia and
3. Das NT, Deshpande C. Effects of intraperitoneal local
anaesthetics bupivacaine and ropivacaine versus placebo
on postoperative pain after laparoscopic cholecystectomy: a
randomised double blind study. Journal of clinical and
diagnostic research. 2017;11(7):8-12.
4. Glowaski MM, Wetmore LA. Propofol: application in
veterinary sedation and anaesthesia. Clinical Techniques
5. Guerrero KSK, Campagna I, Bruhl-Day R, Hegamin-
Younger C, Guerrero TG. Intraperitoneal bupivacaine
with or without incisional bupivacaine for postoperative
analgesia in dogs undergoing ovariohysterectomy.
Veterinary anaesthesia and analgesia. 2016;43(5):571-
578.
6. Hewson CJ, Dohoo IR, Lemke KA. Perioperative use of
analgesics in dogs and cats by canadian veterinarians in
359.
7. Jimenez CP, Mathis A, Mora SS, Brodbelt D, Alibhai H.
Evaluation of the quality of the recovery after
administration of propofol or alfaxalone for induction of
anaesthesia in dogs anaesthetized for magnetic resonance
imaging. Veterinary anaesthesia and analgesia.
SC. Sprayed intraperitoneal bupivacaine reduces early
postoperative pain behavior and biochemical stress
response after laparoscopic ovariohysterectomy in dogs.
Effects of intravenous dazepam or microdose
medetomidine on propofol-induced sedation in dogs.
10. Korkmaz M, Yilmaz O, Saritas ZK, Demirkan I,
Jaroszewski J. Evaluation of intraperitoneal and
incisional bupivacaine or levobupivacaine for
postoperative analgesia in ovariohysterectomized dogs.
11. Leibetseder EN, Mosing M, Jones RS. A comparison of
extradural and intravenous methadone on intraoperative
isoflurane and postoperative analgesia requirements in
dogs. Veterinary Anaesthesia and Analgesia.
12. Lemke KA, Dawson SD. Local and regional
anesthesia, Veterinary Clinics: Small Animal Practice.
tramadol and bupivacaine in total abdominal
hysterectomy. European journal of anaesthesiology.
JS, Cassu RN. Comparison of intraperitoneal ropivacaine
and ropivacaine–dexmedetomidine for postoperative
analgesia in cats undergoing ovariohysterectomy.
Veterinary anaesthesia and analgesia. 2020;47(3):396-
404.
15. Rapolu S, Kumar KA, Aasim SA. A comparative study
on intraperitoneal bupivacaine alone or with
dexmedetomidine for post-operative analgesia following
laparoscopic cholecystectomy. International Archives of
Dexmedetomidine and bupivacaine association in caudal
epidural injection in mares. Journal of Equine Veterinary
Science. 2020;91:103015.
17. Sams L, Braun C, Allman D, Hofmeister E. A
comparison of the effects of propofol and etomidate on
the induction of anaesthesia and on cardiopulmonary
parameters in dogs. Veterinary anaesthesia and analgesia.