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Variation in respiration rate following blind, peripheral nerve stimulator and ultrasound guided proximal paravertebral nerve block using 0.5% ropivacaine in calves

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Abstract
The primary aim of this study was to evaluate the effect of ropivacaine on respiratory rate by undertaking the proximal paravertebral regional block in calves. In this study twenty four calves were randomly distributed into four groups with six animals each based on different techniques - Groups A (anatomical land mark approach), B (peripheral nerve stimulator), C (ultrasound guidance) and D (ultrasound and peripheral nerve stimulator guidance). Respiration rate was monitored manually prior to procedure and thereafter at an interval of 1, 5, 10, 15, 30 minutes post-procedure and then on half hourly basis till 360 minutes. In all the groups, it was found that a significant increase in respiration rate was observed at 1 minute interval followed by a decrease in varying patterns until it became equal to the basal value by the end of observation. It was observed that ropivacaine 0.5% at the dose rate of 0.5 mg/ kg body weight had no significant effect on respiration rate in all the four groups. Therefore it was concluded that the selected dose of ropivacaine via proximal paravertebral block through all the four techniques was safe enough to prevent any untoward respiratory complications.

Keywords: Calves, paravertebral block, peripheral nerve stimulator, ropivacaine ultrasonography

Introduction
Paravertebral block is performed to anesthetize the surgical site for a flank laparotomy and is preferable to infiltration anesthetic techniques because of the smaller volume of anesthetic requirement and reduced postoperative swelling and hematoma (Rostami and Vesal, 2011) [17]. The paravertebral block provides anesthesia of the flank without respiratory depression, hypothermia or pelvic limb paralysis (Skarda and Tranquilli, 2007) [19] and provides effective analgesia in all layers of the abdominal wall unlike infiltration and inverted L block (Sloss and Dufty, 1977) [20]. Paravertebral anesthesia is utilized as an alternative to spinal anaesthesia which would minimize the cardiovascular and respiratory effects of central neuraxial block (Batra *et al.*, 2011) [2]. Paravertebral block is found to be an accurate, simple and safe method which carries significant advantages over intercostal or epidural block. Paravertebral block is superior to epidural block in terms of analgesia, pulmonary function, neuroendocrine stress response, side-effects and post-operative respiratory morbidity (Richardson *et al.*, 1999) [16].
The use of objective methods to locate the target nerves, such as nerve stimulation and ultrasound, has reduced the failure rates associated with many of the techniques previously performed blindly (Lewis *et al.*, 2015; Munirama and McLeod, 2015) [8, 11] and decreased the incidence of block-related complications such as inadvertent vascular puncture (Campoy *et al.*, 2010) [4]. Nerve stimulation allows the inference of nerve location based on the electrical current required to elicit an effector muscle response, while ultrasound allows real-time visualization of the nerve, the needle-to-nerve relationship and the injectate distribution, which overcome the limitations of nerve stimulation (Portela *et al.*, 2008) [14]. When the two modalities are used together, they act synergistically and best overall results can be obtained by utilizing the advantages offered by each, used together (Ralf *et al.*, 2008) [15].
Ropivacaine is a long-acting local anesthetic, which is considered suitable for regional anesthesia (Morton *et al.*, 1997; Sandler *et al.*, 1998) [10, 18]. Ropivacaine has lower central nervous system and cardiac toxicity, and a less frequent incidence of unintended motor block (differential block) during mobilization than bupivacaine (Macias *et al.*, 2002; Hansen, 2004) [9, 6] and thus may be a suitable choice for proximal paravertebral block. Respiration rate is

correlated to stress level and welfare (Fraser and Broom, 2007) [3]. The paravertebral anesthesia with amino-amide long acting local anesthesia like bupivacaine and ropivacaine is a simple and effective method of providing continuous pain relief and also produces a sustained improvement in respiratory parameters and oxygenation (Karmakar *et al.*, 2003) [7]. However limited information is available about efficacy and safety of ropivacaine and its effect in pulmonary ventilation following proximal paravertebral anesthesia in calves. The primary aim of this study was to evaluate the effect of ropivacaine on respiratory rate by undertaking the proximal paravertebral regional nerve block in calves.

Materials and Methods

The study was conducted at Division of Veterinary Surgery and Radiology, Faculty of Veterinary Sciences and Animal Husbandry, SKUAST-Kashmir / Mountain Livestock Research Institute (MLRI) Manasbal. Twenty four young calves irrespective of sex in the age group up to six months, with the mean weight (50±10 kg) were used for the study. The animals were housed under similar managemental conditions. On each calf two experimental procedures were performed with an interval of two weeks. The animals were randomly distributed among four groups with six animals each based on the different techniques - Group A (by anatomical land mark approach), Group B (by peripheral nerve stimulator), Group C (under ultrasound guidance) and Group D (under both ultrasound and peripheral nerve stimulator guidance). A peripheral nerve stimulator cum locator (Inmed ™) with shielded needles (5 cm and 20 gauge; 14 cm and 20 gauge) and an ultrasound system (TELEMED CAB) with a 5-10 MHz linear transducer were used for peripheral nerve stimulator and ultrasound guided proximal paravertebral nerve block in calves in lateral recumbency respectively. Respiration rate was monitored manually by counting chest movement of the animal and recorded prior to procedure and thereafter at an interval of 1, 5, 10, 15, 30 minutes post-procedure and then on half hourly basis till 360 minutes in all the groups. Data collected was subjected to statistical analysis following standard statistical procedures *viz.* analysis of variance (ANOVA) using statistical software (SAS), SAS Incorporation, USA, licensed to Division of Agricultural Statistics, SKUAST-Kashmir, Srinagar.

Results

The results of this study have been presented in table 1 and figure 1. In group A, the normal mean value of respiration rate prior to the nerve block was 20.33±0.67 breaths/minute. After the block, it significantly ($p < 0.05$) increased at 1 minute (25.17±0.31 breaths/minute), and then there was a non-significant ($p > 0.05$) change upto 360 minutes (19.17±0.31), where it was approximately comparable with the pre-injection respiration rate. Similarly in group B, the normal mean value of respiration rate prior to the nerve block was 21.50±0.62 breaths/minute. After the block, it significantly ($p < 0.05$) increased at 1 minute (25.83±0.40 breaths/minute), and then there was a significant ($p < 0.05$) decrease at 5 minutes (24.00±0.26 breaths/minute) and 15 minutes (21.83±0.31 breaths/minute), following which there was a non-significant ($p > 0.05$) decrease upto 240 minutes (20.17±0.17 breaths/minute). After that, there was again a significant decrease at 270 minutes (19.83±0.31 breaths/minute) subsequent to which there was a non-significant ($p > 0.05$) decrease upto 360 minutes (19.67±0.21 breaths/minute). In group C, the normal mean value of respiration rate before the nerve block was 22.67±0.61 breaths/minute. After the block, it significantly ($p < 0.05$) increased at 1 minute (26.83±0.48 breaths/minute), and then there was a significant ($p < 0.05$) decrease at 5 minutes (24.67±0.42 breaths/minute), 10 minutes (22.67±0.33 breaths/minute), and 15 minutes (21.17±0.60 breaths/minute), following which there was a non-significant ($p < 0.05$) change upto 360 minutes (19.83±0.40). However, in group D, the normal mean value of respiration rate before the nerve block was 24.17±0.31 breaths/minute. After the block, it significantly ($p < 0.05$) increased at 1 minute (28.00±0.36 breaths/minute), and then there was a significant decrease at 5 minutes (25.50±0.22 breaths/minute), 10 minutes (23.33±0.21 breaths/minute), and 15 minutes (21.67±0.21 breaths/minute), subsequent to which there was a non-significant ($p > 0.05$) change upto 360 minutes (20.50±0.22).

Table 1: The Mean ± SE of respiration rate in different groups at various intervals of Proximal paravertebral block in calves

	Groups			
Time	**A**	**B**	**C**	**D**
.00	20.33±0.68^{aABC}	21.50±0.63^{abCD}	22.67±0.65^{bcC}	24.17±0.32^{cD}
1.00	25.17±0.31^{aF}	25.83±0.41^{abF}	26.83±0.49^{bE}	28.00±0.37^{cF}
5.00	23.83±0.47^{aEF}	24.00±0.27^{aE}	24.67±0.43^{abD}	25.50±0.23^{bE}
10.00	23.00±0.27^{aDE}	23.00±0.27^{aE}	22.67±0.33^{aC}	23.33±0.21^{aD}
15.00	21.67±0.50^{aCD}	21.83±0.31^{aD}	21.17±0.60^{aB}	21.67±0.21^{aC}
30.00	21.00±0.45^{aBC}	21.33±0.49^{aBCD}	20.67±0.50^{aAB}	21.33±0.61^{aBC}
60.00	19.83±0.10^{aAB}	20.67±0.22^{aABCD}	20.17±0.69^{aAB}	21.17±0.31^{aBC}
90.00	20.17±0.66^{aABC}	20.67±0.43^{aABCD}	20.83±0.49^{aAB}	20.33±0.48^{aAB}
120.00	19.67±0.50^{aAB}	20.67±0.34^{aABCD}	19.67±0.44^{aAB}	20.50±0.64^{aABC}
150.00	20.17±0.42^{aABC}	20.33±049^{aABC}	19.50±0.33^{aA}	20.17±0.31^{aAB}
180.00	19.33±0.43^{aAB}	20.33±0.43^{abABC}	20.00±0.47^{abAB}	20.67±0.36^{cABC}
210.00	19.17±0.31^{aA}	20.33±0.21^{abABC}	20.00±0.58^{abAB}	20.50±0.34^{bABC}
240.00	19.33±0.57^{aAB}	20.17±0.17^{aB}	20.17±0.30^{aAB}	20.17±0.49^{aAB}
270.00	19.50±0.67^{aAB}	19.83±0.31^{aA}	19.67±0.34^{aAB}	21.33±0.34^{bBC}
300.00	19.50±0.60^{aAB}	19.67±0.51^{aA}	19.33±0.35^{aA}	20.50±0.35^{aABC}
330.00	19.00±0.37^{aA}	19.67±0.34^{aA}	19.33±0.43^{aA}	19.83±0.30^{aA}
360.00	19.17±0.31^{aA}	19.67±0.21^{abA}	19.83±0.41^{abAB}	20.50±0.23^{bABC}

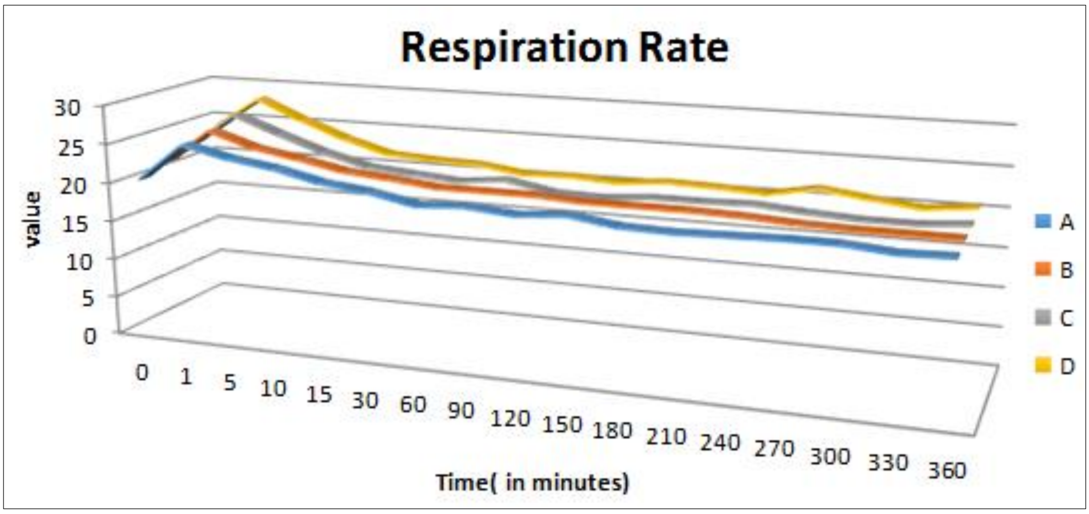

Fig 1: Showing variation of respiration rate in different groups at different observation intervals.

While comparing the effect on the respiration rate using all the techniques it was found that a significant ($p < 0.05$) increase in respiration rate was observed in all the groups subsequently after the procedure at 1 minute interval. At 5 minutes, the respiration rate showed a significantly ($p < 0.05$) decreasing pattern in all the groups except group A, where the decrease (23.83±0.47) was non-significant. Respiration rate in groups C and D further declined significantly ($p < 0.05$) at 10 minutes; however the decrease was non-significant (p>0.05) in groups A and B at the same time interval. At 15 minutes, all the groups except group A showed a significant ($p < 0.05$) decrease. Until 270 minutes, all the groups exhibited a declining trend, which further continued forward except in group B. In this group, there was a significant ($p < 0.05$) decline at 270 minutes (19.83±0.31). Thereafter, a non-significant (p>0.05) decline was observed in all the groups until the last hour of observation.

Discussion

In all the groups, there was an increase soon after the injection at 1 minute post-procedure and this may be due to stress in the animal due to restraint and pin pricks. The results are in accordance with the results of Chepte *et al.*, (2019) [5] who used 0.5% ropivacaine for proximal paravertebral block in cattle and reported that respiration rate was within normal physiological range at all times during the study and thus show no clinical significance. Oliveira *et al.* (2016) also reported that there was no significant change in respiration rate in ewes while comparing of ropivacaine with lidocaine and levobupivacaine for distal paravertebral thoracolumbar anesthesia. The findings of the current study were also in consonance with Olaifa *et al.*, (2009) [12] who reported that the respiratory rate rose but not significantly in the immediate post-administration period and returned to within normal limits in west African dwarf goats undergoing distal paravertebral nerve block using lignocaine hydrochloride. However the findings of the current study were not in agreement with the reports of Aksoy *et al.*, (2012), who reported that there was a drop in respiration rates prior to subarachnoid anaesthesia at certain times during the anaesthesia. This could be possibly due to route of administration used or due to the combination of detomidine and ropivacaine

Conclusion

From the above study it can be concluded that ropivacaine 0.5% at the dose rate of 0.5 mg/ kg body weight has no significant effect on respiration rate in all the four groups. No signs of abnormal breathing or any respiratory distress were encountered during the study. Therefore it can be concluded that the selected dose of ropivacaine via proximal paravertebral block was safe enough to prevent any untoward respiratory complications and the techniques used in our study did not alter the respiratory rate upto a significant value and this advocates the accuracy and safety of the techniques used. Thus the results of the current study can be used for formulation of accurate, precise and efficient anaesthetic plan for patients having respiratory ailments.

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