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Transversus Abdominis plane block to manage post operative pain in canine mastectomy#

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Abstract

The aim of this study was to assess effectiveness of transversus abdominis plane block as part of a multimodal anaesthetic protocol in controlling perioperative nociception/ pain in dogs that underwent mammary tumour excision. The study included twelve dogs belonging to different breeds and ages. The dogs were classified according to the American Society of Anaesthetists (ASA) classification of physical status, based on their pre-anaesthetic evaluations and were divided into two groups: I and II, each with six dogs. Dogs in both groups received dexmedetomidine for premedication and diazepam-propofol for induction. Group I dogs were subjected to Transversus abdominis plane (TAP) block and Group II dogs were given butorphanol. Pain score was assessed using the Glasgow Composite Measure Pain Scale (GCMPS-SF) at one hour post-operatively. The pain score was significantly lower in Group I. None of the dogs in Group I required rescue analgesia. TAP block proved beneficial in mitigating nociception and postoperative pain in dogs undergoing mammary tumour excision.

Keywords: Mammary tumour resection, *TAP block, post-operative pain*.

Mammary tumours are among the most common malignancies in dogs and surgery is the gold standard treatment (Lavalle *et al*., 2012). Dogs have a mammary chain with five glands and in most cases, tumours affect more than one gland. Surgical removal of one or more affected mammary glands is reported to cause moderate to severe pain as it involves an extensive area of skin, subcutaneous tissue, mammary glands and muscles, necessitating comprehensive pain management strategies. Multimodal analgesia was recommended in dogs, to control postoperative pain control after mastectomy (Minto *et al*., 2013). Multimodal analgesia involves employing multiple drugs with different mechanisms of action to affect pain transmission, modulation and perception (Corletto, 2007).

Locoregional anaesthesia completely inhibits the transmission of nociceptive impulses and provides enough analgesia for high-risk patients, generally allowing for a reduction in opioid and general anaesthetic requirements for appropriate surgical plane of anaesthesia (Lemke and Dawson, 2000). Transversus abdominis plane (TAP) block is a popular technique for locoregional anaesthesia in veterinary practice. This block is being used in obstetric surgeries

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with moderate/high pain, such as canine ovariectomy, ovariohysterectomy and mastectomy. The abdominal wall, peritoneum and abdominal mammary glands in dogs are innervated by nerves from the lateral branches of T11 to L3, which can be adequately blocked by TAP block as detailed by Hebbard (2008). TAP block provides analgesia to the ventral and lateral abdominal walls, including the skin, abdominal subcutaneous tissue, abdominal muscles, mammary glands and parietal peritoneum (Baldo *et al*., 2018).

The effectiveness of the TAP block was evaluated with GCMPS-SF. The GCMPS-SF was designed for routine clinical use and includes six behavioural categories with accompanying descriptions: vocalization, attention to wound, mobility, responsiveness to touch, attitude and posture/activity. It takes the form of a structured questionnaire completed by an observer following a standard protocol which includes assessment of spontaneous and evoked behaviours, interactions with the dog and clinical observations (Reid *et al*., 2007).

Materials and methods

The study was conducted in twelve dogs belonging to different breeds presented for mammary tumour resection. All the dogs were subjected to thorough pre-anaesthetic evaluation prior to surgery. Physiological examination, complete blood count, serum biochemical profile and thoracic radiography were performed in all dogs prior to surgery. Based on ASA classification, those dogs which were healthy enough to undergo surgery were selected for the study. The selected dogs were divided into two groups *viz*., I and II with six dogs each. All the dogs received inj. dexmedetomidine intramuscularly, at the dose rate of 2.0 µg per kg body weight as premedication. The surgical site of all dogs along with lateral abdomen of Group I dogs were prepared for surgery. After sedation, anaesthesia was induced by administration of inj. diazepam at the dose rate of 0.25 mg per kg body weight intravenously immediately followed by inj. propofol to effect intravenously. TAP block was performed without any delay.

A linear ultrasound transducer (Esaote MyLabX8 exp) was positioned perpendicular to the long axis of the body. After identification of the three muscles (Fig. 1) layers (obliquus externus abdominis, obliquus internus abdominis, and transversus abdominis) and peritoneum, a 22-gauge spinal needle was introduced "in-plane" in a dorsoventral direction until it reached the inter-fascial plane. Bupivacaine (0.25%) at a dose rate of 0.5 mg per kg body weight, made to a volume of 0.3 mL per kg body weight with normal saline was deposited in the TAP (Fig. 2) at two points, one cranial to the wing of ilium and the other caudal to the last rib. Six dogs in Group II were administered with inj. butorphanol at the dose rate of 0.2 mg/kg body weight intravenously. General anaesthesia was maintained with isoflurane using semi-closed system for all dogs in 100 per cent oxygen at a flow rate of 100 mL/kg.

Continuous monitoring of vital signs, reflexes, SpO_2, $EtCO_2$ and temperature was done. All the dogs were subjected to close monitoring of all the vital signs, rectal temperature, reflexes and blood pressure every five

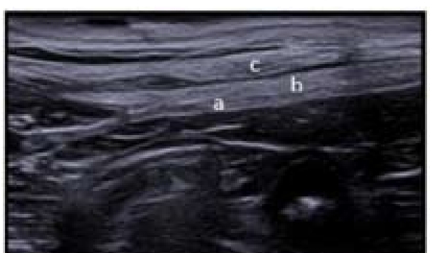

Fig.1: a. transversus abdominis b. internal obliques c. external obliques

Fig. 2: a. drug infiltration between transversus abdominis and internal obliques

Table 1: Mean ± SE values of rate of respiration, heart rate and temperature at different time interval.

Parameters	Group	Before anaesthesia	20 minutes of anaesthesia	40 minutes of anaesthesia	End od of anaesthesia	After recovery
Rate of respiration (per minute)	I	18.33 ± 1.87^{a}	13.0 ± 3.48^{abcA}	10.16 ± 3.40^{bA}	12.0 ± 2.28^{cbA}	14.0 ± 1.97^{ab}
	II	19.67 ± 1.87^{a}	24.0 ± 3.48^{abcB}	26.50 ± 3.40^{bB}	22.33±2.28^{abcB}	19.33 ± 1.97^{c}
Heart rate (per minute)	I	118.33 ± 5.63^{a}	106.83±8.08^{ab}	103 ± 9.76^{ab}	100.8 ± 6.71^{b}	112.3 ± 5.93^{ab}
	II	109.3 ± 5.63^{ab}	103 ± 8.08^{a}	117.8 ± 9.76^{b}	113.1 ± 6.7^{ab}	109.8 ± 5.93^{ab}
Temperature (°C)	I	38.88 ± 0.254^{a}	38.033±0.269^{b}	37.317±0.375^{c}	37.07^{d} ± 0.32	37.98 ± 0.24^{eb}
	II	19.67 ± 1.87^{a}	24.0 ± 3.48^{abcB}	26.50 ± 3.40^{bB}	22.33±2.28^{abcB}	19.33 ± 1.97^{c}

Means having different superscripts (small letters a-d within a row, capital letters A-B within columns) differ significantly at 5% level.

Table 2: Mean ± SE values SpO_2, $EtCO_2$ and perfusion index at different time interval.

Parameters	Group	Beginning of general anaesthesia	20 minutes of anaesthesia	40 minutes of anaesthesia	60 minutes of anaesthesia
SpO_2	I	99.17 ± 0.70	98.33 ± 0.88	98.50 ± 0.74	99.17 ± 0.42
	II	98.83 ± 0.70	98.67 ± 0.88	98.50 ± 0.74	99.50 ± 0.42
$EtCO_2$	I	28.33 ± 1.78	30.50 ± 2.37	28.33 ± 2.77	29.67 ± 2.37
	II	27.50 ± 1.78	30.33 ± 2.37	28.33 ± 2.77	29.33 ± 2.37
Perfusion index	I	1.25 ± 0.23	0.92 ± 0.19	0.88 ± 0.15	0.92 ± 0.16
	II	1.30 ± 0.23	1.07 ± 0.19	0.75 ± 0.15	0.82 ± 0.16

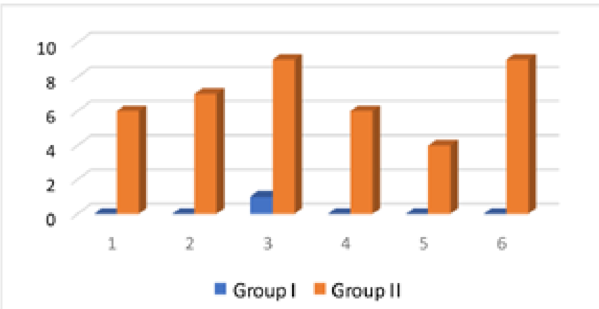

Fig. 3. Showing comparison of pain score

minutes during maintenance of anaesthesia. Pain score was recorded as suggested by Reid *et al*. (2007), at one-hour post-surgery by using Glasgow composite measure pain scale (GCMPS-SF).

Results and discussion

The age of selected dogs ranged from four to ten years, with the dogs in Group I having an average age of 7.8 ± 0.95 years and the dogs in Group II having an average age of 8.7± 0.46 years. Induction of anaesthesia was good in all the dogs of both the Groups as indicated by relaxed jaw muscles and absence of struggling or resistance during the intubation process. It might be due to coinduction of diazepam and propofol (Suresha *et al*., 2012).

Rate of respiration was significantly increased in Group II throughout the procedure but the values were within the normal limit. In Group I the heart rate was found to be stable during the entire period of anaesthesia (Table 1). Five dogs from Group II showed tachycardia during skin incision and tissue dissection. In both groups, the temperature was significantly decreased during maintenance of anaesthesia (Table 1). Due to activation of alpha-2c receptors by dexmedetomidine, there was cold-induced peripheral vasoconstriction leading to hypothermia (Lemke, 2007). According to Mich and Hellyer (2008), heart rate, respiration rate, temperature, arterial pressure and mydriasis are physiological indicators utilized in the assessment of acute pain. These values increased in response to painful stimuli. Therefore, the higher rate of respiration and heart rate might be a sign of nociception during surgery in the case of Group II dogs.

The SpO_2 values and perfusion index were within the normal limit during the entire period of observation in both Groups (Table 2). Capillary refill time was less than two seconds in both groups. The values of $EtCO_2$ were found to be below the normal range in both groups during the entire procedure and no significant differences were observed between the groups (Table 2). The total duration of anaesthesia in Group I was 78.83 ± 8.42 minutes and for Group II it was 87 ± 4.99 minutes.

The mean time for recovery after disconnecting isoflurane in Group I was 6.67 ± 1.63 minutes and in Group II, it was 9.67 ± 2.64 minutes. Though the recovery time was faster in Group I compared to Group II; it was statistically not significant. Compared to general anaesthesia, nerve block anaesthesia with a long-acting local anaesthetic facilitated faster recovery, fewer side effects, better analgesia and higher patient acceptance (Hadzic *et al*., 2005). In Group I, the faster recovery might be due to multimodal anaesthetic protocol with TAP block which was in accordance with Grubb *et al*. (2020) who stated that with local anaesthetic nerve blocks inhalant dosages reduced intraoperatively and opioid dosages reduced both during and after surgery, which promoted a faster recovery from anaesthesia. Nociception, indicated by sudden increase in respiration rate and heart rate associated with skin incision and tissue dissection was observed in dog numbers II_1, II_3, II_4 and II_6. Dog number II_4 showed nociception while skin suturing. Dog number II_5 showed nociception while lymph node removal and during blood vessel ligation. None of the dogs in Group I displayed any signs of nociception. According to Weinstein *et al*. (2018), local anaesthetics totally obstructed nociceptive transduction and transmission and thereby prevented peripheral and central sensitization and thus controlled post operative pain.

One hour after recovery from the general anaesthesia, the recorded pain score was significantly lower ($p<0.01$) in Group I when compared to Group II. Pain score was zero in five dogs and one in one dog for Group I animals. For Group II animals, the pain score was four in one dog, six in two dogs, seven in one dog and nine in two dogs (Fig. 3). It indicated that five dogs in Group II needed rescue analgesia. None of the dogs from Group I needed rescue analgesia. The results of this study showed that TAP block as part of multimodal anaesthesia in dogs undergoing mammary tumour excision, could be linked to decreased post-operative pain. The most likely reason for this observation seems to be a desensitization of the abdominal skin and muscles (Schroeder *et al*., 2011). This was also in accordance with

Cavaco *et al*. (2022) and Campoy *et al*. (2022). A study was conducted by Teixeira (2018) to evaluate the efficacy of TAP block and Serratus plane block in four dogs undergoing unilateral radical mastectomy. No dog needed intraoperative rescue analgesia throughout the procedure. Following surgery, all four dogs showed 0 pain scores, indicating the effectiveness of the protocol. Similar findings were observed in the present study.

According to Champaneria *et al*. (2013), the TAP block reduces pain levels for 24 hours following surgery, both while at rest and during activity. The current study demonstrated that dogs with TAP block had lower postoperative pain levels and requirement of post-operative analgesics than those without TAP block. Similar results were observed in other trials employing TAP to conduct ovariectomy (Campoy *et al*., 2022; Cavaco *et al*., 2022). The two-point TAP injection has previously been shown to reach branches of nerves T13 to L3 (Johnson *et al*., 2018) and has been used successfully for canine ovariohysterectomy (Santos *et al*., 2018) and canine mastectomy (Portela *et al*., 2014). Bupivacaine has been proven to offer analgesia for TAP in dogs undergoing ovariectomy two hours after extubation (Cavaco *et al*., 2022) or mastectomy two to four hours after surgery (Teixeira *et al*., 2018).

Conclusion

This study concluded that the transverse abdominis plane block was found to be effective for control of both intra-operative nociception and post-operative pain associated with mastectomy in dogs.

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Conflict of interest

The authors declare that they have no conflict of interest.

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