SHORT COMMUNICATION

Comparison of the Analgesic Efficacy of Bupivacaine via Wound Catheter with Transdermal Lidocaine Patch for Post-Operative Pain Management in Dogs

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Abstract

Pain management is critical in veterinary care as inadequate relief can lead to stress, immunosuppression, delayed healing and maladaptive behaviours. Local anaesthetics like bupivacaine and lidocaine play key roles by blocking sodium channels to prevent pain transmission. Advanced methods, including wound soaker catheters and transdermal patches, provide site-specific, prolonged pain relief. This study, conducted from May to October 2024, assessed postoperative pain in 12 dogs undergoing tumour excision, amputation and wound repair. Dogs were divided into two groups: group I (n=6) received 0.5% bupivacaine infiltration every 10-12 h, while group II (n=6) received 5% lidocaine transdermal patches applied every 24 h. The pain was assessed using the short form of the Glasgow composite measure pain scale (SF-GCMPS), alongside monitoring hormonal parameter. Results showed that bupivacaine experienced significantly lower pain scores compared to Group lidocaine, particularly during the early postoperative period. The lidocaine group consistently demonstrated higher pain scores. Cortisol levels increased significantly in both groups post-recovery, with the bupivacaine group maintaining the lowest levels at 24 and 48 h postoperatively. The study concluded that bupivacaine infiltration provided superior pain relief and improved recovery compared to lidocaine patch.

Key words: Bupivacaine, Post-operative pain management, Transdermal lidocaine patch, Wound catheter.

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Introduction

Pain perception involves complex interactions between nociceptive stimuli, neurotransmitters and neural pathways, ultimately processed in the central nervous system (CNS), particularly the brain (Woolf, 2011). Understanding these mechanisms is critical for developing effective pain management strategies. Local anaesthetics, unlike opioids that modulate pain at the CNS level, block sodium channels in nerves to prevent pain transmission. This mechanism provides superior pain control compared to opioids, with lower pain scores observed in dogs receiving local blocks post-surgery (Grubb and Lobprise, 2020). Wound soaker catheters, small flexible tubes inserted into wounds, allow continuous or bolus administration of local anaesthetics, effectively blocking somatic sensation in incision sites. This method is safe, cost-effective and widely used in veterinary medicine (Sarvas *et al*., 2008; Abelson *et al*., 2009). Transdermal drug delivery, a non-invasive technique, ensures controlled drug absorption and uniform plasma concentrations, offering advantages over oral or parenteral routes (Singh *et al*., 2023). Bupivacaine, known for its prolonged duration of action and sensory-specific effects, reduces the need for systemic opioids, promoting faster recovery (Errol *et al*., 2009). Lidocaine, with its rapid onset and intermediate duration, delivers effective analgesia through transdermal patches with minimal systemic absorption (Weiland *et al*., 2006; Ko *et al*., 2007). The present study was planned to compare the efficacy of transdermal lidocaine patches and incisional bupivacaine for managing postoperative pain in dogs and to evaluate behavioural, clinical, haemato-biochemical and hormonal changes following analgesic administration.

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Materials and Methods

The present work was carried out in the Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Mhow (MP, India). Total twelve clinical cases of dogs, operated for different surgery like tumour excision, amputation and deep lacerated wound, were selected for the present study. All the animals were randomly divided into 2 groups and each group had 6 animals. All the animals were selected irrespective of age, sex and breed. The patch and the delivery of the drug through the fenestrated polyurethane tube after the removal of tumour, amputation and wound repair provided the analgesic effect for the desired period for the betterment of animal health. All the dogs were anaesthetized by using combination of inj. Atropine sulphate @ 0.02 mg/kg b.wt., inj. Xylazine hydrochloride @ 1 mg/kg b. wt. and inj. Ketamine @ 5 mg/kg b. wt. for surgery. To manage postoperative pain, in group I, 0.5% Bupivacaine @ 1 mg/kg b.wt. diluted @ a ratio of 1:1 with sterile saline was infiltrated at the wound site using a fenestrated tube after surgery every 10-12 h for up to 3 postoperative days. In group II, 5% Lidocaine patch containing 700 mg in an aqueous base (50 mg/g adhesive) was applied around the incision after surgery every 24 h for up to 3 postoperative days. For Preparation of tube, wound catheter was prepared by using a polyurethane tube and was fenestrated using 11 No. BP blade. After removal of tumour, amputation and wound repair, the tube was placed into the subcutaneous tissue or fascia before skin closure and the fixation of the tube outside the end of skin was accomplished using a Chinese finger snare suture for the delivery of a drug. For the application of patch, an area of 2 to 3 inches around the proposed incisional site was clipped, cleaned with water and dried to prepare it aseptically. The patch was pressed firmly approximately 1-2 inches on either side of incision and was protected by paper tape.

Parameters Studied

Behavioural parameters: Pain assessment was done by using short form of the Glasgow composite measure pain scale (SF-GCMPS). The pain score was recorded preoperatively (1 h before surgery), 1 h after complete recovery, 24 and 48 h postoperatively. A number 0 to 5 was assigned for different behavioural parameters to ascertain the level of pain in all the groups. It includes 30 descriptor options within six behavioural categories (Reid *et al*., 2007).

Hormonal parameter: One mL of blood was collected preoperatively (1 h before surgery), 1 h after complete recovery, 24 and 48 h postoperatively in vacutainer serum tubes for hormonal parameter. Cortisol hormone estimation of serum sample was carried out by a commercially available standard ELISA kit (Canine Cortisol, Bioassay Technology Laboratory Kit) and values were expressed in ng/mL.

Statistical analysis

The data was analyzed by using a Completely Randomized Design at the different time intervals under each group, as per the standard procedure outlined by Snedecor and Cochran (1994).

Results and Discussion

All the dogs of both groups were subjected to different types of elective and emergency major surgical interventions. The time required for different types of surgical procedure were approximately 50 to 80 min in both the groups. There was not much difference between the groups in respect to the duration of surgery. All the surgical procedures were successful without any anaesthetic complications and all the animals were recovered smoothly.

There was a significantly higher pain score in lidocaine group compared to bupivacaine group throughout the entire post-treatment observation period (Table 1). At 1 h after complete recovery, the pain score in group lidocaine was notably higher (2.31±0.24) than in group bupivacaine (1.13±0.22). Additionally, at 24 h, group bupivacaine had a significantly lower score (0.50±0.10) than group lidocaine (2.17±0.21). By 48 h, the lidocaine group pain score remained significantly ($p \leq 0.05$) higher (1.20±0.18) when compared to group bupivacaine (0.13±0.05). Effective prevention and management of postoperative pain have become essential components in the surgical care of veterinary patients. Trauma induces subtle but significant changes in the central nervous system (CNS) and inadequate pain control can amplify pain perception, prolonging the pain state (Okafor *et al*., 2014). In the present study, pain score was observed minimum in wound irrigation with the bupivacaine group and maximum in the transdermal lidocaine patch throughout the study period.

In this technique, bupivacaine distributed precisely to exposed nerve endings and pain receptors in surgical field preventing transmission and propagation of impulses leading to motor/sensory blockade and superior analgesia. Bupivacaine has 8-10 h duration of action, hence repeated

Table 1: Mean values (±SE) of behavioural and hormonal parameters of dogs after administration of different drugs at different time intervals

Parameters	Groups	1 h before surgery	Time after complete recovery			
			1 h	24 h	48 h	72 h
Pain score	I	0.13^{Aa}±0.07	1.13^{Ab}±0.22	0.50^{Aab}±0.10	0.13^{Aa}±0.05	--
	II	0.62^{Aa}±0.17	2.31^{Bb}±0.24	2.17^{Bb}±0.21	1.20^{Bc}±0.18	--
Cortisol (ng/mL)	I	90.71^{Aa}±16.32	202.65^{Ab}±67.60	53.13^{Aa}±6.59	80.25^{Aa}±9.24	80.40^{Aa}±11.86
	II	92.72^{Aa}±13.16	128.77^{Bb}±13.08	155.06^{Bb}±36.94	181.33^{Bb}±39.82	134.95^{Ab}±15.27

Gp=I, 0.5% bupivacaine infiltration, Gr=II, 5% lidocaine transdermal patches. Means bearing different superscripts within the row (a, b) and within column (A, B) differ significantly ($p \leq 0.05$).

every 10-12 h after surgery. Further, bupivacaine is 4 times more potent than lidocaine (Roy, 2003). Merema *et al*. (2017) stated that lidocaine patches deliver the drug transdermally, but systemic absorption is minimal in dogs. This limits the ability of lidocaine to reach deep tissues or surgical wound sites effectively. Additionally, the serum levels achieved by transdermal delivery are low, limiting its efficacy in modulating pain associated with surgical trauma. Further, transdermal lidocaine may reduce neuropathic pain but is not highly effective for acute, traumatic or postoperative pain.

Both groups exhibited significantly higher pain scores post recovery compared to their preoperative scores, indicating the presence of substantial pain following the surgical procedure. Surgical tissue manipulation leads to a pronounced increase in nociceptor response (Beckman, 2006) which may account for the elevated pain scores observed immediately after surgery. As the effects of anaesthesia diminish during the recovery period, animals display more pronounced signs of pain once they reach full post-recovery. The transdermal lidocaine patch is generally safe and well tolerated to use on dogs with no systemic toxic effects, but skin irritation was evident in some dogs (Weil *et al*., 2007). On the other hand, the infiltration of bupivacaine into the surgical wound before the closure of the skin is technically very simple and effective for complete analgesia. This method is utilized to manage postoperative pain effectively. It has been demonstrated to lower pain scores, reduce the need for additional pain relief medications, extend the time before patients request analgesia for the first time and shorten the length of hospital stays (Read, 2013).

There was a significant ($p \leq 0.05$) difference in the cortisol level 1 h after complete recovery period with highest level of 202.65±67.60 ng/mL in bupivacaine group compared to lidocaine group with values of 128.77±13.08 ng/mL. Bupivacaine group showed significantly ($p \leq 0.05$) lower cortisol levels at 24 and 48 h in comparison to group lidocaine. At 72 h cortisol value was minimum in group bupivacaine than group lidocaine as depicted in Table 1. The increased serum cortisol levels observed post surgery in all groups likely result from nociceptive stimuli and surgical trauma. These factors trigger the release of cytokines, such as interleukin 1 and interleukin 6, into the bloodstream. This process activates both the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system. Activation of the hypothalamus and pituitary gland leads to the release of adrenocorticotropic hormone (ACTH), while stimulation of the sympathetic nervous system prompts the release of cortisol (Hernandez *et al*., 2021). Further, local infiltration of bupivacaine and lidocaine patch was used after the completion of skin suture which contributes an increased level of cortisol at post recovery. Throughout the study period, the bupivacaine group showed the least rise in serum cortisol than lidocaine group, suggesting a differential nociceptive response to these drugs in managing noxious stimuli. The significant rise in the cortisol values at 1 h after complete recovery in group bupivacaine in comparison to other group might be due to intraoperative extensive surgical field experienced by all animals in this group. The cortisol level in the bupivacaine group was reported lowest because spraying the bupivacaine would uniformly cover the wider area where noxious stimuli occur thereby providing effective analgesia at the surgical site, which can mitigate the stress response associated with surgery (Kim *et al*., 2012). The low cortisol level in the bupivacaine group might be correlated with less postoperative pain in these dogs in comparison to animals of the lidocaine group.

It is concluded that the intermittent local infiltration of bupivacaine is found to be better than lidocaine patch to manage the post operative pain management. Pain score and serum cortisol level were lesser in bupivacaine and maximum in lidocaine group.

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Announcement - II
BEST PAPER AWARDS: SVSBT-2025

Applications in the prescribed format are invited from the **Life Members** of the Society for the **SVSBT Awards - 2025** for the **Best Research Papers (I & II) and the Best Clinical Case Report (I) published in IJVSBT 2024 (January to December), Vol. 20, Issue Nos. 1 to 6**. The awards will be honoured to the deserving scientists during the inaugural ceremony of ***XII Annual Convention*** and ***International Conference of SVSBT on "Bridging Science and Society: Biotechnology for Sustainable One Health"*** to be held **during December 3-5, 2025** at College of Veterinary Sciences, LUVAS, **Hisar-125 004**, Haryana, India.

The interested LMs can apply in the prescribed format (can be had from the President/Secretary, Whataspp: 9898262498). The application must be submitted with 2 copies of reprints of article on or before **1st October, 2025** in person or by speed post/courier to **Dr. A.J. Dhami, President, SVSBT, 48, Mangal Nagar, Vidya Dairy Road, Near Borsal Crossing, Anand-388 001, Gujarat**. It is **mandatory that all authors of the paper under contest should be life members of the Society**. Applications received after the due date will not be entertained.