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RESEARCH ARTICLE

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Comparative evaluation of postoperative pain in dogs undergoing ovariohysterectomy after continuous rate infusion of lignocaine alone, and in combination with dexmedetomidine

Dheeraj Yadav[1]*, Sandeep Potliya[2], Neeraj Arora[3] and Deepak Kumar Tiwari[3]

Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar-125 001 (Haryana)

[1]MVSc Scholar, [3]Assistant Professor, Department of Veterinary Surgery and Radiology, College of Veterinary Sciences, Hisar; [2]Scientist, HPVK, Karnal, Haryana

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The present study aimed to compare the postoperative analgesic effects of lignocaine alone and in combination with dexmedetomidine in 18 female dogs undergoing ovariohysterectomy. The animals were randomly divided into three groups (n=6 each). Premedication was done using atropine sulphate followed by midazolam, and anaesthesia was induced and maintained with 1% propofol in all animals. In the control group (O), a normal saline infusion was maintained. In group L, a loading dose of lignocaine followed by continuous rate infusion (CRI) was administered, whereas in group LD, a loading dose of lignocaine combined with dexmedetomidine followed by their CRI was given throughout the surgery. Pain assessment was performed using the UMPS and GCMPS-SF pain scales. The results indicated that intraoperative administration of lignocaine, both alone and in combination with dexmedetomidine, significantly reduced postoperative pain in dogs undergoing ovariohysterectomy, with a greater analgesic effect observed when lignocaine was combined with dexmedetomidine.

Keywords: Continuous rate infusion, Dexmedetomidine, Dog, Lignocaine, Ovariohysterectomy, Postoperative pain

Ovariohysterectomy is a commonly performed elective surgical procedure in small animals and is frequently used as a model for perioperative analgesic studies. Effective pain management facilitates faster recovery and an earlier return to normal function. Prolonged stimulation of C-afferent fibers during surgical procedures induces an enhanced processing state characterized by expanded receptive fields and increased responsiveness to afferent stimuli, commonly referred to as "wind-up" (Staud, 2002). This phenomenon can result in secondary hyperalgesia, a significant contributor to postoperative pain.

Propofol is widely used for induction and maintenance of anaesthesia due to its rapid onset and smooth recovery; however, it provides minimal analgesic effects. Therefore, to achieve effective postoperative analgesia, a multimodal approach, combining analgesics with different mechanisms of action, is recommended, as it minimizes side effects while ensuring safe and effective pain management (Warren *et al.*, 2013). Lignocaine and dexmedetomidine are analgesic agents with distinct mechanisms of action. Dexmedetomidine produces analgesia by inhibiting the release of neurotransmitters from C-fibers and by hyperpolarizing postsynaptic neurons in the dorsal horn, whereas lignocaine exerts its effect by blocking sodium channels (Kanazi *et al*., 2006; Ghanem *et al*., 2009). Continuous rate infusion (CRI) of lignocaine and dexmedetomidine has been used in dogs, and combinations such as dexmedetomidine-midazolam-lignocaine-ketamine CRI have been reported to provide effective anaesthesia in dogs undergoing soft tissue and orthopaedic surgeries (Verma *et al.*, 2020).

Pain evaluation is essential for ensuring animal welfare and is assessed using various standardized scales. The University of Melbourne Pain Scale (UMPS), based on behavioural responses, is widely used to quantify postoperative pain in animals and is considered more reliable than the Numerical Rating Scale (Firth and Haldane, 1999). The short form of the Glasgow Composite Measure Pain Scale (GCMPS-SF) is also commonly used in clinical and research settings due to its practicality, speed, and validated assessment of acute pain in dogs (Testa *et al*., 2021).

Therefore, the present study was undertaken to compare the effects of continuous rate infusion of lignocaine alone and in combination with dexmedetomidine during propofol anaesthesia on postoperative pain in healthy dogs undergoing ovariohysterectomy.

Materials and Methods

The present study was conducted on 18 clinical cases of female dogs presented for elective ovariohysterectomy. Food and water were withheld for 10 hr prior to surgery. The animals were randomly allocated into different groups. All dogs were premedicated with atropine sulphate (0.02 mg/kg, i.m.) followed by midazolam (0.3 mg/kg, i.v.). In group L, a loading dose of 2% lignocaine (2 mg/kg, i.v.) was administered, followed by CRI (100 µg/kg/min). In group LD, a loading dose of 2% lignocaine (2 mg/kg, i.v.) combined with dexmedetomidine (2 µg/kg, i.v.

+Corresponding author; E-mail: dheerajluvas@gmail.com

bolus) was administered, followed by CRI of lignocaine (100 µg/kg/min) and dexmedetomidine (2 µg/kg/hr) throughout surgery. Ten minutes after the loading dose, anaesthesia was induced using 1% propofol (4-6 mg/kg, i.v., to effect) and maintained with its CRI.

In the control group, normal saline was infused at the same rate during surgery, and meloxicam was administered intramuscularly postoperatively as a pre-emptive analgesic. For CRI preparation, lignocaine (2%) and dexmedetomidine (100 µg/mL) were diluted in 0.9% NaCl. The desired infusion rates were maintained using an IV flow regulator (La-med Healthcare), while propofol CRI was administered via a syringe infusion pump.

Postoperative pain was evaluated using the UMPS and the CMPS-SF scoring systems after recovery from surgical anaesthesia. Recovery was confirmed by the return of the pedal reflex in the forelimb, assessed by applying moderate pressure with the thumb and index finger to the interdigital web for 30 seconds and observing the animal's response.

The UMPS assesses pain based on six parameters: physiological variables, response to palpation, activity, mental status, posture, and vocalization. Each parameter is divided into graded levels with corresponding numerical scores; for example, vocalization is scored from 0 to 3 depending on its severity. The maximum total score is 27 (Firth and Haldane, 1999). The Glasgow Composite Measure Pain Scale (CMPS) is a validated psychometric tool for assessing acute pain in dogs (Holton *et al.*, 1998). Its short version (CMPS-SF), developed for routine clinical use, evaluates six behavioural categories: vocalization, attention to the wound, mobility, response to touch, demeanor, and posture/activity (Reid *et al.*, 2007). Pain scores were recorded following recovery from surgical anaesthesia at 0 (immediately after recovery), 1, 2, 4, 8, 12, 18, and 24 hr, as presented in table 1 and figure 1.

The data were analyzed using SPSS version 23 using appropriate statistical tests. All values were expressed as mean±SE, and a P-value of <0.05 was considered statistically significant. Additionally, correlation analysis was performed to assess the relationship between the two pain scoring methods.

Results and Discussion

In group O, pain scores showed a non-significant decrease at 0.5 hr post-recovery (5.33±0.33), followed by a gradual, non-significant increase up to 8 hr, and a significant rise thereafter until 24 hr (11.83±0.60) compared to the recovery value (6.50±0.43). In group L, pain scores increased non-significantly from recovery (2.67±0.49) to 1 hr, followed by significant increases at 2, 8, and 24 hr (9.33±0.49). In contrast, group LD showed a non-significant increase from recovery (1.67±0.33) up to 4 hr, with significant increases observed at 8 and 12 hr (6.83±0.48).

Between-group comparisons revealed significantly higher UMPS scores in group O at all time points (except at 18 hr) compared to groups L and LD. From 0.5 to 4 hr post-recovery, all three groups differed significantly, with group O showing the highest scores, group L intermediate scores, and group LD the lowest scores. These findings are consistent with previous reports. Tsai *et al.*(2013) observed comparable analgesic effects between lidocaine infusion and meloxicam in dogs undergoing ovariohysterectomy, without additional benefit from their combination. The analgesic effect of lidocaine is attributed to its multifaceted mechanisms, including sodium channel blockade and modulation of nociceptive pathways. It inhibits GlyT1-mediated glycine reuptake at the supraspinal level, reduces glutamate release, increases extracellular glycine concentration, enhances inhibitory glycinergic transmission, promotes endogenous opioid release, and reduces the formation of thromboxane A2 and neurokinins (Lauretti *et al.*,

Table 1: Neurological examination findings in the affected cases.

Time Interval	Group O	Group L	Group LD
Time of recovery	$6.50^{bAB} \pm 0.43$	$2.67^{aA} \pm 0.49$	$1.67^{aA} \pm 0.33$
Half hour of recovery	$5.33^{cA} \pm 0.33$	$3.50^{bAB} \pm 0.56$	$1.67^{aA} \pm 0.21$
1 hr of recovery	$6.67^{cAB} \pm 0.42$	$3.67^{bAB} \pm 0.33$	$2.17^{aA} \pm 0.31$
2 hr of recovery	$7.33^{cBC} \pm 0.49$	$4.67^{bB} \pm 0.49$	$2.50^{aA} \pm 0.34$
4 hr of recovery	$7.50^{cBC} \pm 0.5$	$4.50^{bB} \pm 0.62$	$2.83^{aA} \pm 0.31$
8 hr of recovery	$7.67^{bBC} \pm 0.42$	$6.33^{abC} \pm 0.80$	$5.17^{aB} \pm 0.48$
12 hr of recovery	$8.17^{bCD} \pm 0.40$	$6.67^{aC} \pm 0.33$	$6.83^{aC} \pm 0.48$
18 hr of recovery	$9.17^{D} \pm 0.48$	$8.50^{D} \pm 0.62$	$7.50^{C} \pm 0.56$
24 hr of recovery	$11.83^{bE} \pm 0.6$	$9.33^{aD} \pm 0.49$	$8.00^{aC} \pm 0.37$

Mean (± SE) bearing different superscripts differ significantly (P < 0.05) between groups (a, b, c) and within groups (A, B, C, D, E).

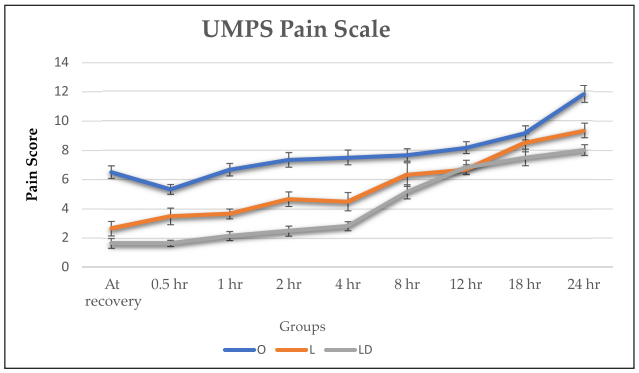

Fig. 1: Mean±SE values of UMPS in different groups at various time intervals.

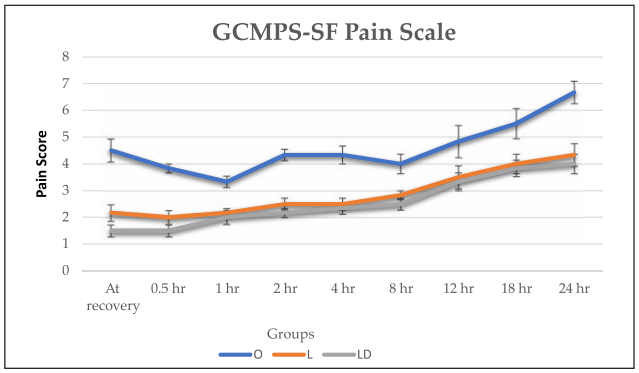

Fig. 2: Mean±SE values of GCMPS-SF in different groups at various time intervals.

Table 2: Mean±SE values of GCMPS-SF in the animals of different groups

Time Interval	Group O	Group L	Group LD
Time of recovery	$4.50^{bABC} \pm 0.43$	$2.17^{aA} \pm 0.31$	$1.50^{aA} \pm 0.22$
Half hour of recovery	$3.83^{bAB} \pm 0.17$	$2.00^{aA} \pm 0.26$	$1.50^{aA} \pm 0.22$
1 hr of recovery	$3.33^{bA} \pm 0.21$	$2.17^{aA} \pm 0.17$	$2.00^{aAB} \pm 0.26$
2 hr of recovery	$4.33^{bABC} \pm 0.21$	$2.50^{aA} \pm 0.22$	$2.17^{aAB} \pm 0.17$
4 hr of recovery	$4.33^{bABC} \pm 0.33$	$2.50^{aA} \pm 0.22$	$2.33^{aAB} \pm 0.21$
8 hr of recovery	$4.00^{bAB} \pm 0.37$	$2.83^{aAB} \pm 0.17$	$2.50^{aB} \pm 0.22$
12 hr of recovery	$4.83^{BC} \pm 0.6$	$3.50^{BC} \pm 0.43$	$3.33^{C} \pm 0.33$
18 hr of recovery	$5.50^{bC} \pm 0.56$	$4.00^{aC} \pm 0.37$	$3.83^{aC} \pm 0.31$
24 hr of recovery	$6.67^{bD} \pm 0.42$	$4.33^{aC} \pm 0.42$	$4.00^{aC} \pm 0.37$

Mean±SE bearing different superscripts differ significantly (P<0.05) between groups (a, b), and within groups(A, B, C, D)

2008). These mechanisms likely contributed to the lower pain scores observed in group L compared to group O. Similarly, Ortega *et al.* (2011) reported that lidocaine infusion (50-200 µg/kg/min) in dogs reduced intraoperative opioid requirements without causing significant haemodynamic instability, likely by attenuating the sympathetic response to surgical stimulation. Although limited studies have evaluated the residual postoperative analgesic effects of intraoperative lidocaine, Smith *et al.* (2004) demonstrated that lidocaine infusion during ophthalmic surgery in dogs provided analgesia comparable to morphine.

Postoperative pain scores assessed using the GCMPS-SF scale after recovery from surgical anaesthesia are presented in table 2 and figure 2. In group O, pain scores showed non-significant variations throughout the observation period, with a significant increase observed at 24 hr of recovery (6.67±0.42). In group L, pain scores increased non-significantly up to 8 hr, followed by a significant rise from 12 to 24 hr (4.33±0.42). In group LD, a non-significant increase was observed up to 4 hr, followed by significant increases from 8 to 24 hr (4.00±0.37).

Between-group comparisons revealed significant differences at all time points except at 12 hr. Group O consistently exhibited significantly higher pain scores than groups L and LD, whereas group L showed slightly higher but non-significant scores compared to group LD.These findings are supported by previous studies. Mitra *et al.* (2021) reported progressive reduction in pain scores up to 72 hr following ovariohysterectomy in dogs, with superior analgesia achieved using fentanyl-lignocaine-ketamine CRI combined with carprofen as part of a multimodal analgesic protocol. Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, provides mild to moderate analgesia, maintains haemodynamic stability, reduces anaesthetic requirements, and attenuates perioperative stress responses (Greenberg *et al.*, 2017). It has demonstrated efficacy in various models of acute, inflammatory, surgical, and chronic pain (Mantz *et al.*, 2011). Intravenous lidocaine contributes to analgesia through multiple mechanisms, including enhancement of inhibitory descending pain pathways via increased acetylcholine levels in cerebrospinal fluid, release of endogenous opioids, interaction with muscarinic (M3) receptors,

Table 3: Association between UMPS and GCMPS-SF pain scoring methods in the animals at different time intervals.

Time Interval	Correlation coefficient (r)
Time of recovery	0.82**
Half hour of recovery	0.80**
1 hr of recovery	0.73**
2 hr of recovery	0.81**
4 hr of recovery	0.67**
8 hr of recovery	0.43
12 hr of recovery	0.61**
18 hr of recovery	0.71**
24 hr of recovery	0.60**
Overall	0.79**

***Significant at 1 % level*

and modulation of glycine receptors (Biella and Sotgiu, 1993; Hollmann *et al*., 2001; Abelson and Höglund, 2002; Cohen and Mao, 2003).

The improved analgesic effect observed in group LD may be attributed to the principles of multimodal analgesia, where drugs with different mechanisms of action act synergistically to provide superior pain control (Corletto, 2007; Shih *et al*., 2008).

In the present study, UMPS detected significant differences in pain earlier than GCMPS, consistent with the findings of Kamyabnia *et al.* (2024). This may be because physiological parameters play a more decisive role in UMPS compared to GCMPS. A strong positive correlation was observed between the two pain scoring systems, UMPS and GCMPS-SF, as shown in table 3.

A potential limitation of the study design was the use of meloxicam as a preemptive analgesic in the control group to minimize animal suffering, which may have influenced postoperative pain assessment. The findings were consistent with the known mechanisms of action of intravenous lidocaine and dexmedetomidine, both of which reduce central sensitization. In conclusion, lignocaine in combination with dexmedetomidine significantly reduced postoperative pain in dogs undergoing ovariohysterectomy and may be considered an effective protocol for pain management.

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