

Haemato-Biochemical Response in Dogs to Ropivacaine Administered via Intraperitoneal Route and Quadratus Lumborum Block for Ovariohysterectomy under Propofol-Diazepam Anaesthesia

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ABSTRACT

Abdominal surgery induces inflammatory responses during the peri and post-operative period in dogs necessitating the incorporation of effective analgesic strategies. Ropivacaine, an amino amide local anaesthetic is favoured in analgesic protocols due to its lower cardiotoxicity. This study was conducted to evaluate the haemato-biochemical changes associated with ropivacaine when administered via intraperitoneal route and quadratus lumborum block in 24 clinical cases of female dogs undergoing ovariohysterectomy. The dogs were randomly divided into three groups: the control group (Group M), the intraperitoneal group (Group RP), and the quadratus lumborum group (Group RQ), comprising of 8 dogs in each. Anaesthetic protocol included premedication with IM glycopyrrolate and meloxicam, followed by IV diazepam, induction achieved with propofol and maintained by continuous infusion of propofol. Haemato-biochemical parameters were evaluated at 0 min (before premedication), 1 and 24 h after laparotomy incision. Haematological fluctuations were within the physiological limit throughout the study. Serum creatine kinase remained increased till 24 h; serum cortisol and blood glucose increased significantly at 1 h; however, the changes were within the physiological limit. These findings suggest that ropivacaine, administered via either route, provides safe and effective analgesia without significant adverse effects.

Key words: Dogs, Haemato-biochemical, Intraperitoneal, Quadratus lumborum block, Ropivacaine

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INTRODUCTION

Abdominal surgical procedures are considered to cause moderate to severe post-operative abdominal pain (Brioschi *et al.*, 2023). Inadequate intraoperative analgesia may result in postoperative pain or distress which can lead to loss of appetite, behavioural changes, increased protein catabolism, cardiac dysrhythmias, depressed respiratory function and central stimulation which may delay the return to normal activities (Kim *et al.*, 2012). Multimodal analgesia that includes both systemically and locally/regionally administered drugs is considered the most effective approach for surgical pain management (Hewson *et al.*, 2006). Local anaesthetics, primarily block sodium channels in nerves to prevent depolarization and propagation of pain signals and their inclusion in analgesic protocols offers profound pain relief, a high safety margin when used judiciously, and reduces the reliance on rescue analgesics, including opioids (Grubb and Lobprise, 2020). Furthermore, local anaesthetics are cost-effective and widely accessible.

Ropivacaine, an optically pure S (-) enantiomer, is a long-acting local anaesthetic agent belonging to the group of amino-amide with a mean half-life of 1.8 h and 4.2 h after intravenous and epidural administration, respectively (Kuthiala and Chaudhary, 2011). It typically takes around 5 to 10 min to show its action and lasts for 4 to 6 h when

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used for diffusion techniques (Grubb and Lobprise, 2020). Ropivacaine has a similar duration of action of sensory analgesia as bupivacaine; however, it is favoured for clinical implementation due to its lower cardiac as well as central nervous system toxic effects, less motor block as compared to bupivacaine (Kaur *et al.*, 2015).

The intraperitoneal administration of local anaesthetic has been explored as a potential method for managing visceral pain in animals for abdominal surgeries and other intra-abdominal procedures (Korkmaz *et al.*, 2019). It tends

to block the peritoneum's free afferent nerve endings and the systemic absorption of the local anaesthetic from the intraperitoneal space also contributes to reduce the pain perception (Oza *et al.*, 2016). Interfascial plane blocks, such as the quadratus lumborum block, has also emerged as transformative elements in modern regional anaesthesia which involves the precise deposition of local anaesthetics within interfascial spaces, effectively disrupting nociceptive pathways and providing effective intraoperative and postoperative analgesia (Elsharkawy *et al.*, 2018). It can provide somatic analgesia by blocking the somatic nerve fibers that innervates the abdominal wall and can also potentially block the sympathetic nerves in the abdomen, thus providing visceral analgesia (Raman and Prabha, 2021). Despite growing evidence supporting the analgesic efficacy of ropivacaine in both intraperitoneal route and quadratus lumborum block applications, limited information is available regarding their impact on haemato-biochemical parameters in clinical settings in dogs. This study was undertaken to evaluate the safety profile of ropivacaine administered via intraperitoneal and quadratus lumborum block and to optimize its use in pain management protocols by assessing its impact on haemato-biochemical parameters in dogs undergoing abdominal surgery.

MATERIALS AND METHODS

Animals and Grouping

All the animal handling and procedures were approved by Institutional Animal Ethics Committee, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University (Imphal), Mizoram (Approval Reference Number: CVSC/CAU/IAEC/23-24/P-26.1). Twenty-four client-owned female dogs of different ages, body conditions, and breeds presented for elective ovariohysterectomy were enrolled in a randomized clinical trial. Only dogs with ASA (American Society of Anaesthesiologists) status I was included in the study. The exclusion criteria were nervous or aggressive behaviour, ASA \geq II, aged $>$ 6 years, or dogs with previous abdominal surgery. A pre-anaesthetic evaluation was carried out in all the dogs which included physical, clinical, haematology, and biochemistry examinations. The dogs were fasted for 12 h for food and 4 h for water before surgery.

The dogs were randomly divided into three groups: the control group (Group M), the intraperitoneal group (Group RP), and the quadratus lumborum group (Group RQ), comprising of 8 dogs in each. All the dogs were premedicated with an IM glycopyrrolate (Corolate; 0.2 mg/mL, Miraculus Pharma Pvt. Ltd., Mumbai, India) @ 0.01 mg/kg b.wt. and meloxicam (Melonex; 5 mg/mL, Intas Pharmaceuticals (vet), Ahmedabad, India) @ 0.2 mg/kg b.wt. After 10 min, IV diazepam (Zepine; 5 mg/mL, Themis Medicare Limited, Mumbai, India) @ 1 mg/kg b.wt. was administered. Following 10 min of premedication, induction of anaesthesia was achieved with IV propofol (MCT-ROF; 10 mg/mL, Neon Laboratories Limited, Mumbai, India) @

3 to 5 mg/kg b.wt. or till effect and endotracheal intubation was performed. Anaesthesia was maintained by continuous rate infusion of propofol @ 0.2-0.5 mg/kg/min, IV. Under general anaesthesia, the physiological parameters were constantly monitored with vital signs monitor (Multipara Monitor, New Gen Medical NGMS-90V).

Haemato-Biochemical Parameters

Venous blood samples were collected in sterile dry vials containing EDTA at 0 min (before premedication), thereafter 1 h and 24 h after laparotomy incision for evaluation of haematological parameters on MS4S² Automated Haematology Blood Cell Counter (Melet Schloesing Laboratories, France).

Blood samples collected in clot activator vials were analysed for serum gamma glutamyl transferase (GGT) (Coral Clinical Diagnostics, Goa), creatinine, creatine kinase (Automated serum biochemical analyser DRI-CHEM NX600V, Fuji Film, Japan), and cortisol (Canine Cortisol ELISA Kit 96T, Everon Life Sciences, New Delhi, India). Blood glucose was estimated at similar time intervals with the help of an instant glucometer (Accu-check Instant S glucometer, India).

Loco-Regional Anaesthesia Technique

The dogs in Group RQ were prepared for ultrasound scanning after preparing the site aseptically. After anaesthetic induction, the dogs were positioned in lateral recumbency with the targeted flank facing upwards and a microconvex transducer (5-8 MHz) placed transversely to the longitudinal axis of the spine, caudal and parallel to the last rib, with marker directed ventrally or towards the operator (Viscasillas *et al.*, 2021a). The key anatomical landmarks were visualised: erector spinae muscles, external oblique muscle, internal oblique muscle, transverse abdominal muscle, transverse process of L1, transverse abdominal muscle aponeurosis, quadratus lumborum muscle, psoas muscle and vertebral body of L1. A 23-gauge, 88 mm Quincke spinal needle (Spinocan; B. Braun, Recklinghausen, Germany) was inserted in-plane at a 45° angle, from ventrolateral to dorsomedial, until the tip was positioned between the quadratus lumborum and psoas muscles (Viscasillas *et al.*, 2021b) and 0.5% ropivacaine (Ropin 0.5%; 5 mg/mL, Neon Laboratories Limited, Mumbai, India) at the dose of 1.5 mg/kg b.wt. per site was administered at the interfascial plane. The entire procedure was then repeated on the contralateral side.

Intraperitoneal Analgesia

The dogs in Group RP were administered 0.5% ropivacaine @ 3 mg/kg b.wt. mixed with an equal volume of normal saline in a single syringe intraperitoneally after laparotomy incision. After 5 min of ropivacaine administration, the ovaries and uterus were removed.

Statistical Analyses

General Linear Model of one-way and two-way ANOVA based on Fisher's Least Significant Difference method was used to determine the significant difference among time points for different treatment groups as well as among treatment groups for different time points using the statistical package SPSS version 27.0. The Duncan multiple range test was used for analysing the significant values noticed in the ANOVA and the non-parametric data were analysed by Independent-Samples Kruskal-Wallis Test. Results are showed as mean \pm SE and differences were considered significant when $p < 0.05$.

RESULTS AND DISCUSSION

Haematological Observations

The haemoglobin level, packed cell volume and total erythrocyte count decreased significantly ($p \leq 0.01$) at 1 h of observation from 0 min (baseline) in all the groups which gradually returned towards the baseline values at 24 h of observation, which might be attributed to anaesthetic-induced vasodilation, pooling of circulatory blood cells in the spleen or other reservoirs secondary to decreased sympathetic activity, shifting of fluid from the extravascular compartment to intravascular compartment to maintain the normal cardiac output, as well as surgical blood loss and intravenous administration of non-haemoglobin-containing fluid during the surgery (Khurana *et al.*, 2014). However, there was no significant difference in the mean values among the treatment groups throughout the evaluation period (Table 1). Similar significant decrease in haematological parameters were also observed by Costa *et al.* (2013), Saikia *et al.* (2022) and Zalavadiya *et al.* (2024) after induction with propofol in dogs and by Suresha *et al.* (2012) and Khurana *et al.* (2014) after administration of benzodiazepine-propofol anaesthesia in dogs.

The total leukocyte count showed a non-significant decrease from 0 min (baseline) at 1 h of observation in all the groups, which might be due to inter-compartmental fluid redistribution to maintain normal cardiac output or haemodilution due to fluid therapy (Khurana *et al.*, 2014); thereafter, the values showed a non-significant increase at 24 h of observation within the physiological range which might be due to the release of neutrophils from the marrow storage pool in response to inflammation following surgery, thus, increasing the total leukocyte count (Jung *et al.*, 2019). The mean values of total leukocyte count did not vary significantly among the treatment groups throughout the evaluation period (Table 1).

Biochemical Observations

In all the groups, a non-significant elevation in the serum gamma glutamyl transferase was observed at 1 h of observation from the base level within the physiological limit which might be due to the hepatic metabolism of propofol by glucuronide conjugation (Abdelhakiem *et al.*, 2019) and the complete biotransformation of ropivacaine into inactive metabolites in the liver mediated by cytochrome

P450 and aliphatic hydroxylation (Kumari *et al.*, 2017). The non-significant alteration within the physiological limit during the study period also indicates the absence of deleterious effect on liver by all the anaesthetic agents. Similar increase in liver enzymes was also reported by Chaithra *et al.* (2024) in dogs and Meher *et al.* (2023) in cattle. However, the mean values did not differ significantly among the treatment groups.

The serum creatinine level decreased non-significantly from baseline up to 24 h of observation in all the groups during the study and no significant variations between the groups. The decline in the values might be associated with continuous intravenous fluid infusion responsible for adequate renal blood flow which maintained adequate glomerular filtration rate (Arya *et al.*, 2021). A similar decline in serum creatinine was also observed by Suresha *et al.* (2012) at 6 and 48 h under diazepam-propofol anaesthesia in dogs.

The mean values of serum creatine kinase increased significantly ($p \leq 0.01$) from 0 min (baseline) up to 24 h of observation in all the groups but within the physiological limit; however, the values showed no significant variation among the treatment groups (Table 1). The marked increase in serum creatine kinase level up to 24 h might be associated with tissue damage and organ manipulation during surgical procedures as it is commonly used as an indicator of acute muscle damage (Kopanke *et al.*, 2023). Similar increase in serum creatine kinase levels at 24 h after surgery was also reported by Rubio *et al.* (2022) in dogs.

The serum cortisol and blood glucose increased significantly ($p \leq 0.05$) from 0 min (baseline) up to 24 h of observation with a maximum increase at 1 h in all the three groups. The elevation in serum cortisol level at 1 h of observation might be caused by surgical trauma and the effect of anaesthetic agents causing activation of the hypothalamic-pituitary-adrenal axis primarily triggered through autonomic afferent pathways from intraperitoneal organs, while somatic sensory pathways play no key role in cortisol release (Ivascu *et al.*, 2024). Similar findings were also reported by Kumar *et al.* (2023) during ovariohysterectomy in dogs. Further, the high rise of glucose at 1 h in all the groups might be attributed to decreased membrane transport of glucose, decreased glucose utilization due to reduced basal metabolic rate, impaired insulin activity and increased blood concentration of adrenocortical hormones (Jena *et al.*, 2014; Rubio *et al.*, 2022). Intraoperative hyperglycemia, in this study, might be ascribable to the combined effect of the anaesthetic and the surgical procedures as reported in dogs by Costa *et al.* (2013) and Saikia *et al.* (2022).

A significantly ($p \leq 0.05$) elevated serum cortisol level and blood glucose was exhibited by Group M at 1 h of observation (Table 1), which might be due to the superior visceral analgesia provided by the administration of ropivacaine interfascially and intraperitoneally, respectively (Perniola *et al.*, 2014; Li *et al.*, 2022). Similar observations were also reported by Kim *et al.* (2012) and Farokhzad *et al.* (2021) with intraperitoneal administration of bupivacaine and lidocaine, respectively, in dogs.



Table 1: Mean \pm SE values of haemato-biochemical parameters recorded at different time intervals in dogs of Group M, RP and RQ

Parameters	Group	Premedication			Time interval post-incision			P value
		0 min	1 h	24 h	0 min	1 h	24 h	
Haemoglobin (g/dL)	Group M	16.70 \pm 0.26 ^a	13.75 \pm 0.41 ^b	15.76 \pm 0.37 ^a	0.000**			
	Group RP	17.05 \pm 0.17 ^a	14.09 \pm 0.39 ^b	16.47 \pm 0.47 ^a	0.000**			
	Group RQ	16.86 \pm 0.22 ^a	14.02 \pm 0.52 ^b	15.96 \pm 0.52 ^a	0.001**			
	P value	0.537 ^{NS}	0.853 ^{NS}	0.536 ^{NS}				
Packed cell volume (%)	Group M	45.08 \pm 1.12 ^a	40.95 \pm 0.60 ^b	45.22 \pm 0.79 ^a	0.005**			
	Group RP	48.17 \pm 0.73 ^a	41.67 \pm 1.67 ^b	46.12 \pm 0.90 ^a	0.004**			
	Group RQ	47.25 \pm 1.12 ^a	41.05 \pm 1.09 ^b	45.90 \pm 0.94 ^a	0.002**			
	P value	0.118 ^{NS}	0.902 ^{NS}	0.756 ^{NS}				
Total erythrocyte count (millions/cu.mm)	Group M	7.44 \pm 0.19 ^a	6.21 \pm 0.17 ^b	7.08 \pm 0.18 ^a	0.001**			
	Group RP	7.68 \pm 0.19 ^a	6.16 \pm 0.17 ^b	7.21 \pm 0.26 ^a	0.000**			
	Group RQ	7.55 \pm 0.15 ^a	6.34 \pm 0.36 ^b	7.15 \pm 0.16 ^a	0.001**			
	P value	0.646 ^{NS}	0.880 ^{NS}	0.917 ^{NS}				
Total leukocyte count (thousands/cu.mm)	Group M	13.45 \pm 0.78	11.86 \pm 0.89	15.11 \pm 1.14	0.084 ^{NS}			
	Group RP	12.54 \pm 0.99	11.25 \pm 0.72	13.46 \pm 0.75	0.202 ^{NS}			
	Group RQ	14.14 \pm 0.47	13.44 \pm 0.77	15.36 \pm 0.53	0.107 ^{NS}			
	P value	0.369 ^{NS}	0.170 ^{NS}	0.259 ^{NS}				
Serum gamma glutamyl transferase (U/L)	Group M	2.66 \pm 0.17	3.03 \pm 0.13	2.84 \pm 0.15	0.245 ^{NS}			
	Group RP	2.63 \pm 0.16	2.99 \pm 0.19	2.79 \pm 0.18	0.388 ^{NS}			
	Group RQ	2.46 \pm 0.13	2.81 \pm 0.11	2.60 \pm 0.12	0.157 ^{NS}			
	P value	0.622 ^{NS}	0.534 ^{NS}	0.513 ^{NS}				
Serum creatinine (mg/dL)	Group M	0.85 \pm 0.05	0.73 \pm 0.06	0.66 \pm 0.07	0.128 ^{NS}			
	Group RP	0.91 \pm 0.05	0.74 \pm 0.07	0.69 \pm 0.08	0.084 ^{NS}			
	Group RQ	0.81 \pm 0.04	0.76 \pm 0.05	0.72 \pm 0.06	0.474 ^{NS}			
	P value	0.344 ^{NS}	0.929 ^{NS}	0.807 ^{NS}				
Serum creatine kinase (U/L)	Group M	90.50 \pm 2.25 ^a	184.67 \pm 4.57 ^b	458.33 \pm 9.89 ^c	0.000**			
	Group RP	86.50 \pm 3.32 ^a	168.17 \pm 9.38 ^b	448.17 \pm 8.99 ^c	0.000**			
	Group RQ	82.33 \pm 2.31 ^a	158.50 \pm 7.68 ^b	440.33 \pm 6.97 ^c	0.000**			
	P value	0.131 ^{NS}	0.073 ^{NS}	0.366 ^{NS}				
Serum cortisol (μ g/dL)	Group M	4.13 \pm 0.27 ^a	6.15 \pm 0.47 ^{Ab}	5.10 \pm 0.23 ^a	0.003**			
	Group RP	4.07 \pm 0.20 ^a	5.28 \pm 0.23 ^{ABb}	4.67 \pm 0.29 ^{ab}	0.012*			
	Group RQ	4.09 \pm 0.07 ^a	4.80 \pm 0.16 ^{Bb}	4.29 \pm 0.15 ^a	0.006**			
	P value	0.976 ^{NS}	0.026*	0.081 ^{NS}				
Blood glucose (mg/dL)	Group M	90.67 \pm 2.23 ^a	101.17 \pm 1.79 ^{Ab}	96.17 \pm 1.11 ^b	0.003**			
	Group RP	91 \pm 2.07 ^a	97.17 \pm 1.45 ^{ABab}	93.83 \pm 0.79 ^b	0.038*			
	Group RQ	90.17 \pm 1.92 ^a	95.67 \pm 0.72 ^{Bab}	93.17 \pm 1.40 ^b	0.050*			
	P value	0.960 ^{NS}	0.043*	0.177 ^{NS}				

**P \leq 0.01 = significant at 1%, *P \leq 0.05 = significant at 5%, P>0.05= non-significant (NS). Values in the same row with different small superscripts and those in columns with capital superscripts for a parameter differ significantly.

CONCLUSION

The alterations observed in haemato-biochemical parameters were associated with the combined effects of the anaesthetic agents. Both treatment groups showed lower levels of blood glucose and serum cortisol as compared to the control group.

This reduction may be attributed to the administration of ropivacaine via the intraperitoneal route and quadratus lumborum block, which effectively provided analgesia in the peri and post-operative period. Additionally, the elevated levels of creatine kinase in all groups could result from tissue

trauma associated with the surgical procedures. However, no adverse effects were observed in the haemato-biochemical parameters' indicating that ropivacaine in both treatment methods is considered safe and effective for managing pain in dogs undergoing abdominal surgery under propofol-diazepam anaesthesia.

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REFERENCES

- Abdelhakiem, M.A.H., Ahmed, A.A., Ali, M.M., Abd-Ellah, M.R., & Ali, M.A.M. (2019). Evaluation of physical and haemato-biochemical parameters after administration of different doses of propofol in xylazine-ketamine premedicated dogs. *EC Veterinary Science*, 4, 684-693.
- Arya, N., Shukla, B.P., Jain, R., Rajput, N., & Parihar, A. (2021). Haemato-biochemical evaluation of glycopyrrolate, dexmedetomidine, butorphanol/buprenorphine as preanesthetic with ketamine dissociative anesthetic in canines. *The Pharma Innovations*, 10(6), 803-807.
- Brioschi, F.A., Ravasio, G., Ferrari, F., Amari, M., Di Cesare, F., Valentini Visentin, M., & Rabbogliatti, V. (2023). Comparison of intraperitoneal and incisional lidocaine or ropivacaine irrigation for postoperative analgesia in dogs undergoing major abdominal surgeries. *Plos One*, 18(4), e0284379.
- Chaithra, S., Saikia, B., Konwar, B., Bayan, H., Devi, T.R., Das, C.J., & Zorinpui, H. (2024). Comparative studies on haemato-biochemical changes following pre-emptive analgesia with tramadol, pentazocine lactate and meloxicam in pain management of canine ovariohysterectomy. *The Indian Journal of Animal Sciences*, 94(2), 123-130.
- Costa, P.F., Nunes, N., Belmonte, E.A., Moro, J.V., & Lopes, P.C.F. (2013). Hematologic changes in propofol-anesthetized dogs with or without tramadol administration. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 65, 1306-1312.
- Elsharkawy, H., Pawa, A., & Mariano, E.R. (2018). Interfascial plane blocks: Back to basics. *Regional Anesthesia & Pain Medicine*, 43(4), 341-346.
- Farokhzad, B., Sabiza, S., Razi Jalali, M., & Baniadam, A. (2021). Intraperitoneal administration of lidocaine or tramadol alone or in combination on postoperative pain after ovariohysterectomy in dogs. *Veterinary Medicine and Science*, 7(3), 634-641.
- Grubb, T., & Lobprise, H. (2020). Local and regional anaesthesia in dogs and cats: Overview of concepts and drugs (Part 1). *Veterinary Medicine and Science*, 6(2), 209-217.
- Hewson, C.J., Dohoo, I.R., & Lemke, K.A. (2006). Perioperative use of analgesics in dogs and cats by Canadian veterinarians in 2001. *The Canadian Veterinary Journal*, 47(4), 352.
- Ivascu, R., Torsin, L. I., Hostiu, L., Nitipir, C., Corneci, D., & Dutu, M. (2024). The Surgical Stress Response and Anesthesia: A Narrative Review. *Journal of Clinical Medicine*, 13(10), 3017.
- Jena, B., Das, J., Nath, I., Sardar, K.K., Sahoo, A., Beura, S.S., & Painuli, A. (2014). Clinical evaluation of total intravenous anaesthesia using xylazine or dexmedetomidine with propofol in surgical management of canine patients. *Veterinary World*, 7(9), 671-680.
- Jung, G.H., Hwang, H.K., Lee, W.J., & Kang, C.M. (2019). Extremely high white blood cell counts on postoperative day 1 do not predict severe complications following distal pancreatectomy. *Annals of Hepato-Biliary-Pancreatic Surgery*, 23(4), 377.
- Kaur, A., Singh, R.B., Tripathi, R.K., & Choubey, S. (2015). Comparison between bupivacaine and ropivacaine in patients undergoing forearm surgeries under axillary brachial plexus block: A prospective randomized study. *Journal of Clinical and Diagnostic Research*, 9(1), UC01.
- Khurana, A., Kumar, A., Sharma, S.K., & Kumar, A. (2014). Electrocardiographic and hemato-biochemical effects of two balanced anesthetic protocols in dogs. *Veterinary World*, 7(10), 835-841.
- Kim, Y.K., Lee, S.S., Suh, E.H., Lee, L., Lee, H.C., Lee, H.J., & Yeon, S.C. (2012). Sprayed intraperitoneal bupivacaine reduces early postoperative pain behavior and biochemical stress response after laparoscopic ovariohysterectomy in dogs. *The Veterinary Journal*, 191(2), 188-192.
- Kopanke, J.H., Chen, A.V., Brune, J.E., Brenna, A.C., & Thomovsky, S.A. (2023). Creatine kinase and its isoenzymes in the serum and cerebrospinal fluid of healthy canines. *Veterinary Clinical Pathology*, 52(4), 654-660.
- Korkmaz, M., Yilmaz, O., Saritas, Z.K., Demirkan, I., & Jaroszewski, J. (2019). Evaluation of intraperitoneal and incisional bupivacaine or levobupivacaine for postoperative analgesia in ovariohysterectomized dogs. *Acta Scientiae Veterinariae*, 47, 1-8.
- Kumar, R., Bishnoi, P., Tanwar, M., Jhirwal, S.K., & Kumari, A. (2023). Haemato-biochemical changes after laparoscopic and conventional ovariohysterectomy in dogs. *Indian Journal of Veterinary Sciences and Biotechnology*, 19(2), 88-93.
- Kumari, L., Sharma, A.K., Kumari, L., & Sinha, M.P. (2017). Haemato-biochemical effects of lumbosacral epidural anaesthesia with ropivacaine and dexmedetomidine in goats. *Indian Journal of Small Ruminants*, 23(1), 117-119.
- Kuthiala, G., & Chaudhary, G. (2011). Ropivacaine: A review of its pharmacology and clinical use. *Indian Journal of Anaesthesia*, 55(2), 104-110.
- Li, J., Wei, C., Huang, J., Li, Y., Liu, H., Liu, J., & Jin, C. (2022). Efficacy of quadratus lumborum block for pain control in patients undergoing hip surgeries: a systematic review and meta-analysis. *Frontiers in Medicine*, 8, 771859.
- Meher, B.N., Kumar, D., Tandia, N., Singh, S., Singh, P., Dehariya, V., & Wadiwa, S. (2023). Study on the effect of epidural ropivacaine in combination with dexmedetomidine anesthesia on haemato-biochemical alteration in cattle. *The Pharma Innovations*, 12, 481.
- Oza, V.P., Parmar, V., Badheka, J., Nanavati, D.S., Taur, P., & Rajyaguru, A.M. (2016). Comparative study of postoperative analgesic effect of intraperitoneal instillation of dexmedetomidine with bupivacaine and bupivacaine alone after laparoscopic surgery. *Journal of Minimal Access Surgery*, 12(3), 260-264.
- Perniola, A., Magnuson, A., Axelsson, K., & Gupta, A. (2014). Intraperitoneal local anesthetics have predominant local analgesic effect: A randomized, double-blind study. *Anesthesiology*, 121(2), 352-361.
- Raman, R., & Prabha, R. (2021). Quadratus Lumborum block for patients undergoing percutaneous nephrolithotomy: a randomized controlled study. *Anesthesia Essays and Researches*, 15(2), 174-178.



- Rubio, M., Satué, K., Carrillo, J.M., Hernández Guerra, Á., Cuervo, B., Chicharro, D., Damiá, E., Del Romero, A., & Sopena, J. (2022). Changes in hematological and biochemical profiles in ovariohysterectomized bitches using an alfaxalone–midazolam–morphine–sevoflurane protocol. *Animals*, *12*(7), 914.
- Saikia, B., Sarma, K.K., & Sarma, K. (2022). Effects of propofol, ketamine and their combination (ketofol) as total intravenous anesthesia (TIVA) on haematological, serum biochemical and hormonal profile in the surgical management of canine patients. *Indian Journal of Animal Research*, *56*(7), 866-872.
- Suresha, L., Ranganath, B.N., Vasanth, M.S., & Ranganath, L. (2012). Haemato-biochemical studies on triflupromazine HCL and diazepam premedication for propofol anaesthesia in dogs. *Veterinary World*, *5*(11), 672-675.
- Viscassillas, J., Sanchis-Mora, S., Burillo, P., Esteve, V., Del Romero, A., Lafuente, P., & Redondo, J.I. (2021b). Evaluation of quadratus lumborum block as part of an opioid-free anaesthesia for canine ovariohysterectomy. *Animals*, *11*(12), 3424.
- Viscassillas, J., Terrado, J., Marti-Scharfhausen, R., Castiñeiras, D., Esteve, V., Clancy, N., & Redondo, J.I. (2021a). A modified approach for the ultrasound-guided quadratus lumborum block in dogs: A cadaveric study. *Animals*, *11*(10), 2945.
- Zalavadiya, S.H., Vadalia, J.V., Vagh, A.A., Bhatt, R.H., Talekar, S.H., Dodia, V.D., & Bhesaniya, M.B. (2024). Comparative anaesthetic effects of propofol and tiletamine-zolazepam anaesthetic agents in dogs. *Indian Journal of Veterinary Sciences & Biotechnology*, *20*(3), 153-157.