



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2026): 4.61

VET 2026; 11(4): 91-95

© 2026 VET

www.veterinarypaper.com

Received: 11-01-2026

Accepted: 15-02-2026

A Naga Vara Prasad

M.V.Sc. Scholar, Department of
Veterinary Surgery & Radiology,
NTR College of Veterinary
Science, Gannavaram, Sri
Venkateswara Veterinary
University, Andhra Pradesh,
India

Dr. K Lavanya

Assistant Professor, Department
of Veterinary Surgery &
Radiology, College of Veterinary
Science, Garividi, Andhra
Pradesh, India

Dr. Rambabu Kalaka

Associate Professor & Head,
Department of Veterinary
Surgery & Radiology, NTR
College of Veterinary Science,
Gannavaram, Andhra Pradesh,
India

Dr. P Ramesh

Associate Professor, Department
of Veterinary Medicine, NTR
College of Veterinary Science,
Gannavaram, Andhra Pradesh,
India

Corresponding Author:

A Naga Vara Prasad

M.V.Sc. Scholar, Department of
Veterinary Surgery & Radiology,
NTR College of Veterinary
Science, Gannavaram, Sri
Venkateswara Veterinary
University, Andhra Pradesh,
India

Clinical and cardiopulmonary effects of nalbuphine– dexmedetomidine and butorphanol–dexmedetomidine premedication with propofol–isoflurane anaesthesia in dogs undergoing elective ovariohysterectomy

A Naga Vara Prasad, K Lavanya, Rambabu Kalaka and P Ramesh

DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i4b.3169>

Abstract

The present study was conducted to evaluate and compare the clinical and cardiopulmonary effects of butorphanol and nalbuphine as premedicants in combination with dexmedetomidine, followed by propofol induction and isoflurane maintenance for elective ovariohysterectomy in dogs. Twelve healthy female dogs were randomly divided into two groups comprising six animals each. Dogs in Group I received butorphanol at 0.1 mg/kg body weight intramuscularly, whereas dogs in Group II received nalbuphine at 1 mg/kg body weight intramuscularly. Fifteen minutes later, dexmedetomidine was administered intravenously at 5 µg/kg to all animals. Anaesthesia was induced two minutes later using propofol intravenously to effect and maintained with isoflurane in oxygen in both groups. The mean sedation time in Group I and Group II was 5.35 ± 0.26 minutes and 5.88 ± 0.40 minutes, respectively, while the mean induction time was 37.83 ± 1.14 seconds and 39.50 ± 1.45 seconds, respectively. The quality of anaesthesia was satisfactory in both groups. Cardiopulmonary parameters showed mild variations during the anaesthetic period; however, all values remained within normal physiological limits. Based on the findings of the present study, both anaesthetic protocols provided adequate sedation, smooth induction, and satisfactory anaesthetic depth with stable cardiopulmonary parameters, indicating that both combinations are suitable for elective ovariohysterectomy in dogs.

Keywords: Dogs, butorphanol, nalbuphine, dexmedetomidine, ovariohysterectomy, anaesthesia

1. Introduction

General anaesthesia is routinely performed in dogs to facilitate both elective and emergency surgical procedures. An ideal anaesthetic protocol should provide sedation, amnesia, muscle relaxation, and analgesia. Since no single agent can produce all these effects, combinations of drugs are commonly used to achieve balanced anaesthesia, thereby enhancing desirable effects while minimizing adverse reactions (Dewangan *et al.*, 2024) [8]. Opioids and α_2 -adrenoceptor agonists are frequently combined in veterinary practice to provide sedation and analgesia for various procedures and as premedication prior to induction of anaesthesia. These combinations may produce synergistic or supra-additive sedative and antinociceptive effects, allowing lower doses of individual agents and reducing drug-related side effects (Nishimura *et al.*, 2018; Ravasio *et al.*, 2025) [25, 30].

Butorphanol tartrate is a synthetic opioid with agonist–antagonist activity at opioid receptors and is widely used as a premedicant in dogs, either alone or in combination with other agents (Bufalari *et al.*, 1997) [5]. It provides sedation and mild to moderate analgesia, although respiratory depression may occur at recommended preanaesthetic doses, as reported with most opioids (Bufalari *et al.*, 1995; Chang *et al.*, 1999) [6, 7].

Nalbuphine, a κ -opioid receptor agonist and μ -opioid receptor antagonist, exhibits analgesic properties comparable to morphine with minimal cardiorespiratory depression. Even at higher doses, nalbuphine has been reported to maintain stable cardiopulmonary parameters, making it a potentially safe alternative opioid for veterinary anaesthesia (Torad *et al.*, 2018; Gomes *et*

al., 2019) [33, 11].

Dexmedetomidine is a highly selective α_2 -adrenoceptor agonist widely used in veterinary medicine for sedation, anxiolysis, and analgesia. However, it may produce biphasic cardiovascular effects, characterized by transient hypertension followed by reflex bradycardia due to peripheral vasoconstriction (Diao *et al.*, 2016; Kumar *et al.*, 2020) [9, 16]. Propofol, a non-barbiturate intravenous anaesthetic agent, is commonly used for induction in dogs due to its rapid onset and short duration of action. Nevertheless, propofol may cause dose-dependent respiratory depression and moderate hypotension, with variable effects on heart rate (Gomez-Villamandos *et al.*, 2006; Aguilera *et al.*, 2020; Mair *et al.*, 2009) [12, 1, 19].

Materials and Methods

The clinical study was carried out on twelve healthy female dogs with mean body weight of 10.83 ± 1.01 kg ranging from 6 to 20 kg and a mean age of 45.36 ± 5.40 months presented for elective ovariohysterectomy. Animals were randomly allocated into two groups (Group I and Group II) comprising of six animals each. Dogs in Group I received butorphanol at a dose rate of 0.1 mg/kg body weight intramuscularly, whereas dogs in Group II received nalbuphine at 1 mg/kg body weight intramuscularly. Fifteen minutes later, all animals were administered dexmedetomidine at 5 μ g/kg intravenously. Anaesthesia was induced two minutes later using propofol intravenously to effect, and maintained with isoflurane in oxygen in both groups. The rectal temperature, respiratory rate, heart rate, pulse rate and SpO₂ were recorded at 0 minute (before premedication) and 5 minutes, 15 minutes, 30 minutes, 45 minutes and 60 minutes and 90 minutes.

Onset of sedation (minutes) was recorded immediately after administration of dexmedetomidine to appearance of ataxia, eyelid drooping, and drowsiness. The quality of sedation was graded as per method described by Wagner *et al.* (2017) [35] and scores were given as 1 – No sedation, 2 – Mild sedation, 3 – Moderate sedation, 4 – Complete sedation. Induction Time was recorded (seconds) from administration of the propofol till the animal is anaesthetized. After endotracheal intubation animal was connected to isoflurane anaesthetic machine and ovariohysterectomy was performed by standard surgical manner under aseptic conditions. Duration of anaesthesia was recorded (minutes) from induction to the reappearance of reflexes. Recovery time (minutes) was recorded from period of discontinuation of anaesthesia to animal able to rise and stand voluntarily without any support. The recovery parameters such as extubation time, sitting time and complete recovery time was evaluated and quality of recovery was graded as per method described by Pottie *et al.* (2007) [28] and scores was given as 0 - Very poor recovery, severe agitation, paddling and vocalisation, 1 - Vocalisation, restless, paddling, urination or defecation, 2 - Whining, agitated, some paddling or trembling, 3 - Gradual, slow, moderate restlessness, 4 - Gradual, smooth, quiet, rapid, comfortable. The collected data was statistically analysed using one-way analysis of variance (ANOVA) and independent sample t test with the aid of SPSS software.

Results and Discussion

Rectal temperature showed a statistically significant decrease in Group I between 15 and 60 minutes (101.95 ± 0.36 to 101.18 ± 0.62) and returned to normal during recovery,

whereas Group II exhibited a mild, non-significant decline. The reduction observed in Group I may be attributed to the thermoregulatory depressant effects of opioid analgesics. Similar findings were reported by Springfield *et al.* (2022) [32], who noted that butorphanol decreases rectal temperature in dogs due to central depression of thermoregulation. Dexmedetomidine may also influence thermoregulatory mechanisms and cause gradual hypothermia during anaesthesia, as described by Murrell (2009) [23]. Respiratory rate showed a significant decrease in Group I, with the maximum fall at 45 minutes 15.67 ± 0.95 , although values remained within physiological limits and returned to baseline during recovery. Group II demonstrated a mild, non-significant reduction. These findings are in agreement with Bufalari *et al.* (2011) and Monteiro *et al.* (2009) [22], who reported decreased respiratory rate in dogs administered butorphanol. Dexmedetomidine induces minimal respiratory depression at clinically effective doses (Ahmad *et al.*, 2019; Murthy *et al.*, 2009) [2, 24]. The mild changes observed in Group II are supported by Marques *et al.* (2020) [20] and Wang *et al.* (2022) [36], who reported that nalbuphine produces comparatively less respiratory depression than other opioids. Heart rate showed a mild, non-significant decrease after premedication in both groups, remaining within normal physiological limits. This decrease may be attributed to dexmedetomidine-induced vagal stimulation and reduced sympathetic tone, as reported by Mendes *et al.* (2003) [21] and Kusolphat *et al.* (2022) [18]. Pulse rate exhibited a slight decline during the anaesthetic period in both groups, with no significant difference within or between groups. The mild reduction may be due to the combined pharmacological effects of dexmedetomidine, opioids, and propofol used in the balanced anaesthetic protocol. Similar findings were recorded by Bispo *et al.* (2025) [4] and Kim *et al.* (2023) [15]. Peripheral oxygen saturation (SpO₂) showed mild, non-significant variations in both groups, indicating adequate oxygenation. Comparable observations were reported by Marques *et al.* (2020) [20], Rasio *et al.* (2025) [30], and Diao *et al.* (2016) [9], who noted that balanced anaesthetic protocols involving opioid agonist-antagonists and dexmedetomidine maintain stable oxygen saturation.

The mean onset time of sedation was 5.35 ± 0.26 minutes in Group I and 5.88 ± 0.40 minutes in Group II. Most animals in both groups achieved moderate to complete sedation, with 83.33% of dogs in Group I and 66.67% in Group II showing complete sedation. Adequate sedation facilitated smooth handling and intravenous catheter placement prior to induction. These findings agree with Nishimura *et al.* (2018) [25] and Trimble *et al.* (2018) [34], who reported superior sedation with opioid- α_2 agonist combinations. Rafee *et al.* (2015) [29] and Pawde *et al.* (2023) [27] also reported enhanced sedation and improved muscle relaxation with dexmedetomidine-butorphanol combinations due to pharmacological synergy. The mean induction time was 37.83 ± 1.14 seconds in Group I and 39.50 ± 1.45 seconds in Group II, with no significant difference between groups. Slightly faster induction in Group I may be attributed to the additive sedative effects of the butorphanol-dexmedetomidine combination. Similar findings were reported by Rafee *et al.* (2015) [29] and Sethi *et al.* (2018) [31], who observed reduced induction time and improved jaw relaxation with dexmedetomidine-butorphanol combinations.

Table 1: Changes in Physiological parameters in Group I and Group II

Time (min)	Rectal Temp (°F) G-I	Rectal Temp (°F) G-II	Heart Rate (beats/min) G-I	Heart Rate (beats/min) G-II	Pulse Rate (beats/min) G-I	Pulse Rate (beats/min) G-II	Respiratory Rate (breaths/min) G-I	Respiratory Rate (breaths/min) G-II	SpO ₂ (%) G-I	SpO ₂ (%) G-II
Before	102.42 ± 0.32 ^a	102.18 ± 0.20 ^a	128.33 ± 2.10	129.17 ± 2.65	124.83 ± 1.20	126.17 ± 2.10	21.50 ± 0.85 ^a	21.00 ± 0.75 ^a	98.83 ± 0.38	98.50 ± 0.60
0	102.08 ± 0.37	101.95 ± 0.22 ^a	122.67 ± 2.29	123.00 ± 2.76	120.00 ± 1.15	120.33 ± 2.15	21.17 ± 0.65 ^a	20.83 ± 0.30 ^a	97.50 ± 0.42	97.00 ± 0.81
5	102.03 ± 0.45 ^a	101.95 ± 0.17 ^a	121.00 ± 2.23	121.00 ± 2.76	119.17 ± 1.22	120.00 ± 2.06	20.67 ± 1.22 ^{ab}	20.83 ± 0.91 ^a	97.50 ± 0.56	97.67 ± 0.42
15	101.95 ± 0.36 ^b	101.78 ± 0.18 ^a	118.00 ± 2.36	119.00 ± 2.46	118.50 ± 1.11	119.33 ± 1.68	19.67 ± 0.95 ^{ab}	20.17 ± 1.51 ^a	96.83 ± 0.30	96.67 ± 0.33
30	101.61 ± 0.50 ^{ab}	101.75 ± 0.09 ^a	117.33 ± 1.60	119.00 ± 2.76	116.83 ± 1.32	119.00 ± 1.34	18.00 ± 1.03 ^{bc}	18.00 ± 0.73 ^a	96.50 ± 0.56	96.83 ± 0.47
45	101.36 ± 0.63 ^{bc}	101.56 ± 0.16 ^a	117.00 ± 1.61	117.17 ± 1.60	117.67 ± 1.38	118.33 ± 1.82	15.67 ± 0.95 ^{cA}	20.00 ± 0.73 ^{aB}	96.33 ± 0.61	97.33 ± 0.49
60	101.18 ± 0.62 ^c	101.60 ± 0.14 ^a	117.83 ± 1.93	117.83 ± 1.86	117.17 ± 1.16	117.33 ± 2.06	17.67 ± 0.80 ^{bc}	18.00 ± 0.73 ^a	98.00 ± 0.44	97.67 ± 0.49
90	101.33 ± 0.57 ^c	101.53 ± 0.19 ^a	118.67 ± 1.52	119.00 ± 1.34	117.33 ± 2.04	117.33 ± 2.62	19.00 ± 1.12 ^{ab}	18.17 ± 1.68 ^a	97.67 ± 0.91	97.17 ± 0.70

Means with different lowercase superscripts (a, b, c, d) within a column indicate significant differences over time within the same group ($p < 0.05$).

Means with different uppercase superscripts (A, B) within a row indicate significant differences between groups at the same time interval ($p < 0.05$).

Rapid and smooth induction in both groups was also due to propofol administration, as described by Hofmeister *et al.* (2009) [14]. Anaesthesia was maintained with isoflurane in all dogs, providing an adequate surgical plane without complications. The requirement of isoflurane appeared reduced due to the multimodal drug combination. Kumar *et al.* (2022) [17] reported that opioid and α_2 -agonist combinations reduce inhalant anaesthetic requirements through synergistic sedation and analgesia. Similarly, Pascoe (2015) [26] demonstrated that dexmedetomidine decreases the minimum alveolar concentration (MAC) of isoflurane in dogs.

Table 2: Onset of sedation (minutes)

Groups	Sedation Time
Group I	5.35 ± 0.26
Group II	5.88 ± 0.4

Table 3: Induction time (seconds)

Groups	Induction Time
Group I	37.83 ± 1.14
Group II	39.50 ± 1.45

Table 4: Evaluation of dogs for quality of sedation

Quality of sedation	Score	Number of animals Group-I	Number of animals Group-II
No sedation	1	0	0
Mild sedation	2	0	0
Moderate sedation	3	1	2
Complete sedation	4	5	4

Analgesia assessed by pedal reflex revealed significantly superior analgesia in Group I compared to Group II, particularly during recovery. Enhanced analgesia in Group I is supported by Krimins *et al.* (2012), who reported prolonged analgesia with dexmedetomidine–butorphanol combinations. Pawde *et al.* (2023) [27] also noted reduced nociceptive responses with this combination. In contrast, nalbuphine provided moderate analgesia, consistent with Aqeel *et al.* (2024) [3] and Hamad *et al.* (2022) [13], who reported comparatively shorter duration and moderate analgesic depth with nalbuphine.

Table 5: Degree of analgesia

	Before	Sedation	5 min	Induction	5 min	15 min	45 min	60 min	120 min
Group I	0.00 ± 0.00 ^{aA}	0.50 ± 0.22 ^{bA}	1.67 ± 0.21 ^{cA}	3.00 ± 0.00 ^{dA}	3.00 ± 0.00 ^{dA}	3.00 ± 0.00 ^{dA}	2.67 ± 0.21 ^{dA}	2.00 ± 0.26 ^{cA}	1.00 ± 0.26 ^{bA}
Group II	0.00 ± 0.00 ^{aA}	0.33 ± 0.21 ^{bA}	0.83 ± 0.17 ^{bB}	3.00 ± 0.00 ^{cA}	3.00 ± 0.00 ^{cA}	3.00 ± 0.00 ^{cA}	2.50 ± 0.22 ^{cA}	1.17 ± 0.17 ^{bB}	0.17 ± 0.17 ^{aB}

Means with different lowercase superscripts (a, b, c, d) within a column indicate significant differences over time within the same group ($p < 0.05$).

Means with different uppercase superscripts (A, B) within a row indicate significant differences between groups at the same time interval ($p < 0.05$).

Recovery parameters, including extubation, sternal recumbency, and standing time, were slightly shorter in Group II, although differences were not statistically significant. Recovery was smooth and uneventful in both groups. The relatively faster recovery in Group II may be attributed to the milder sedative effects of nalbuphine. Gomes *et al.* (2019) [10] reported that nalbuphine produces minimal

cardiopulmonary depression and facilitates faster recovery. Zhao *et al.* (2024) [37] also observed shorter awakening times with nalbuphine–dexmedetomidine combinations. Slightly prolonged recovery in Group I may be due to sustained sedative and analgesic effects of butorphanol, as reported by Rafee *et al.* (2015) [29].

Table 6: Recovery parameters

Group	Duration of anaesthesia (minutes)	Extubation Time (minutes)	Sternal recumbency time (minutes)	Complete recovery time (minutes)
Group I	68.83 ± 2.53	4.76 ± 0.10 ^a	6.95 ± 0.15	21.14 ± 0.15
Group II	66.83 ± 1.44	4.31 ± 0.07 ^b	6.73 ± 0.20	20.08 ± 0.19

Means bearing different lowercase superscripts within a column differ significantly ($p < 0.05$) (a,b).

Conclusion

Among the two protocols, the Group I exhibited superior sedation and analgesia compared to the Group II. However, the Group II protocol was associated with shorter recovery time and comparatively lesser cardiopulmonary depression than the Group I. It is concluded that, considering the relative advantages and limitations of both anaesthetic protocols, the Group II protocol is better suited for geriatric patients and those with cardiopulmonary compromise.

Conflict of Interest

Not available

Financial Support

Not available

References

- Aguilera R, Sinclair M, Valverde A, Bateman S, Hanna B. Dose and cardiopulmonary effects of propofol alone or with midazolam for induction of anesthesia in critically ill dogs. *Veterinary anaesthesia and analgesia*. 2020;47(4):472-480.
- Ahmad RA, Amarpal GM. Dexmedetomidine: Systemic effects and clinical application in animals. *The Pharma Innovation Journal*. 2018;7(1):272-278.
- Aqeel M, Tunio AN, Khoso AS, Bhutto MB, Solangi LA, Ali B, Lakhani L. Assessment of pain by comparison of nalbuphine and tramadol with combination of ketamine for ovariohysterectomy in dogs. *Pakistan's Multidisciplinary Journal for Arts and Science*. 2024;5(2):19-36.
- Bispo GA, Cabral de Oliveira T, Moretti MF, Soares MF, Linhares LCM, Souza NSND, *et al.* Dexmedetomidine in healthy dogs: impact on electrocardiographic parameters. *Veterinary Medicine International*. 2025;2025(1):9947159.
- Bufalari A, Miller SM, Short CE, Giannoni G. The use of propofol for induction of anaesthesia in dogs premedicated with acepromazine, butorphanol and acepromazine-butorphanol. *New Zealand Veterinary Journal*. 1997;45(4):129-134.
- Bufalari A, Nilsson LE, Short CE, Giannoni C. A comparative study of neurologically-equivalent propofol anaesthetic combinations in the dog. *Journal of Veterinary Anaesthesia*. 1995;22(1):19-24.
- Chang HC, Li LC, Marsh KC, Tian Y, Grischeau D. Parenteral sustained-release dosage forms of butorphanol for dogs. *International journal of pharmaceutics*. 1999;176(2):147-156.
- Dewangan R, Pal S, Sharda R, Khutey BB, Kumar I, Kurrey L. Sedative, analgesic and anaesthetic evaluation of propofol in combination with butorphanol dexmedetomidine and acepromazine in clinically healthy dogs. *Indian Journal of Animal Research*. 2024;1:1-10.
- Diao HX, Jiang S, Gao PY, Liu HY, Li JN, Fan HG. Comparison of the effects of propofol and emulsified isoflurane alone or combined with dexmedetomidine on induction of anesthesia in dogs. *Veterinary anaesthesia and analgesia*. 2016;43(2):145-152.
- Gomes VH, Barcellos MC, Lima VC, de Moura RA, de Freitas JB, da Silva MF. Effect of three doses of nalbuphine on reversal of sedation and cardiopulmonary effects of morphine-acepromazine in healthy dogs. *Veterinary anaesthesia and analgesia*. 2019;46(4):429-434.
- Gomes VH, Marques JLR, Janiques Borre LDS, de Cerqueira Teixeira JG, da Silva MFA. Comparison of the sedative effects of three nalbuphine doses, alone or combined with acepromazine, in dogs. *American Journal of Veterinary Research*. 2022;83(7):1-8.
- Gomez-Villamandos RJ, Domínguez S, Redondo JI, Fernandez-Sagredo J. Dexmedetomidine or medetomidine premedication before propofol-desflurane anaesthesia in dogs. *Veterinary anaesthesia and analgesia*. 2006;33(3):129-137.
- Hamad AA, Abu-Seida AM, Torad FA, Thabet NS, Gadallah SM. Comparison of the sedative, analgesic, behavioral, hematological and serum biochemistry effects of four analgesics in dogs. *Advances in Animal and Veterinary Sciences*. 2022;10(4):942-954.
- Hofmeister EH, Weinstein WL, Burger D, Brainard BM, Accola PJ, Moore PA. Effects of graded doses of propofol for anesthesia induction on cardiovascular parameters and intraocular pressures in normal dogs. *Veterinary anaesthesia and analgesia*. 2009;36(5):442-448.
- Kim D, Seo M, Choi G, Lee SK, Lee S, Lee WJ, *et al.* Cardiovascular and respiratory effects of increased intra-abdominal pressure with and without dexmedetomidine in anesthetized dogs. *Veterinary Sciences*. 2023;10(11):634.
- Kumar R, Aakanksha AK, Verma NK, Saxena AC, Hoque M. Systemic effects and clinical application of dexmedetomidine. *Pharm Innov J*. 2020;9(11):241-246.
- Kumar R, Kumari A, Verma N, Saxena A, Hoque M. Comparison of the sedative and analgesic effects of butorphanol with acepromazine, midazolam, or dexmedetomidine following propofol induction and isoflurane maintenance in canines. *The Indian Journal of Animal Sciences*. 2022;92(11):1285-1288.
- Kusolphat P, Soimala T, Sunghan J. Intraocular pressure and cardiovascular effects of dexmedetomidine premedication and tiletamine-zolazepam for anesthetic induction in dogs. *Veterinary World*. 2022;15(12):2929-2935.
- Mair AR, Pawson P, Courcier E, Flaherty D. A comparison of the effects of two different doses of ketamine used for co-induction of anaesthesia with a target-controlled infusion of propofol in dogs. *Veterinary anaesthesia and analgesia*. 2009;36(6):532-538.
- Marques MG, Marques AEG, De Siqueira CE, De Sousa EA, Ribeiro YS, Floriano BP, *et al.* Conventional echocardiography and two-dimensional speckle tracking in healthy sevoflurane-anesthetized dogs undergoing

- continuous rate infusion of nalbuphine. *Veterinary Medicine International*. 2020;2020(1):9278751.
21. Mendes GM, Selmi AL, Barbudo-Selmi GR, Lins BT, Figueiredo JP. Clinical use of dexmedetomidine as premedicant in cats undergoing propofol–sevoflurane anaesthesia. *Journal of Feline Medicine and Surgery*. 2003;5(5):265-270.
 22. Monteiro ER, Junior AR, Assis HM, Campagnol D, Quitzan JG. Comparative study on the sedative effects of morphine, methadone, butorphanol or tramadol, in combination with acepromazine, in dogs. *Veterinary anaesthesia and analgesia*. 2009;36(1):25-33.
 23. Murrell J. Dexmedetomidine (Dexdomitor®). *UK Vet Companion Animal*. 2009;14(2):43-48.
 24. Murthy TVSP, Singh R. Alpha-2 adrenoceptor agonist dexmedetomidine: role in anaesthesia and intensive care: a clinical review. *Journal of Anaesthesiology Clinical Pharmacology*. 2009;25(3):267-272.
 25. Nishimura LT, Auckburally A, Santilli J, Vieira BH, Garcia DO, Honsho CS, de Mattos-Junior E. Effects of dexmedetomidine combined with commonly administered opioids on clinical variables in dogs. *American journal of veterinary research*. 2018;79(3):267-275.
 26. Pascoe PJ. The cardiopulmonary effects of dexmedetomidine infusions in dogs during isoflurane anaesthesia. *Veterinary anaesthesia and analgesia*. 2015;42(4):360-368.
 27. Pawde AM, Saxena AC, De UK. Evaluation of dexmedetomidine with and without butorphanol in tiletamine-zolazepam anesthetized dogs for ovariohysterectomy. *Indian Journal of Veterinary Surgery*. 2023;44(2):95-99.
 28. Pottie RG, Dart CM, Perkins NR, Hodgson DR. Effect of hypothermia on recovery from general anaesthesia in the dog. *Australian veterinary journal*. 2007;85(4):158-162.
 29. Rafee MA, Kinjavdekar P, Amarpal HP. Effect of dexmedetomidine with or without butorphanol on the clinico-physiological and haemodynamic stability in dogs undergoing ovariohysterectomy in midazolam and ketamine anaesthesia. *International Journal of Scientific and Research Publications*. 2015;5(5):1-7.
 30. Ravasio G, Amari M, Locatelli C, Ferrari F, Jacchetti A, Bronzo V, Brioschi FA. Dexmedetomidine or butorphanol for co-induction of general anaesthesia with propofol in unpremedicated healthy dogs: clinical and echocardiographic assessment. *Veterinary Sciences*. 2025;12(9):885-895.
 31. Sethi S, Singh J, Nath I, Johnson D. Clinico-physiological and haemodynamic evaluation of butorphanol-xylazine/dexmedetomidine-ketamine anaesthesia in canine pyometra patients. *Indian Journal of Canine Practice*. 2018;10(2):163-167.
 32. Springfield D, KuKanich B, Gray M, KuKanich K, Lai P. Dosing protocols to increase the efficacy of butorphanol in dogs. *Journal of veterinary pharmacology and therapeutics*. 2022;45(6):516-529.
 33. Torad FA, Hassan EA. Sedative, analgesic, and behavioral effects of nalbuphine-xylazine and nalbuphine-midazolam combinations in dogs. *Journal of Veterinary Behavior: Clinical Applications and Research*. 2018;28:40-45.
 34. Trimble T, Bhalla RJ, Leece EA. Comparison of sedation in dogs: methadone or butorphanol in combination with dexmedetomidine intravenously. *Veterinary anaesthesia and analgesia*. 2018;45(5):597-603.
 35. Wagner MC, Hecker KG, Pang DSJ. Sedation levels in dogs: a validation study. *BMC Veterinary Research*. 2017;13(1):110-120.
 36. Wang P, Chen Y, Guo Y, Cao J, Wang H, Mi W, *et al*. Comparison of propofol-nalbuphine and propofol-fentanyl sedation for patients undergoing endoscopic retrograde cholangiopancreatography: a double-blind randomized controlled trial. *BMC anesthesiology*. 2022;22(1):47-55.
 37. Zhao GG, Lou C, Gao RL, Lei FX, Zhao J. Combined use of dexmedetomidine and nalbuphine in laparoscopic radical gastrectomy for gastric cancer. *World Journal of Gastrointestinal Oncology*. 2024;16(7):2952-2960.

How to Cite This Article

Prasad ANV, Lavanya K, Kalaka R, Ramesh P. Clinical and cardiopulmonary effects of nalbuphine–dexmedetomidine and butorphanol–dexmedetomidine premedication with propofol–isoflurane anaesthesia in dogs undergoing elective ovariohysterectomy. *International Journal of Veterinary Sciences and Animal Husbandry*. 2026;11(4):91-95.

Creative Commons (CC) License

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.