Indian J. Vet. Surg. 47(2): 176-179, August 2026

SHORT COMMUNICATION

Propofol, etomidate, and their combination for induction of anaesthesia in atropine and dexmedetomidine premedicated goats undergoing orthopaedic interventions

Vijay Mali[1], Dharmendra Kumar[2]*, Neelam Tandia[3], Priya Singh[4], Shailendra Singh[5], Varimadugu Siva Sai krishna[1], Tanya Pawar[1], Tejasvi Meshram[1] and Yash Sharma[1]

Nanaji Deshmukh Veterinary Science University, Jabalpur- 486 001 (Madhya Pradesh)

[1]MVSc Scholar, [2]Professor, [3]Associate Professor,[4]Assistant Professor, Department of Veterinary Surgery; [5]Associate Professor, Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, Rewa.

DOI No.: 10.5958/0973-9726.2026.00047.1 *Accepted: April 2026*

The study was conducted to compare propofol, etomidate and their combination (etofol) for anaesthesia in atropine and dexmedetomidine premedicated goats undergoing orthopaedic procedures. Eighteen goats were randomly divided into three groups, having six each. All animals were premedicated with atropine sulphate (0.045 mg/kg body weight, i.m.) and dexmedetomidine (10 µg/kg, i.v.). Induction of anaesthesia was done with etomidate (1-2 mg/kg, i.v.), propofol (4 mg/kg, i.v.), and etofol (1:1 ratio, i.v.), and maintained using etomidate, propofol, and etofol (as required) in groups A, B, and C, respectively.

Etofol demonstrated superior haemodynamic stability, improved muscle relaxation, and smoother induction compared with propofol or etomidate alone. Although heart rate, respiratory rate, rectal temperature, mean arterial pressure, and SpO_2 showed variations among the groups, all parameters remained within physiological limits throughout the study period. Recovery was significantly faster in the etomidate group. No adverse effects were observed with any of the anaesthetic protocols. Based on the overall anaesthetic performance, etofol appears to be the preferred induction agent in atropine- and dexmedetomidine-premedicated goats undergoing orthopaedic interventions.

Keywords: Dexmedetomidine, Etofol, Etomidate, Propofol,

General anaesthesia in goats is typically induced with intravenous agents and maintained with either inhalation or intravenous drugs. Intravenous anaesthetic agents offer ease of administration, minimal equipment needs, reduced environmental impact and greater intra-operative cardiovascular stability. Premedication with anticholinergics like atropine is used to prevent bradycardia and reduce salivary and tear secretions by inhibiting vagal stimulation (Alvaides *et al*., 2008). Dexmedetomidine provides sedation, analgesia, and anaesthetic-sparing effects and attenuates haemodynamic responses to surgical stimuli (Kumar *et al*., 2014). Etomidate through GABAergic inhibition causes CNS depression and hypnosis (Grimm *et al*., 2015). Propofol, a short-acting sedative-hypnotic agent, is ideal for induction and maintenance due to its rapid onset and recovery. The combination of etomidate and propofol known as etofol, offers a synergistic effect, haemodynamic stability with smooth induction and recovery, and minimizes side effects. Hence the present study was conducted to evaluate propofol, etomidate, and their combination for induction of anaesthesia in atropine and dexmedetomidine premedicated goats undergaoing orthopaedic procedures.

Eighteen goats were used in this study with approval from the institutional ethical committee (letter No. 142/IAEC/Co.V.Sc./Rewa/2024). All the animals were randomly divided into three groups, having six animals each. All the animals were premedicated with atropine sulphate (0.045 mg/kg body weight, i.m.) and dexmedetomidine (10 µg/kg, i.v.). Anaesthetic induction was made with etomidate (1-2 mg/kg, i.v.), propofol (4 mg/kg, i.v.), and etofol (1:1 ratio, i.v.), and maintained using etomidate, propofol, and etofol (as required) in groups A, B, and C, respectively. Heart rate, respiratory rate, rectal temperature, mean arterial pressure and oxygen saturation were record at 0, 15, 30, 45, 60, 75 and 90 min intervals. The data were analyzed using "SPSS Statistics Version 20" software (Snedecor and Cochran, 1994).

The heart rate (HR) decreased significantly in group A, at 15 min post-induction, with values continuing to decline up to 90 min. These findings are consistent with Kutter *et al*. (2006) and Kamble *et al*. (2021). The animals of group B also exhibited a similar trend, with a significant decrease in HR at 15 min followed by further decrease throughout. The decline in HR may be attributed to propofol-induced vasodilation and reduced myocardial contractility (Lumb *et al*., 2007). Group C demonstrated a gradual, non-significant reduction in HR across all time intervals and stabilized by 75-90 min as also reported by Bansal *et al.* (2022). No significant differences recorded among different groups; however, group C showed the most stable HR profile.

The respiratory rate (RR) decreased non-significantly in group A at 15 min interval, which remained so till 90 min with minimal fluctuations. Kamble *et al*. (2021) reported non-significant reduction of RR following dexmedetomidine and etomidate

*Corresponding author; E-mail: dharmendrabrooke@gmail.com

Table 1: Mean±SE values of heart rate, respiratory rate and rectal temperature in different groups.

Time (in min)	Heart rate (beats/min)			Respiratory rate (breaths/min)			Rectal temperature (°F)		
	Gr A	Gr B	Gr C	Gr A	Gr B	Gr C	Gr A	Gr B	Gr C
0	94.83^{B}± 1.52	92.50^{C}± 2.40	92.00^{A}± 5.32	21.16^{A} ± 1.77	20.83^{A}± 1.97	21.83^{B}± 1.30	102.90^{D}± 0.09	102.60^{B}± 0.34	102.82^{C}± 0.24
15	87.33^{A}± 2.51	82.67^{B}± 4.37	85.67^{A}± 6.31	20.67^{A}± 1.62	18.67^{A}± 1.14	20.67^{AB}± 1.23	102.75^{D}± 0.08	102.45^{B}± 0.29	102.17^{C}± 0.18
30	84.67^{A}± 2.03	78.83^{AB}± 2.14	83.67^{A}± 6.50	19.00^{A}± 1.03	19.50^{A}± 1.61	19.67^{AB}± 0.80	102.48^{CDb}± 0.15	101.70^{ABab}± 0.38	101.33^{Ba}± 0.24
45	83.17^{A}± 1.47	74.67^{A}± 2.29	83.33^{A}± 6.57	19.00^{A}± 1.26	19.00^{A}± 1.71	19.00^{AB}± 0.81	102.20^{BCD}± 0.20	101.53^{AB}± 0.42	101.21^{B}± 0.30
60	$81.83^{A\pm}$ 2.59	73.83^{A}± 1.80	79.33^{A}± 6.16	18.33^{A}± 1.36	18.00^{A}± 0.86	18.00^{A}± 0.81	101.78^{ABC}± 0.25	100.95^{A}± 0.60	101.00^{B}± 0.27
75	80.83^{A}± 2.90	73.00^{A}± 2.11	77.50^{A}± 6.12	18.67^{A}± 1.56	18.33^{A}± 0.88	18.50^{A}± 0.84	101.51^{AB}± 0.31	100.78^{A}± 0.52	101.03^{B}± 0.27
90	80.00^{A}± 3.14	73.00^{A}± 2.37	77.33^{A}± 6.25	18.50^{A}± 1.56	18.67^{A}± 2.65	18.67^{A}± 0.92	101.33^{Ab}± 0.41	100.60^{Aab}± 0.52	100.02^{Aa}± 0.27

Means within row with different lower-case superscripts (a, b, c) differ significantly among groups (P≤0.05); Means within column with different upper-case superscripts (A, B) differ significantly within groups (P≤0.05).

Table 2: Mean±SE values of mean arterial pressure and oxygen saturation.

Time (in min)	Mean arterial pressure (mmHg)			Oxygen saturation (SpO_2; %)		
	Gr A	Gr B	Gr C	Gr A	Gr B	Gr C
0	98.16^{B}±1.49	96.33^{C}±2.57	96.66^{B}±2.76	97.33^{B}±0.61	96.16±0.94	96.33±0.66
15	94.00^{A}±0.89	93.83^{C}±4.0	90.33^{A}±1.22	96.16^{AB}±0.54	95.50±0.42	96.17±0.66
30	94.16^{A}±0.83	293.83^{BC}±3.41	89.16^{A}±1.42	97.00^{AB}±0.73	96.33±0.76	97.00±0.68
45	93.66^{Ab}±1.42	89.33^{ABCab}±1.97	87.66^{Aa}±1.60	96.33^{AB}±1.05	95.50±0.99	95.66±0.95
60	92.33^{Ab}±1.38	84.83^{ABa}±1.95	87.83^{Aab}±1.74	95.16^{AB}±0.60	95.50±0.61	95.33±0.66
75	91.16^{A}±1.37	87.00^{A}±2.70	87.50^{A}±1.80	95.00^{AB}±0.36	95.66±0.61	95.00±0.51
90	90.00^{A}±1.69	85.66^{A}±2.45	87.33^{A}±1.49	95.50^{A}±0.61	95.33±0.61	95.83±0.94

Means within row with different lower-case superscripts (a, b, c) differ significantly among groups (P≤0.05); Means within column with different upper-case superscripts (A, B) differ significantly within groups (P≤0.05)

administration. Group B showed a similar non-significant decrease in RR at 15 min, followed by minor fluctuations throughout the observation period; with a slight increase at 30 min, followed by a decrease until the end. These results correspond with findings from Prassinos *et al*. (2005) and Brohi *et al*. (2019) in ruminants. In group C, a non-significant decrease in RR was observed up to 45 min, followed by a significant decline at 60 min and a non-significant increase thereafter. Kumar (2023) also noted similar biphasic trends in buffaloes after etofol administration. Comparison among groups revealed no statistically significant difference. The observed decreases across all groups are likely due to the sedative effects of etomidate and propofol, both of which enhances GABAnergic neurotransmission leading to central respiratory suppression and reduced oxygen demand (Clancy, 2023).

A non-significant decrease in rectal temperature (RT) was noted at 15 min in all groups. In group A, RT showed a gradual decline with a non-significant decrease at 45 min and a significant drop at 60 min compared to baseline. The lowest value was recorded at 90 min. Kamble *et al*. (2021), Kumar (2023) and Singh (2024) also reported similar reductions in RT following etomidate use. The decrease may be attributed to the CNS depressant effects of etomidate, impairing hypothalamic thermoregulation and causing vasodilatation and heat loss. In group B, RT decreased non-significantly until 45 min, followed by a significant decrease from 60 min onward. Kumar *et al*. (2014) and Ragab *et al*. (2022) have also reported hypothermia with dexmedetomidine-propofol combinations. The hypothermic effect is likely due to propofol's suppression of hypothalamic thermoregulatory function and peripheral heat loss via vasodilatation (Lumb *et al*., 2007). Group C recorded significant temperature reduction at 30 min followed by a non-significant decline through 75 min and significant drop at 90 min interval. Intergroup comparison revealed no significant differences among groups except at 30 and 90 min, where group A recorded higher temperature than group C.

In group A, a significant reduction in mean arterial pressure (MAP) was recorded at 15 min post-induction compared to baseline with a continued downward trend observed throughout the study. The lowest MAP value was observed at 90 min. Sprung *et al*. (2000), Karki and Singh (2017), and Singh (2024), observed drop in MAP following etomidate administration, which might be attributed to negative inotropic effects and myocardial depression, decreased vascular resistance and diminished sympathetic outflow. In group B, MAP showed a gradual, non-significant decline from the baseline till the end of 45 min. A further non-significant decrease was noted at 60 min, which represented the lowest MAP observation. Similar observations were recorded by Kumar *et al*. (2014), and Thomas and Lerche (2003). Group C recorded a significant reduction in MAP from 15 min to 90 min of observation period, with no significant difference from other two groups at most intervals. Karthik *et al*. (2019) reported improved haemodynamic stability with a 1:1 etomidate-propofol combination. Similarly, Bansal *et al*. (2020) reported that etofol offers shorter induction and better haemodynamic control than either agent alone due to the synergistic anaesthetic effects including vasodilation and myocardial depression.

In group A, SpO2 levels showed a non-significant decrease from 5 min till the end with a significant decrease at 90 min. Hareesh *et al*. (2018) also reported non-significant reductions in SpO2 after etomidate administration in dogs. In group B, SpO2 values fluctuated non-significantly throughout the observation period, with the lowest value recorded at 90 min. Suarez *et al*. (2012) and Kumar *et al*. (2018), noted similar non-significant SpO2 changes following propofol administration in dogs and goats, respectively. Group C demonstrated stable SpO2 levels throughout the study period. Overall, oxygen saturation remained within a narrow, clinically acceptable range, suggesting stable respiratory and haemodynamic performance. Karthik *et al*. (2019) and Viburajah and Selvaraj (2024), have reported superior haemodynamic stability with etofol.

Based on the findings of this study, etofol appears to be the superior anaesthetic induction agent for atropine and dexmedetomidine premedicated goats undergoing orthopaedic procedures.

References

Alvaides, R.K., Neto, F.J., Aguiar, A.J., Campagnol, D. and Steagall, P.V. 2008. Sedative and cardiorespiratory effects of acepromazine or atropine given before dexmedetomidine in dogs. Vet. Rec. **162**: 852-856.

Bansal, V., Sisodia, R.S., Tiwari, D. and Bhargava, S. 2020. A comparative study of effect of propofol, etomidate and propofol-etomidate admixture on haemodynamic response and on bis values at induction of general anaesthesia-a RCT. Int. J. Health Clin. Res**. 3**: 61-67.

Brohi, R.D., Kalhoro, A.B., Kachiwal, A.B., Kalhoro, I.B., Kalhoro, D.H. and Bhattaria, D. 2019. Comparative effect of propofol and thiopentone sodium in sheep sedated with xylazine hydrochloride. Pak. J. Zool. **51**: 1-7.

Clancy, N. 2023. The Veterinary Nurse's Practical Guide to Small Animal Anaesthesia, 1st edn. Wiley Blackwell, UK. pp 160-180.

Grimm, K.A., Lamont, L.A., Tranquilli, W.J., Greene, S.A. and Robertson, S.A. 2015. Lumb and Jones' Veterinary Anesthesia and Analgesia, 5th edn., Wiley-Blackwell Publ., England. pp 28-30.

Hareesh, A.U., Veena, P., Dhanalakshmi, N. and Veerabrahmaiah, K. 2018. Comparative evaluation of etomidate and propofol anaesthesia following atropine, diazepam and fentanyl premedication in geriatric dogs. Int. J. Curr. Microbiol. Appl. Sci. **7:** 3144-3150.

Kamble, M., Sharda, R., Dewangan, R., Tiwari, S. K., Ali, S.L., Jolhe, D.K. and Kalim, M.O. 2021. Comparative evaluation of clinico-physiological effect of total intravenous anaesthesia of etomidate in midazolam and dexmedetomidine premedication in dogs. J. Pharm. Innov. **10**: 15-20.

Karki, G. and Singh, V. 2017. Comparative evaluation of induction characteristics of propofol and etomidate during general anaesthesia. Indian J. Clin. Anaesth. **4**: 447-452.

Karthik, P., Alarasan, A.K., Balamurugan, B. and Mathews, L. 2019. Haemodynamic effects of etomidate, propofol and their combination on induction and intubation: A prospective randomized clinical trial. Indian J. Clin. Anaesth. **6**: 180-186.

Kumar, A. 2023. Evaluation of etomidate, propofol and their combination as induction agents in buffaloes undergoing diaphragmatic herniorrhaphy. MVSc thesis, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar-125 001 (Haryana), India.

Kumar, R., Kinjavdekar, P., Amarpal, A., Aithal, H.P., Pawde, A.M., Kumar, A., Singh, J., Khattri, S. and Madhu, D.N. 2014. Clinicophysiological, haematobiochemical and haemodynamic effects of propofol and ketamine with dexmedetomidine in urolithic goats. Vet. World. **7**: 566-573.

Kumar, R., Kinjavdekar, P., Amarpal, Aithal, H.P., Pawde, A.M., Singh, J. and Khattri, S. 2018. Comparative evaluation of propofol and ketamine total intravenous anaesthesia (TIVA) with dexmedetomidine and butorphanol in goats. Indian J. Anim. Sci. **88**: 667-671.

Kutter, A.P., Kastner, S.B.R., Bettschart Wolfensberger, R. and Huhtinen, M. 2006. Cardiopulmonary effects of dexmed-etomidine in goats and sheep anaesthetised with sevoflurane. Vet. Rec. **159**: 624-629.

Lumb, W.V., Tranquilli, W.J., Jones, E.W., Thurmon, J.C., and Grimm, K.A. 2007. Lumb and Jones' Veterinary Anesthesia and Analgesia, 4th edn. Blackwel Publishing. pp 280-281.

Prassinos, N.N., Galatos, A.D. and Raptopoulos, D. 2005. A comparison of propofol, thiopental or ketamine as induction agents in goats. Vet. Anaesth. Analg. **32**: 289–296.

Ragab, G., Hassan, S.E., Fathi, M.Z. and Hagag, U. 2022. Clinico-physiological and haemato-biochemical effects of dexmedetomidine or diazepam with ketamine and propofol in total intravenous anaesthesia in goats. Beni-Suef Univ. J. Basic Appl. Sci. **11**: 1-12.

Singh, A. 2024. Comparative evaluation of etomidate, tiletamine-zolazepam and ketofol in conjunction with glycopyrrolate, pentazocine-lactate and midazolam for surgical intervention in dogs. MVSc thesis, Nanaji Deshmukh Veterinary Science University, Jabalpur-482 004 (Madhya Pradesh), India.

Sprung, J., Ogletree-Hughes, M.L. and Moravec, C.S. 2000. The effects of etomidate on the contractility of failing and nonfailing human heart muscle. Anesth. Analg. **91**: 68-75.

Suarez, M.A., Dzikiti, B.T., Stegmann, F.G. and Hartman, M. 2012. Comparison of alfaxalone and propofol administered as total intravenous anaesthesia for ovariohysterectomy in dogs. Vet. Anaesth. Analg. **39**: 236-244.

Thomas, J. and Lerche, P. 2003. Anesthesia and Analgesia for Veterinary Technicians, 4th edn. Elsevier Health Sciences. pp 61-65.

Viburajah, V. and Selvaraj, V. 2024. Comparative evaluation of effect of propofol, etomidate and a combination of propofol and etomidate on the hemodynamic response to induction and endotracheal intubation: A prospective randomized double blinded study. J. Anesth. **32**: 20-26.