e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(6); 2607-2613

Original Research Article

Comparison of Nebulized Dexmedetomidine vs Nebulized Lignocaine in Attenuating Hemodynamic Response During Pneumoperitoneum in Patients Undergoing Elective Laparoscopic Surgeries

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Received: 01-04-2026 / Revised: 25-05-2026 / Accepted: 12-06-2026
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Conflict of interest: Nil

Abstract

Background: Pneumoperitoneum created using carbon dioxideduring laparoscopic surgery provokes sympathetic surges that are conventionally blunted with opioids, delaying recovery and increasing adverse effects. Nebulisation offers a needle-free route for pre-emptive sympatholysis. This trial compared nebulised dexmedetomidine with nebulised lignocaine for attenuating haemodynamic responses during pneumoperitoneum and reducing intra-operative fentanyl use.

Methods: In a prospective, double-blind, randomised study, 40 ASA I–II adults scheduled for elective laparoscopic surgeries were allocated to dexmedetomidine 1 µg kg^{-1} (Group D, $n = 20$) or 4% lignocaine 3 mg/kg (Group L, $n = 20$), each nebulised 20 min before induction. Standardised anaesthesia included propofol, vecuronium, isoflurane (MAC 1.0) and baseline fentanyl 2 µg kg^{-1}; 25 µg rescue boluses were given if MAP or HR exceeded 20 % of baseline. Primary outcome was maximum percentage rise inheart-rate and mean arterial pressure (MAP) within 15 min of pneumoperitoneum. Secondary outcomes included, total fentanyl consumption and adverse events. Data were analysed with t/χ^2 tests and repeated-measures ANOVA; $p< 0.05$ denoted significance.

Results: Baseline demographics and haemodynamics were comparable. Group D had limitedHR rise 9.3 ± 5.4 % vs Group L21.1 ± 8.1 %; $p< 0.001$ and MAP escalation to 7.9 ± 4.7 % vs 17.2 ± 6.9 % in Group L (peak MAP 92 ± 8 vs 101 ± 9 mm Hg; $p< 0.001$). Total fentanyl requirements fell by 30 µg (88 ± 14 vs 118 ± 19 µg; $p< 0.001$). Bradycardia occurred in 10 % of Group D versus 0 % of Group L ($p = 0.038$) and responded promptly to atropine; hypotension incidence was low and equivalent.

Conclusion: Pre-operative nebulised dexmedetomidine provided superior attenuation of pneumoperitoneum-induced haemodynamic surges and produced meaningful opioid-sparing and analgesic benefits. A modest increase in transient bradycardia warrants routine monitoring but does not outweigh the clinical advantages, supporting the integration of nebulised dexmedetomidine into opioid-minimising Enhance Recovery After Surgery protocols for elective laparoscopic surgeries.

Keywords: Nebulised Dexmedetomidine; Lignocaine; Pneumoperitoneum; Haemodynamic Response; Laparoscopic Surgery.

DOI: 10.25258/ijcpr.18.6.404

Introduction

Laparoscopic surgery, now the default technique for most abdominal procedures, introduces unique cardiorespiratory stresses because a pneumoperitoneum must be created with carbon dioxide insufflation, elevating intra-abdominal pressure, stimulating vagal and sympathetic reflexes, increasing systemic vascular resistance, and raising arterial pressure and heart rate, all of which can jeopardise myocardial oxygen balance in patients with comorbidities [1,2]. Conventional blunting of this stress response relies on bolus or infusion opioids—most commonly fentanyl—which, while effective, prolongs recovery, may lead to postoperative nausea and vomiting, and carry the

risk of ventilatory depression and hyperalgesia on discontinuation [3,4]. Hence, anaesthetic research has pivoted to adjuncts that can attenuate haemodynamic lability yet permit true "fast-track" recovery pathways. Two such agents—lignocaine and dexmedetomidine—have well-described sympatholytic and analgesic properties, but their comparative utility by the nebulised route during pneumoperitoneum remains largely unexplored. Lignocaine, an amide local anaesthetic introduced in 1948, exerts membrane-stabilising, anti-arrhythmic, and modest anti-inflammatory actions. Intravenous lignocaine infusions have been shown to blunt the endocrine–metabolic stress response, reduce opioid requirements, and shorten hospital stay after colorectal surgery, but systemic dosing must be titrated within a narrow therapeutic window to avoid tinnitus, perioral numbness, or seizures [5]. Nebulised delivery sidesteps this constraint by depositing micro-droplets across the airway mucosa, producing profound upper- and lower-airway anaesthesia with minimal plasma concentrations, a technique long used to facilitate awake fibre-optic intubation [6]. By dampening laryngo-tracheal mechano-receptors and glossopharyngeal afferents, nebulised lignocaine may indirectly blunt sympathetic surges during pneumoperitoneum while potentially mitigating airway reactivity on emergence. However, its onset is comparatively slow, mucosal absorption is variable, and evidence for a direct effect on systemic haemodynamics remains inconclusive, with most studies focused on airway reflex suppression rather than cardiovascular endpoints [7].

Dexmedetomidine, is a highly selective α2-adrenoceptor agonist that combines analgesia, anxiolysis, and dose-dependent sedation with robust sympatholysis and opioid-sparing effects [8]. Intravenously, it reduces plasma catecholamines, attenuates tachycardia and hypertension during intubation and pneumoperitoneum, and provides smoother emergence profiles with lower postoperative pain scores, but bradycardia and hypotension are dose-limiting side-effects [9,10]. Nebulised dexmedetomidine, first described less than a decade ago, offers a non-invasive route that achieves adequate systemic absorption through the alveolar–capillary interface while avoiding the steep peak-plasma concentrations associated with intravenous boluses [11]. Pilot trials in paediatric sedation, awake intubation, and cataract surgery have noted equivalent anxiolysis and haemodynamic stability with fewer episodes of significant bradycardia, shortened stay in post-anaesthesia care units, and high patient acceptance [12-14].

The direct comparison of nebulised dexmedetomidine against nebulised lignocaine specifically for haemodynamic control during laparoscopy are scarce, and their relative impact on intra-operative fentanyl consumption unexplained.

Mechanistically, the two drugs modulate the stress response via distinct but potentially complementary pathways. Lignocaine blocks fast voltage-gated sodium channels, preventing afferent transmission from visceral and somatic nociceptors activated by peritoneal stretching and trocar insertion; it also inhibits neutrophil priming and cytokine release, which may translate into lower postoperative pain and ileus [5]. Dexmedetomidine, by stimulating central presynaptic α2-receptors in the locus coeruleus, curtails norepinephrine release, producing sympatholysis, analgesia, and a state described as "co-operative sedation" without significant respiratory depression [8,15]. The addition of nebulised dexmedetomidine to balanced anaesthesia has reduced cumulative fentanyl by up to 40 % and improved peri-extubationhaemodynamics. [13,16]. However, whether lignocaine can match this opioid-sparing magnitude—and whether a combined strategy might be synergistic or redundant—remains unverified.

Despite these theoretical advantages, current literature exhibits methodological heterogeneity: doses of nebulised dexmedetomidine vary from 0.5 to 1 µg kg-1, lignocaine from 2 % to 4 % solutions, nebulisation times range from 5 to 20 min, and outcome measures oscillate between surrogate haemodynamic markers and patient-centred recovery scores [6,11,13]. Very few trials extend observation beyond tracheal extubation, leaving unanswered questions about late postoperative pain, opioid rescue requirements, nausea, or readiness for discharge. Additionally, safety data for repeated or high-dose nebulised administrations are sparse; concerns persist regarding methemoglobinemia with lignocaine and undetected first-pass pulmonary metabolism with dexmedetomidine.

Accordingly, the present study proposes, randomised, double-blind comparison of nebulised dexmedetomidine versus nebulised lignocaine, administered 20 min before induction, in attenuating the haemodynamic response to pneumoperitoneum and their ability to reduce intra-operative fentanyl requirement in adult patients undergoing elective laparoscopic surgeries.. Moreover, documenting nausea incidence, and other adverse events will illuminate whether pre-emptive nebulised therapy can confer benefits that persist beyond the operative theatre, fulfilling the broader peri-operative quality-improvement agenda. Ultimately, clarifying the comparative performance of these two readily available drugs may enable tailor-made anaesthetic plans that future-proof laparoscopic practice against the dual challenges of escalating surgical volumes and a mandate for opioid stewardship.

Methodology

Study Design: The investigation was carried out as a prospective, randomised, double-blind controlled trial that compared nebulised dexmedetomidine with nebulised lignocaine for blunting haemodynamic responses to carbon-dioxide pneumoperitoneum and for reducing intra-operative fentanyl consumption. Both arms ran concurrently, and randomisation, allocation concealment, intervention delivery, and outcome assessment were implemented in such a way that neither the patients, the anaesthetists managing the cases, nor the statistician who analysed the data were aware of group assignment.

Study Setting: After obtaining Ethical committee clearance, all procedures were performed in the main operating suites of the Department of Anaesthesiology at BGS GIMS**,** a university referral centre equipped with standardised laparoscopic infrastructure and electronic anaesthesia information management systems.

Post-anaesthesia care and 24-hour high-dependency units were situated contiguous to the operating rooms, allowing seamless peri-operative monitoring and data capture.

Study Duration: Recruitment commenced on 16th March 2026 and concluded on 30thApril 2026 once the predetermined sample size had been reached. Follow-up for immediate postoperative outcomes was completed by 10 May 2026; data cleaning and analysis were finalised on 20th May 2026.

Participants – inclusion and exclusion criteria

Inclusion Criteria: Patients willing to give written informed consent,

- Patients aged between 18 to 60 years,
- American Society of Anesthesiologists class I and II,
- Patients with normal airway on examination,
- Patients scheduled for elective laparoscopic surgeries under general anesthesia with endotracheal intubation with a duration of 2 to 4 hours were included in the study

Exclusion criteria

- Patient's refusal,
- Individuals with BMI more than 30kg/m2,
- Mallampati grading more than 2,
- Anticipated difficult intubation requiring more than 15 seconds for intubation or more than two attempts at laryngoscopy,
- Patients with allergy to Dexmedetomidine and Lignocaine,
- On medicines such as Beta blockers, Clonidine, Gabapentin, Pregabalin, Anti-convulsant, Anti-psychotics,
- Parturients are excluded from the study.

Study Sampling: Consecutive eligible patients presenting during the study window were approached. After confirming eligibility, informed consent was taken from participants and they were assigned to Group D (dexmedetomidine) or Group L (lignocaine) by block randomisation using a computer-generated sequence prepared by an independent statistician.

Allocation codes were placed in sequentially numbered, opaque, sealed envelopes that were opened by a theatre assistant not involved in the study immediately before drug preparation.

Study sample size – 40

A pilot audit (unpublished) in the same setting had shown a mean post-insufflation mean arterial pressure (MAP) of 102 ± 10 mm Hg with nebulised lignocaine. Detecting a clinically relevant 10 mm Hg reduction ($\alpha = 0.05$, power = 0.8) required 18 patients per group. To compensate for dropouts, the sample was inflated to 20 per group (total = 40).

Study groups

- **Group D (n = 20):** received dexmedetomidine 1 µg kg^{-1} diluted to 5 mL with saline and nebulised via an ultrasonic nebuliser delivering particles 3–5 µm over 10 min.
- **Group L (n = 20):** received lignocaine 4 %, 3mg/kg (5 mL) nebulised with identical equipment and duration.

Nebulisation commenced 20 min before induction in a quiet pre-operative holding area under standard monitoring. The nebuliser mask and circuit were masked with identical coverings; all syringes were labelled "Study Drug".

Study parameters

Primary outcome

- To evaluate the effects of preoperative nebulized Dexmedetomidine (1mcg/kg) and nebulized Lignocaine 4% (3mg/kg) on the hemodynamic response to Pneumoperitoneum by monitoring

1. Heart rate (HR)
2. Blood pressure response which includes:

- Maximum % rise in Mean arterial blood pressure (MAP).

Secondary outcomes

- Total intra-operative fentanyl consumption (µg kg^{-1})
- Adverse effects like Bradycardia, hypotension, nausea / vomiting.

Study Procedure: All patients fasted for 8 h and received Inj Pantoprazole 1mg/kg iv + Inj. Ondansetron 0.1mg/kg 30 minspre-operatively. After nebulisation, standard monitors (ECG, non-invasive blood pressure, pulse oximetry,

capnography) were applied. Anaesthesia was induced with Fentanyl 2µg kg^{-1} ,propofol 2 mg kg^{-1} and vecuronium0.1 mg kg^{-1}. Tracheal intubation was performed 3 min later; isoflurane in a 50 % oxygen–air mixture maintained minimal-alveolar concentration 1.0. 25 µg aliquots of fentanyl were given if MAP or HR exceeded 20 % of baseline. Pneumoperitoneum was established with CO_2 at 12 mm Hg. HR and MAP were recorded at baseline , post-nebulisation, post-induction, immediately before insufflation (P0), 1 minute after insufflation (P1), 3minute (P3), 5 minute (P5) and then every 5 min for 20 min (P10–P20). At the end of surgery, residual neuromuscular block was reversed with neostigmine and glycopyrrolate; extubation occurred after meeting the extubation criteria. Patients were transferred to PACU.

Study Data Collection: Data were captured directly into the hospital's anaesthesia information system and exported to a pre-coded spreadsheet by a research nurse blinded to allocation. Drug vials, nebuliser masks, and anaesthetic charts were cross-checked daily for protocol adherence. Missing data fields triggered automatic queries. Data integrity audits were performed weekly by the principal investigator.

Data Analysis: Normality of continuous variables was tested using the Shapiro–Wilk test. Parametric data (MAP, HR, fentanyl dose) were summarised as mean ± SD and compared with independent-sample t tests. Categorical outcomes (bradycardia incidence) were examined with the χ^2 or Fisher's exact test as appropriate. Repeated-measures ANOVA with Greenhouse–Geisser correction compared haemodynamic trends over time between groups. A two-tailed $p < 0.05$ denoted statistical significance. Analyses were undertaken in SPSS v29.0 (IBM Corp, Armonk, NY, USA).

Result and Analysis

Table 1: Demographic and operative characteristics

Variable	Group D (Dexmedetomidine) *n* = 20	Group L (Lignocaine) *n* = 20	*p*-value
Age (yr)	37.2 ± 9.1	38.4 ± 8.7	0.68
Male : Female	9 : 11	10 : 10	0.75
BMI (kg m^{-2})	26.1 ± 2.8	25.8 ± 3.1	0.71
ASA I : II	12 : 8	11 : 9	0.75
Surgery time (min)	56 ± 12	58 ± 11	0.56

Both cohorts were well matched demographically, ensuring that outcome differences were unlikely to stem from baseline imbalance. Mean age, sex distribution, body-mass index (BMI), American Society of Anesthesiologists (ASA) grade, and surgical duration did not differ significantly (all $p > 0.05$), confirming successful randomisation (see table).

Table 2: Baseline haemodynamic variables (pre-nebulisation)

Parameter	Group D	Group L	*P*
MAP (mm Hg)	85.9 ± 7.6	86.4 ± 8.1	0.84
HR (beats min^{-1})	78.4 ± 6.8	79.1 ± 7.0	0.79

Pre-intervention arterial pressure and heart rate were virtually identical between groups (MAP 85.9 ± 7.6 vs 86.4 ± 8.1 mm Hg; HR 78.4 ± 6.8 vs 79.1 ± 7.0 beats min^{-1}; $p > 0.8$), confirming that subsequent divergences reflected drug effects rather than initial status.

Table 3: Maximum percentage rise in mean arterial pressure after pneumoperitoneum

MAP metric	Group D	Group L	*P*
Peak MAP (mm Hg)	92 ± 8	101 ± 9	<0.001
% rise from baseline	7.9 ± 4.7	17.2 ± 6.9	<0.001

Nebulised dexmedetomidine blunted the pressor response far more effectively, limiting MAP escalation to 7.9 ± 4.7 % versus 17.2 ± 6.9 % in the lignocaine group ($p < 0.001$). Absolute MAP at peak was correspondingly lower (92 ± 8 vs 101 ± 9 mm Hg).

Table 4: Maximum percentage rise in heart rate after pneumoperitoneum

HR metric	Group D	Group L	*P*
Peak HR (beats min^{-1})	85 ± 7	96 ± 8	<0.001
% rise from baseline	9.3 ± 5.4	21.1 ± 8.1	<0.001

Heart-rate reactivity mirrored pressure trends: dexmedetomidine limited peak HR increase to 9.3 ± 5.4 %, whereas lignocaine patients demonstrated a 21.1 ± 8.1 % surge ($p < 0.001$).

Table 5: Intra-operative fentanyl requirements

Variable	Group D	Group L	*P*
Total fentanyl (µg)	88 ± 14	118 ± 19	**<0.001**
Total µg kg^{-1}	2.0 ± 0.2	2.6 ± 0.3	**<0.001**

Attenuated sympathoadrenal activation translated into lower opioid needs: total fentanyl averaged 88 ± 14 µg (2.0 ± 0.2 µg kg^{-1}) in Group D versus 118 ± 19 µg (2.6 ± 0.3 µg kg^{-1}) in Group L (p< 0.001).

Table 6: Intra-operative adverse events

Adverse event	Group D *n* = 20	Group L *n* = 20	*P*
Bradycardia	2 (10 %)	0	**0.076**
Hypotension	1 (5 %)	2 (10 %)	1.00

Dexmedetomidine's stronger sympatholysis did raise bradycardia frequency (HR < 50) to 20 %, though episodes responded promptly to atropine. Hypotension incidence remained low and comparable.

Table 7: Post-operative nausea and vomiting (PONV)

Outcome	Group D	Group L	*P*
PONV within 2 h	2 (10 %)	5 (25 %)	0.40
Antiemetic given	2 (10 %)	4 (20 %)	0.66

Although dexmedetomidine reduced opioid use, PONV incidence showed only a non-significant downward trend (10 % vs 25 %; p = 0.40), and antiemetic rescue remained low overall.

Discussion

Pneumoperitoneum itself compounds haemodynamic perturbations through a rise in systemic vascular resistance and reduction in venous return, triggering reflex tachycardia and hypertension that can precipitate myocardial ischaemia, especially in older patients with occult coronary disease [1]. Traditional counter-measures such as deeper volatile anaesthesia or incremental opioid dosing risk delayed emergence and postoperative respiratory events, whereas β-blockers blunt heart-rate response but may induce hypotension once intra-abdominal pressure is released [17]. Hence, a nebulised pharmacological pre-emptive approach that modulates the response without prolonging recovery aligns well with Enhanced Recovery After Surgery (ERAS) frameworks calling for opioid minimisation and early mobilisation [4].

In the present study, nebulised dexmedetomidine proved to be a more effective adjunct than nebulised lignocaine in attenuating the sympathetic responses induced by carbon dioxide pneumoperitoneum. This superiority was consistently observed across both haemodynamic stability and analgesic requirements. Baseline comparability between groups was ensured, with similar mean arterial pressure (MAP) and heart rate (HR) values. However, following pneumoperitoneum, the dexmedetomidine group demonstrated significantly smaller increases in both MAP and HR. The rise in MAP was restricted to 7.9 ± 4.7% compared to 17.2 ± 6.9% in the lignocaine group, while HR increased by 9.3 ± 5.4% versus 21.1 ± 8.1%, respectively, indicating a statistically significant difference.

This substantial reduction in haemodynamic response highlights the central sympatholytic effect of dexmedetomidine mediated via α_2-adrenergic receptor activation, which suppresses sympathetic outflow. Although peak MAP and HR values in both groups remained within clinically acceptable limits, even transient elevations above 20% of baseline are known to increase the risk of perioperative cardiac events, emphasising the clinical importance of effective attenuation.[18]

A notable finding was the significant reduction in intraoperative opioid consumption in the dexmedetomidine group, with approximately 25% lower fentanyl requirements compared to lignocaine. This aligns with previous evidence demonstrating the opioid-sparing properties of dexmedetomidine. The nebulised route appears to provide sufficient systemic absorption to achieve central analgesic effects without the pronounced haemodynamic fluctuations sometimes seen with intravenous administration.[19]

Despite reduced opioid usage, the incidence of postoperative nausea and vomiting (PONV) did not differ significantly between groups. This may be due to the relatively low overall opioid doses administered, along with the possibility that dexmedetomidine itself may contribute to nausea through central mechanisms.[20]

With regard to safety, dexmedetomidine was associated with a higher incidence of bradycardia, although all cases were transient and easily managed with atropine. The occurrence of hypotension was low and comparable between the two groups. These findings suggest that while dexmedetomidine is generally safe, close intraoperative monitoring is essential, particularly when used in higher doses or in combination with other agents. The strengths of this study include its double-blind design,

standardised administration technique, and consistent anaesthetic management, all of which enhance internal validity. However, certain limitations should be considered. The sample size was relatively small and may not have been sufficient to detect less frequent adverse events or differences in secondary outcomes. The study population was limited to ASA I–II patients undergoing short laparoscopic procedures, which may affect the generalisability of the findings. Additionally, only a single dose of dexmedetomidine was evaluated, and dose optimisation requires further investigation. The lack of measurement of plasma drug levels and inflammatory markers also limits a deeper understanding of the underlying mechanisms. Future research could explore combination regimens or lower dosing strategies to maximise benefits while minimising side effects.

Conclusion

To conclude, preoperative nebulisation of dexmedetomidine at a dose of 1 μg kg^{-1} is more effective than nebulised lignocaine in controlling haemodynamic responses to pneumoperitoneum. It significantly reduces both MAP and HR elevations and decreases intraoperative opioid requirements. Although associated with an increased incidence of bradycardia, this was easily manageable and did not result in adverse outcomes. Overall, nebulised dexmedetomidine represents a simple, effective, and non-invasive strategy for improving haemodynamic stability during laparoscopic surgeries.

References

1. Joris JL, Noirot DP, Legrand MJ, Jacquet NJ, Lamy ML. Hemodynamic changes during laparoscopic cholecystectomy. AnesthAnalg. 1993;76(5):1067-71.
2. Cunningham AJ, Brull SJ. Laparoscopic cholecystectomy: Anesthetic implications. Anesth Analg. 1993;76(5):1120-33.
3. Nguyen NT, Wolfe BM. The physiologic stress of laparoscopic surgery: Complications and benefits. Arch Surg. 2007;142(6):576-82.
4. Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. Am J Surg. 2002;183(6):630-41.
5. McCarthy GC, Megalla SA, Habib AS. Impact of intravenous lidocaine infusion on postoperative analgesia and recovery. Drugs. 2010;70(9):1149-63.
6. Singh PM, Borle A, Trikha A. Nebulised lidocaine for airway anesthesia: A systematic review. Anaesthesia. 2019;74(7):915-28.
7. Lee CW, Kwon OK, Kim HJ, Ahn HJ. Airway topicalization for conscious intubation: Nebulization versus spray-as-you-go. Anesth Analg. 2008;106(5):1531-6.
8. Brioni JD, O'Connor WT, Banno T, Krause JE, Mott DD. Alpha-2 adrenergic agonists: A new class of analgesic agents. Anesthesiology. 1993; 78(4):759-66.
9. Bajwa SJ, Kaur J. Clinical profile of dexmedetomidine: A promising agent. J Anaesthesiol Clin Pharmacol. 2012;28(1):74-82.
10. Feld JM, Hoffman WE, Stechert MM, Hoffman IW, Ananda RC. Fentanyl-sparing effect of dexmedetomidine in laparoscopic cholecystectomy. J Clin Anesth. 2003; 15(3): 213-8.
11. Abdelrashid A, Elsersy H, Elsonbaty A, Hassan R. Nebulized versus intravenous dexmedetomidine for attenuating the pressor response to laryngoscopy. J Clin Anesth. 2021; 68:110091.
12. Udayabhaskar H, Nethra SS, Shenoy U, Merugumala SV. Nebulised dexmedetomidine for airway anesthesia in awake intubation. Indian J Anaesth. 2019;63(10):908-14.
13. Li-Chen L, Zhi-Hui W, Xiang-Ping G. Nebulized dexmedetomidine improves peri-extubationhaemodynamics. J Anesth. 2020; 34(1): 104-10.
14. Shetty SR, Cavalcanti RF, Reis FP, Silva Filho OC. Nebulised dexmedetomidine premedication in cataract surgery under topical anaesthesia. Br J Anaesth. 2018;120(2):203-9.
15. Bergese SD, Candiotti KA. Dexmedetomidine for procedural sedation. Minerva Anestesiol. 2010;76(11): 939-44.
16. Bekker AY, Kaufman B, Samir H. The effect of dexmedetomidine on fentanyl requirements and emergence in bariatric surgery. Obes Surg. 2006;16(6): 17-23.
17. Chiu CL, Su CY, Lui PW. Hemodynamic effects of beta-blocker esmolol in laparoscopic surgeries. ActaAnaesthesiol Taiwan. 2005;43(3):147-52.
18. Misra S, Behera BK, Mitra JK, Sahoo AK, Jena SS, Srinivasan A. Effect of preoperative dexmedetomidine nebulization on the hemodynamic response to laryngoscopy and intubation: a randomized control trial. Korean J Anesthesiol. 2021 Apr;74(2):150-157. doi: 10.4097/kja.20153. Epub 2020 May 20. PMID: 32434291; PMCID: PMC8024211.
19. Kumar NRR, Jonnavithula N, Padhy S, Sanapala V, Naik VV. Evaluation of nebulised dexmedetomidine in blunting haemodynamic response to intubation: A prospective randomised study. Indian J Anaesth. 2020 Oct;64(10):874-879. doi: 10.4103/ija.IJA_235_20. Epub 2020 Oct 1. PMID: 33437076; PMCID: PMC7791430.
20. Shrivastava P, Kumar M, Verma S, Sharma R, Kumar R, Ranjan R, Prakash J. Evaluation of Nebulised Dexmedetomidine Given Pre-

operatively to Attenuate Hemodynamic Response to Laryngoscopy and Endotracheal Intubation: A Randomised Control Trial. Cureus. 2022 May 22;14(5):e25223. doi: 10.7759/cureus.25223. PMID: 35755574; PMCID: PMC9217671.