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Original Research Article

Effect of Perioperative Dexmedetomidine Infusion on Blood Glucose Levels in Non-Diabetic Patients Undergoing Laparoscopic Cholecystectomy: A Randomized Double-Blind Controlled Study

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Conflict of interest: Nil

Abstract

Background: Surgical and anesthetic stress lead to a transient perioperative hyperglycemia thru sympathetic activation, increased counter-regulatory hormone release, hepatic glucose production and insulin resistance. Dexmedetomidine is a selective α2-adrenergic agonist which decreases sympathetic activity and may alter the metabolic stress response. However, its effect on perioperative glucose homeostasis is poorly delineated.

Objective: To assess the impact of perioperative intravenous dexmedetomidine infusion on blood glucose levels in non-diabetic patients undergoing laparoscopic cholecystectomy under general anesthesia.

Materials and Methods: This randomized double-blind placebo-controlled study was conducted on 60 patients aged 18–60 years belonging to American Society of Anesthesiologists physical status I–II and body mass index 20–30kg/m 2 scheduled to undergo elective laparoscopic cholecystectomy. Patients were randomized 1:1 to either dexmedetomidine (Group D, n=30) or normal saline (Group S, n=30). Group D received dexmedetomidine 0.6 µg/kg/h 10 min before induction and 0.5 µg/kg/h after induction. Capillary blood glucose was measured at baseline (T0), 1 hour intraoperatively (T1), 2 hours after extubation (T2) and at 4 and 6 hours postoperatively (T4 and T6). Inter-group comparisons were performed with unpaired t test and $P<0.05$ was considered statistically significant;

Results: Baseline glucose was similar between the two groups (88.20±6.85 vs 87.23±6.70 mg/dL; P=0.583). Glucose increased progressively in both groups but values were significantly lower with dexmedetomidine at T1 (105.80±5.64 vs 110.80±18.99 mg/dL; P=0.044), T2 (117.50±10.95 vs 128.80±17.97 mg/dL; P=0.012), T4 (121.17±15.13 vs 129.83±11.76 mg/dL; P=0.035) and T6 (130.83±11.11 vs 140.57±12.29 mg/dL; P=0.009).

Conclusions: In non-diabetic patients undergoing laparoscopic cholecystectomy, perioperative infusion of dexmedetomidine was associated with a lower perioperative blood glucose increase than saline. These results suggest a potential role of dexmedetomidine in blunting the metabolic response to surgical stress, but larger studies including diabetic patients and longer follow up are needed.

Keywords: Dexmedetomidine; Perioperative Hyperglycemia; Blood Glucose; Laparoscopic Cholecystectomy; Surgical Stress; Sympatholysis; General Anesthesia.

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Introduction

Laparoscopic cholecystectomy is widely used for the surgical treatment of symptomatic gallbladder disease and has the advantages of minimal invasive surgery including less postoperative pain and shorter recovery.

However, both surgical trauma and general anesthesia induce neuroendocrine and inflammatory stress responses that could influence glucose homeostasis. Perioperative hyperglycemia is not confined to patients with diabetes. Surgical stress causes increased sympathetic activity and secretion of catecholamines, cortisol, glucagon and other counter-regulatory mediators. This causes increased hepatic glycogenolysis and gluconeogenesis and impaired insulin-mediated glucose utilization.

This response is associated with release of inflammatory cytokines and transient insulin

resistance. Poor outcomes from surgery have been associated with disturbances in glucose homeostasis during the perioperative period, especially if the hyperglycemia is severe or persistent. [1-4] Laparoscopic surgery is associated with less tissue trauma than open surgery, but still produces measurable systemic stress responses. A randomized trial comparing laparoscopic and open cholecystectomy demonstrated that the minimally invasive approach does not abolish the systemic stress response of surgery. [5] Strategies that dampen sympathetic and neuroendocrine activation may have metabolic and hemodynamic effects.

Dexmedetomidine is an α 2 adrenergic agonist with sedative, analgesic and sympatholytic properties. It is a highly selective It may attenuate the endocrine response to surgical stress by decreasing sympathetic outflow and norepinephrine release. The effect of perioperative dexmedetomidine on endocrine mediators of the stress response has been demonstrated by a meta-analysis. [6] Furthermore, dexmedetomidine has been demonstrated to reduce peri-operative glucose concentrations in specific surgical populations in clinical studies. [7-9]

However, the effect of dexmedetomidine on glucose metabolism is not always consistent. Some studies have shown lower rates of hyperglycemia with lower doses, but a higher risk with higher doses. Differences have been seen dose dependent. [10] Experimental evidence indicates that α2A-adrenergic receptor activity may also be involved in insulin secretion and glucose homeostasis. [11,12] Therefore, the net metabolic impact of dexmedetomidine may be dose-, timing-, patient-, and surgery-specific.

The present study therefore assessed the effect of perioperative intravenous dexmedetomidine infusion on perioperative blood glucose concentrations in non-diabetic patients undergoing laparoscopic cholecystectomy under general anesthesia.

Objective: To determine the effect of intravenous dexmedetomidine infusion on perioperative blood glucose levels in patients undergoing laparoscopic cholecystectomy under general anesthesia.

Materials and Methods

Study Design and Location: This was a randomized, double-blind, placebo-controlled study carried out in the Department of Anesthesiology, Pain and Critical Care, ESIC Medical College and PGIMSR, Rajajinagar, Bengaluru. The study period in this thesis is 18 months. The study was approved by the Institutional Ethics Committee and written informed consent was obtained from all eligible participants before their enrollment into the study.

Participants: Inclusion criteria Patients of either sex, age 18-60 years posted for elective laparoscopic cholecystectomy under general anesthesia. Other eligibility criteria included ASA physical status I or II and BMI 20-30 kg/m2.

Patients were excluded if they had diabetes mellitus or prediabetes, fasting blood glucose ≥100 mg/dL, HbA1c ≥5.7%, known allergy to dexmedetomidine, recent exposure to steroids, use of medications that can alter blood glucose, recent chemotherapy or radiotherapy, immunosuppression, or pregnancy.

All patients were subjected to pre-anesthetic assessment and routine investigations including blood glucose and HbA1c estimation. Preoperative fasting was 6 hours for solids and 2 hours for clear liquids.

Sample Size Calculation: The sample size was computed based on previously reported blood glucose values in a study of perioperative dexmedetomidine in non-diabetic patients. Based on 90% power, 5% alpha error and 1:1 allocation ratio , computed minimum sample size was 24 patients per group. Sample size calculation A sample size of 30 patients in each group was calculated to be appropriate to detect a difference and accounting for dropouts a total of 60 patients were recruited.

Randomization and Masking: Participants were randomly allocated to two groups by random number table generated by computer. Group D received dexmedetomidine and Group S received normal saline as control The study drug was prepared by an anesthesiology resident not involved in subsequent study procedures. Patients, anesthesiologists involved in intraoperative management and investigators responsible for postoperative data collection were blinded to group allocation.

Intervention: Group D received intravenous infusion of dexmedetomidine at a dose of 0.6 μg/kg/h for 10 minutes before induction of anesthesia and 0.5 μg/kg/h after induction.

Group S patients received normal saline as a placebo.

Technique of Anesthetic: Standard monitoring included electrocardiography, non-invasive blood pressure, pulse oximetry and capnography. After preoxygenation for 3 min, midazolam 0.02 mg/kg and fentanyl 2 mg/kg were administered before induction with propofol 2 mg/kg and vecuronium 0.15 mg/kg. Anesthesia was maintained with positive-pressure ventilation with 35% oxygen, 65% nitrous oxide and 1-2% sevoflurane. Laparoscopic cholecystectomy was performed using a standard technique, with pneumoperitoneum pressure maintained < 14

mmHg. Ondansetron, diclofenac and paracetamol were administered before emergence. The neuromuscular blockade was reversed with neostigmine and glycopyrrolate and extubation was carried out after fulfilling the standard recovery criteria.

Blood Glucose Testing: Capillary blood glucose was determined at five predetermined time points with the same Accu-Chek Active glucometer (Roche Diagnostics GmbH, Mannheim, Germany):

- T0: baseline, just before administration of the study drug
- T1: 1 hour during operation
- T2: 2 hours post extubation
- T4: 4 hours post operation
- T6: 6 Hours after surgery

Intravenous fluids without dextrose were administered at a rate of 2 mL/kg/h for 6 hours postoperatively and no dextrose-containing fluid was given during the study period. Postoperatively, patients were kept fasting for 6 hours. The main analysis compared blood glucose levels in the dexmedetomidine and saline groups at predefined time points.

Statistical Analysis: Data were collected using Microsoft Excel and analyzed by SPSS version 26.0. Quantitative variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Chi-square test was used for comparison of proportions and unpaired t test for comparison between two groups. Statistical significance was set at $P<0.05$.

Results

Participant Characteristics: A total of 60 patients were included, with 30 patients allocated to each group. The mean age was 40.8±7.10 years in the dexmedetomidine group and 39.47±5.96 years in the saline group, with no statistically significant difference (P=0.254).

Table 1: Baseline demographic and clinical characteristics

Characteristic	Dexmedetomidine group (n=30)	Saline group (n=30)	P value
Age, years	40.80 ± 7.10	39.47 ± 5.96	0.254
Female, n (%)	21 (70.0)	17 (56.7)	0.284
Male, n (%)	9 (30.0)	13 (43.3)	
BMI, kg/m²	21.773 ± 1.753	21.750 ± 1.732	0.33
ASA I, n (%)	23 (76.7)	25 (83.3)	0.519
ASA II, n (%)	7 (23.3)	5 (16.7)	

The distribution of sex, BMI, and ASA physical status was comparable between the groups.

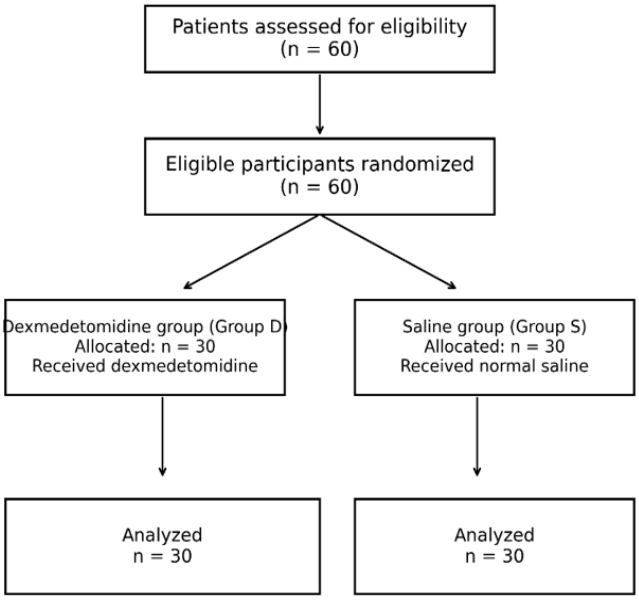

Figure 1: Participant flow through the randomized study

Perioperative Blood Glucose: Baseline glucose concentrations were comparable between groups. Mean glucose was 88.20±6.85 mg/dL in Group D and 87.23±6.70 mg/dL in Group S (P=0.583).

Following induction and surgery, glucose concentrations increased progressively in both groups. However, the increase was consistently greater in the saline group. At T1, glucose was 105.80±5.64 mg/dL in Group D compared with 110.80±18.99 mg/dL in Group S (P=0.044). At T2, mean glucose was significantly lower in Group D than in Group S (117.50±10.95 vs 128.80±17.97 mg/dL; P=0.012). The between-group difference persisted at T4 (121.17±15.13 vs 129.83±11.76 mg/dL; P=0.035) and T6 (130.83±11.11 vs 140.57±12.29 mg/dL; P=0.009).

Table 2: Perioperative blood glucose concentrations

Time point	Dexmedetomidine, mean ± SD (mg/dL)	Saline, mean ± SD (mg/dL)	P value
T0 – Baseline	88.20 ± 6.85	87.23 ± 6.70	0.583
T1 – 1 h intraoperative	105.80 ± 5.64	110.80 ± 18.99	0.044
T2 – 2 h post-extubation	117.50 ± 10.95	128.80 ± 17.97	0.012
T4 – 4 h postoperative	121.17 ± 15.13	129.83 ± 11.76	0.035
T6 – 6 h postoperative	130.83 ± 11.11	140.57 ± 12.29	0.009

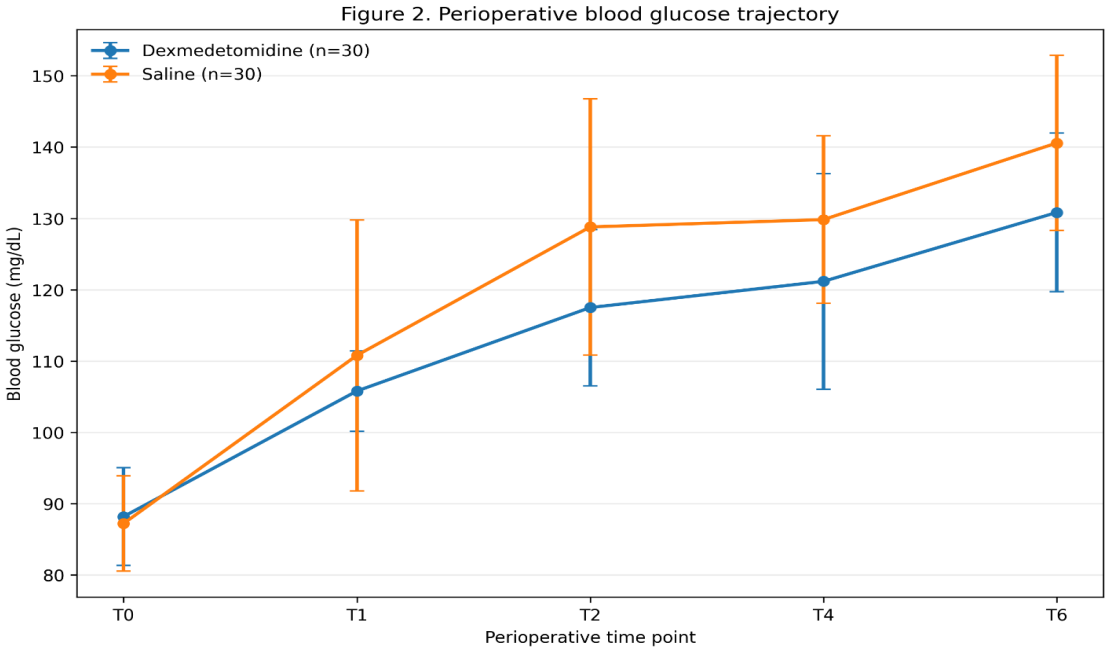

Figure 2: Perioperative blood glucose trajectory

The glucose trajectory demonstrated separation between the groups beginning at T1, with progressively higher glucose concentrations in the saline group through T6. The greatest observed between-group difference was at T6, when mean glucose was 9.74 mg/dL lower in the dexmedetomidine group.

Discussion

The main finding of this randomized double-blind study was that perioperative dexmedetomidine infusion was associated with lower blood glucose concentrations compared with saline in non-diabetic patients undergoing laparoscopic cholecystectomy. In both groups, glucose levels increased over time. The saline group had significantly higher glucose levels from 1 hour intraoperatively to 6 hours postoperatively. Baseline glucose concentrations were similar, supporting the interpretation that the subsequent divergence was temporally related to the perioperative intervention and not to an existing difference between groups.

The surgical stress response includes neuroendocrine and inflammatory response. Activation of the sympathetic nervous system and hypothalamic-pituitary-adrenal axis leads to elevated catecholamine and cortisol levels, while other counter-regulatory hormones increase hepatic glucose production and decrease peripheral glucose utilization.

Thus, surgical stress is linked to a transient state of insulin resistance and hyperglycemia. [1-5] The present study showed this anticipated increase in glucose in patients even without DM, with increasing concentrations during the perioperative period. The lower glucose concentrations with dexmedetomidine are biologically plausible. Dexmedetomidine is a central α2-adrenergic agonist and induces sympatholysis with reduction in norepinephrine release and attenuation of the

neuroendocrine stress response. Meta-analysis of perioperative dexmedetomidine studies showed attenuation of endocrine mediators of surgical stress. [6] Reduced sympathetic activation may lessen the increase in circulating glucose by diminishing catecholamine-induced activation of hepatic glycogenolysis and gluconeogenesis.

The results of previous clinical investigations are broadly consistent with the present study. Intraoperative dexmedetomidine infusion in general anesthesia was related to lower perioperative blood glucose levels than placebo. [8]

Similarly Mostafa et al reported significantly lower perioperative glucose concentrations with dexmedetomidine in non-diabetic patients undergoing laparoscopic bariatric surgery. The difference was present from around 1 hour after surgery till 6 hours postoperatively. [13] The time pattern in that study is especially relevant since the present study also found significant between-group differences starting during the intraoperative period and extending thru postoperative monitoring.

Studies of laparoscopic surgery have also suggested that dexmedetomidine attenuates the metabolic stress response. Gupta et al reported lower blood glucose with dexmedetomidine compared with fentanyl premedication during laparoscopic cholecystectomy 6. Singh et al reported serial glucose changes consistent with attenuation of metabolic and hemodynamic stress responses during laparoscopic surgery 7. [16,17] The thesis also cites a study by Shukla et al, which studied modulation of neuroendocrine stress response during laparoscopic cholecystectomy. [18]

However, the metabolic effects of dexmedetomidine are not necessarily consistent across all clinical settings. Zhou et al. studied dose-related effects of dexmedetomidine in non-diabetic patients undergoing gastrointestinal tumor surgery, and found that the relationship between dexmedetomidine dose and perioperative hyperglycemia may be complex. [10] Experimental studies with α2A-adrenoceptors further support a role for this receptor subtype in glucose homeostasis and insulin secretion. [11,12] Consequently, the lower glucose concentrations observed in the present study need to be interpreted according to the specific dose regimens, patient population and surgical procedure studied.

The present study employed a loading infusion of dexmedetomidine (0.6 μg/kg/h over 10 min) followed by a maintenance infusion (0.5 μg/kg/h after induction). This regimen was associated with lower glucose concentrations at all 4 postbaseline measurements. The absolute difference between groups was around 5 mg/dL at T1, increased to 11.3 mg/dL at T2 and was around 8.7–9.7 mg/dL at T4 and T6. Although these differences were statistically significant, their clinical significance should not be exaggerated, particularly as the glucose values observed remained below the specified hyperglycemic ranges usually linked to major metabolic complications.

A major strength of the study was that enrollment was limited to non-diabetic patients with relatively homogeneous baseline characteristics. Age, sex distribution, BMI and ASA physical status were similar between groups, making it unlikely that major baseline demographic differences contributed to the observed glucose pattern.

Some potential sources of variation were also minimized by standardization of anesthesia, laparoscopic technique, fasting after surgery, and intravenous fluid administration. The use of the same point of care glucose device for all measurements further improved the consistency of the assessment of glucose.

The present study also has important limitations. First, the sample size was quite small with only 30 patients in each group, which limited the precision and generalizability. Second, patients with diabetes and prediabetes were specifically excluded, so the findings cannot be extrapolated directly to patients at greater risk of perioperative dysglycemia. Third, glucose monitoring was discontinued at 6 hours postoperatively, so the duration of the observed effect and its relationship to later postoperative outcomes are unknown. Fourth, detailed peroperative stress hormone concentrations, nutritional status and fluid-related parameters, which are potential determinants of perioperative glucose metabolism, were not well evaluated. These limitations are also acknowledged in the thesis.

A further issue is that in the current study serial blood glucose concentrations were measured, and not formal glycemic variability using a predefined variability metric. Thus, the results should be described as an attenuation of the perioperative glucose rise/trajectory and not as definitive evidence that dexmedetomidine reduces a specific mathematical measure of glycemic variability.

However, the results still suggest that dexmedetomidine may attenuate the metabolic response to laparoscopic cholecystectomy in otherwise healthy non-diabetic adults. This potential effect could be of clinical importance when dexmedetomidine is chosen for its known sedative, analgesic, and sympatholytic properties. Further larger trials are needed to see whether perioperative glucose reduction translates into meaningful improvement of postoperative outcomes and whether a similar effect is observed

in patients with diabetes, prediabetes, obesity, or other conditions with increased metabolic risk.

Conclusion

Perioperative intravenous dexmedetomidine was associated with significantly lower blood glucose concentrations than normal saline in non-diabetic patients undergoing laparoscopic cholecystectomy under general anesthesia.

Although glucose showed a progressive increase in both groups, the increase was blunted in patients receiving dexmedetomidine with significant between-group differences from 1 hour intraoperatively thru 6 hours postoperatively.

These findings indicate that dexmedetomidine may attenuate the metabolic response to surgical stress in this selected population. However, its effect should be interpreted as a potential property for modulating stress response rather than a therapeutic glucose-lowering effect. Larger, appropriately powered studies in diabetic and high-risk surgical populations, longer post-operative follow-up, and clinically relevant outcomes are warranted.

References

1. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth. 1997;78(5):606-617.
2. Duggan E, Chen Y. Glycemic management in the operating room: screening, monitoring, oral hypoglycemics, and insulin therapy. Curr Diab Rep. 2019;19(11):134.
3. Nair BG, Neradilek MB, Newman SF, Horibe M. Association between acute phase perioperative glucose parameters and postoperative outcomes in diabetic and non-diabetic patients undergoing non-cardiac surgery. Am J Surg. 2019;218(2):302-310.
4. Palermo NE, Gianchandani RY, McDonnell ME, Alexanian SM. Stress hyperglycemia during surgery and anesthesia: pathogenesis and clinical implications. Curr Diab Rep. 2016;16(3):33.
5. Karayiannakis AJ, Makri GG, Mantzioka A, Karousos D, Karatzas G. Systemic stress response after laparoscopic or open cholecystectomy: a randomized trial. Br J Surg. 1997;84(4):467-471.
6. Wang XW, Cao JB, Lv BS, Mi WD, Wang ZQ, Zhang C, et al. Effect of perioperative dexmedetomidine on the endocrine modulators of stress response: a meta-analysis. Clin Exp Pharmacol Physiol. 2015;42(8):828-836.
7. Wang K, Wu M, Xu J, Wu C, Zhang B, Wang G, Ma D. Effects of dexmedetomidine on perioperative stress, inflammation, and immune function: systematic review and meta-analysis. Br J Anaesth. 2019;123(6):777-794.
8. Harsoor SS, Rani DD, Lathashree S, Nethra SS, Sudheesh K. Effect of intraoperative dexmedetomidine infusion on sevoflurane requirement and blood glucose levels during entropy-guided general anesthesia. J Anaesthesiol Clin Pharmacol. 2014;30(1):25-30.
9. Hui Yun S, Suk Choi Y. The effects of dexmedetomidine administration on postoperative blood glucose levels in diabetes mellitus patients undergoing spinal anesthesia: a pilot study. Anesthesiol Pain Med. 2016;6(6):e40483.
10. Zhou W, Zhang DS, Tian SP, Tan C, Ma RR, Zhang J, et al. Optimal dose of dexmedetomidine for perioperative blood glucose regulation in non-diabetic patients undergoing gastrointestinal malignant tumor resection: a randomized double-blinded controlled trial. J Investig Surg. 2021;34(8):869-874.
11. Fagerholm V, Grönroos T, Marjamäki P, Viljanen T, Scheinin M, Haaparanta M. Altered glucose homeostasis in alpha2A-adrenoceptor knockout mice. Eur J Pharmacol. 2004;505(1-3):243-252.
12. Savontaus E, Fagerholm V, Rahkonen O, Scheinin M. Reduced blood glucose levels, increased insulin levels and improved glucose tolerance in alpha2A-adrenoceptor knockout mice. Eur J Pharmacol. 2008;578(2-3):359-364.
13. Mostafa RH, Ibrahim IM, Ayoub AH. Effect of perioperative dexmedetomidine infusion on blood glucose levels in non-diabetic morbid obese patients undergoing laparoscopic bariatric surgery. Egypt J Anaesth. 2018;34(3):75-81.
14. Gupta K, Maggo A, Jain M, Gupta PK, Rastogi B, Singhal AB. Blood glucose estimation as an indirect assessment of modulation of neuroendocrine stress response by dexmedetomidine versus fentanyl premedication during laparoscopic cholecystectomy: a clinical study. Anesth Essays Res. 2013;7(1):34-38.
15. Singh I, Gupta K, Gupta PK, Jain M, Rastogi B, Bansal MK. Serial blood glucose level estimation to assess the attenuation of metabolic and hemodynamic stress responses with dexmedetomidine infusion during laparoscopic surgery: a randomized control study. Acad Anesthesiol Int. 2019;4(1):85-89.
16. Shukla U, Kumar M, Srivastava S, Srivastava S. A comparative study of modulation of neuroendocrine stress response by dexmedet omidine versus fentanyl premedication during laparoscopic cholecystectomy. Anesth Essays Res. 2020;14(4):589-593.

17. Fayaz FE, Asad N, Khurshid H, Butt Z, Awan N, Saeed A. Estimation of blood glucose levels and hemodynamic changes during laparoscopic cholecystectomy: a comparison of dexmedetomidine and nalbuphine. Pak Armed Forces Med J. 2022;72(2):435-439.

18. Abd-Elaziz AH, Mickhael HK, Mohammed AK. Effects of dexmedetomidine versus nalbuphine as a premedication on blood glucose level and hemodynamics during gynecological diagnostic laparoscopy. Malaysian J Med Res. 2017;28(1):140-144.