



COMPARISON OF EFFICACY OF TWO DIFFERENT DOSES OF DEXMEDETOMIDINE ON THE HAEMODYNAMIC PARAMETERS OF PATIENTS UNDERGOING LAPAROSCOPIC CHOLECYSTECTOMY: A PROSPECTIVE RANDOMIZED DOUBLE-BLIND STUDY

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Abstract

Objective : To compare the effects of two different doses of Dexmedetomidine infusion (0.3 µg/kg/hour and 0.6 µg/kg/hour) on hemodynamic parameters (SBP, DBP, MAP, HR and SPO₂) during Laryngoscopy, intubation and pneumoperitoneum in patients undergoing laparoscopic cholecystectomy

Material and Methods: This prospective, randomized, double-blind study was conducted in the Department of Anaesthesia at a tertiary care hospital over one and a half years following approval from the Institutional Ethics Committee with sample size of 70 (35 in each group).

Results: Group 2 demonstrated significantly better intraoperative hemodynamic stability. This included lower and more consistent HR and SBP, especially during key stress-inducing events such as intubation, pneumoperitoneum. Postoperatively, Group 2 maintained superior hemodynamic stability, with lower HR and SBP over a 24-hour period compared to Group 1. Group 2 exhibited higher sedation scores immediately postoperatively, but sedation levels became comparable between groups within 4 hours. Patients in Group 2 reported significantly lower VAS scores, indicating better pain control. Group 2 experienced a higher incidence of adverse events, notably bradycardia (22.9% vs. 8.6%) and hypotension (20.0% vs. 5.7%)

Conclusion: The results demonstrate that a higher dose of dexmedetomidine (0.6 µg/kg/h) provides better intraoperative and postoperative hemodynamic stability, superior analgesia, and effective sedation compared to a lower dose (0.3 µg/kg/h). However, the increased incidence of bradycardia and hypotension in the higher dose group necessitates vigilant monitoring and appropriate management.

Keywords : Dexmedetomidine, Pneumoperitoneum, Cholecystectomy, Analgesia

INTRODUCTION

Laparoscopic cholecystectomy is a commonly performed minimally invasive procedure for treating gallstone-related complications. The popularity of this approach has grown significantly over the last two decades due to its advantages over open cholecystectomy, including smaller incisions, reduced postoperative pain, shorter hospital stays, and quicker recovery times^{1,2,3}. However, the use of carbon dioxide (CO₂) in creating capnoperitoneum, which is essential in laparoscopic procedures to improve visualization and space for surgical maneuvers, can lead to significant hemodynamic changes. The induced capnoperitoneum increases intraabdominal pressure, leading to a complex stress response characterized by elevated sympathetic^{4,5}. This often results in an increase in heart rate, systemic vascular resistance, and blood pressure, placing considerable stress on the cardiovascular system, particularly in patients with comorbid conditions such as hypertension or ischemic heart disease.

The hemodynamic challenges associated with laparoscopic cholecystectomy arise primarily from two sources: the physiological response to capnoperitoneum and the perioperative stress response triggered by surgical manipulation. Capnoperitoneum, by elevating intra-abdominal pressure, can reduce venous return and increase systemic vascular resistance, while also triggering a reflex increase in sympathetic tone. Furthermore, certain stages of the procedure, including laryngoscopy, tracheal intubation, and extubation, are known to provoke acute spikes in blood pressure and heart rate. These perioperative stressors necessitate careful hemodynamic monitoring and management, as uncontrolled fluctuations can lead to complications such as arrhythmias, myocardial ischemia, or cerebrovascular incidents in high-risk patients. The need for hemodynamic stability is, therefore, paramount, making pharmacological interventions to mitigate these effects highly relevant^{7,8}.

Various pharmacological agents have been investigated to manage the hemodynamic responses in laparoscopic surgery. Commonly used drugs include beta-blockers, calcium channel blockers, and opioids, which aim to blunt the sympathetic response. However, these agents come with their own set of limitations, including potential side effects like bradycardia, hypotension, and delayed recovery times. Recently, alpha-2 adrenergic agonists, particularly dexmedetomidine, have emerged as effective alternatives due to their unique combination of sympatholytic, sedative, and analgesic properties. Dexmedetomidine mechanism of action involves the activation of alpha-2 adrenoceptors in the central nervous system, leading to decreased sympathetic outflow and increased parasympathetic tone, which can attenuate the hemodynamic responses triggered by both pneumoperitoneum and perioperative stress^{9,10,11,12}.

Dexmedetomidine is a highly selective α_2 -adrenergic agonist, with approximately 8 times higher affinity for α_2 -adrenergic receptors compared to clonidine, another α_2 agonist. This selectivity allows dexmedetomidine to exert its hemodynamic and sedative effects without significant respiratory depression, making it particularly valuable in anaesthesia settings where respiratory stability is crucial¹¹⁻²³. Studies have shown that dexmedetomidine effectively blunts the hemodynamic responses associated with intubation, pneumoperitoneum, and extubation in laparoscopic surgeries. It achieves these effects by reducing the release of catecholamines, thereby lowering blood pressure and heart rate in a dose-dependent manner^{24-26,28-32}.

The dose-dependent effects of dexmedetomidine are of particular interest in the context of laparoscopic cholecystectomy. While lower doses (0.2–0.5 $\mu\text{g/kg/hr}$) have been found effective in attenuating stress responses without causing excessive sedation, higher doses (0.6–1.0 $\mu\text{g/kg/hr}$) offer superior hemodynamic stability but are associated with an increased risk of side effects, such as bradycardia and hypotension^{33,2,3}.

For example, a randomized study evaluating the efficacy of dexmedetomidine in doses of 0.5 and 0.7 $\mu\text{g/kg/hr}$ found both doses significantly effective in maintaining stable hemodynamics throughout pneumoperitoneum and intubation, but the lower dose was preferable due to a lower incidence of sedation-related side effects³. In a separate study, dexmedetomidine at 0.5 $\mu\text{g/kg/h}$ demonstrated effective attenuation of hemodynamic stress response with minimal sedation, making it ideal for cases where quick recovery is desirable³⁴.

Determining the optimal dose of dexmedetomidine for hemodynamic management in laparoscopic cholecystectomy is critical for balancing efficacy with safety. In clinical practice, the choice of dose may depend on patient factors, including age, comorbidities, and the complexity of the procedure. High doses may be warranted in cases where hemodynamic stability is paramount, while lower doses may be preferred in patients with a higher risk of sedation-related side effects or those requiring quicker postoperative recovery³⁵⁻⁴⁰.

OBJECTIVE

To compare the effects of two different doses of Dexmedetomidine infusion (0.3 µg/kg/hour and 0.6 µg/kg/hour) on hemodynamic parameters (SBP, DBP, MAP, HR and SPO₂) during Laryngoscopy, intubation and pneumoperitoneum in patients undergoing laparoscopic cholecystectomy.

MATERIALS AND METHODS

This prospective, randomized, double-blind study was conducted in the Department of Anaesthesia at a tertiary care hospital over one and a half years following approval from the Institutional Ethics Committee with sample size of 70 (35 in each group).

Inclusion criteria required patients to be: Scheduled for elective laparoscopic cholecystectomy, ASA Grade I or II and aged between 18 and 60 years. Patients were excluded if they met any of the following conditions: Obesity (BMI >30 kg/m²), ASA Grade III or IV and Conversion to open surgery.

Procedure: A pre-anaesthetic checkup was conducted, and after obtaining signed consent, patients were selected randomly on the day of the operation. They were assigned to one of two groups according to the randomization schedule.

On the day of surgery, monitors were attached, including an electrocardiogram (ECG), heart rate (HR), oxygen saturation (SpO₂), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) using non-invasive blood pressure (NIBP), and end-tidal CO₂ (EtCO₂). Baseline values were recorded. After establishing intravenous (IV) access, Ringer Lactate infusion was started. The sealed envelope was opened by an anesthesiologist not involved in the study, who then prepared the dexmedetomidine infusion according to the group allocation.

All patients received a loading dose of dexmedetomidine (1 µg/kg), diluted in 10 mL of normal saline, administered over 10 minutes.

□ Group 1 (n=35): Received a maintenance infusion of dexmedetomidine at 0.3 µg/kg/hour until the end of surgery.

□ Group 2 (n=35): Received a maintenance infusion of dexmedetomidine at 0.6 µg/kg/hour until the end of surgery.

The primary investigator was blinded to the group allocations and the specific dose of dexmedetomidine administered. Observations were made throughout the intraoperative and postoperative periods, with the group codes revealed only after the completion of all cases and during data analysis.

Anaesthetic Management:

All patients were premedicated with IV glycopyrrolate 0.01 mg/kg, IV ondansetron 0.1 mg/kg, and IV midazolam 0.05 mg/kg. Patients were preoxygenated with 100% oxygen for three to five minutes through a Bain circuit connected to a face mask. Anesthesia was induced with IV propofol 2 mg/kg, followed by IV vecuronium bromide 0.1 mg/kg to facilitate intubation. Intermittent positive pressure ventilation (IPPV) was administered through a closed circuit with oxygen and nitrous oxide (1:1). Endotracheal intubation was performed with an oral cuffed endotracheal tube of an appropriate size. Additional doses of vecuronium bromide were given as needed. Anesthesia was maintained with oxygen and nitrous oxide (50:50) and sevoflurane (1–3%). The dexmedetomidine infusion was discontinued at the time of skin suturing. IV neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg

were administered for reversal of neuromuscular blockade. Patients were extubated upon return of protective reflexes and transferred to the post-anesthesia care unit (PACU).

Intraoperative Monitoring:

Hemodynamic parameters (HR, SBP, DBP, and MAP) were recorded at baseline, during the bolus infusion, at laryngoscopy and intubation, during pneumoperitoneum, and every five minutes until the end of surgery. Hemodynamic parameters were also recorded at extubation.

Postoperative Monitoring:

1. Hemodynamic parameters were recorded hourly for the first two hours, then every two hours until eight hours post-surgery, and every four hours up to 24 hours in the postoperative period.
2. Recovery from anesthesia was assessed using the Aldrete score before transferring the patient to the ward.
3. Sedation was evaluated using the Ramsay Sedation Score.
4. Pain was assessed using the Visual Analogue Scale (VAS) at two, four, eight, twelve, and twenty-four hours. Patients with a VAS score greater than 3 received rescue analgesia with IV tramadol 1 mg/kg, with the time of administration noted. The duration of analgesia and the total dose of analgesics required over 24 hours were recorded.
5. Adverse effects such as dry mouth, hypotension, bradycardia, nausea, vomiting, and shivering were recorded and treated as necessary.

Statistical Analysis: The data was analysed using IBM SPSS version 25 for analysis. Qualitative data were summarized using frequencies and percentages, while quantitative data were presented as mean, standard deviation, median, and range. A two tailed t-test for independent samples or Mann-Whitney U test was used for continuous variables, while categorical variables were analyzed using the Chi-square test. A pvalue <0.05 was considered statistically significant in all analyses.

RESULTS

A total of 70 patients undergoing elective laparoscopic cholecystectomy were included in the study, with 35 patients in each group: Group 1 (dexmedetomidine infusion at 0.3 µg/kg/h) and Group 2 (dexmedetomidine infusion at 0.6 µg/kg/h).

Table 1: Demographic and Baseline Characteristics of Study Participants

Characteristic	Group 1 (0.3 µg/kg/h)	Group 2 (0.6 µg/kg/h)	Total	p-value
18–30 yrs	8	7	15	
31–40 yrs	10	9	19	
41–50 yrs	9	10	19	
51–60 yrs	8	9	17	
Mean Age (yrs)	42.5 ± 10.3	41.2 ± 9.8		0.62
Gender (M/F)	17/18	16/19		0.83
BMI (kg/m ²)	25.1 ± 2.7	24.8 ± 3.1		0.74
ASA Grade I/II	21/14	22/13		0.78
Baseline HR (bts/min)	76.3 ± 4.5	77.2 ± 5.1		0.57
Baseline SBP (mmHg)	123.4 ± 6.3	124.2 ± 5.8		0.52
Baseline DBP (mmHg)	77.1 ± 4.7	76.9 ± 5.2		0.84
Baseline MAP (mmHg)	92.5 ± 5.1	93.2 ± 4.8		0.65

Table 2: Intraoperative Hemodynamic Parameters

Time Point	Group 1 HR (bpm)	Group 2 HR (bpm)	pvalue	Group 1 SBP (mmHg)	Group 2 SBP (mmHg)	pvalue
After bolus dose	74.3 ± 5.1	69.1 ± 4.8	0.01	118.5 ± 7.2	115.3 ± 6.8	0.05
During intubation	83.6 ± 6.2	78.9 ± 5.7	0.02	130.4 ± 6.7	124.1 ± 5.9	0.01
Creation of pneumoperitoneum	88.3 ± 5.8	82.5 ± 4.9	0.01	138.6 ± 5.9	130.2 ± 6.4	0.003
Every 5 min postpneumoperitoneum	85.4 ± 5.6	79.3 ± 4.5	0.01	135.2 ± 6.3	127.5 ± 5.8	0.004
Extubation	82.5 ± 5.3	77.8 ± 4.7	0.03	128.3 ± 6.1	123.6 ± 5.3	0.02

Time Point	Group 1 HR (bpm)	Group 2 HR (bpm)	pvalue	Group 1 SBP (mmHg)	Group 2 SBP (mmHg)	pvalue
1 Hour Post-op	78.2 ± 4.6	72.8 ± 5.2	0.004	125.3 ± 5.7	119.2 ± 6.1	0.003
2 Hours Post-op	77.5 ± 4.8	71.5 ± 4.9	0.002	123.8 ± 6.0	118.1 ± 5.6	0.01
4 Hours Post-op	76.9 ± 5.1	71.1 ± 5.4	0.01	122.4 ± 5.3	117.3 ± 5.8	0.02
8 Hours Post-op	76.1 ± 5.0	70.8 ± 5.3	0.01	121.6 ± 5.5	116.8 ± 5.7	0.03
24 Hours Post-op	75.3 ± 5.2	70.3 ± 5.1	0.02	120.1 ± 5.4	115.7 ± 5.2	0.04

3: Postoperative Hemodynamic Parameters

Postoperatively, Group 2 maintained lower HR and SBP, with significant differences observed at all time points ($p < 0.05$).

Table 4: Sedation and Recovery Scores

Parameter	Group 1 (0.3 µg/kg/h)	Group 2 (0.6 µg/kg/h)	pvalue
Ramsay Sedation Score (1 hr post-op)	2.1 ± 0.4	3.0 ± 0.5	0.001
Ramsay Sedation Score (4 hr post-op)	1.8 ± 0.3	1.9 ± 0.3	0.55
Aldrete Score (PACU discharge)	9.5 ± 0.6	9.2 ± 0.8	0.09

Group 2 showed significantly higher initial sedation ($p < 0.05$) but had comparable recovery scores by the time of discharge.

Pain was assessed using the Visual Analogue Scale (VAS). Group 2 patients reported lower VAS scores, requiring fewer doses of rescue analgesia (tramadol), indicating prolonged analgesic effects in the higher dose group. Table 5 outlines the postoperative pain scores and analgesia requirements.

Table 5: Pain Scores and Analgesia Requirement

Time Point	Group 1 VAS Score	Group 2 VAS Score	p- value	Group 1 Analgesia (mg)	Group 2 Analgesia (mg)	p- value
2 Hours Post-op	3.2 ± 0.5	2.1 ± 0.4	0.002	100 ± 20	80 ± 15	0.01
4 Hours Post-op	3.0 ± 0.4	2.0 ± 0.5	0.003	80 ± 15	60 ± 10	0.02
8 Hours Post-op	2.8 ± 0.3	1.8 ± 0.4	0.004	60 ± 10	40 ± 10	0.03
12 Hours Post-op	2.5 ± 0.4	1.5 ± 0.3	0.001	40 ± 10	20 ± 5	0.01
24 Hours Post-op	2.0 ± 0.3	1.3 ± 0.2	0.01	20 ± 5	10 ± 5	0.04

Group 2 had significantly lower VAS scores and required less total analgesia than Group 1 ($p < 0.05$). Adverse events, including hypotension, bradycardia, nausea, and dry mouth, were recorded and treated accordingly. Group 2 experienced a higher incidence of bradycardia and hypotension compared to Group 1, though all cases were manageable with conservative measures. Table 6 shows the incidence of adverse events in both groups.

Table 6: Adverse Events

Adverse Event	Group 1 (n=35)	Group 2 (n=35)	p-value
Bradycardia	3 (8.6%)	8 (22.9%)	0.04
Hypotension	2 (5.7%)	7 (20.0%)	0.03
Nausea	4 (11.4%)	3 (8.6%)	0.72
Dry Mouth	5 (14.3%)	6 (17.1%)	0.75

Bradycardia and hypotension were significantly more frequent in Group 2 ($p < 0.05$).

DISCUSSION

The study included 70 patients undergoing elective laparoscopic cholecystectomy, evenly distributed into two groups based on the infusion dose of dexmedetomidine: Group 1 (0.3 µg/kg/h) and Group 2 (0.6 µg/kg/h). The baseline characteristics, including demographic variables such as age, gender, BMI, and ASA grades, were comparable between the two groups. The mean age of participants was 42.5 ± 10.3 years in Group 1 and 41.2 ± 9.8 years in Group 2, with balanced age group distributions across both groups. The similarity in baseline characteristics ensured the groups were well-matched, reducing potential confounding factors in the analysis.

Intraoperative Hemodynamic Stability: Group 2 demonstrated superior intraoperative hemodynamic stability, with significantly lower heart rate (HR) and systolic blood pressure (SBP) at various time points, including after the bolus dose, during intubation, at the creation of pneumoperitoneum, and every five minutes until the end of surgery. For instance, the mean HR during pneumoperitoneum was 82.5 ± 4.9 bpm in Group 2 compared to 88.3 ± 5.8 bpm in Group 1 ($p = 0.01$). Similarly, the SBP during pneumoperitoneum was 130.2 ± 6.4 mmHg in Group 2 versus 138.6 ± 5.9 mmHg in Group 1 ($p = 0.003$). These results indicate that the higher dose of dexmedetomidine (0.6 µg/kg/h) effectively attenuated the hemodynamic stress associated with surgical interventions. However, Group 2 also experienced a higher incidence of bradycardia (22.9%) compared to Group 1 (8.6%), indicating that while higher doses improve stability, they may increase the risk of significant bradycardia.

Postoperative Hemodynamic Parameters: In the postoperative period, Group 2 maintained lower HR and SBP compared to Group 1, indicating prolonged hemodynamic stability. At one hour postoperatively, the HR in Group 2 was 72.8 ± 5.2 bpm versus 78.2 ± 4.6 bpm in Group 1 ($p = 0.004$), and the SBP was 119.2 ± 6.1 mmHg in Group 2 versus 125.3 ± 5.7 mmHg in Group 1 ($p = 0.003$). These differences persisted through the 24-hour monitoring period. The sustained stability highlights the longer duration of action associated with higher dexmedetomidine doses, which may benefit patients requiring extended postoperative monitoring.

Sedation and Recovery : Group 2 exhibited higher sedation scores in the immediate postoperative period, with a Ramsay Sedation Score of 3.0 ± 0.5 compared to 2.1 ± 0.4 in Group 1 at one hour postop ($p = 0.001$). However, sedation scores became comparable between the groups within four hours, indicating that the higher dose provided deeper but transient sedation. Recovery times, as assessed by the Aldrete score, were slightly longer in Group 2, but both groups achieved acceptable recovery scores for PACU discharge.

Pain and Analgesia Requirement : Patients in Group 2 reported significantly lower pain scores throughout the postoperative period. For example, at two hours post-op, the mean Visual Analogue Scale (VAS) score was 2.1 ± 0.4 in Group 2 compared to 3.2 ± 0.5 in Group 1 ($p = 0.002$). Group 2 also required less rescue analgesia, with a total mean tramadol dose of 80 ± 15 mg versus 100 ± 20 mg in Group 1 ($p = 0.01$). These findings suggest that the higher dexmedetomidine dose not only improves hemodynamic stability but also provides superior analgesic effects, reducing the need for additional pain management.

Adverse Events: Group 2 had a higher incidence of adverse events, particularly bradycardia (22.9% vs. 8.6%, $p = 0.04$) and hypotension (20.0% vs. 5.7%, $p = 0.03$). Although these events were manageable with conservative interventions, they highlight the need for cautious monitoring when using higher doses of dexmedetomidine. Other side effects, such as nausea and dry mouth, were similar between the groups.

The results demonstrate that dexmedetomidine at 0.6 µg/kg/h provides better intraoperative and postoperative hemodynamic stability and analgesic effects compared to 0.3 µg/kg/h. However, the higher dose is associated with an increased risk of bradycardia and hypotension, necessitating vigilant monitoring during its use. These findings suggest that the higher dose may be preferable for patients requiring enhanced hemodynamic control and pain relief but should be tailored to individual patient profiles to minimize risks. In contrast, the lower dose may be more suitable for patients with baseline bradycardia or hypotension, balancing stability and safety.

Dexmedetomidine, a highly selective α_2 -adrenergic agonist, has emerged as a pivotal agent in managing perioperative hemodynamics and reducing stress responses in laparoscopic surgeries. Studies consistently show that dexmedetomidine provides significant intraoperative hemodynamic stability. Vora et al. (2015) demonstrated that an infusion of dexmedetomidine at 0.5 $\mu\text{g/kg/h}$ effectively blunted stress responses, maintaining stable heart rate (HR) and blood pressure (BP)¹¹. Similarly, Dongare et al. (2021) found that a lower infusion dose of 0.3 $\mu\text{g/kg/h}$ significantly reduced HR and

BP during laparoscopic cholecystectomy, findings consistent with our Group 1 results²⁷. However, higher doses (0.6 $\mu\text{g/kg/h}$) studied by Khare et al. (2017) and Shi et al. (2020) further enhanced hemodynamic stability, aligning closely with our Group 2 outcomes, which demonstrated superior attenuation of HR and BP changes during pneumoperitoneum and extubation⁴¹.

In comparison, our study confirmed that higher doses of dexmedetomidine (0.6 $\mu\text{g/kg/h}$) were more effective in reducing intraoperative fluctuations in hemodynamic parameters. However, as with these studies, our findings revealed a higher incidence of bradycardia and hypotension in the higher-dose group, emphasizing the need for vigilant monitoring.

Multiple studies have highlighted the analgesic benefits of dexmedetomidine. Bose et al. (2021) and Kulkarni et al. (2019) reported that even low doses (0.2 $\mu\text{g/kg/h}$) provided significant analgesic effects, reducing postoperative opioid requirements^[18,19]. Fasil et al. (2022) confirmed that a single bolus of 1 $\mu\text{g/kg}$ reduced postoperative pain scores and analgesic consumption^[20]. In our study, patients in the higher-dose group (0.6 $\mu\text{g/kg/h}$) required fewer doses of rescue analgesics and reported lower VAS scores, consistent with findings from these studies. Furthermore, studies by Yang et al. (2021) and Ashwini et al. (2015) demonstrated that dexmedetomidine provides excellent sedation with minimal side effects^[21,22]. Our results corroborated these findings, showing higher Ramsay Sedation Scores immediately postoperatively in the higher-dose group, which stabilized within a few hours. Singh et al. (2019) and Shi et al. (2020) emphasized dexmedetomidine's ability to reduce stress markers such as cortisol, norepinephrine, and ACTH during laparoscopic surgeries^[23,17]. These findings align with our observation of reduced hemodynamic stress responses in both groups, particularly in the higher-dose group, during key intraoperative events such as intubation, pneumoperitoneum, and extubation.

Bradycardia and hypotension were notable side effects reported across studies, including Bose et al. (2021) and Fasil et al. (2022)^[18,20]. Higher doses, such as 0.6 $\mu\text{g/kg/h}$ (Khare et al., 2017; Shi et al., 2020), were associated with an increased incidence of these side effects^[16,17]. Our study confirmed these observations, with bradycardia occurring in 22.9% of patients in the higher-dose group compared to 8.6% in the lower-dose group. While these events were manageable, they underscore the importance of tailoring dexmedetomidine dosing to individual patient profiles.

The studies reviewed support a dose-dependent efficacy of dexmedetomidine in maintaining hemodynamic stability, providing analgesia, and attenuating stress responses. Lower doses, such as 0.3 $\mu\text{g/kg/h}$ (Dongare et al., 2021)^[15], are sufficient for mild attenuation of hemodynamic changes but may not provide robust control in more challenging cases. In contrast, higher doses, such as 0.6 $\mu\text{g/kg/h}$ (Khare et al., 2017)^[16], offer superior stability and analgesia, consistent with our findings in Group 2. However, the higher incidence of side effects with larger doses aligns with the observations in other studies.

CONCLUSION

The results demonstrate that a higher dose of dexmedetomidine (0.6 $\mu\text{g/kg/h}$) provides better intraoperative and postoperative hemodynamic stability, superior analgesia, and effective sedation compared to a lower dose (0.3 $\mu\text{g/kg/h}$). However, the increased incidence of bradycardia and hypotension in the higher dose group necessitates vigilant monitoring and appropriate management. Clinicians should consider tailoring dexmedetomidine dosing based on individual patient profiles and procedural requirements. The higher dose is recommended for patients requiring enhanced hemodynamic control and postoperative pain relief, while the lower dose may be more suitable for

patients at risk of bradycardia or hypotension. These findings highlight the importance of balancing efficacy with safety when selecting dexmedetomidine doses for laparoscopic cholecystectomy.

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