



Original Article

Comparison of Dexmedetomidine and Clonidine Infusion During Laparoscopic Cholecystectomy

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ABSTRACT

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Background: Laparoscopic cholecystectomy is associated with sympathetic stimulation and haemodynamic fluctuations due to pneumoperitoneum. Alpha-2 adrenergic agonists such as dexmedetomidine and clonidine are used to improve perioperative stability. This study compared the effects of dexmedetomidine and clonidine infusion during laparoscopic cholecystectomy.

Methods: This prospective randomized comparative study included 110 patients undergoing elective laparoscopic cholecystectomy, allocated into two groups of 55 each. Group D received dexmedetomidine infusion, while Group C received clonidine infusion. Haemodynamic parameters, anaesthetic requirement, postoperative analgesia, recovery profile, and adverse effects were assessed.

Results: Dexmedetomidine provided better haemodynamic stability, with lower heart rate after intubation (86.2 ± 9.5 vs 94.8 ± 10.6 beats/min, $p < 0.001$) and pneumoperitoneum (88.1 ± 9.8 vs 96.2 ± 11.2 beats/min, $p < 0.001$). Fentanyl (112.4 ± 25.6 vs 146.8 ± 31.2 μ g, $p < 0.001$) and propofol requirements (38.5 ± 12.4 vs 56.8 ± 15.7 mg, $p < 0.001$) were significantly lower with dexmedetomidine. It also prolonged analgesia (8.9 ± 2.4 vs 6.7 ± 2.1 hours, $p < 0.001$) and reduced extubation time (8.6 ± 2.1 vs 10.2 ± 2.8 minutes, $p = 0.004$). Adverse effects were comparable between groups.

Conclusion: Dexmedetomidine infusion offers superior haemodynamic control, reduces anaesthetic and opioid requirements, improves postoperative analgesia, and enhances recovery compared with clonidine during laparoscopic cholecystectomy. It may be a preferable anaesthetic adjunct for optimizing perioperative outcomes.

Keywords: Dexmedetomidine, Clonidine, Laparoscopic Cholecystectomy
Haemodynamic Stability, Alpha-2 Adrenergic Agonists.

INTRODUCTION

Laparoscopic cholecystectomy is currently considered the standard surgical approach for the management of symptomatic gallbladder disease because of its advantages, including reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic outcomes compared with open surgery[1]. However, despite being minimally invasive, laparoscopic procedures are associated with significant physiological stress due to carbon dioxide pneumoperitoneum, changes in intra-abdominal pressure, patient positioning, and surgical stimulation. Pneumoperitoneum induces sympathetic activation, resulting in increased catecholamine release, tachycardia, hypertension, increased systemic vascular resistance, and haemodynamic fluctuations, which require effective perioperative management. [2]Balanced general anaesthesia during laparoscopic surgery aims to provide adequate hypnosis, analgesia, and cardiovascular stability while facilitating rapid postoperative recovery. Although opioids and conventional anaesthetic agents are routinely used to suppress surgical stress responses, their use may be associated with adverse effects such as respiratory depression, postoperative nausea and vomiting, excessive sedation, increased opioid consumption, and delayed recovery. Therefore, the incorporation of anaesthetic adjuvants that reduce sympathetic responses, decrease anaesthetic requirements, and improve perioperative outcomes has gained considerable importance. [3,4]Alpha-2 adrenergic receptor agonists, particularly clonidine and

dexmedetomidine, have been extensively studied as anaesthetic adjuncts because of their sedative, anxiolytic, analgesic, and sympatholytic properties. These agents act by stimulating central alpha-2 receptors, leading to inhibition of norepinephrine release and reduction of sympathetic outflow. As a result, they attenuate haemodynamic responses associated with laryngoscopy, tracheal intubation, pneumoperitoneum, and surgical stimulation while reducing the requirement of opioids and anaesthetic drugs. [5,6]Clonidine is an established alpha-2 adrenergic agonist that has been widely used for perioperative analgesia and attenuation of stress responses. It decreases central sympathetic activity, provides sedation and analgesia, and contributes to improved haemodynamic stability during surgery. However, its relatively lower alpha-2 receptor selectivity and prolonged duration of action may increase the risk of adverse effects such as hypotension, bradycardia, and delayed recovery from anaesthesia. [7]Dexmedetomidine is a highly selective alpha-2 adrenergic receptor agonist with approximately eight times greater affinity for alpha-2 receptors compared with clonidine. It produces sedation resembling natural sleep, anxiolysis, analgesia, and sympatholysis while maintaining respiratory function[8]. Due to its favourable pharmacological profile and shorter distribution and elimination half-life, dexmedetomidine is suitable for continuous intravenous infusion during anaesthesia. Studies have demonstrated its ability to attenuate haemodynamic responses, reduce opioid and anaesthetic requirements, and improve postoperative analgesia during laparoscopic procedures. [9,10]Comparative evaluation of dexmedetomidine and clonidine is clinically relevant because both drugs share similar mechanisms of action but differ in receptor selectivity, potency, pharmacokinetics, and clinical effects. Dexmedetomidine may provide superior haemodynamic control and opioid-sparing effects, whereas clonidine remains a cost-effective and widely available alternative. Previous studies comparing these agents during laparoscopic cholecystectomy have shown beneficial effects on intraoperative haemodynamics and recovery characteristics; however, further evaluation is required to determine their relative efficacy and safety profile. [3,8,11]Therefore, the present study was conducted to compare dexmedetomidine and clonidine infusion during laparoscopic cholecystectomy, focusing on intraoperative haemodynamic changes, anaesthetic requirements, postoperative analgesia, recovery characteristics, and adverse effects.

MATERIALS AND METHODS

This prospective, randomized, comparative, double-blinded clinical study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital. The study included patients undergoing elective laparoscopic cholecystectomy under general anaesthesia.

Study Population

A total of 110 patients scheduled for elective laparoscopic cholecystectomy were enrolled in the study and randomly allocated into two groups of 55 patients each. Group D received dexmedetomidine infusion, whereas Group C received clonidine infusion as an anaesthetic adjuvant.

Inclusion Criteria

Patients aged 18–60 years, belonging to American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective laparoscopic cholecystectomy under general anaesthesia were included in the study.

Exclusion Criteria

Patients with significant cardiovascular, respiratory, renal, hepatic, or neurological disorders; uncontrolled hypertension; diabetes mellitus with complications; known allergy to study drugs; patients receiving alpha-2 adrenergic agonists or beta-blockers; pregnant patients; patients with anticipated difficult airway; and those requiring conversion from laparoscopic to open surgery were excluded.

Randomization and Blinding

Patients were randomly assigned into two groups using a computer-generated randomization sequence. Allocation concealment was achieved using sealed opaque envelopes. The study drugs were prepared by an anaesthesiologist not involved in patient assessment. The patients, surgeons, and anaesthesiologists involved in intraoperative management and postoperative evaluation were blinded to the group allocation.

Preoperative Assessment

All patients underwent detailed preoperative evaluation, including medical history, physical examination, airway assessment, baseline haemodynamic parameters, routine investigations, and ASA physical status assessment. Patients were kept fasting according to standard fasting guidelines before surgery. No premedication was administered on the day of surgery except as per institutional protocol.

Anaesthetic Technique

On arrival in the operating room, standard monitoring was initiated, including electrocardiography, non-invasive blood pressure measurement, pulse oximetry, and end-tidal carbon dioxide monitoring. Baseline heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation were recorded. Intravenous access was secured, and all patients received standard preoxygenation. General anaesthesia was induced with intravenous propofol and fentanyl, followed by neuromuscular blockade using an appropriate dose of rocuronium/atracurium to facilitate

endotracheal intubation. Anaesthesia was maintained with oxygen-air mixture, inhalational anaesthetic agent, and intermittent doses of muscle relaxant as required.

Study Drug Administration

Patients in Group D received dexmedetomidine infusion at a predetermined dose diluted in normal saline and administered intravenously over the specified infusion period before induction of anaesthesia. Patients in Group C received clonidine infusion at an equivalent study protocol dose diluted in normal saline and administered intravenously before induction. The infusion protocol was selected based on previous clinical studies evaluating alpha-2 adrenergic agonists as anaesthetic adjuvants during laparoscopic surgery.

Intraoperative Monitoring and Assessment

Haemodynamic parameters including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were recorded at predefined intervals:

- Baseline (before study drug infusion)
- After study drug infusion
- After induction of anaesthesia
- Immediately after intubation
- At pneumoperitoneum creation
- During surgery at regular intervals
- After extubation

Any episodes of hypotension or bradycardia were recorded and managed according to standard institutional protocols.

Assessment of Anaesthetic Requirement

The requirement of intraoperative anaesthetic agents and opioid supplementation was recorded and compared between both groups. Total intraoperative opioid consumption and requirement of rescue anaesthetic doses were assessed.

Postoperative Assessment

After completion of surgery, neuromuscular reversal was achieved, and patients were extubated after fulfilling standard extubation criteria. Recovery characteristics were assessed, including time to eye opening, response to verbal commands, extubation time, and orientation after anaesthesia. Postoperative pain was assessed using a visual analogue scale (VAS) at predetermined intervals. Duration of analgesia, requirement of rescue analgesics, and postoperative opioid consumption were recorded. Sedation level was assessed using an appropriate sedation scoring system. Patients were monitored for adverse effects including nausea, vomiting, hypotension, bradycardia, respiratory depression, excessive sedation, and other drug-related complications.

Outcome Measures

The primary outcome measure was comparison of intraoperative haemodynamic stability between dexmedetomidine and clonidine infusion groups. Secondary outcome measures included comparison of anaesthetic and opioid requirements, postoperative analgesic duration, recovery profile, sedation characteristics, and incidence of adverse effects.

Statistical Analysis

Data analysis was performed using SPSS.26. Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range depending on data distribution, while categorical variables were presented as frequencies and percentages. Comparison between groups was performed using independent sample t-test or Mann–Whitney U test for continuous variables and Chi-square test or Fisher's exact test for categorical variables. Repeated measurements of haemodynamic parameters were analysed using repeated measures analysis of variance (ANOVA). A p-value <0.05 was considered statistically significant.

RESULTS

A total of 110 patients undergoing elective laparoscopic cholecystectomy were enrolled and randomly allocated into two groups of 55 patients each. Group D received dexmedetomidine infusion, whereas Group C received clonidine infusion as an anaesthetic adjunct. All patients completed the study protocol and were included in the final analysis. Baseline demographic and clinical characteristics were comparable between both groups (Table 1). The mean age was 42.6 ± 9.8 years in Group D and 43.1 ± 10.2 years in Group C ($p=0.79$). Age distribution, gender, BMI, ASA physical status, duration of surgery, and baseline haemodynamic parameters showed no statistically significant differences between groups ($p>0.05$). Baseline HR was 82.4 ± 9.6 beats/min in Group D and 81.8 ± 10.1 beats/min in Group C ($p=0.75$), while baseline MAP was 94.2 ± 8.5 mmHg and 93.8 ± 8.7 mmHg, respectively ($p=0.81$), confirming comparable preoperative status (Table 1). The intraoperative heart rate variations between groups are presented in Table 2 and Figure 1. Both drugs attenuated sympathetic responses during anaesthesia; however, dexmedetomidine provided better heart rate control during critical stimulation periods. Following intubation, mean heart rate was significantly lower in Group D compared with Group C (86.2 ± 9.5 vs 94.8 ± 10.6 beats/min; $p<0.001$). Similarly, after pneumoperitoneum creation, Group D showed significantly

lower heart rate values (88.1 ± 9.8 vs 96.2 ± 11.2 beats/min; $p < 0.001$). Significant differences were also observed at 30 minutes intraoperatively (79.5 ± 8.6 vs 85.3 ± 9.4 beats/min; $p = 0.001$), end of surgery (81.2 ± 8.9 vs 86.5 ± 9.7 beats/min; $p = 0.004$), and extubation (89.4 ± 10.2 vs 98.1 ± 11.5 beats/min; $p < 0.001$) (Table 2, Figure 1). The intraoperative systolic blood pressure changes are shown in Table 3 and Figure 2. Baseline systolic blood pressure was comparable between groups (126.5 ± 12.4 mmHg in Group D vs 125.8 ± 13.1 mmHg in Group C; $p = 0.78$). Dexmedetomidine significantly attenuated hypertensive responses after intubation (132.8 ± 13.2 vs 145.6 ± 15.4 mmHg; $p < 0.001$) and pneumoperitoneum creation (136.4 ± 14.1 vs 150.8 ± 16.2 mmHg; $p < 0.001$). Lower systolic blood pressure values were also observed at 30 minutes intraoperatively (121.5 ± 12.2 vs 130.4 ± 14.3 mmHg; $p = 0.001$), end of surgery (124.8 ± 12.6 vs 134.1 ± 14.8 mmHg; $p = 0.001$), and extubation (138.2 ± 14.7 vs 151.6 ± 16.8 mmHg; $p < 0.001$) in Group D compared with Group C (Table 3, Figure 2). The intraoperative drug requirements are presented in Table 4. Patients receiving dexmedetomidine required significantly lower fentanyl doses compared with clonidine (112.4 ± 25.6 μ g vs 146.8 ± 31.2 μ g; $p < 0.001$). Additional propofol requirement was also significantly lower in Group D (38.5 ± 12.4 mg vs 56.8 ± 15.7 mg; $p < 0.001$). The need for intraoperative rescue analgesia was significantly reduced with dexmedetomidine (14.5% vs 36.4%; $p = 0.009$). Total opioid consumption was also lower in Group D compared with Group C (1.85 ± 0.42 vs 2.43 ± 0.51 μ g/kg; $p < 0.001$) (Table 4). Recovery characteristics and postoperative analgesic outcomes are presented in Table 5 and Figure 3. Patients in the dexmedetomidine group demonstrated faster recovery, with shorter time to eye opening (7.2 ± 2.1 vs 8.8 ± 2.6 minutes; $p = 0.001$), extubation time (8.6 ± 2.1 vs 10.2 ± 2.8 minutes; $p = 0.004$), and time to orientation (12.4 ± 3.5 vs 15.1 ± 4.2 minutes; $p < 0.001$). Dexmedetomidine significantly prolonged postoperative analgesia duration compared with clonidine (8.9 ± 2.4 vs 6.7 ± 2.1 hours; $p < 0.001$). Postoperative VAS scores were significantly lower in Group D at 6 hours (2.1 ± 0.8 vs 3.4 ± 1.0 ; $p < 0.001$) and 12 hours (3.2 ± 1.1 vs 4.1 ± 1.2 ; $p < 0.001$). Rescue analgesic requirement during the first 24 hours was significantly lower in Group D (32.7% vs 61.8%; $p = 0.003$) (Table 5, Figure 3). Postoperative adverse effects are presented in Table 6. The incidence of bradycardia, hypotension requiring intervention, nausea/vomiting, and excessive sedation was comparable between groups ($p > 0.05$). Bradycardia occurred in 5 (9.1%) patients in Group D and 3 (5.5%) patients in Group C ($p = 0.46$), while hypotension requiring intervention occurred in 4 (7.3%) and 3 (5.5%) patients, respectively ($p = 0.70$). No patient in either group developed respiratory depression. Patient satisfaction scores were significantly higher in the dexmedetomidine group compared with clonidine (8.7 ± 1.1 vs 8.1 ± 1.3 ; $p = 0.01$) (Table 6).

Table 1. Demographic and Baseline Characteristics of Study Participants (n=110)

Variables	Group D (Dexmedetomidine) (n=55)	Group C (Clonidine) (n=55)	p-value
Age (years), Mean $\pm$ SD	42.6 $\pm$ 9.8	43.1 $\pm$ 10.2	0.79
Age group, n (%)			
18–40 years	22 (40.0)	20 (36.4)	0.70
41–60 years	33 (60.0)	35 (63.6)	
Gender, n (%)			
Male	25 (45.5)	27 (49.1)	0.70
Female	30 (54.5)	28 (50.9)	
BMI (kg/m ²), Mean $\pm$ SD	24.3 $\pm$ 3.2	24.7 $\pm$ 3.5	0.54
ASA physical status, n (%)			
ASA I	32 (58.2)	30 (54.5)	0.69
ASA II	23 (41.8)	25 (45.5)	
Duration of surgery (min), Mean $\pm$ SD	78.5 $\pm$ 15.6	80.2 $\pm$ 16.4	0.59
Baseline HR (beats/min), Mean $\pm$ SD	82.4 $\pm$ 9.6	81.8 $\pm$ 10.1	0.75
Baseline MAP (mmHg), Mean $\pm$ SD	94.2 $\pm$ 8.5	93.8 $\pm$ 8.7	0.81

Table 2. Comparison of Intraoperative Heart Rate Changes Between Dexmedetomidine and Clonidine Groups

Time interval	Group D (n=55) Mean $\pm$ SD	Group C (n=55) Mean $\pm$ SD	p-value
Baseline	82.4 $\pm$ 9.6	81.8 $\pm$ 10.1	0.75
After study drug infusion	74.8 $\pm$ 8.2	77.6 $\pm$ 8.7	0.08
After induction	72.6 $\pm$ 7.9	75.4 $\pm$ 8.4	0.07
Immediately after intubation	86.2 $\pm$ 9.5	94.8 $\pm$ 10.6	<0.001
After pneumoperitoneum	88.1 $\pm$ 9.8	96.2 $\pm$ 11.2	<0.001
30 min intraoperative	79.5 $\pm$ 8.6	85.3 $\pm$ 9.4	0.001
End of surgery	81.2 $\pm$ 8.9	86.5 $\pm$ 9.7	0.004
Extubation	89.4 $\pm$ 10.2	98.1 $\pm$ 11.5	<0.001

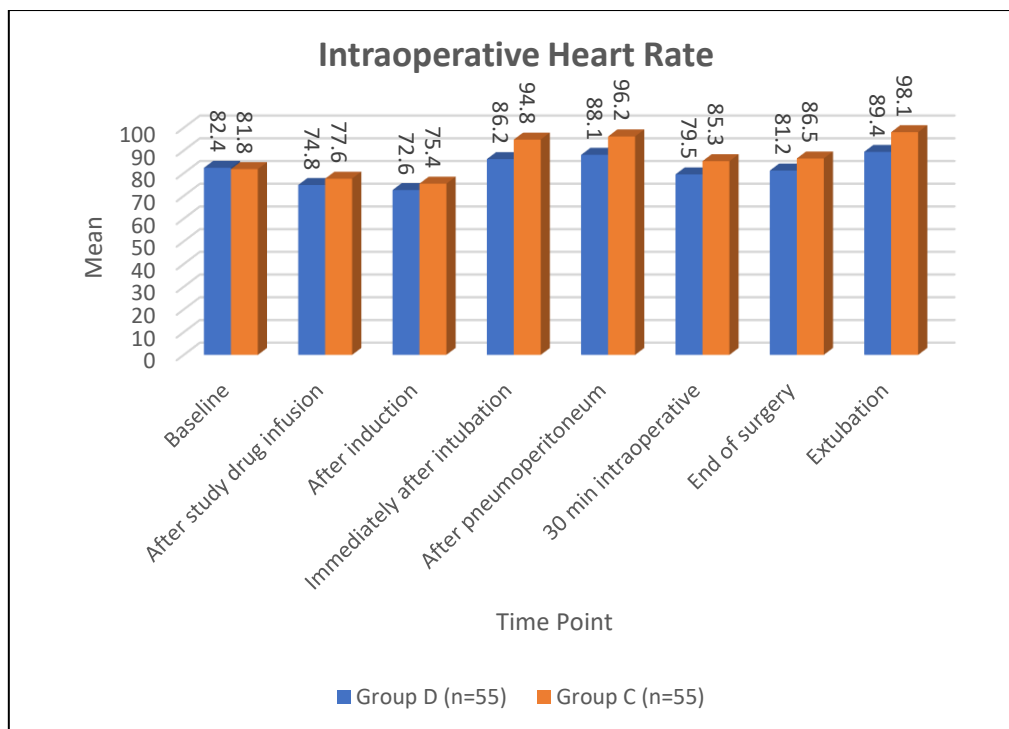


Figure 1. Comparison of Intraoperative Heart Rate Changes Between Dexmedetomidine and Clonidine Groups

Table 3. Comparison of Intraoperative Blood Pressure Changes Between Groups

Time interval	SBP (mmHg) Group D	SBP (mmHg) Group C	p-value
Baseline	126.5 ± 12.4	125.8 ± 13.1	0.78
After induction	112.6 ± 11.8	115.4 ± 12.6	0.23
After intubation	132.8 ± 13.2	145.6 ± 15.4	<0.001
After pneumoperitoneum	136.4 ± 14.1	150.8 ± 16.2	<0.001
30 min intraoperative	121.5 ± 12.2	130.4 ± 14.3	0.001
End of surgery	124.8 ± 12.6	134.1 ± 14.8	0.001
Extubation	138.2 ± 14.7	151.6 ± 16.8	<0.001

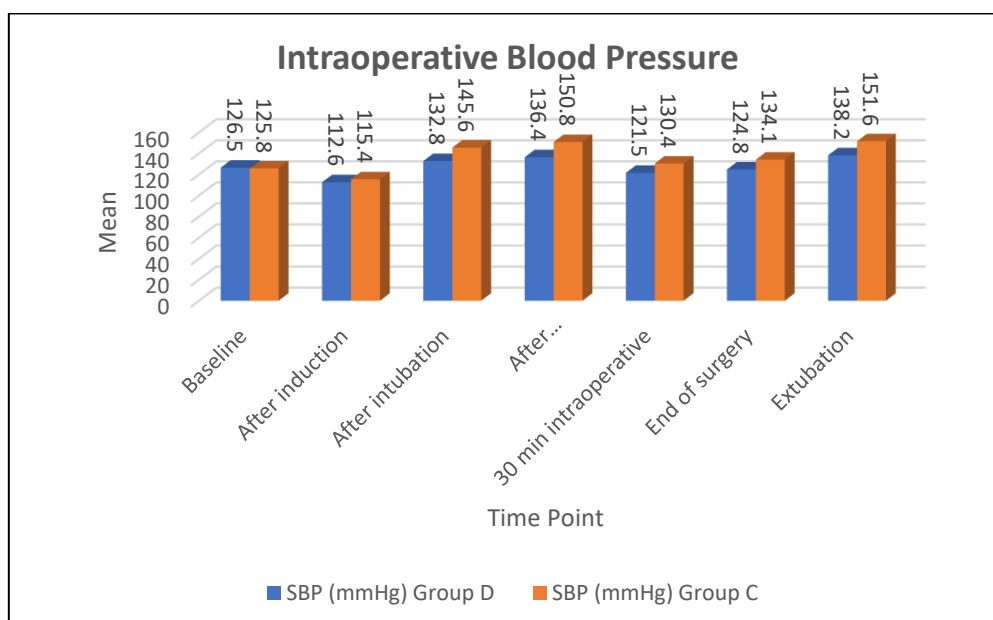


Figure 2. Comparison of Intraoperative Blood Pressure Changes Between Groups

Table 4. Comparison of Anaesthetic and Opioid Requirement Between Groups

Parameters	Group D (n=55)	Group C (n=55)	p-value
Total fentanyl requirement (µg), Mean ± SD	112.4 ± 25.6	146.8 ± 31.2	<0.001

Additional propofol requirement (mg), Mean $\pm$ SD	38.5 $\pm$ 12.4	56.8 $\pm$ 15.7	<0.001
Requirement of rescue analgesia intraoperatively, n (%)	8 (14.5)	20 (36.4)	0.009
Total intraoperative opioid dose (μ g/kg), Mean $\pm$ SD	1.85 $\pm$ 0.42	2.43 $\pm$ 0.51	<0.001

Table 5. Comparison of Recovery Profile and Postoperative Analgesic Outcomes

Parameters	Group D (n=55)	Group C (n=55)	p-value
Time to eye opening (min), Mean $\pm$ SD	7.2 $\pm$ 2.1	8.8 $\pm$ 2.6	0.001
Extubation time (min), Mean $\pm$ SD	8.6 $\pm$ 2.1	10.2 $\pm$ 2.8	0.004
Time to orientation (min), Mean $\pm$ SD	12.4 $\pm$ 3.5	15.1 $\pm$ 4.2	<0.001
Duration of analgesia (hours), Mean $\pm$ SD	8.9 $\pm$ 2.4	6.7 $\pm$ 2.1	<0.001
VAS score at 6 hours	2.1 $\pm$ 0.8	3.4 $\pm$ 1.0	<0.001
VAS score at 12 hours	3.2 $\pm$ 1.1	4.1 $\pm$ 1.2	<0.001
Rescue analgesic requirement in first 24 h, n (%)	18 (32.7)	34 (61.8)	0.003

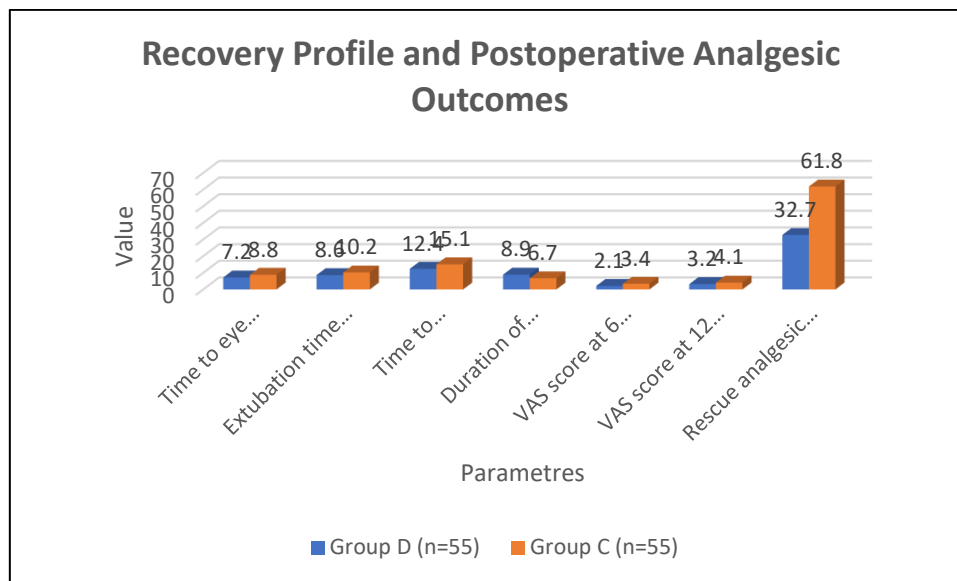


Figure 3. Comparison of Recovery Profile and Postoperative Analgesic Outcomes

Table 6. Comparison of Postoperative Adverse Effects Between Groups

Adverse effects	Group D (n=55)	Group C (n=55)	p-value
Bradycardia, n (%)	5 (9.1)	3 (5.5)	0.46
Hypotension requiring intervention, n (%)	4 (7.3)	3 (5.5)	0.70
Nausea/vomiting, n (%)	6 (10.9)	8 (14.5)	0.56
Excessive sedation, n (%)	3 (5.5)	5 (9.1)	0.46
Patient satisfaction score (0–10), Mean $\pm$ SD	8.7 $\pm$ 1.1	8.1 $\pm$ 1.3	0.01

DISCUSSION

The present prospective comparative study evaluated the effects of dexmedetomidine and clonidine infusion as anaesthetic adjuvants during laparoscopic cholecystectomy. In 110 patients (55 in each group), dexmedetomidine demonstrated better intraoperative haemodynamic stability, reduced anaesthetic and opioid requirements, prolonged postoperative analgesia, and improved recovery characteristics compared with clonidine. Laparoscopic cholecystectomy is associated with sympathetic activation due to carbon dioxide pneumoperitoneum, leading to increased heart rate, blood pressure, and systemic vascular resistance. Alpha-2 adrenergic agonists attenuate these responses by reducing central sympathetic outflow and norepinephrine release. In the present study, dexmedetomidine provided superior haemodynamic control compared with clonidine. The mean heart rate after intubation was significantly lower in the dexmedetomidine group (86.2 ± 9.5 vs 94.8 ± 10.6 beats/min, $p < 0.001$), and similar findings were observed after pneumoperitoneum creation (88.1 ± 9.8 vs 96.2 ± 11.2 beats/min, $p < 0.001$). Systolic blood pressure after intubation (132.8 ± 13.2 vs 145.6 ± 15.4 mmHg, $p < 0.001$) and after pneumoperitoneum (136.4 ± 14.1 vs 150.8 ± 16.2 mmHg, $p < 0.001$) was also significantly lower with dexmedetomidine. Anjum et al. [3] compared dexmedetomidine and clonidine as propofol adjuvants during laparoscopic cholecystectomy and reported that both agents attenuated haemodynamic responses; however, dexmedetomidine provided better control of heart rate and mean arterial pressure due to its greater alpha-2 receptor selectivity. Bhagat et al. [9] also demonstrated improved haemodynamic stability and reduced opioid and anaesthetic requirements with dexmedetomidine during laparoscopic cholecystectomy. Lu et al. [12] explained the mechanism of alpha-2 agonist-mediated cardiovascular effects by demonstrating that enhanced alpha-2A receptor signalling increases hypotensive and bradycardic responses,

supporting the sympatholytic action of dexmedetomidine. Dexmedetomidine significantly reduced intraoperative anaesthetic and opioid requirements in the present study. Total fentanyl requirement was significantly lower in the dexmedetomidine group compared with clonidine ($112.4 \pm 25.6 \mu\text{g}$ vs $146.8 \pm 31.2 \mu\text{g}$, $p < 0.001$). Similarly, additional propofol requirement was significantly reduced ($38.5 \pm 12.4 \text{ mg}$ vs $56.8 \pm 15.7 \text{ mg}$, $p < 0.001$). Bielka et al. [8] reported significantly reduced intraoperative fentanyl consumption and postoperative opioid requirement with dexmedetomidine infusion during laparoscopic cholecystectomy, supporting its opioid-sparing effect. Bhagat et al. [9] also observed reduced opioid and anaesthetic requirements with dexmedetomidine along with improved haemodynamic control. Dutta et al. [13] demonstrated that dexmedetomidine reduced propofol requirements in healthy volunteers due to its sedative and hypnotic-sparing effects. Similarly, Richards et al. (1990) reported reduced propofol requirement with clonidine premedication during propofol-alfentanil anaesthesia, while Higuchi et al. [14] showed that clonidine reduced the awakening concentration of propofol, confirming the anaesthetic-sparing effects of alpha-2 agonists. Dexmedetomidine was associated with improved recovery characteristics compared with clonidine. In our study, time to eye opening (7.2 ± 2.1 vs 8.8 ± 2.6 minutes, $p = 0.001$), extubation time (8.6 ± 2.1 vs 10.2 ± 2.8 minutes, $p = 0.004$), and time to orientation (12.4 ± 3.5 vs 15.1 ± 4.2 minutes, $p < 0.001$) were significantly shorter in the dexmedetomidine group. Bellaïche et al. [15] evaluated clonidine during anaesthesia and reported that clonidine did not significantly prolong recovery time. The improved recovery observed with dexmedetomidine in our study may be related to reduced opioid and hypnotic requirements. Dexmedetomidine demonstrated superior postoperative analgesic efficacy. The duration of analgesia was significantly longer in the dexmedetomidine group (8.9 ± 2.4 vs 6.7 ± 2.1 hours, $p < 0.001$). Postoperative VAS scores were lower at 6 hours (2.1 ± 0.8 vs 3.4 ± 1.0 , $p < 0.001$) and 12 hours (3.2 ± 1.1 vs 4.1 ± 1.2 , $p < 0.001$), with reduced rescue analgesic requirement (32.7% vs 61.8%, $p = 0.003$). Bielka et al. [8] similarly reported prolonged analgesia and reduced postoperative opioid consumption with dexmedetomidine infusion during laparoscopic cholecystectomy. Hall et al. [10] demonstrated that low-dose dexmedetomidine infusion produces sedative, amnestic, and analgesic effects, supporting its role in reducing postoperative analgesic requirements.

Both drugs were well tolerated in the present study. Bradycardia occurred in 5 patients (9.1%) in the dexmedetomidine group and 3 patients (5.5%) in the clonidine group ($p = 0.46$), while hypotension requiring intervention occurred in 4 patients (7.3%) and 3 patients (5.5%), respectively ($p = 0.70$). No significant difference was observed in postoperative nausea, vomiting, or respiratory complications. Bustillo et al. [16] reported that dexmedetomidine may transiently influence cognitive assessment due to its sedative effects; however, these effects are dose-dependent and reversible. In the present study, no clinically significant cognitive impairment or prolonged sedation was observed.

CONCLUSION

Dexmedetomidine infusion provided superior perioperative outcomes compared with clonidine during laparoscopic cholecystectomy. It achieved better haemodynamic stability, reduced anaesthetic and opioid requirements, prolonged postoperative analgesia, and improved recovery characteristics without increasing adverse effects. Dexmedetomidine may therefore be considered a more effective alpha-2 adrenergic agonist adjunct for optimizing perioperative management in laparoscopic surgery.

Limitations

The study was conducted at a single centre with a relatively limited sample size, which may restrict the generalizability of the findings. Long-term postoperative outcomes, including persistent cognitive effects and patient-reported quality of recovery, were not evaluated. Further multicentric studies with larger sample sizes and extended follow-up are required to confirm these findings.

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