Section: Anaesthesia

Original Research Article

# A CLINICAL COMPARISON OF MEAN ARTERIAL PRESSURE BETWEEN LOW-DOSE DEXMEDETOMIDINE INFUSION AND NORMAL SALINE BEFORE INDUCTION OF GENERAL ANAESTHESIA IN LAPAROSCOPIC SURGERY

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## ABSTRACT

**Background:** Laryngoscopy, tracheal intubation, patient positioning, and pneumoperitoneum during laparoscopic surgeries cause significant haemodynamic stress responses. These can be harmful, especially in patients with limited cardiovascular reserve. Dexmedetomidine is a highly selective $\alpha_2$-adrenergic agonist. It can attenuate sympathetic responses and provide haemodynamic stability. However, higher doses can cause bradycardia and hypotension. This study evaluated the efficacy and safety of low-dose dexmedetomidine (0.2 µg/kg) given before general anaesthesia induction to reduce haemodynamic responses during laparoscopic surgery.

**Materials and Methods:** This was a prospective, Quasi-randomised, double-blind, controlled study. It included 126 patients aged 18–60 years, ASA physical status I–II. All were scheduled for elective laparoscopic surgery under general anaesthesia. Patients were randomly allocated into two groups of 63 each using an alternate allocation technique. The dexmedetomidine group received 0.2 µg/kg dexmedetomidine in 100 mL of normal saline as an intravenous infusion over 10 minutes before induction. The control group received 100 mL of normal saline. Haemodynamic parameters, including mean arterial pressure (MAP), were recorded at baseline, during laryngoscopy and intubation, and at 5, 15, 30, 45, and 60 minutes after intubation. Data were analysed using appropriate statistical tests. P-values $<0.05$ were considered significant.

**Results:** Baseline MAP values were similar between the groups. The dexmedetomidine group showed significantly lower MAP at 5 minutes ($99 \pm 15$ vs $105 \pm 18$ mmHg; $p \approx 0.045$), 15 minutes ($99 \pm 17$ vs $106 \pm 16$ mmHg; $p \approx 0.019$), and 45 minutes ($98 \pm 12$ vs $103 \pm 12$ mmHg; $p \approx 0.021$) than the control group. In the control group, MAP increased more from baseline. In the dexmedetomidine group, this rise was significantly less and became non-significant by 60 minutes. This indicates better haemodynamic stability. No significant bradycardia, hypotension, or oxygen desaturation occurred.

**Conclusion:** Low-dose dexmedetomidine (0.2 µg/kg) before induction effectively reduces haemodynamic responses to laryngoscopy, tracheal intubation, and pneumoperitoneum. It maintains a favourable safety profile. This dose is a safe and effective anaesthetic adjunct for perioperative haemodynamic stability during laparoscopic surgery.

**Keywords:** Dexmedetomidine; Mean arterial pressure; Laparoscopic surgery; Haemodynamic response; Laryngoscopy and intubation; Pneumoperitoneum.

## INTRODUCTION

Laryngoscopy, tracheal intubation, and pneumoperitoneum during laparoscopic surgery often elicit haemodynamic stress responses. These responses raise heart rate, systolic and diastolic blood pressure, and mean arterial pressure. They are caused by intense sympathoadrenal stimulation and elevated catecholamine levels. While usually temporary and tolerated in healthy people, these changes can trigger myocardial ischaemia, arrhythmias, or cerebrovascular events in those with limited cardiovascular reserve.[1] Attenuating this pressor response is thus a key goal in modern anaesthetic practice.

Various drugs are used to blunt haemodynamic surges, including intravenous and topical lignocaine, opioids such as fentanyl and remifentanil, vasodilators like sodium nitroprusside and nitroglycerine, β-blockers like esmolol and labetalol, and calcium channel blockers. None is ideal due to limitations like incomplete suppression of the stress response, short action duration, hypotension, bradycardia, or respiratory depression.[2] The search for an agent providing stable haemodynamics with minimal side effects continues.

Dexmedetomidine is a highly selective $\alpha_2$-adrenergic receptor agonist with a selectivity ratio of 1600:1 for $\alpha_2$:$\alpha_1$ receptors. It draws attention as an anaesthetic adjuvant due to its unique pharmacological profile. It provides sedation, anxiolysis, analgesia, and sympatholysis without significant respiratory depression.[3,4] By reducing central sympathetic outflow and plasma norepinephrine, dexmedetomidine can attenuate haemodynamic responses to airway manipulation, pneumoperitoneum, and surgery.[5] It also reduces intraoperative anaesthetic and opioid needs and can improve postoperative analgesia and recovery.[6]

Higher doses of dexmedetomidine (0.5–1 µg/kg or more) often cause significant bradycardia and hypotension. This limits its routine use before induction.[7] Recent studies suggest lower doses may provide adequate haemodynamic suppression with fewer side effects. This is important in laparoscopic surgery, where pneumoperitoneum increases intra-abdominal pressure, systemic vascular resistance, and neurohumoral activation, adding haemodynamic stress.[8,9,10]

There is growing interest in low-dose dexmedetomidine. However, strong clinical evidence for a very low-dose infusion (0.2 µg/kg) given before induction is limited. Finding an optimal dose that reduces haemodynamic responses without causing hypotension or bradycardia is essential for perioperative safety.

This study evaluated the effect of a single low dose of dexmedetomidine (0.2 µg/kg) administered before general anaesthesia on haemodynamic responses during laryngoscopy, tracheal intubation, and pneumoperitoneum in patients undergoing elective laparoscopic surgery. Responses were compared with a control group that received normal saline.

**Aim of the Study**

To compare the mean arterial pressure between low-dose dexmedetomidine infusion and normal saline before induction of general anaesthesia for laparoscopic surgery.

**Objectives of the Study**

1. To assess the effectiveness of low-dose dexmedetomidine infusion on MAP during laryngoscopy, intubation, and pneumoperitoneum.
2. To compare these MAP values with a control group receiving 100 ml of normal saline.
3. To evaluate the extent of attenuation of the pressor response to laryngoscopy and intubation in the dexmedetomidine group compared with the control group.

## MATERIALS AND METHODS

**Study design and setting**

This prospective, quasi-randomised, double-blind, controlled clinical study took place in the Department of Anaesthesiology at a tertiary care teaching hospital (JIIU'S IIMSR, Warudi, Badnapur, Jalna, Maharashtra). Institutional Ethics Committee approval was obtained (IEC approval letter number IIMSR/IEC/PG/23/2023). All participants gave written informed consent before joining the study.

**Study population**

Adult patients, 18–60 years old, of either sex, with ASA physical status I or II, scheduled for elective laparoscopic surgery under general anaesthesia, were included.

**Sample size and randomisation**

The sample size was based on prior studies, aiming to detect a clinically significant difference in mean arterial pressure, with 80% power and 95% confidence level. A total of 126 patients were allocated to two groups (n=63 each) using a Quasi-randomisation.

**Exclusion Criteria**

Patients were excluded if they had significant cardiovascular disease, uncontrolled hypertension, conduction abnormalities, arrhythmias, severe liver or kidney problems, known hypersensitivity to dexmedetomidine, were taking β-blockers or other drugs affecting haemodynamics, were pregnant or breastfeeding, or were expected to have a difficult airway.

**Blinding**

An anaesthesiologist not involved in intraoperative management or data collection prepared the study drug. Both the patient and the anaesthesiologist recording haemodynamic parameters were unaware of (blinded to) the group allocation.

**Study procedure:**

**A Quasi-Randomised Systematic Technique**

Patients were allocated into two groups using an alternate randomisation technique:

- Group C (Control Group): Received 100 ml of normal saline IV infusion 10 minutes prior to induction.
- Group D (Dexmedetomidine Group): Received intravenous dexmedetomidine 0.2 mcg/kg, diluted in 100 ml of normal saline, infused over 10 minutes prior to induction.

**Anaesthetic technique**

All patients were kept nil by mouth as per standard fasting guidelines and received routine premedication as per institutional protocol. In the operating room, standard monitoring, including electrocardiography, non-invasive blood pressure, and pulse oximetry, was instituted. Baseline MAP was recorded before the start of the study drug infusion.

After administration of the study drug, patients were preoxygenated for three minutes, and anaesthesia was induced with intravenous propofol (2 mg/kg). Neuromuscular blockade was achieved with an appropriate muscle relaxant to facilitate endotracheal intubation. Laryngoscopy and tracheal intubation were performed after adequate relaxation. Anaesthesia was maintained with an inhalational anaesthetic in a mixture of oxygen and air, along with intermittent doses of muscle relaxant. Mechanical ventilation was adjusted to maintain normocapnia. Carbon dioxide pneumoperitoneum was created for the laparoscopic procedure, and intra-abdominal pressure was maintained within the recommended standard range.

**Data Collection:** MAP was recorded at the following time intervals: baseline (before study drug infusion), during laryngoscopy and intubation, and at 5, 15, 30, 45, and 60 minutes after induction of anaesthesia. Any episode of hypotension or bradycardia was noted and managed as per standard institutional protocol.

**Outcome measures**

The primary outcome was the comparison of MAP between the two groups at different time points. The secondary outcome was to compare changes in mean arterial pressure from baseline within each group.

**Statistical Analysis**

Data were entered into Microsoft Excel and analysed using appropriate statistical software. Continuous variables were reported as mean ± standard deviation (SD). Intergroup comparisons were performed using the unpaired Student's t-test, and intragroup comparisons were analysed using the paired t-test. A p-value $< 0.05$ was considered statistically significant.

## RESULTS

A total of 126 patients were included and analysed. Both groups were comparable in terms of baseline mean arterial pressure (MAP). There was no statistically significant difference between the groups at baseline and at the time of laryngoscopy and intubation ($p > 0.99$). However, MAP was significantly lower in the dexmedetomidine group at 5, 15, and 45 minutes after induction. Although MAP values remained lower in the dexmedetomidine group at 30 and 60 minutes, the differences were not statistically significant.

**Table 1: Mean Arterial Pressure (MAP) at Different Time Intervals**

| Time Interval | Control (Mean ± SD) | Dexmedetomidine (Mean ± SD) | p-value | Significance |
|---|---|---|---|---|
| Baseline | 90 ± 8 | 90 ± 9 | > 0.99 | Not significant |
| Intubation | 90 ± 5 | 90 ± 9 | > 0.99 | Not significant |
| 5 min | 105 ± 18 | 99 ± 15 | 0.045 | Significant |
| 15 min | 106 ± 16 | 99 ± 17 | 0.019 | Significant |
| 30 min | 93 ± 14 | 91 ± 13 | 0.414 | Not significant |
| 45 min | 103 ± 12 | 98 ± 12 | 0.021 | Significant |
| 60 min | 97 ± 10 | 94 ± 11 | 0.115 | Not significant |

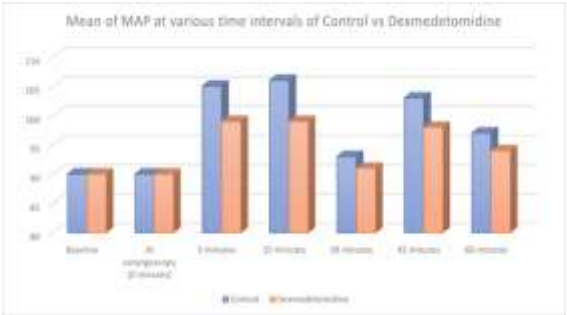


**Figure 1: Mean Arterial Pressure (MAP) at Different Time Intervals**

At 5 minutes, MAP increased significantly in the control group compared to the dexmedetomidine group (105 ± 18 mmHg vs 99 ± 15 mmHg; $p = 0.045$). A similar significant difference was observed at 15 minutes (106 ± 16 mmHg vs 99 ± 17 mmHg; $p = 0.019$) and 45 minutes (103 ± 12 mmHg vs 98 ± 12 mmHg; $p = 0.021$). These findings indicate better attenuation of the haemodynamic response in the dexmedetomidine group.

Intragroup comparison of MAP changes from baseline showed a greater rise in the control group than the dexmedetomidine group.

**Table 2: Comparison of Changes in MAP from Baseline Within the Groups**

| Time Interval | Control Δ vs Baseline (mmHg) | t-value | p-value | Dexmedetomidine Δ vs Baseline (mmHg) | t-value | p-value |
|---|---|---|---|---|---|---|
| Baseline → Laryngoscopy | 0 | 0.00 | 1.0000 | 0 | 0.00 | 1.0000 |
| Baseline → 5 min | +15 | 4.17 | 0.0002 | +9 | 2.82 | 0.0070 |
| Baseline → 15 min | +16 | 4.90 | 0.0000 | +9 | 2.46 | 0.0139 |
| Baseline → 30 min | +3 | 1.02 | 0.3135 | +1 | 0.35 | 0.7304 |
| Baseline → 45 min | +12 | 4.94 | 0.0000 | +8 | 2.92 | 0.0051 |
| Baseline → 60 min | +7 | 2.99 | 0.0041 | +4 | 1.54 | 0.1288 |

The control group showed a statistically significant increase in MAP from baseline at 5, 15, 45, and 60 minutes, indicating marked intraoperative haemodynamic fluctuations. In contrast, the dexmedetomidine group demonstrated a smaller and more controlled rise in MAP, with non-significant changes at 30 and 60 minutes, reflecting improved haemodynamic stability.

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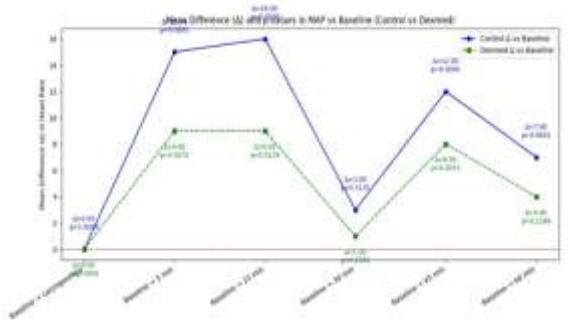

**Figure 2: Mean difference (Δ) and p-values in MAP vs Baseline (Control vs Dexmed)**

The graphical representation shows a consistently higher MAP in the control group than in the dexmedetomidine group between 5 and 45 minutes, whereas both groups had comparable values at baseline, at intubation, and at 60 minutes.

## DISCUSSION

The present study evaluated the effect of a low-dose dexmedetomidine infusion (0.2 µg/kg) administered before induction of general anaesthesia on MAP during laparoscopic surgery. The findings demonstrate that dexmedetomidine significantly attenuates the haemodynamic responses to laryngoscopy, tracheal intubation, and pneumoperitoneum when compared with normal saline.

In this study, baseline MAP values were comparable between both groups, confirming adequate randomisation and homogeneity. At the time of laryngoscopy and intubation, no statistically significant difference in MAP was observed. This may be attributed to the relatively low dose of dexmedetomidine used, which might not have reached peak central sympatholytic activity at the time of intubation. However, significant differences became evident in the early intraoperative period.

At 5, 15, and 45 minutes after induction, the dexmedetomidine group showed significantly lower MAP compared to the control group. These findings suggest that even at a low dose, dexmedetomidine effectively blunts the sustained sympathetic response associated with pneumoperitoneum and surgical stimulation. In contrast, the control group exhibited a greater, statistically significant increase in MAP from baseline, indicating inadequate attenuation of the haemodynamic stress response.

The mechanism underlying these effects is related to dexmedetomidine's action as a highly selective $\alpha_2$-adrenergic agonist. It reduces central sympathetic outflow and circulating catecholamine levels, leading to decreased heart rate and blood pressure. Additionally, its analgesic and sedative properties help reduce stress responses during surgery. The absence of respiratory depression further enhances its utility as an anaesthetic adjunct.

The intragroup analysis further supports these findings. The control group demonstrated significant increases in MAP at multiple time points, whereas the dexmedetomidine group showed smaller, more controlled changes, with non-significant variations at later time intervals (30 and 60 minutes). This indicates that dexmedetomidine provides more stable haemodynamics throughout the intraoperative period.

These results are consistent with previous studies demonstrating the efficacy of dexmedetomidine in attenuating haemodynamic responses. Studies by Surwade et al. [6] and Manne et al. [7]. reported that low-dose dexmedetomidine reduces intraoperative blood pressure fluctuations and improves haemodynamic stability during laparoscopic procedures. Similarly, De Cassai et al. [5], in a meta-analysis, confirmed that dexmedetomidine significantly blunts the pressor response to tracheal intubation.

An important observation in the present study is the favourable safety profile of low-dose dexmedetomidine. Higher doses (0.5–1 µg/kg) have been associated with adverse effects such as bradycardia and hypotension. However, in this study, no significant episodes of bradycardia, hypotension, or oxygen desaturation were observed. This suggests that a dose of 0.2 µg/kg strikes an optimal balance between efficacy and safety.

The clinical implications of these findings are significant. Maintaining stable haemodynamics during laparoscopic surgery is essential, especially in patients with limited cardiovascular reserve. By reducing fluctuations in MAP, dexmedetomidine may decrease myocardial oxygen demand and the risk of perioperative cardiovascular complications.

However, the study has certain limitations. First, it was conducted in a single centre with a relatively small sample size, which may limit the generalisability of the findings. Second, only ASA I and II patients were included; therefore, the results may not be directly applicable to high-risk populations. Third, other haemodynamic parameters such as heart rate and cardiac output were not extensively analysed. Future studies with larger sample sizes, inclusion of high-risk patients, and evaluation of additional parameters are recommended.

## CONCLUSION

The present study demonstrates that a single pre-induction low-dose infusion of dexmedetomidine (0.2 µg/kg) effectively attenuates the haemodynamic stress response to laryngoscopy, tracheal intubation, and pneumoperitoneum in patients undergoing laparoscopic surgery. Patients receiving dexmedetomidine showed significantly smaller increases in mean arterial pressure during the early and intermediate intraoperative periods, indicating superior haemodynamic stability compared with the control group.

Importantly, this low-dose regimen provided adequate sympatholysis without causing clinically significant hypotension, bradycardia, or oxygen desaturation, thereby maintaining a favourable safety profile. The reduced magnitude of haemodynamic fluctuations observed with dexmedetomidine is clinically relevant, as it may decrease myocardial oxygen demand and the risk of perioperative cardiovascular complications, particularly in patients with limited cardiovascular reserve.

Thus, low-dose dexmedetomidine administered before the induction of general anaesthesia can be considered a safe and effective anaesthetic adjunct for laparoscopic surgeries, helping achieve better perioperative haemodynamic control.

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**Conflict of Interest:** None.

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