**Biomedical and Biopharmaceutical Research**
**Abbreviation**: Biomed. Biopharm. Res.
Volume: 22: Issue: 01 |Year: 2025
Page Number: 766-772

# ALPHA 2 AGONISTS AS AN ADJUVANT TO ANAESTHESIA DURING LAPAROSCOPIC SURGERY: A COMPARATIVE STUDY TO ASSESS HAEMODYANAMIC CHANGES

Dr. Anuja A. Kukadapwar[1], Dr. Vaishali C. Shelgaonkar[2]

[1]Junior Resident, Department of Anaesthesiology, Indira Gandhi Government Medical College, Nagpur

[2]Professor and Head and Department, Department of Anaesthesiology, Indira Gandhi Government Medical College, Nagpur

***Corresponding Author***

**Dr. Vaishali C. Shelgaonkar**
Professor and Head and Department, Department of Anaesthesiology, Indira Gandhi Government Medical College, Nagpur

Article Received:11-04-2025

Article Accepted:25-05-2025



## Abstract

**Background** - Laparoscopy surgeries offer many advantages over open surgeries. But pneumoperitoneum created by CO2 insufflation during laparoscopic procedures affects several homeostatic systems leading to alteration in cardiovascular, pulmonary physiology and stress responses, acid-base balance. Amongst which cardiovascular changes may be detrimental hence to obtund intubation and CO2 insufflation/stress response alpha agonist clonidine and dexmedetomidine can be used as adjunct.

**Methodology** – It was comparative study conducted over 15 months in the Department of Anaesthesiology at a tertiary care hospital, amongst 90 adult patients of age group 18-50 years of either gender, ASA I-II undergoing elective surgical procedures under general anaesthesia. Patients were randomized into three groups as Group D (inj. Dexmedetomidine 1ucg/kg), Group C (inj. Clonidine 1ucg/kg) both in in 10 ml NS and Group S (10 ml NS) for use of pretreatment drugs to be given slowly over 15 mins.

**Results** - Demographic parameters were noted and found comparable. During laparoscopic surgeries stress points are laryngoscopy and insufflation both alpha 2 agonist supressed haemodynamic responses compared to group S that is placebo. After intubation changes seen in heart rate were group D (88.43 ± 15.776) beats/ min and group C (88.43 ± 15.776) beats/ min compared to group S (97.7 ± 14.686) beats/ min. Another stress point such as creation pneumoperitoneum, compared to baseline values mean arterial pressure changes were prevented in group D (92.2 ± 10.223) mmHg and group C (89.43 ± 11.825) mmHg as compared to group S (100.4 ± 10.731) mmHg. Similar results were seen for SBP and DBP. Requirement of inhalational agents was reduced in Group D and C compared to S.

**Conclusion** - Both α 2 agonists were found to be effective in attenuating the hemodynamic response to pneumoperitoneum during laparoscopic surgeries and also provided sedation when used as a premedication agent.

**Keywords:** Alpha-2 Agonists, Laparoscopic Surgery, Hemodynamic Stability

## INTRODUCTION

Laparoscopic surgery has significantly advanced, offering benefits such as cosmetically superior scars, reduced bowel manipulation, quicker postoperative recovery, and less morbidity. General anaesthesia during laparoscopy can provoke marked sympathoadrenal responses, particularly during critical events like laryngoscopy, tracheal intubation, and extubation. Creating pneumoperitoneum with carbon dioxide (CO2) alters cardiovascular and pulmonary physiology, stress responses, and acid-base balance. Hemodynamic changes include increased heart rate, mean arterial pressure (MAP), decreased cardiac output (CO), and increased systemic vascular resistance (SVR). (1–4)

Various pharmacological methods are employed to manage these above changes. Pharmacological agents such as adrenoreceptor blockers, alpha agonists (dexmedetomidine, clonidine), beta blockers, and vasodilators like nitro-glycerine have been used to prevent haemodynamic changes. Regional anaesthesia can also help to reducing sedative and narcotic needs but may not fully alleviate comfort and pain.

Dexmedetomidine and Clonidine are α2-adrenergic receptor agonist, provides sedation, anxiolysis, and analgesia, attenuates stress responses during critical events, increasing perioperative stability and decreases postoperative analgesic requirements. (1,5,6)

With this interest in mind, a study was conducted to compare the benefits of dexmedetomidine and clonidine in maintaining perioperative hemodynamic parameters and reducing postoperative analgesic needs in patients undergoing laparoscopic surgeries.

**MATERIALS AND METHODOLOGY**

Total 90 patients of ASA physical status I and II were included in the study after obtaining institutional ethical committee approval and written informed consent of patients. Patients of age between 18 to 50 years, posted for elective laparoscopic surgery under general anaesthesia, were randomly allocated to one of the three study groups (n= 30) (1,6,7)

Group C (n:30): receive Clonidine 1 mcg/kg in 10ml normal Saline I.V. over 10 min.

Group D (n:30): receive Dexmedetomidine 1 mcg/kg in 10ml normal saline I.V. over 10 min.

Group S (n=30): Saline 10 ml I.V. over 10 min.

Detailed pre-anaesthetic evaluation of the patients was performed by an anaesthesiologist. Investigations like blood grouping, complete blood count, liver, kidney function tests, ECG and XRAY chest were done, random blood glucose levels, coagulation profile were done and fitness for surgery ensured.

On the day of surgery demographic factors and preoperative vitals were noted and I.V. line secured. All patients pretreated with Inj. Glycopyrrolate 0.2 mg I.V. Inj. Pantoprazole 40mg I.V. 30 mins prior to surgery.

Study drug injected over 10 minutes which ended 15 minutes prior to induction considering appropriate action to obtund the stress response in all the groups with continuous monitoring of vitals.

Patients were premedicated with and Inj. Midazolam 0.03mg/kg IV and Inj. Fentanyl with 2 ug/kg I.V. after study drug given. All patients were preoxygenated with 100% oxygen for 3-5 min. Patients induced with inj. Propofol 2mg/kg, Inj. suxamethonium 1.5 mg/kg. Endotracheal intubation was done with appropriate sized endotracheal tube. Muscle relaxation given by inj. Vecuronium 1 mg/kg and sevoflurane was started as inhalational agent.

Laparoscopic surgical technique involved intraperitoneal insufflation of carbon dioxide via a Verres needle inserted into a small umbilical incision or by 5 mm cannula with total gas flow rate set from 0-10 l/min. Intra-abdominal pressure was maintained between 10-15 mmHg.

The tidal volume of 6 ml/kg and respiratory frequency 14-16/min were adjusted and intermittent positive pressure ventilation (IPPV) was continued by mechanical ventilator to maintain end tidal carbon dioxide level between 30-45 mm Hg on closed circuit.

Anaesthesia was maintained with sevoflurane in Oxygen and Nitrous oxide (50% and 50%respectively) total 3 L flow rate with Inj. Vecuronium 0.02 mg/kg as intermittent muscle relaxant.

Parameters like Systolic blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arteria Pressure (MAP), Heart Rate (HR) at 1, 5,10 minutes after intubation were noted. Intra-abdominal pressure noted after insufflation for every 5 min till 20 min, then every 10 mins for 1st hour and then 20 minutes till completion of surgery noted. Along with SBP, DBP and MAP other parameters like SPO2, ETCO2 also noted.

Dial concentration of inhalational agents, Minimum Alveolar Concentration (MAC) requirements were noted. Haemodynamic stability was maintained +/- 20% of baseline by adjusting dial concentration. If hypertension and tachycardia persists which can be first sign of inadequate depth of anaesthesia, was over come by increasing dial concentration and in-spite of that haemodynamic stability is not maintained the drugs like fentanyl, metoprolol, esmolol or labetalol were used according to need. Hypotension was defined as decrease in MAP 20% or more from baseline and treated with 100 ml bolus dose of ringer lactate over 5 mins followed by inj. Mephentermine 6mg intravenously if the patient was unresponsive. Bradycardia (HR< 50 bpm) was treated with inj. atropine 0.6 mg iv.

Paracetamol was administered 15-20 minutes before completion of surgery in patients of all 3 groups. Ensuring adequate respiratory efforts ,patients were reversed with Inj. Neostigmine 0.05mg/kg and Inj. Glycopyrrolate 0.008mg/kg and extubated after return of all reflexes. Intravenous fluids were continued in the postoperative period till. Finally, patients were shifted to the recovery room after assessing Aldrete score greater than 8. In post-operative room pain was assessed on visual analogue score (VAS). Patients were observed in the PACU for every 10 mins till 1 hour and then after every 20 min. When VAS >4 analgesia in the form of injection Diclofenac sodium 75 mg IV given.

**STATISTICAL ANALYSIS:**

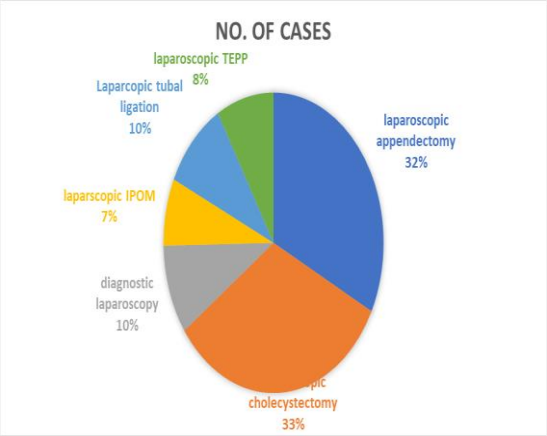
Data was collected, tabulated, coded then analysed using SPSS computer software version 20.0 and Microsoft word and Excel was used to generate graphs and tables. The quantitative data was expressed in terms of mean and standard deviation. The qualitative data was expressed in terms of numbers. Fisher exact test was applied to determine the association between the two categorical variables. p value < 0.05 was considered significant.

**OBSERVATIONS AND RESULTS:**

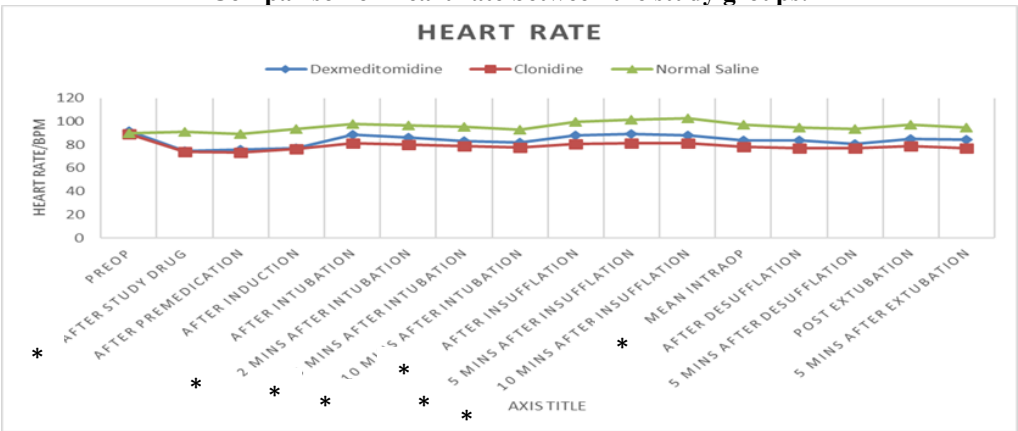
The patients in all the groups were comparable in respect to demographic parameters. The type of surgeries, duration of surgeries were almost comparable between the all groups and was statistically insignificant. Hemodynamic parameters like heart rate, systolic, diastolic, mean blood pressure and EtCO2, dial concentration, MAC, Abdominal pressure and sedation score were monitored between the groups.

**Table – Demographic data and other variables**

| DEMOGRAPHIC CHARACTERISTICS | GROUP D (n=30) | GROUP C (n=30) | GROUP S n=30) | P- value |
|---|---|---|---|---|
| Age[years] | 39.05 ± 8.84 | 39.37 ± 8.83 | 41.03 ± 7.64 | 0.267 |
| Gender (M:F) | 1.14:1 | 0.76:1 | 1.14:1 | 0.6543 |
| Weight [kg] | 58.97 ±9.133 | 59.33 ± 10.09 | 59.87 ± 9.402 | 0.395 |
| Duration of surgery | 89.3 ± 22.19 | 92.2 ± 29.41 | 90.16 ± 9.36 | 0.435 |




**Comparison of Heart rate between the study groups:**




* - mark values mentioned in the below box

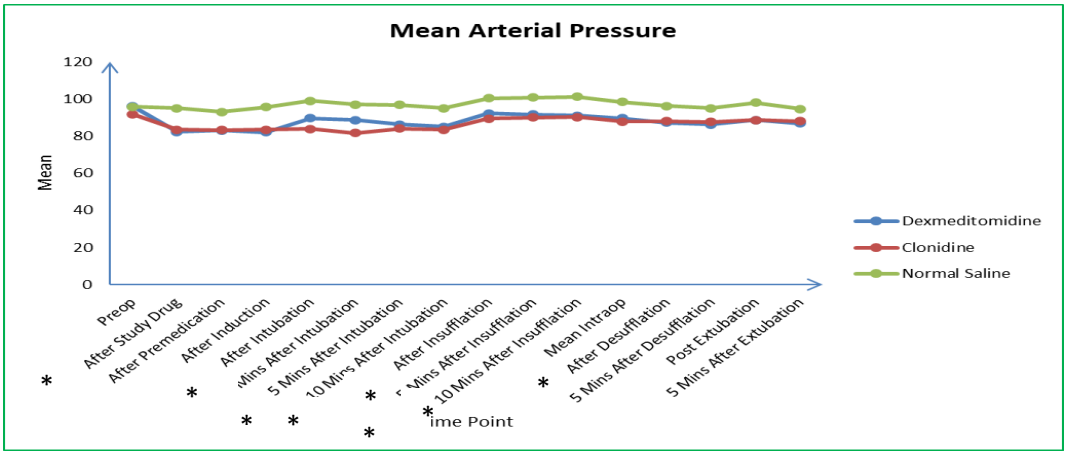
| HEART RATE | Group | | | P Value (ANOVA) |
|---|---|---|---|---|
| | GROUP D | GROUP C | GROUP S | |
| After Study Drug | 74.8 ± 10.968 | 74.2 ± 12.554 | 91.23±13.604 | <0.001 |
| After Intubation | 88.43 ± 15.776 | 81.07±15.627 | 97.7 ± 14.686 | <0.001 |
| 5 Mins After Intubation | 83.33 ± 12.347 | 79.17±16.133 | 95.43±15.485 | <0.001 |
| 10 Mins After Intubation | 81.93 ± 13.017 | 77.46±17.571 | 93.1 ± 14.155 | 0.001 |
| After Insufflation | 87.77 ± 13.741 | 80.6 ± 15.932 | 99.87±16.433 | <0.001 |
| 5 Mins After Insufflation | 88.97 ± 15.426 | 81.07±16.152 | 101.5±16.749 | <0.001 |
| 10 Mins After Insufflation | 87.97 ± 14.628 | 81.37±14.915 | 102.8±19.885 | <0.001 |
| Mean Intraoperative | 83.73 ± 12.597 | 78.2 ± 13.9 | 97.23±14.906 | <0.001 |

**Comparison of Systolic, Diastolic and Mean Arterial pressure between the study groups:**

| SBP | Group | | | P Value (ANOVA) |
|---|---|---|---|---|
| | Group D | Group C | Group S | |
| Preoperative | 128.7 ± 9.326 | 124 ± 10.599 | 125.73 ± 9.649 | 0.182 |
| After Study Drug | 109.4 ± 8.386 | 112 ± 10.576 | 124.6 ± 9.747 | <0.001 |
| After Intubation | 120.23 ± 16.332 | 114.2 ± 14.545 | 131.03±14.459 | <0.001 |
| 2 Mins After Intubation | 119.53 ± 13.957 | 112.45±15.749 | 132.59±11.843 | <0.001 |
| After Insufflation | 124.6 ± 14.026 | 121.03±13.865 | 133.8 ±13.862 | 0.002 |
| 5 Mins After Insufflation | 125 ± 13.928 | 121.17±12.052 | 133.4 ±14.141 | 0.002 |
| Mean Intraoperative | 121.3 ± 8.15 | 117.93 ± 8.263 | 126.77 ±8.431 | <0.001 |
| Post Extubation | 121.03 ± 8.822 | 119.57 ± 9.797 | 130.43 ±8.332 | <0.001 |

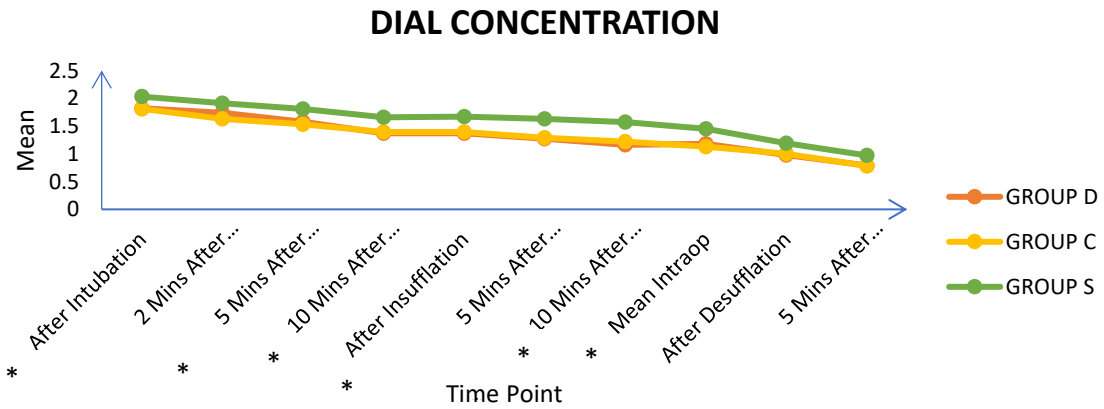
| | | | | |
|---|---|---|---|---|
| | | | | |

| DBP | Group | | | P Value (ANOVA) |
|---|---|---|---|---|
| | Group D | Group C | Group S | |
| **Preoperative** | 79.9 ± 8.592 | 75.87 ± 7.606 | 80.83 ± 7.391 | 0.039 |
| **After Study Drug** | 68.77 ± 7.815 | 69.2 ± 8.277 | 80.33 ± 8.087 | <0.001 |
| **After Intubation** | 74.37 ± 9.561 | 68.7 ± 7.671 | 83.2 ± 10.243 | <0.001 |
| **2 Mins After Intubation** | 73.37 ± 8.83 | 68.07 ± 9.537 | 81.57 ± 9.457 | <0.001 |
| **After Insufflation** | 76.07 ± 10.419 | 73.5 ± 11.936 | 83.8 ± 10.317 | 0.001 |
| **5 Mins After Insufflation** | 74.97 ± 10.542 | 74.57 ± 11.141 | 84.67 ± 9.939 | <0.001 |
| **Mean Intraoperative** | 73.87 ± 9.198 | 72.97 ± 8.219 | 84.37 ± 7.942 | <0.001 |
| **Post Extubation** | 72.37 ± 6.985 | 73.17 ± 8.116 | 81.63 ± 7.654 | <0.001 |




| MAP | Group | | | P Value (ANOVA) |
|---|---|---|---|---|
| | Group D | Group C | Group S | |
| **After Study Drug** | 82.37 ± 7.165 | 83.5 ± 8.029 | 95.13 ± 8.076 | <0.001 |
| **After Intubation** | 89.73 ± 10.904 | 83.83 ± 9.063 | 99.1 ± 10.613 | <0.001 |
| **5 Mins After Intubation** | 86.3 ± 9.841 | 84.2 ± 10.213 | 96.77 ± 8.365 | <0.001 |
| **10 Mins After Intubation** | 85.17 ± 9.443 | 83.54 ± 8.046 | 95.13 ± 8.46 | <0.001 |
| **After Insufflation** | 92.2 ± 10.223 | 89.43 ± 11.825 | 100.4 ± 10.731 | 0.001 |
| **5 Mins After Insufflation** | 91.63 ± 10.453 | 90.07 ± 10.027 | 100.93 ± 10.612 | <0.001 |
| **10 Mins After Insufflation** | 91.07 ± 10.932 | 90.23 ± 8.908 | 101.33 ± 10.72 | <0.001 |
| **Mean Intraoperative** | 89.67 ± 7.91 | 87.9 ± 6.905 | 98.4 ± 7.463 | <0.001 |

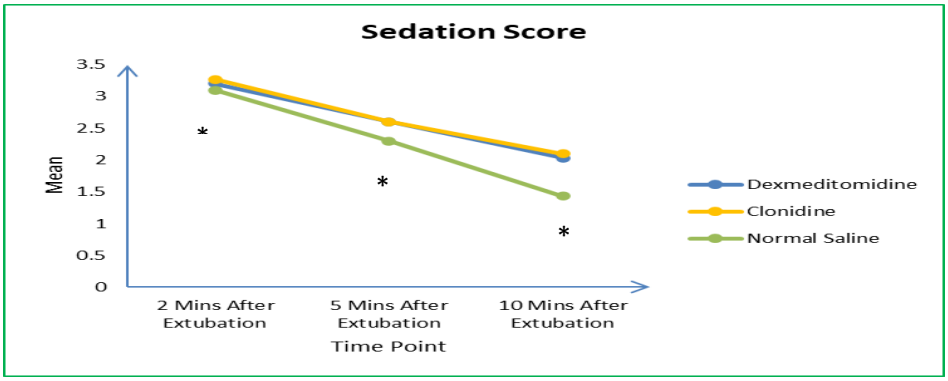
**Comparison of Dial Concentration between the study groups:**



| Dial Concentration | Group | | | P Value (ANOVA) |
|---|---|---|---|---|
| | Group D | Group C | Group S | |
| **After Intubation** | 1. ± 0.00 | 1 ± 00 | 1 ± 00 | 0.003 |
| **5 Mins After Intubation** | 1.53 ± 0.26 | 1.39 ± 0.28 | 1.76 ± 0.23 | 0.001 |
| **10 Mins After Intubation** | 1.33 ± 0.26 | 1.32 ± 0.24 | 1.59 ± 0.24 | <0.001 |
| **After Insufflation** | 1.39 ± 0.26 | 1.39 ± 0.22 | 1.65 ± 0.24 | <0.001 |
| **10 Mins After Insufflation** | 1.16 ± 0.216 | 1.23 ± 0.261 | 1.57 ± 0.337 | <0.001 |
| **Mean Intraoperative** | 1.16 ± 0.24 | 1.07 ± 0.17 | 1.46 ± 0.31 | <0.001 |

For minimum alveolar concentrartion (MAC) tried to maintain in normal range from 1-1.4 and in group D nad C it was less

**Post operative sedation score:**




| Sedation Score | Group | | | P Value (ANOVA) |
|---|---|---|---|---|
| | Group D | Group C | Group S | |
| **2 Mins After Extubation** | 3.2 ± 0.407 | 3.27 ± 0.45 | 3.1 ± 0.403 | 0.308 |
| **5 Mins After Extubation** | 2.6 ± 0.498 | 2.6 ± 0.498 | 2.3 ± 0.466 | 0.027 |
| **10 Mins After Extubation** | 2.03 ± 0.183 | 2.1 ± 0.305 | 1.43 ± 0.504 | <0.001 |

**TABLE: SIDE EFFECTS AND COMPLICATIONS:**

| SR. NO. | VARIABLES | GROUP D | GROUP C | GROUP S |
|---|---|---|---|---|
| 1. | Bradycardia | 1 | 2 | 0 |
| 2. | Hypotension | 4 | 2 | 0 |
| 3. | Persistent Hypertension | 3 | 1 | 10 |
| 4. | Persistent Tachycardia | 2 | 1 | 11 |
| 5. | Arrythmia | 0 | 0 | 0 |
| 6. | Hypercarbia (ETCO2>45) | 0 | 0 | 0 |
| 7. | Desaturation (SPO2<92) | 0 | 0 | 0 |
| 8. | PONV | 2 | 1 | 6 |
| 9. | Surgical Emphysema, pneumothorax, carbo mediastinum | 0 | 0 | 0 |
| 10. | Barotrauma, pulmonary Oedema | 0 | 0 | 0 |

**DISCUSSION**

Haemodynamic responses including heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure for Group D were effectively stabilized particularly during events such as intubation and pneumoperitoneum. While its performance was more stable compared to Group S as it significantly mitigated stress-induced cardiovascular changes. The dexmedetomidine acts on Central Nervous System and it interacts with both alpha-2A and alpha-2C receptors, reducing sympathetic outflow and enhancing parasympathetic activity, which blunts stress responses

effectively. Another response is through acting peripherally to reduces norepinephrine release, inducing vasodilation and minimizing stress-related sympathetic activity.(2,5,9–11)

While in group Group C use of clonidine also demonstrated better control over hemodynamic parameters during stressful events like intubation and pneumoperitoneum compared to group S. Clonidine primarily acts on presynaptic alpha-2 receptors, reducing norepinephrine release and decreasing sympathetic tone, which leads to a reduction in heart rate and blood pressure and acting on Peripherally it induces vasodilation and effectively blunts sympathetic responses to stress.(3,13,14)

On comparing group D and C, i.e two drugs dexmedetomidine and clonidine there was significant difference after intubation and 2 mins after intubation and in group C mean arterial pressure remains on lower side than group D. This suggests that clonidine is marginally superior (at intubation for group D 89.73 ± 10.904 and for group C 83.83 ± 9.063 and 2 mins after intubation for group D 88.77 ± 9.569 and for group C 81.67 ± 13.134).

Requirement of inhalational agents lowered in group D compared to group S as dexmedetomidine leads to sedation and some amount of analgesia thus anaesthetic-sparing effect. Patients in Group D showed a prolonged sedative effect, which delayed recovery compared to Group S but ensured improved analgesia and patient comfort in the immediate post-operative period. This effect is by targeting alpha-2A and alpha-2C adrenergic receptors, dexmedetomidine effectively inhibited pain transmission, reducing substance P release and ensuring significant analgesic benefits.(2,9,12)

Clonidine's ability to provide sedation, analgesia, and sympatholysis also reduced the requirement for inhalational anaesthetic agents, stabilizing haemodynamics while decreasing anaesthetic consumption compare to group S. Patients in Group C exhibited moderate sedation in the immediate post-extubation period, which was reflected in their Ramsay Sedation Scores. This prolonged sedation indicates a slower recovery profile compared to Group S but contributes to enhanced analgesia. Clonidine’s modulation of alpha-2 adrenergic receptors in the dorsal horn of the spinal cord suppressed pain transmission, ensuring better post-operative analgesia. (5,15,16)

Side effects and complications were noted. As alpha-2 agonists pharmacologically lead to various side effects, bradycardia (HR< 60 bpm) was observed in 1 patient in Group D and 2 patients in Group C, this can be due to slow administration of drugs. Hypotension was noted in 4 patients in Group D and 2 patients in Group C. Persistent hypertension in-spite of giving medications was observed in 3 patients in Group D, 1 patient in Group C, and 10 patients in Group S.

## CONCLUSION

The study concludes that alpha-2 agonists dexmedetomidine and clonidine effectively reduces hemodynamic stress response to laryngoscopy, intubation, and CO2 insufflation during laparoscopic procedures, compared to normal saline (placebo). Both dexmedetomidine and clonidine are equally effective as adjuvants to general anaesthesia for laparoscopic surgeries and can be recommended for routine practice.

## REFERENCES


1. Neil L. Effect of Dexmedetomidine Versus Fentanyl on Haemodynamic Response to Patients Undergoing Elective Laparoscopic Surgery: A Double Blinded Randomized Controlled Study.
2. Gautam P. Comparative Study of Clonidine Vs Dexmedetomidine for Hemodynamic Stability and Postoperative Analgesia during Laproscopic Surgery.
3. Effect of intravenous clonidine on hemodynamic changes in laparoscopic cholecystectomy: a randomized control study
4. O’Leary E, Hubbard K, Tormey W, Cunningham AJ. Laparoscopic cholecystectomy: haemodynamic and neuroendocrine responses after pneumoperitoneum and changes in position. Br J Anaesth. 1996 May;76(5):640–4.
5. Anjum N, Tabish H, Debdas S, Bani HP, Rajat C, Anjana Basu GD. Effects of dexmedetomidine and clonidine as propofol adjuvants on intra-operative hemodynamics and recovery profiles in patients undergoing laparoscopic cholecystectomy: A prospective randomized comparative study.
6. Bhalerao PM, Thombre SK, Kapse US, Targe KV. Intravenous clonidine for suppression of haemodynamic response to laparoscopy- a prospective randomised, placebo controlled, single centre study.
7. Shreya S, Shashi P, Mandeep M, Vivek S, Chandramani. A comparison of dexmedetomidine and clonidine premedication in perioperative hemodynamic stability and postoperative analgesia in laparoscopic cholecystectomy. Indian J Clin Anaesth. 2020 Nov 25;7(4):600–6.
8. Patil M, Gharde P, Reddy K, Nayak K. Comparative Analysis of Laparoscopic Versus Open Procedures in Specific General Surgical Interventions.
9. Vora KS, Baranda U, Shah VR, Modi M, Parikh GP, Butala BP. The effects of dexmedetomidine on attenuation of hemodynamic changes and there effects as adjuvant in anesthesia during laparoscopic surgeries. Saudi J Anaesth. 2

10. Kalra NK, Verma A, Agarwal A, Pandey H. Comparative study of intravenously administered clonidine and magnesium sulfate on hemodynamic responses during laparoscopic cholecystectomy. J Anaesthesiol Clin Pharmacol.
11. Ismail, E.A., Mostafa, A.A. & Abdelatif, M.M. Attenuation of hemodynamic response to laryngoscopy and endotracheal intubation with single dose dexmedetomidine in controlled hypertensive patients: prospective randomized double-blind study.
12. Manne GR, Upadhyay MR, Swadia V. Effects of low dose dexmedetomidine infusion on haemodynamic stress response, sedation and post-operative analgesia requirement in patients undergoing laparoscopic cholecystectomy. Indian J Anaesth.
13. Singh M, Choudhury A, Kaur M, Liddle D, Verghese M, Balakrishnan I. The comparative evaluation of intravenous with intramuscular clonidine for suppression of hemodynamic changes in laparoscopic cholecystectomy. Saudi J Anaesth.
14. Singh S, Arora K. Effect of oral clonidine premedication on perioperative haemodynamic response and postoperative analgesic requirement for patients undergoing laparoscopic cholecystectomy. Indian J Anaesth.
15. Effect of clonidine and dexmedetomidine premedication on perioperative oxygen consumption and haemodynamic state - PubMed [Internet].
16. HAEMODYNAMIC CHANGES DURING LAPAROSCOPIC CHOLECYSTECTOMY: EFFECT OF CLONIDINE PREMEDICATION : Indian Journal of Anaesthesia [Internet].