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Original Research Article

A Comparative Assessment of Dexmedetomidine and Clonidine in Elective Surgical Procedures under General Anaesthesia

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Abstract

Background and Objectives: Introduction: Alpha-2 agonists have gained widespread usage in the field of anesthesia, serving as adjuncts. Dexmedetomidine exhibits eightfold greater selectivity for alpha-2 receptors in comparison to clonidine. The primary objective of this study was to contrast the impacts of clonidine and dexmedetomidine on hemodynamic stability, anesthetic requirements, and recovery characteristics during general anesthesia for surgeries.

Material and Method: 156 participants falling within American Society of Anesthesiologists (ASA) grade I and II, aged between 18 to 60 years, scheduled for surgeries under general anesthesia, were enrolled. They were randomly assigned to two groups, each comprising 78 patients. Group C received an intravenous bolus of clonidine at a dosage of 2 µg/kg over 10 minutes, followed by normal saline infusion. In contrast, Group D received an intravenous bolus of dexmedetomidine at a dosage of 1 µg/kg over 10 minutes, followed by a dexmedetomidine infusion at a rate of 0.5 µg/kg/hr. Evaluation of hemodynamic parameters, anesthetic requirements, and recovery profiles was conducted.

Results: Both clonidine and dexmedetomidine demonstrated sustained intraoperative hemodynamic stability, with no discernible statistical distinctions. Both agents exhibited comparable efficacy in reducing the requirement for anesthetic agents and minimizing blood loss. Moreover, there were no significant differences between the two groups concerning recovery profiles and adverse effects. Notably, Group D exhibited a significantly shorter extubation time compared to Group C.

Conclusion: Dexmedetomidine and clonidine exert analogous effects on hemodynamic stability, anesthetic requirements, and recovery profiles in the context of surgeries under general anesthesia.

Keywords: Clonidine, Dexmedetomidine, Surgery, Anaesthesia.

Introduction

Surgeries pose distinctive challenges for anesthesiologists, demanding attention to stable hemodynamics, a relatively dry surgical field, rapid recovery for timely neurological evaluation, and precise perioperative positioning. These considerations necessitate the use of pharmacological agents to maintain the appropriate depth of anesthesia tailored to the surgery's specific requirements. Previous studies have explored the perioperative administration of clonidine, dexmedetomidine, esmolol (a beta-blocker), opioids, and magnesium sulfate during general anesthesia, albeit with varying degrees of success [1].

The perioperative application of alpha-2 adrenoceptor agonists serves to diminish sympathetic tone, attenuate stress responses to anesthesia and surgery, induce sedation, and facilitate postoperative analgesia.

Both clonidine and dexmedetomidine are alpha-2 adrenergic receptor agonists, acting on alpha-2 receptors. Notably, dexmedetomidine exhibits eightfold greater selectivity for alpha-2 receptors compared to clonidine [2]. Acting on α2 receptors situated at the locus ceruleus in the brainstem, dexmedetomidine manifests sedative and hypnotic effects while preserving an arousable state. It delivers dose-dependent sedation, anxiolytics, and analgesia without inducing respiratory depression and boasts a shorter duration of action compared to clonidine. Several studies in the existing literature [3-9] underscore the efficacy of both clonidine and

dexmedetomidine in ensuring intraoperative hemodynamic stability, reducing anesthetic requirements, and enhancing postoperative recovery during general anesthesia.

Against this backdrop, the present study was conducted with the primary objective of comparing hemodynamic stability, anesthetic requirements, and recovery profiles. Additionally, secondary objectives encompassed the evaluation of average blood loss, duration of surgery, and adverse effects between intravenous clonidine and intravenous dexmedetomidine in patients undergoing surgeries under general anesthesia.

Material and Methods

This prospective randomized study involved 176 patients (78 individuals in each group) classified under the American Society of Anesthesiologists (ASA) grades I and II, aged between 18 to 60 years, undergoing general anesthesia for surgery at an Indian tertiary hospital. Randomization was achieved using the Chit method. Exclusion criteria comprised patient refusal, cardiac conduction defects, severe pulmonary, cardiac, hepatic, or renal diseases, beta-blocker usage, pregnancy, cervical spine surgery, and heart rates below 50 beats per minute.

The patients and the monitoring anesthesiologists were blinded to the study drug. In Group C, intravenous clonidine (2 µg/kg) was diluted with normal saline to create a 10 ml bolus (in a 10 ml syringe), and 0.9% normal saline (in a 50 ml syringe) was prepared for intraoperative infusion. For Group D, intravenous dexmedetomidine (1 µg/kg) was diluted with normal saline to form a 10 ml bolus (in a 10 ml syringe), and 5 µg/ml of dexmedetomidine (2.5 ml [250 µg] of dexmedetomidine diluted with 47.5 ml of 0.9% normal saline) in a 50 ml syringe was prepared for intraoperative infusion. Both drugs were intentionally made to appear similar to avoid bias. Pre-anesthetic evaluation, including history, comprehensive physical examination, baseline investigations, and airway examination, was conducted. On the day of surgery, after confirming adequate fasting, patients were randomized into two groups. The study drug as a bolus was administered over 10 minutes using a syringe pump. Group C received a clonidine bolus of 2 µg/kg intravenously over 10 minutes, while Group D received a dexmedetomidine bolus of 1 µg/kg intravenously over the same duration. Heart rate (HR), blood pressure (BP), and oxygen saturation (SpO2) were recorded at the start and end of the bolus infusion. Subsequently, all patients were pre-medicated with injection midazolam (0.03 mg/kg) and fentanyl (2 µg/kg). Anesthesia induction was accomplished with injection propofol (1-2 mg/kg) until the loss of verbal contact, followed by neuromuscular blockade with atracurium (0.5 mg/kg). After 3 minutes of mask ventilation, tracheal intubation was performed.

Anesthesia was maintained with a mixture of nitrous oxide and oxygen (50:50) and isoflurane (MAC value of 0.8 to 1). Muscle paralysis was sustained with atracurium infusion at a rate of 5 µg/kg/min. HR, BP, end-tidal CO2 (EtCO2), and SpO2 were recorded at the time of intubation, and subsequently at 1, 3, and 5 minutes after intubation. Patients in the clonidine group received an infusion of 0.9% normal saline, while those in the dexmedetomidine group received a dexmedetomidine infusion of 0.5 µg/kg/hr.

Upon positioning the patient prone, HR, BP, SpO2, and EtCO2 were recorded at 1, 5, and 15 minutes, and then every 15 minutes until the end of skin closure. Intravenous diclofenac (1 mg/kg) or paracetamol (1 g) was administered for analgesia at the beginning of skin closure, with BP targeted to remain within 20% of the baseline value. Following surgery completion, residual neuromuscular blockade was reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (8 µg/kg). Tracheal extubation occurred after meeting extubation criteria, and the time of extubation was documented. Recovery scores were noted based on the Aldrete criteria. Subsequently, both groups were compared concerning intraoperative hemodynamic parameters, anesthetic requirements, recovery profile, average blood loss, duration of surgery, and adverse effects.

Results

The demographic data, encompassing age, sex, weight, and ASA status of patients in both groups, exhibited comparability, with no statistically significant differences found (Table 1).

The requirement for fentanyl and propofol demonstrated similarity between the two groups, with no statistically significant distinctions observed. In the Dexmedetomidine group, the extubation time was significantly shorter than that in the Clonidine group, while the time to achieve an Aldrete score of > 9 was comparable between the two groups. Average blood loss and duration of surgery were also comparable between the two groups, with no statistically significant differences (Table 2).

By administering clonidine and dexmedetomidine via injection, the intraoperative hemodynamic parameters (HR, SBP, DBP, and MBP) remained stable, showing no statistically significant differences.

Table 1: Demographic parameters of study participants

Parameters	Group C	Group D	P value
Age (in Years)	41.20 ±12.10	38.90 ±11.80	0.69
Gender (Male/Female)	48 (61.54%) / 30 (38.46%)	39 (50%) / 39 (50%)	0.12
Weight (in Kg)	55.20 ± 9.80	57.00 ± 9.00	0.78
ASA Grade I/II	56 (71.79%) / 22 (28.21%)	61 (78.21%) / 17 (21.79%)	0.49

Table 2: Anaesthetic need, recovery profile, means blood loss and duration for surgery

Variables	Group C	Group D	P value
Total dose of fentanyl used	132.40±34.20	119.80±23.70	0.156
Total dose of propofol used	144.70±30.60	128.90±28.20	0.105
Extubation time	10.60±3.80	9.10±4.4	0.042
Time to achieve Aldrete score >9	4.25±1.60	3.60±1.20	0.509
Average blood loss (ml)	312.20±120.50	329.80±128.70	0.087
Duration of surgery (Min.)	174.30±64.10	180.80±59.50	0.13

Discussion

The study found that both clonidine and dexmedetomidine had comparable effects on hemodynamic stability and reduced anesthetic consumption. Demographic data and surgery duration were similar between groups, with no statistically significant differences, indicating that these factors did not influence the study's outcome.

No statistically significant differences were observed between the clonidine and dexmedetomidine groups in terms of heart rate, systolic, diastolic, and mean arterial blood pressure. The intergroup comparison consistently showed a p-value >0.05, indicating comparable effects on hemodynamic parameters. Chandrasekaraiah MM et al. [10] found that clonidine premedication effectively countered cardiovascular changes induced by pneumoperitoneum. Kumar et al. [11] compared dexmedetomidine and clonidine premedication, concluding that both were equally effective in attenuating the hemodynamic response to pneumoperitoneum. Subramaniam et al. [12] evaluated clonidine vs. dexmedetomidine in mitigating the hemodynamic response to laryngoscopy and intubation, finding no significant differences between the two, supporting our study's findings.

We assessed anesthetic requirements by analyzing the amounts of fentanyl and propofol needed to maintain hemodynamics in both clonidine and dexmedetomidine groups. We maintained Isoflurane concentration at MAC 0.8 to 1.0 for all patients. The need for fentanyl and propofol was similar between the two groups, with no statistically significant differences (P values of 0.167 and 0.092, respectively). Keniya VM et al. [4] investigated dexmedetomidine's efficacy in reducing sympathoadrenal response to tracheal intubation and intraoperative anesthetic requirement. They reported a 30% and 32% decrease in the requirement of thiopentone and isoflurane, respectively, in the dexmedetomidine group compared to the control group. The fentanyl requirement during the operation was 40% lower in the dexmedetomidine group. Mariappan R et al. compared oral clonidine premedication with intraoperative dexmedetomidine infusion in major surgery. Both drugs demonstrated anesthesia-sparing effects, with dexmedetomidine exhibiting a more pronounced effect. Our study aligns with these findings and other relevant studies [7,8,13].

In the clonidine group, we observed less bleeding compared to the dexmedetomidine group, with a non-statistically significant P value. This outcome aligns with previous studies. Adverse effects of alpha-2 agonists, such as hypotension and bradycardia, were monitored in our study. Episodes of hypotension, bradycardia, hypertension, and tachycardia were comparable between the clonidine and dexmedetomidine groups, showing no statistically significant differences. These findings are consistent with other studies. It is important to note the limitations of our study, including the absence of a placebo group for comparing hemodynamic stability, anesthetic requirements, and recovery. Additionally, the non-availability of Bispectral Index monitoring was a constraint in our study [13-15].

Conclusion

In the current study, study drugs, clonidine and dexmedetomidine, exhibited analogous effects on intraoperative hemodynamic stability. They proved equally effective in reducing the requirement for anesthetic agents and demonstrated comparable profiles in terms of recovery. Additionally, both drugs were equally efficacious in minimizing blood loss and presented comparable adverse effects.

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