Original Article

Effect of Dexmedetomidine on Emergence Characteristics in Patients Undergoing General Anaesthesia with Desflurane: An Observational Study

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Abstract

Background: Emergence agitation (EA) and delirium are recognized complications after desflurane anaesthesia, potentially compromising patient safety. Dexmedetomidine, a highly selective α2-adrenoceptor agonist, has sedative, analgesic, and sympatholytic properties that may attenuate EA without causing significant respiratory depression. This study aimed to evaluate the effect of dexmedetomidine on emergence characteristics in adult patients undergoing general anaesthesia with desflurane. **Material and Methods:** This prospective, comparative observational study included 60 adult patients (ASA I–II, aged 18–60 years) scheduled for elective surgeries of less than 120 minutes duration under general anaesthesia. Patients were allocated into two groups (n = 30 each): Group D received dexmedetomidine (1 μg/kg IV infusion over 10 min), and Group C received saline placebo. Emergence and extubation times, incidence of EA (Riker Sedation-Agitation Scale ≥ 5), cough severity, pain scores (Cameron scale), and perioperative hemodynamic parameters were assessed. **Results:** Demographic variables and surgical duration were comparable between groups. Emergence and extubation times were similar ($p > 0.05$). EA occurred in significantly fewer patients in Group D (6.7%) compared with Group C (26.7%) ($p = 0.006$). Pain scores were lower in Group D ($p = 0.037$), while cough scores did not differ significantly. Hemodynamic stability was better maintained in Group D, with significantly lower HR, SBP, DBP, and MAP at extubation, 2 min post-extubation, and on PACU arrival ($p < 0.05$). No adverse events or complications were reported. **Conclusion:** Dexmedetomidine effectively reduced the incidence of emergence agitation and attenuated hemodynamic fluctuations without prolonging recovery or causing respiratory compromise in adult patients undergoing desflurane anaesthesia. Its perioperative use may enhance patient safety and improve recovery quality.

Keywords: Anaesthesia, General, Inhalation, Desflurane, Dexmedetomidine, Emergence Agitation, Hemodynamic.

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Introduction

General anaesthesia (GA) produces reversible unconsciousness with amnesia, analgesia, and muscle relaxation, thereby facilitating safe surgical procedures. Since Morton's public demonstration of ether anaesthesia in 1846, several inhalational agents have been developed, with modern agents such as sevoflurane and desflurane offering rapid induction and recovery due to their low blood–gas solubility coefficients.[1] Among these, desflurane—with the lowest blood–gas partition coefficient (0.42)—is particularly valued for fast emergence, yet it has been associated with adverse recovery phenomena such as emergence agitation (EA) and emergence delirium.[2,3]

EA, characterized by restlessness, confusion, disorientation, and psychomotor disturbances, can increase the risk of self-injury, accidental removal of catheters, haemorrhage at surgical sites, and delayed postoperative recovery.[4,5] The incidence of EA is well-documented in paediatric patients but is increasingly recognized in adults exposed to fast-acting volatile anaesthetics.[6,7] Identifying strategies to mitigate EA remains a priority to improve perioperative safety and recovery quality.

Dexmedetomidine, a highly selective α2-adrenoceptor agonist, possesses sedative, anxiolytic, and analgesic properties while providing sympatholysis without significant respiratory depression.[8] It has demonstrated efficacy in reducing anaesthetic and opioid requirements, maintaining hemodynamic stability, and attenuating stress responses.[9,10] Several studies, particularly in paediatric and neurosurgical populations, have reported its benefit in reducing EA, though evidence in adult patients undergoing desflurane anaesthesia remains limited and heterogeneous.[11–13]

Objectives: This study was designed to evaluate the effect of

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dexmedetomidine on emergence characteristics, specifically the incidence of EA, hemodynamic stability, and recovery profile, in adult patients undergoing desflurane-based general anaesthesia.

Materials and Methods

This prospective, double-blind, comparative study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital between December 2014 and September 2016. Institutional Ethics Committee approval KIMS/EC/2014-15/66 and written informed consent were obtained. The study followed the Declaration of Helsinki.

Sixty adult patients (18–60 yr), ASA physical status I–II, undergoing elective surgery under general anaesthesia lasting <120 min was enrolled. Exclusion criteria were: anticipated difficult airway, cardiovascular disease, bradyarrhythmia, BMI >30 kg/m², neurological or psychiatric illness, chronic use of sedatives/analgesics, or drug hypersensitivity.

Group allocation and blinding: Patients were alternately assigned into two groups (n = 30 each). Study drugs were prepared by an anaesthesiologist not involved in patient care. Both patients and observers were blinded to group allocation. Group D was with dexmedetomidine 1 µg/kg in 10 mL saline IV over 10 min before induction and Group C was with 10 mL saline IV over 10 min.

The Anaesthesia protocol had premedication having oral pantoprazole 40 mg, night before and morning of surgery; 8-h fasting. Standard ASA monitors were applied (ECG, NIBP, SpO_2, capnography, end-tidal anaesthetic). Induction: glycopyrrolate 0.004 mg/kg, propofol 2 mg/kg, fentanyl 2.5 µg/kg, atracurium 0.6 mg/kg. Maintenance: desflurane 3% in 50% nitrous oxide and oxygen.

For the Intraoperative management, Bradycardia (HR <40 bpm): atropine 0.6 mg IV. Tachycardia (HR >120 bpm): esmolol 10 mg IV increments. Hypotension (MAP <60 mmHg): ephedrine 6 mg IV boluses.

Emergence and extubation- At the end of surgery, residual neuromuscular block was reversed with neostigmine 50 µg/kg and glycopyrrolate 10 µg/kg IV. Inhalation agents were discontinued (time = 0). Patients were ventilated with 100% O_2 at 8 L/min until extubation. Extubation criteria: spontaneous breathing (VT >5 mL/kg, RR >12/min), SpO_2 ≥95%, intact airway reflexes. All patients were transferred to the PACU. Rescue analgesia: diclofenac 1.5 mg/kg IV.

Outcome measures

Primary outcomes:

- Extubation time (time 0 to tracheal extubation).
- Emergence time (time 0 to eye opening on command).

Secondary outcomes:

- Hemodynamic parameters (HR, MAP, SpO_2).
- Respiratory rate during emergence.
- Emergence agitation (Riker Sedation–Agitation Scale; EA defined as ≥5, dangerous agitation as 7).
- Cough severity (4-point scale).
- Pain (Cameron 4-point scale).

Statistical analysis: Sample size of 30 patients per group was based on feasibility for a postgraduate study. Continuous data were expressed as mean ± SD and compared using Student's t-test or Mann–Whitney U test. Categorical variables were analysed using Chi-square or Fisher's exact test. A p value <0.05 was considered significant. Analysis was performed with SPSS version 15.0 (SPSS Inc., Chicago, IL, USA).

Results

A total of 60 patients were analysed, with 30 patients in each group. The demographic and baseline characteristics were comparable between groups [Table 1]. The mean age was 42.7 ± 10.5 years in Group C and 40.8 ± 12.4 years in Group D (p = 0.526). The mean body weight was 66.7 ± 9.1 kg and 64.1 ± 9.4 kg, respectively (p = 0.267). Gender distribution and ASA physical status were also similar (p > 0.05).

The distribution of surgical procedures is summarized in Table 2. Laparoscopic surgeries were more frequent in Group D (63.3%) than in Group C (36.7%). Other surgeries included open hernioplasty, upper limb procedures, lumbar discectomy, hemithyroidectomy, and miscellaneous surgeries, with no statistically significant difference in distribution. The mean duration of surgery was comparable between groups (73.2 ± 22.2 min vs. 70.0 ± 20.8 min; p = 0.575).

The emergence time was longer in Group D compared with Group C (317.0 ± 68.5 s vs. 283.7 ± 67.2 s), but the difference was not statistically significant (p = 0.062). The time to tracheal extubation was also similar between the groups (355.3 ± 74.6 s vs. 330.0 ± 74.8 s; p = 0.194).

Emergence agitation (Riker Sedation-Agitation Scale ≥ 5) occurred in 26.7% of patients in Group C compared with 6.7% in Group D, a statistically significant difference (p = 0.006). No patient in either group experienced dangerous agitation (score = 7). Cough scores were similar across groups (p = 0.272). Pain scores assessed on the Cameron scale showed significantly more patients in Group D with a score of 0 (40% vs. 20%), while Group C patients more often scored 1 (60% vs. 40%; p = 0.037).

Respiratory rates and SpO_2 values were comparable between groups at all-time points, except for a transient difference at the end of surgery (time 0). Hemodynamic parameters showed significantly lower HR, SBP, DBP, and MAP in Group D at extubation, 2 minutes post-extubation, and in the PACU [Figure 1–4]. The relative rise in these parameters during emergence was consistently attenuated in Group D compared with Group C.

No adverse events or complications were reported in either group.

Table 1: Demographic and Clinical Characteristics of Patients

Variable	Group C (n = 30)	Group D (n = 30)	p-value
Age (years)	42.7 ± 10.5	40.8 ± 12.5	0.526
Weight (kg)	66.7 ± 9.1	64.1 ± 9.4	0.267
Gender (M/F)	20 / 10	16 / 14	0.292
ASA I / II	18 / 12	17 / 13	0.795
Duration of surgery (min)	73.2 ± 22.2	70.0 ± 20.8	0.575

Values are presented as mean ± SD or number of patients. ASA = American Society of Anaesthesiologists.

Table 2: Distribution of Surgical Procedures

Procedure type	Group C (n = 30)	Group D (n = 30)	p-value
Laparoscopic (appendix, gallbladder, hernia)	11 (36.7%)	19 (63.3%)	0.052
Open hernioplasty	7 (23.3%)	0 (0%)	–
Upper limb surgery	3 (10.0%)	5 (16.7%)	0.448
Lumbar discectomy	5 (16.7%)	4 (13.3%)	0.715
Hemithyroidectomy	2 (6.7%)	2 (6.7%)	1.000
Other (laparotomy, MRM)	2 (6.7%)	0 (0%)	–

Values are expressed as number (%). MRM = modified radical mastectomy.

Table 3: Emergence and Recovery Characteristics

Variable	Group C (n = 30)	Group D (n = 30)	p-value
Emergence time (s)	283.7 ± 67.2	317.0 ± 68.5	0.062
Extubation time (s)	330.0 ± 74.8	355.3 ± 74.6	0.194
Emergence agitation (RSAS ≥ 5)	8 (26.7%)	2 (6.7%)	0.006*
Severe agitation (RSAS = 7)	0	0	–
Cough (score ≥ 2)	15 (50.0%)	12 (40.0%)	0.272
Pain score (Cameron 0/1)	12 (40.0%) / 18 (60.0%)	18 (60.0%) / 12 (40.0%)	0.037*

Values are presented as mean ± SD or number (%). RSAS = Riker Sedation-Agitation Scale. $p < 0.05$ considered statistically significant.

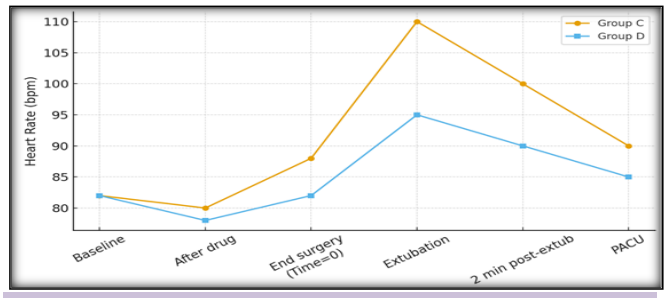

Figure 1: Heart rate trends at different perioperative time points.

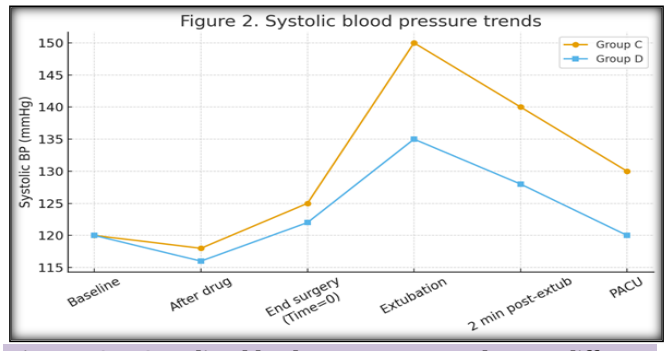

Figure 2: Systolic blood pressure trends at different perioperative time points.

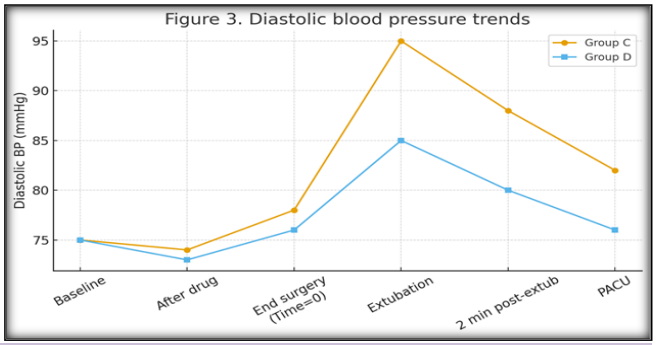

Figure 3: Diastolic blood pressure trends at different perioperative time points.

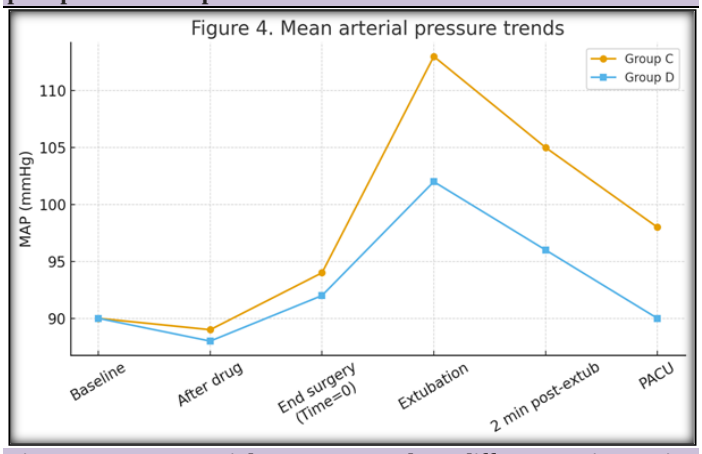

Figure 4: Mean arterial pressure trends at different perioperative time points.

Discussion

In this prospective comparative study, dexmedetomidine administration significantly reduced the incidence of EA in adults undergoing desflurane anaesthesia, while maintaining favourable hemodynamic stability and reducing postoperative pain scores without prolonging emergence or extubation times. These findings align with previous literature supporting the role of α2-agonists in modulating recovery from anaesthesia.

The incidence of EA in the control group (26.7%) was consistent with previous reports associating desflurane with increased agitation due to its rapid offset and pungency.[2,3,6] In contrast, the marked reduction in EA observed with dexmedetomidine (6.7%) underscores its sedative and anxiolytic efficacy, likely mediated through locus coeruleus modulation and reduced sympathetic outflow.[8,9] Similar benefits of dexmedetomidine in attenuating EA have been reported in paediatric anaesthesia and neurosurgical patients.[11,12]

Hemodynamic parameters, particularly HR, SBP, DBP, and MAP, were significantly lower in the dexmedetomidine group at emergence and in the PACU. This blunting of sympathetic

responses is consistent with its pharmacological profile.[9,14] and has clinical significance in minimizing stress-related complications, especially in patients with cardiovascular risk. Importantly, no bradycardia requiring intervention was observed, reflecting safe perioperative administration in our study population.

Postoperative pain scores were also significantly improved in the dexmedetomidine group, reinforcing its opioid-sparing analgesic effect.[10,15] The reduction in EA may partly be attributable to superior analgesia, as pain itself is a recognized risk factor for agitation.[4,16]

Notably, neither extubation time nor overall emergence time was significantly prolonged, contrasting with concerns raised in some earlier studies.[13,17] This may reflect careful titration of dexmedetomidine bolus dosing, avoiding excessive sedation.

The study has certain limitations. It was conducted at a single tertiary care centre with a modest sample size, which may limit generalizability. Long-term outcomes such as postoperative cognitive recovery and delirium were not assessed. Additionally, plasma concentrations of dexmedetomidine were not measured, precluding pharmacokinetic correlations.

Despite these limitations, our findings add to the growing body of evidence that dexmedetomidine is a valuable adjuvant in desflurane-based anaesthesia, enhancing safety and quality of emergence without compromising recovery times.

Conclusion

Dexmedetomidine administration during desflurane-based general anaesthesia significantly reduces the incidence of emergence agitation and improves postoperative pain control, while providing better hemodynamic stability during the emergence period. Importantly, these benefits are achieved without clinically significant prolongation of emergence or extubation times. The attenuation of sympathetic responses and improved quality of recovery highlight dexmedetomidine as an effective and safe adjuvant in adult patients undergoing surgery under desflurane anaesthesia. Further large-scale, multicentric studies are recommended to validate these findings and explore long-term outcomes such as postoperative cognitive function and delirium.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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