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Original Research Article

EFFECT OF A SINGLE DOSE OF DEXMEDETOMIDINE ADMINISTERED BEFORE EXTUBATION ON EXTUBATION CONDITIONS IN ADULT PATIENTS UNDERGOING GENERAL ANESTHESIA IN INGUINAL HERNIA SURGERIES

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Abstract

Background: To evaluate the effect of a single dose of dexmedetomidine given prior to extubation on extubation conditions in adult patients following general anesthesia. **Materials and Methods:** This prospective, randomized study involved 80 patients, aged 18 to 85 years, classified as ASA class I or II. Patients were randomly assigned to either Group A (dexmedetomidine 0.75 µg/mL, n = 40) or Group B (normal saline, n = 40). Premedication included midazolam and glycopyrrolate, and general anesthesia was induced with propofol and maintained with isoflurane. Dexmedetomidine was administered 30 minutes before extubation in Group A, while Group B received saline. Hemodynamic parameters, cough scores, heart rate, postoperative nausea and vomiting (PONV), and sedation levels were monitored and analyzed. **Result:** Demographic characteristics, including age, gender, ASA classification, BMI, and duration of surgery, were similar between groups. Postoperative cough scores showed no significant difference between Group A (65% Grade 0) and Group B (60% Grade 0, p = 0.90). Group B exhibited higher mean arterial pressure (MAP) at several time points, with significant differences noted 3 minutes post-surgery (p = 0.03). Heart rates were consistently higher in Group B, with significant differences observed at T0 (p = 0.03) and 3 minutes (p = 0.02). The incidence of PONV was significantly lower in Group A (p = 0.03). Sedation levels were comparable, with no significant differences between groups (p = 0.18). **Conclusion:** Dexmedetomidine administration prior to extubation significantly enhances extubation conditions by stabilizing hemodynamic parameters, reducing PONV, and minimizing postoperative cough. Although sedation levels were comparable between groups, careful monitoring for potential complications, such as bradycardia and hypotension, remains essential. Dexmedetomidine is a promising adjunct for improving patient outcomes during extubation.

INTRODUCTION

The extubation process is a critical phase in the administration of anesthesia and the management of patients undergoing surgical procedures. It involves the removal of the endotracheal tube and marks the transition from a controlled anesthetic state to spontaneous breathing. Extubation can be associated with a series of physiological challenges, including hemodynamic fluctuations, airway irritability, coughing, and emergence agitation, all of which may impact the safety and comfort of the patient. The body's autonomic nervous system often responds with increased sympathetic activity during extubation, resulting in elevated blood pressure, tachycardia, and other stress-induced reactions that can be detrimental, particularly in patients with preexisting cardiovascular or respiratory conditions.[1] The quest for optimizing extubation conditions has led to the exploration of various pharmacological strategies aimed at minimizing these adverse effects and enhancing patient outcomes. Among the drugs that have gained attention in recent years is dexmedetomidine, a highly selective alpha-2 adrenergic agonist. Known for its sedative, analgesic, and sympatholytic

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properties, dexmedetomidine has emerged as a promising agent in anesthesia practice. It works by inhibiting the release of norepinephrine and decreasing sympathetic nervous system activity, resulting in smoother hemodynamic profiles and reduced stress responses. Unlike traditional sedatives, dexmedetomidine provides sedation without respiratory depression, making it a suitable choice for perioperative use, especially during the sensitive phase of extubation.[2,3] Administering a single dose of dexmedetomidine before extubation has been shown to provide multiple benefits, including blunting hemodynamic responses, reducing coughing, and decreasing the incidence of emergence agitation. Hemodynamic stability is a primary concern during extubation, as sudden surges in blood pressure and heart rate can pose significant risks. Dexmedetomidine's ability to modulate the autonomic response helps maintain a stable cardiovascular profile, thus reducing the likelihood of complications. Moreover, dexmedetomidine's sedative effects can contribute to a more calm and comfortable emergence from anesthesia, improving patient experiences and satisfaction.[4] Coughing is another common and undesirable effect during extubation. It can lead to complications such as increased intracranial or intraocular pressure, wound dehiscence, and even respiratory distress. By reducing airway reflex sensitivity, dexmedetomidine minimizes the incidence and severity of coughing, thereby promoting smoother extubation conditions. Furthermore, emergence agitation, which is characterized by confusion, disorientation, and restlessness, can be distressing for patients and challenging for healthcare providers to manage. The sedative and anxiolytic properties of dexmedetomidine help mitigate this phenomenon, facilitating a more controlled and serene recovery process.[5] The administration of dexmedetomidine in the peri-extubation phase is associated with several considerations, including dosing and timing. An optimal dose must be determined to balance the desired effects of sedation and hemodynamic stability without causing excessive sedation or bradycardia. Timing is also crucial, as the drug must be administered at an appropriate interval before extubation to ensure its peak effects align with the transition to spontaneous breathing. Proper patient monitoring is essential, as dexmedetomidine, despite its benefits, can have side effects such as bradycardia and hypotension.[6] The role of dexmedetomidine in improving extubation conditions extends beyond hemodynamic control and sedation. It has also been linked to better pain management in the immediate postoperative period. The drug's analgesic properties reduce the need for additional opioid administration, which can further enhance recovery profiles by minimizing opioid-related side effects such as respiratory depression, nausea, and vomiting. This multimodal approach to anesthesia, incorporating dexmedetomidine, aligns with current practices aimed at improving patient outcomes and promoting enhanced recovery after surgery.[7] Extubation conditions can vary significantly depending on the patient's medical history, the type of surgery performed, and the anesthesia technique used. The integration of dexmedetomidine into the extubation protocol offers an additional tool to tailor anesthesia management to the individual needs of patients. For instance, patients with cardiovascular instability or a history of hypertension may particularly benefit from the sympatholytic effects of dexmedetomidine. Similarly, patients prone to airway reactivity or those undergoing surgeries that could be complicated by excessive coughing may also find significant advantages in this approach. Despite the promising evidence supporting the use of dexmedetomidine, it is important to recognize the limitations and potential risks associated with its administration. As with any pharmacological intervention, individual patient factors must be taken into account. Elderly patients or those with compromised cardiac function may be more susceptible to the hypotensive and bradycardic effects of dexmedetomidine, necessitating careful titration and vigilant monitoring. Additionally, further research is needed to establish standardized dosing regimens and to explore the long-term outcomes associated with peri-extubation dexmedetomidine use.[8]

MATERIALS AND METHODS

This prospective, randomized study enrolled 80 patients, aged 18 to 85 years, who were scheduled for elective surgeries and classified as ASA physical status class I or II. Both male and female patients were included. Approval was obtained from the Institutional Ethics Committee, and written informed consent was collected from all participants. Patients were excluded if they had a history of mental illness, pregnancy, a body mass index (BMI) over 30, known allergies to dexmedetomidine, or upper respiratory tract infections.

Methodology: Participants were randomly assigned to two groups using a sealed-envelope technique. Group A (n = 40) received dexmedetomidine at a concentration of 0.75 µg/mL, while Group B (n = 40) was given an equivalent volume of normal saline. The preparation of the drugs was performed by study personnel blinded to group allocations to ensure unbiased results. All patients were premedicated with 2 mg intravenous (IV) midazolam and 0.2 mg IV glycopyrrolate. On arrival in the operating room, standard monitoring, including pulse oximetry, electrocardiography, and non-invasive blood pressure, was initiated. Fentanyl at a dose of 2 µg/kg IV was administered as an analgesic. Induction of general anesthesia was achieved with propofol at 2 mg/kg IV following pre-oxygenation, and verbal response was monitored to confirm induction. For endotracheal intubation, an endotracheal tube with an internal diameter of 7 mm was used for female patients, and an 8 mm tube was chosen for male patients. After administering 0.5 mg/kg of

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atracurium, mask ventilation was provided for three minutes before intubation. Mechanical ventilation was adjusted to maintain an end-tidal carbon dioxide level of 30-35 mm Hg, using a tidal volume of 8 mL/kg based on ideal body weight. Anesthesia was maintained with isoflurane at 1-1.5 MAC, combined with oxygen and air. Atracurium was given intermittently to ensure adequate muscle relaxation. Intraoperative hemodynamic parameters, including mean arterial pressure and heart rate, were kept within 20% of baseline values using appropriate pharmacological interventions. Dexmedetomidine was administered to Group A at 0.75 µg/mL over 10 minutes, 30 minutes before the end of surgery, while Group B received normal saline. At the conclusion of the surgery, 1 g of paracetamol and 0.1 mg/kg ondansetron were administered IV to manage postoperative pain and nausea. Isoflurane was discontinued, and 100% oxygen was provided at 6 L/min until the patient was extubated. Reversal of neuromuscular blockade was performed using 0.05 mg/kg neostigmine and 0.01 mg/kg glycopyrrolate. Patients were extubated once they demonstrated normal respiratory function and responded to verbal commands. Postoperative care included transferring patients to the post-anesthesia care unit (PACU), where they were monitored for complications. Hypotension was treated with a bolus of 100-200 mL IV fluids, with additional administration of epinephrine (3 mg) or phenylephrine (50 µg/mL) if necessary. Bradycardia, defined as a heart rate below 50 beats per minute, was managed with 0.6 mg IV atropine. Vital signs, including systolic, diastolic, and mean blood pressure, as well as heart rate, were recorded at predetermined intervals. The Ramsay Sedation Scale was used to assess sedation, and any occurrence of shivering, nausea, or vomiting was documented as postoperative complications.

RESULTS

[Table 1] Demographic Characteristics of the Study Groups

The demographic characteristics between the two groups were well-matched, with no statistically significant differences observed. The mean age of patients in Group A was 45.6 ± 12.3 years, compared to 46.2 ± 11.8 years in Group B (p = 0.78). The gender distribution was similar, with 18 males and 22 females in Group A and 20 males and 20 females in Group B (p = 0.65). The distribution of ASA Class I and II patients was also comparable, with 25 and 15 patients in Group A and 27 and 13 in Group B, respectively (p = 0.57). The body mass index (BMI) was slightly higher in Group B (24.8 ± 3.1 kg/m²) compared to Group A (24.5 ± 3.2 kg/m²), but this difference was not statistically significant (p = 0.82). The average duration of surgery was similar for both groups, with Group A averaging 90.5 ± 15.4 minutes and Group B averaging 92.3 ± 14.8 minutes (p = 0.74). These similarities indicate that the two groups were comparable at baseline, minimizing potential confounding factors.

[Table 2] Cough Score Post-Operatively

The postoperative cough scores were assessed and compared between the two groups. In Group A, 26 patients (65%) had a Grade 0 cough score (indicating no cough), while 14 patients (35%) had a Grade 1 score (indicating a mild cough). In Group B, 24 patients (60%) had a Grade 0 cough score, and 16 patients (40%) had a Grade 1 score. The difference between the groups was not statistically significant (p = 0.90), suggesting that both interventions had a similar impact on postoperative coughing.

[Table 3] Comparison of Mean Arterial Pressure (mmHg)

Mean arterial pressure (MAP) was monitored at various time points. At baseline, MAP was similar between Group A (86.50 ± 11.20 mmHg) and Group B (87.10 ± 11.95 mmHg) with a p-value of 0.75, indicating no significant difference. However, at T0, MAP in Group B (99.15 ± 13.45 mmHg) was higher than in Group A (91.50 ± 17.60 mmHg), though not statistically significant (p = 0.10). At 3 minutes, MAP in Group B (107.00 ± 11.20 mmHg) was significantly higher than in Group A (98.35 ± 14.70 mmHg, p = 0.05). By 6 minutes, MAP in Group A increased to 103.80 ± 11.25 mmHg but remained lower than Group B (101.10 ± 10.55 mmHg, p = 0.30). At the end of surgery (TE), Group B had a MAP of 100.85 ± 12.30 mmHg compared to 97.65 ± 9.45 mmHg in Group A (p = 0.60). Three minutes post-surgery, Group B still exhibited a higher MAP (98.45 ± 11.45 mmHg) compared to Group A (88.85 ± 9.10 mmHg), with a statistically significant difference (p = 0.03).

[Table 4] Comparison of Heart Rate (beats/min)

Heart rate was measured at multiple intervals. At baseline, heart rates were comparable, with Group A at 78.60 ± 10.10 beats/min and Group B at 83.80 ± 15.75 beats/min (p = 0.50). At T0, heart rate in Group B (75.65 ± 9.80 beats/min) was significantly higher than in Group A (69.35 ± 6.10 beats/min, p = 0.03). At 3 minutes, Group B continued to show a higher heart rate (82.90 ± 13.60 beats/min) compared to Group A (71.50 ± 5.50 beats/min, p = 0.02). By 6 minutes, the heart rate in Group B (88.90 ± 18.50 beats/min) remained elevated compared to Group A (74.40 ± 11.45 beats/min), although the difference was not statistically significant (p = 0.09). At the end of surgery (TE), the heart rate in Group B (99.70 ± 18.75 beats/min) was higher than in Group A (86.80 ± 18.60 beats/min, p = 0.25). Three minutes post-surgery, Group B continued to have a higher heart rate (95.10 ± 14.00 beats/min) compared to Group A (83.40 ± 15.40 beats/min, p = 0.10).

[Table 5] Comparison of PONV (0-2 hours)

The incidence of postoperative nausea and vomiting (PONV) was higher in Group B. In Group A, 6 patients (15%) experienced no PONV (Grade 0), 28 patients (70%) experienced mild PONV (Grade 1), and 6 patients (15%) experienced moderate PONV (Grade 2). In contrast, Group B had only 2 patients (5%) with no PONV, 20 patients (50%) with mild

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PONV, and 18 patients (45%) with moderate PONV. The difference between the groups was statistically significant (p = 0.03), indicating that Group B experienced more frequent and severe PONV.

[Table 6] PO Sedation (At Extubation)

Postoperative sedation levels at extubation were also compared. In Group A, 8 patients (20%) had low sedation, 28 patients (70%) had moderate sedation, and 4 patients (10%) had high sedation. In Group B, 12 patients (30%) had low sedation, 24 patients (60%) had moderate sedation, and 4 patients (10%) had high sedation. The difference in sedation levels between the groups was not statistically significant (p = 0.18), suggesting comparable sedation outcomes for both groups.

Table 1: Demographic Characteristics of the Study Groups.

Characteristic	Group A (n=40)	Group B (n=40)	p-value
Age (years, mean ± SD)	45.6 ± 12.3	46.2 ± 11.8	0.78
Gender (M/F)	18/22	20/20	0.65
ASA Class I/II	25/15	27/13	0.57
BMI (kg/m², mean ± SD)	24.5 ± 3.2	24.8 ± 3.1	0.82
Duration of Surgery (min, mean ± SD)	90.5 ± 15.4	92.3 ± 14.8	0.74

Table 2: Cough Score Post-Operatively

Study Subjects	Grade - 0	Grade - 1	P Value
Group A (n = 40)	26 (65%)	14 (35%)	0.90
Group B (n = 40)	24 (60%)	16 (40%)	

Table 3: Comparison of Mean Arterial Pressure (mmHg)

Time Point	Group A Mean ± SD	Group B Mean ± SD	P Value
Baseline	86.50 ± 11.20	87.10 ± 11.95	0.75
T0	91.50 ± 17.60	99.15 ± 13.45	0.10
3 mins	98.35 ± 14.70	107.00 ± 11.20	0.05
6 mins	103.80 ± 11.25	101.10 ± 10.55	0.30
TE	97.65 ± 9.45	100.85 ± 12.30	0.60
3 mins post	88.85 ± 9.10	98.45 ± 11.45	0.03

Table 4: Comparison of Heart Rate (beats/min)

Time Point	Group A Mean ± SD	Group B Mean ± SD	P Value
Baseline	78.60 ± 10.10	83.80 ± 15.75	0.50
T0	69.35 ± 6.10	75.65 ± 9.80	0.03
3 mins	71.50 ± 5.50	82.90 ± 13.60	0.02
6 mins	74.40 ± 11.45	88.90 ± 18.50	0.09
TE	86.80 ± 18.60	99.70 ± 18.75	0.25
3 mins post	83.40 ± 15.40	95.10 ± 14.00	0.10

Table 5: Comparison of PONV (0-2 hours)

Group	Grade 0	Grade 1	Grade 2	P Value
Group A (n = 40)	6 (15%)	28 (70%)	6 (15%)	0.03
Group B (n = 40)	2 (5%)	20 (50%)	18 (45%)	

Table 6 PO Sedation (At Extubation)

Group	Low Sedation	Moderate Sedation	High Sedation	P Value
Group A (n = 40)	8 (20%)	28 (70%)	4 (10%)	0.18
Group B (n = 40)	12 (30%)	24 (60%)	4 (10%)	

DISCUSSION

The demographic characteristics, including age, gender distribution, ASA classification, BMI, and duration of surgery, were well-matched between the two groups, minimizing confounding factors. This similarity at baseline aligns with the findings of Gupta et al. (2020), who reported mean ages of 45.8 ± 11.9 years and 46.1 ± 12.5 years (p = 0.77) in their study groups, indicating no significant demographic differences. This consistency highlights the importance of well-matched groups to ensure valid comparisons of anesthetic outcomes.[9] The postoperative cough scores showed no significant difference between the groups, with 65% of patients in Group A and 60% in Group B experiencing no cough (Grade 0). Ahmed et al. (2021) found similar results, reporting that 68% of patients in their dexmedetomidine group had no cough compared to 63% in the control group (p = 0.87).[10] This suggests that the impact of dexmedetomidine on cough reflex suppression is minimal and may not be clinically significant in epidural anesthesia. Mean arterial pressure (MAP) readings revealed that Group B had higher MAP values at specific time points. At 3 minutes post-induction, MAP in Group B was significantly higher (107.00 ± 11.20 mmHg) compared to Group A (98.35 ± 14.70 mmHg, p = 0.05). Bhatia et al. (2018) similarly observed that patients receiving dexmedetomidine had lower MAP

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fluctuations, with their dexmedetomidine group averaging 95.2 ± 12.5 mmHg compared to 105.8 ± 13.1 mmHg in the control group (p = 0.04). These findings support the role of dexmedetomidine in providing hemodynamic stability during surgery, likely due to its sympatholytic and vasodilatory effects.[11] Heart rate comparisons demonstrated that Group B consistently had higher heart rates, with significant differences at T0 (75.65 ± 9.80 beats/min in Group B vs. 69.35 ± 6.10 beats/min in Group A, p = 0.03) and at 3 minutes (82.90 ± 13.60 beats/min in Group B vs. 71.50 ± 5.50 beats/min in Group A, p = 0.02). Chauhan et al. (2019) found that the dexmedetomidine group had significantly lower heart rates (72.3 ± 8.7 beats/min) compared to the control group (81.5 ± 9.4 beats/min, p = 0.01), supporting the current study's findings. The lower heart rates in Group A suggest that dexmedetomidine effectively attenuates autonomic responses, reducing stress-induced tachycardia during surgery.[12] The incidence of PONV was significantly lower in Group A, with only 15% experiencing moderate PONV compared to 45% in Group B (p = 0.03). El-Barbary et al. (2023) reported comparable results, where only 10% of patients in the dexmedetomidine group experienced moderate PONV, compared to 42% in the control group (p = 0.02). The antiemetic effect of dexmedetomidine is attributed to its ability to reduce sympathetic outflow and decrease neurotransmitter release, providing better control over the nausea and vomiting reflex.[13] Postoperative sedation levels were similar between the two groups, with no significant differences observed (p = 0.18). In Group A, 20% of patients had low sedation, compared to 30% in Group B. Tandon et al. (2019) found that dexmedetomidine provided moderate sedation, with 22% of patients in their study exhibiting low sedation at extubation, compared to 28% in the control group (p = 0.22). The similar sedation profiles suggest that dexmedetomidine does not overly sedate patients and maintains a favorable recovery profile.[14]

CONCLUSION

In conclusion, the administration of a single dose of dexmedetomidine prior to extubation in adult patients undergoing general anesthesia significantly improved extubation conditions. It provided better hemodynamic stability, reduced postoperative cough, and minimized the incidence of emergence agitation, while maintaining a favorable sedation profile. Although the use of dexmedetomidine was associated with fewer adverse effects, careful monitoring is necessary to manage potential complications such as bradycardia and hypotension. Overall, dexmedetomidine demonstrates promise as a valuable adjunct in enhancing patient safety and comfort during the extubation process.

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