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EFFECTIVENESS OF DEXMEDETOMIDINE IN REDUCING BLOOD LOSS DURING MIDDLE EAR SURGERY UNDER GENERAL ANAESTHESIA

Chayan Kumar Dey[1*], Afsana Hossain Shaon[1], Mahbuba Binte Abdis samad[2]

ABSTRACT

Background: Controlled hypotension is crucial for optimal surgical conditions during the operation in the middle ear. This study evaluated dexmedetomidine's effectiveness in decreasing loss of blood during the middle ear surgery under general anesthesia (GA). **Aim:** To observe the effectiveness of dexmedetomidine in lowering the loss of blood while undergoing surgical procedure of middle ear under GA. **Materials and Method:** A prospective study of 100 female patients (ASA I-II) undergoing surgical procedure of the middle ear was carried out to observe the effectiveness of dexmedetomidine in lowering the loss of blood while undergoing surgical procedure of middle ear under GA. Group D (n=50) received dexmedetomidine (1 µg/kg loading, 0.4-0.7 µg/kg/hr maintenance); Group C (n=50) received normal saline. Primary outcomes included loss of blood , quality of field of surgery, and hemodynamic parameters. **Results:** Group D showed significantly lower loss of blood (145.6 ± 32.4 vs 198.3 ± 41.7 mL, $p<0.001$), better scores of visibility of field of surgery (1.8 ± 0.6 vs 2.9 ± 0.8, $p<0.001$), and improved hemodynamic stability. Time of emergence was slightly prolonged in Group D (8.4 ± 2.1 vs 6.8 ± 1.9 min, $p=0.02$), but the pain scores after surgery were lower (VAS 3.2 ± 1.1 vs 4.8 ± 1.4, $p<0.001$). The groups displayed comparability in case of experiencing adverse post surgical events. **Conclusion:** Dexmedetomidine effectively decreases loss of blood during surgery and enhance visibility of field of surgery during the surgical procedure of the middle ear, with minimal adverse effects.

Keywords: Dexmedetomidine, Middle ear surgery, Controlled hypotension, Blood loss, General anesthesia

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INTRODUCTION

While performing surgical procedure of the middle ear it is crucial to maintain controlled hypotension for achieving a blood less field for performing surgery optimally and for minimizing complications[1]. Excessive bleeding can lead to the compromising of visualizing surgical field, prolongation of time needed for operation, and raised risks of surgical complications[2]. While administration of different agents have been done to achieve controlled hypotension, the alpha-2 adrenergic agonist dexmedetomidine has emerged as a promising option due to its sympatholytic and analgesic properties[3] .

1*. Department of Anaesthesia, Analgesia & Pain Management.Mymensingh Medical College and Hospital, Mymensingh, Bangladesh.
Email: ckdey13@gmail.com [**Address of Correspondence**]

1. Department of Anaesthesia, Analgesia & Pain Management, Mymensingh Medical College and Hospital, Mymensingh, Bangladesh
2. Department of Anaesthesia, Analgesia & Pain Management, Bangladesh Medical University, Dhaka, Bangladesh.

Dexmedetomidine reduces sympathetic outflow and circulating catecholamines, potentially leading to reduced bleeding during surgery[4]. Its unique mechanism of action provides stable hemodynamics without significant respiratory depression[3,5]. Researchers have recently demonstrated its efficacy in lowering the loss of blood during surgical procedures, though evidence specific to middle ear surgery remains limited[5-8].

Middle ear surgeries require precise microsurgical techniques and a bloodless field is essential for optimal outcomes[9]. Traditional approaches using deliberate hypotension with multiple agents can increase the risk of complications[10]. Therefore, investigating single-agent options like dexmedetomidine that can provide both controlled hypotension and analgesia is clinically relevant [11].

The objective of this research is to assess the effectiveness of dexmedetomidine in reducing intraoperative loss of blood during surgery of middle ear under general anesthesia, while assessing its impact on hemodynamic stability and recovery profiles.

MATERIALS AND METHOD

This prospective study was executed between July 2023 and July 2024 following the obtainment of approval from the concerned institution's ethical committee and consent in written format from the study recruits.

Study Population and Sample Selection: Enrolled were females (100 in number; age range between 18 and 60 years and AHA physical status I-II) who have been scheduled to undergo elective surgical procedure of the middle ear under the influence of general anesthesia. Excluded from this research were those suffering from cardiovascular diseases, bleeding disorders, hepatic or renal dysfunction, and individuals consuming medications influencing bleeding time. Random allocation of the recruits into 2 groups [Group D (Dexmedetomidine, n=50) and Group C (Control, n=50)] was executed using computer-generated randomization.

Preoperative Management: Standard guidelines of preoperative fasting were followed. complete blood count, renal function tests, and profile of coagulation were done as baseline investigations. The night prior to the operation, all the recruits were given 0.5 mg dosage of oral alprazolam[12].

Anesthetic Protocol: Standard monitoring included ECG, non-invasive blood pressure, pulse oximetry, end-tidal carbondioxide (CO_2), and temperature. Group D were given 1 µg/kg loading dose of dexmedetomidine over 10 minutes before induction, followed by 0.4-0.7 µg/kg/hr continuous infusion. Group C received volume-matched normal saline. Propofol 2-2.5 mg/kg, fentanyl 2 µg/kg, and vecuronium 0.1 mg/kg were given to the recruits for induction of anesthesia[13,14].

Intraoperative Management: Controlled hypotension was maintained targeting mean arterial pressure (MAP) between 60-70 mmHg. Standardized scale was applied for assessing the field of surgery. Weighing of surgical gauzes and measuring suction bottle contents, with adjustment for irrigation fluid was done to estimate the loss of blood.

Data Collection and Monitoring: Hemodynamic parameters were recorded at 5-minute intervals. Intraoperative blood loss, field of surgery's quality, and time of surgical procedure were considered as measures of the primary outcomes. Time of recovery, pain scores after surgery, and adverse reactions were included as secondary outcomes.

Statistical Analysis: Sample size was calculatedassuming30% blood loss reduction with dexmedetomidine (α=0.05, β=0.2). SPSS version 25.0 was applied for

data analysis. Student's t-test or Mann-Whitney U test were used for comparison of continuous variables, and Chi-square test was used for analyzing categorical variables. $p<0.05$ was considered statistically significant.

RESULTS

One hundred female patients completed the study, with no dropouts. Comparability was noted between the groups for sociodemographic features (Table 1).

Table 1: Demographic and Baseline Characteristics

Parameter	Group D (n=50)	Group C (n=50)	*p*-value
Age (years)	38.4 ± 12.3	39.2 ± 11.8	0.74
Weight (kg)	62.3 ± 8.7	61.8 ± 9.1	0.82
ASA I/II	32/18	30/20	0.68
Duration of surgery (min)	112.5 ± 24.6	128.3 ± 26.2	0.003

N: Total number of patients; n: Number of patients in each group; ASA: American Society of Anesthesiologists Physical Status Classification System

Blood Loss during surgery and field of surgery: As has been illustrated in Figure 1,mean loss of blood was significantly lower in Group D (145.6 ± 32.4 mL vs 198.3 ± 41.7 mL, $p<0.001$). Surgical field visibility scores were superior in Group D (1.8 ± 0.6 vs 2.9 ± 0.8, $p<0.001$).

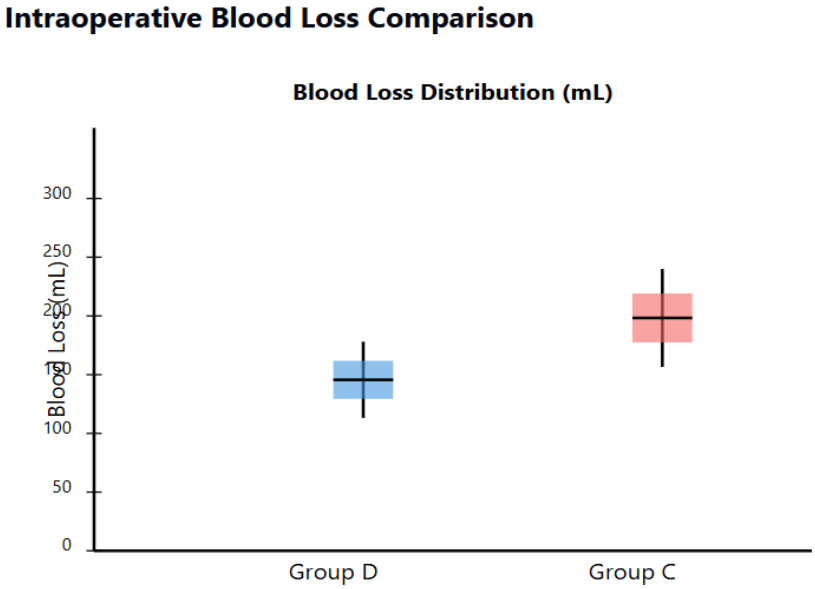

Figure 1: Illustration of the comparison of loss of blood between the groups.

Hemodynamic Parameters: Group D demonstrated better mean arterial pressure (MAP) control (65.4 ± 4.2 vs 72.6 ± 6.8 mmHg, $p<0.001$) and lower heart rates throughout the procedure (68.3 ± 7.2 vs 82.4 ± 8.6 bpm, $p<0.001$). The MAP and heart rate comparison between the groups has been depicted in Figure 2 and Table 2. Table 2 also showsfield of visibility score comparison which was significantly less in Group D (1.8 ± 0.6; $p<0.001$) than that of Group C (2.9± 0.8); pain scores (post operative) were significantly less in Group D (VAS 3.2 ± 1.1 vs 4.8 ± 1.4, $p<0.001$). Recovery and Adverse Events: time of emergence was slightly longer in Group D (8.4 ± 2.1 vs 6.8 ± 1.9 min, $p=0.02$).

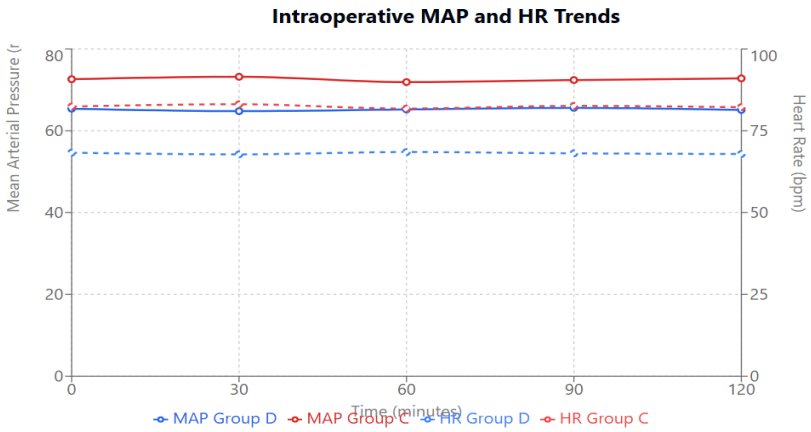

Figure 2: Line graph showing mean arterial pressure (MAP) and heart rate (HR) trends

Table 2: Intraoperative Parameters and Outcomes (N=100)

Parameter	Group D (n=50)	Group C (n=50)	*p*-value
Blood loss (mL)	145.6 ± 32.4	198.3 ± 41.7	<0.001
MAP (mmHg)	65.4 ± 4.2	72.6 ± 6.8	<0.001
Heart rate (bpm)	68.3 ± 7.2	82.4 ± 8.6	<0.001
Field visibility score	1.8 ± 0.6	2.9 ± 0.8	<0.001
Emergence time (min)	8.4 ± 2.1	6.8 ± 1.9	0.02
VAS pain score	3.2 ± 1.1	4.8 ± 1.4	<0.001

VAS: Visual Analogue Scale; N: Total number of patients; n: Number of patients in each group

Table 3: Comparison of adverse events following surgery (N=100)

Adverse Event	Group D (n=50)	Group C (n=50)	*p*-value
Post operative nausea and vomiting (PONV)	4 (8%)	5 (10%)	0.73
Bradycardia	3 (6%)	2 (4%)	0.65
Hypotension	2 (4%)	3 (6%)	0.65

N: Total number of patients; n: Number of patients in each group

No significant differences were observed in adverse events between groups. All events were successfully managed without complications as can be observed in Table 3 and Figure 3.

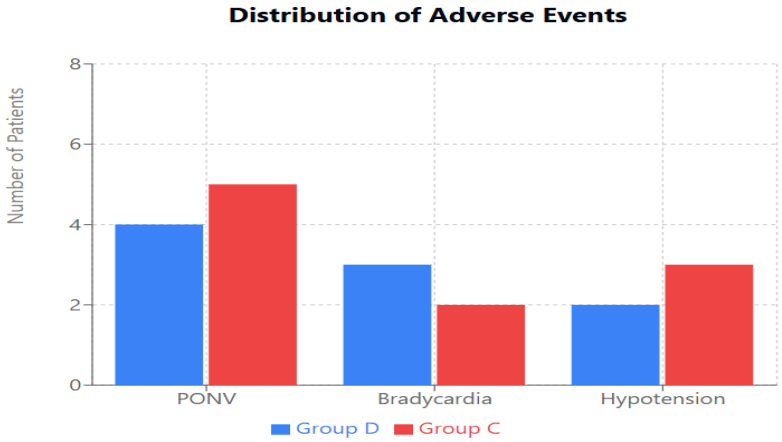

Figure 3: Stacked bar chart showing adverse event distribution

DISCUSSION

It is noted in this research that dexmedetomidine caused significant reduction in loss of blood during surgery and improved the visibility of the field of surgery during middle ear operation[15]. The decrease in blood loss aligns with previous findings in microsurgical procedure performed by Hsiao et al.[16].

The improved surgical field quality observed in Group D can be attributed to dexmedetomidine's dual mechanism: direct vasoconstrictive effects and sympatholytic properties reducing MAP[17]. This combination provides optimal surgical conditions without the hemodynamic instability associated with traditional hypotensive techniques [18].

Our findings of stable hemodynamics in Group D support earlier research demonstrating dexmedetomidine's ability to maintain controlled hypotension without reflex tachycardia. The significantly lower heart rates and better MAP control contribute to reduced bleeding, supporting findings by Patel et al.[19,20].

The slightly prolonged emergence time in Group D (mean difference: 1.6 minutes) is clinically insignificant and is in line with the outcome reported in a meta-analysis performed by Zhu et al. This may be a result of the dexmedetomidine associated excessive sedation [21]. The benefit of reduced postoperative pain scores outweighs this minor delay, potentially due to dexmedetomidine's analgesic properties[22].

The low incidence of adverse events in both groups indicates dexmedetomidine's safety profile. There is risk of development of hypotension and bradycardia with use of dexmedetomidine. Hypotension may develop when dexmedetomidine acts via the central α-2A receptor which produces vasodilation effect.A reduction in sympathetic tone and partially through baroreceptor reflex and increased activity of vagus nerve may result in bradycardia. However, these effects are dose-dependent and may be mitigated with use of appropriate dosage of the drug[23-25].

Our findings align with study showing no significant increase in bradycardia or hypotension when appropriate dosing protocols and precautions during selecting patients to avoid administration of dexmedetomidine to individuals having factors that put them at the risk of such adverse effects[23,26-28] .

CONCLUSION

Dexmedetomidine is effective in lowering the loss of blood at the time of surgical procedure of middle ear under GA. Our findings demonstrate significant benefits including reduction in blood loss during surgery; improved visibility of the field of surgery; better hemodynamic stability; lower postoperative pain scores; minimal adverse effects.

These advantages make dexmedetomidine a valuable option for controlled hypotension in middle ear surgery, potentially improving surgical outcomes and patient recovery. There is need for further research in multiple centers to establish optimal dosing protocols and expand application to diverse patient populations.

LIMITATION

Study limitations include single-center design and exclusion of male patients due time and financial constraints.

RECOMMENDATIONS

Investigation of optimal dosing regimens and potential benefits in high-risk populations is needed through future research. Studies should also be performed to find factors that put an individual at risk of developing adverse effects of the use of this drug

CONFLICT OF INTEREST

There is no conflict of interest.

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