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Original Research Article

A COMPARATIVE STUDY TO EVALUATE EFFICACY AND SAFETY BETWEEN DIFFERENT SEDATIVE DRUGS COMBINATION IN THERAPEUTIC ENDOSCOPIC PROCEDURES

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Abstract

Background: Sedation during endoscopic procedures is essential for patient comfort and procedural success. This study aimed to compare the efficacy, safety, and recovery outcomes of three sedation combinations: ketamine + propofol (Group A), dexmedetomidine + propofol (Group B), and dexmedetomidine + ketamine (Group C) in patients undergoing endoscopic procedures. **Materials and Methods:** A prospective, randomized controlled trial was conducted involving patients scheduled for endoscopic procedures. Patients were divided into three groups based on the sedation regimen administered. Outcomes measured included sedation quality, hemodynamic stability, oxygen saturation, incidence of adverse effects, recovery time, and endoscopist satisfaction. **Result:** Group C (dexmedetomidine + ketamine) demonstrated a lower incidence of adverse effects, with 80% of patients experiencing no significant events such as falls in mean arterial pressure (MAP) or SpO_2. The ketamine + propofol combination (Group A) required significantly more propofol rescue doses compared to the other groups. Dexmedetomidine-based combinations (Groups B and C) provided better sedation, stable hemodynamics, and fewer adverse events, while recovery times were longer than in the ketamine + propofol group (Group A). No significant differences were observed in endoscopist satisfaction across the groups. **Conclusion:** Dexmedetomidine-based sedation combinations, provide effective sedation with minimal adverse effects, maintaining stable hemodynamics and oxygen saturation. These combinations are particularly suitable for patients with underlying conditions such as hepatic disease, offering a safer alternative to ketamine + propofol.

INTRODUCTION

Therapeutic endoscopic procedures have transformed the management of gastrointestinal (GI) disorders, offering minimally invasive diagnostic and treatment options for a variety of conditions. However, these procedures are not without challenges, as they often evoke significant fear, anxiety, and pain in patients, potentially compromising procedural compliance and outcomes. To address these concerns, the integration of sedation and analgesia has become a cornerstone of modern endoscopy, aiming to enhance both patient comfort and the endoscopist's efficiency. Effective sedation not only alleviates discomfort but also ensures procedural success, making the choice of sedative agents a critical factor in optimizing outcomes.[1]

In the pursuit of achieving ideal sedation, numerous pharmacological agents have been explored. The perfect sedative regimen would provide rapid induction, smooth maintenance, and quick recovery with minimal adverse effects, facilitating early discharge while ensuring patient safety and procedural efficacy. Among the currently available options, Propofol, Ketamine, and Dexmedetomidine stand out as widely used agents, either alone or in combination, due to their distinct pharmacological properties.[2]

Propofol, a phenolic derivative acting primarily on GABA receptors, is characterized by its rapid onset and recovery. However, its lack of analgesic effects and potential for cardiovascular and respiratory depression necessitate its combination with other agents for better outcomes.[3,4] Ketamine, an NMDA receptor antagonist, offers a unique profile with its combined sedative, hypnotic, and analgesic effects, alongside the preservation of airway reflexes. Despite its advantages, side effects such as psychomimetic

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emergence, vomiting, and delayed recovery limit its standalone use.[5] Similarly, Dexmedetomidine, a highly selective alpha-2 adrenergic agonist, provides anxiolytic, sedative, and analgesic effects with minimal respiratory depression but poses a risk of bradycardia and hypotension due to its sympatholytic action.[6–9]

Given the limitations of individual agents, combining sedatives has emerged as a promising approach to enhance efficacy while mitigating side effects. Synergistic combinations can optimize sedation, analgesia, and hemodynamic stability, addressing the diverse demands of therapeutic endoscopy. This study aims to compare the efficacy and safety of three sedative drug combinations i.e., Propofol-Ketamine, Dexmedetomidine-Propofol, and Dexmedetomidine-Ketamine in therapeutic endoscopic procedures, including Endoscopic Retrograde Cholangiopancreatography (ERCP), Esophageal Variceal Banding (EVB), Esophageal Balloon Dilatation (EBD), and Colonic Dilatation (CD). By assessing critical parameters such as sedation depth, hemodynamic changes, adverse events, recovery scores, and endoscopist satisfaction, this study seeks to identify the most effective and safe sedation protocol.[10]

MATERIALS AND METHODS

Study Approval, Study duration and Study Site

This prospective comparative study was conducted following approval from the institutional ethical and scientific research committee. The study was conducted over a one-year period, from June 2022 to June 2023. The study was carried out at Ruby Hall Clinic Hospital, Pune-411001, and included adult patients undergoing therapeutic endoscopic procedures at the hospital who met the specified inclusion criteria.

Eligibility Criteria

Patients were included in the study if they were classified as ASA Grade I, II, or III, aged between 18 and 65 years, and provided informed consent for sedation. Exclusion criteria included ASA Grade IV and above, patients younger than 18 or older than 65 years, those with difficult airways, severe heart failure, lung disease, neuropsychiatric disorders, allergies to study drugs, or those who were already intubated.

Sample Size Calculation

The sample size was calculated using G* Power software, based on effect sizes derived from previously published studies by Algharabawy et al., and Tekeli et al.[3,10] The input parameters included an effect size (f) of 0.4180, a significance level (α) of 0.05, and a power (1-β) of 0.90. The output parameters were as follows: Non-centrality parameter (λ) of 13.6285, a critical F-value of 3.1186, and degrees of freedom (Numerator/Denominator) of 2/75. Based on these calculations, the total sample size required was 78, ensuring an actual power of 0.9099. Accordingly, the study included a total of 78 patients, with a minimum of 26 patients allocated to each group.

Study Resources

The study required various materials and drugs for sedation and emergency management. The drugs included Dexmedetomidine, Ketamine, Propofol, Fentanyl, and Midazolam. Additionally, emergency drugs and a crash cart were available, along with a difficult airway kit and intubation equipment. Monitoring was conducted using a multi-parameter monitor to continuously track mean arterial pressure (MAP), heart rate (HR), ECG, and oxygen saturation levels (SpO2) during the procedure.

Study Population and Preparation

The study was conducted on adult patients aged between 18 to 65 years, belonging to ASA grades I, II, and III. Each patient underwent a thorough pre-anesthetic evaluation before being included in the study. Patients were informed about the procedure and the requirement for sedation, and written informed consent was obtained. Prior to the procedure, all patients were premedicated with midazolam (0.02 mg/kg) and fentanyl (1 mcg/kg). Additionally, paracetamol was given during the procedure, and topical 10% lidocaine (2 puff) was sprayed over the posterior aspect of the tongue, pharyngeal wall, and epiglottis for local anesthesia.

Procedure Protocol

Patients were positioned supine for the procedure. To eliminate subjective bias, all endoscopic procedures were carried out by the same endoscopist. The sedation regimen varied according to the group the patient was assigned to:

1. Propofol and Ketamine Group (Group A): 30 patients received a bolus dose of Ketamine (1 mg/kg) and Propofol (0.5 mg/kg) to achieve a Ramsay Sedation Score (RSS) greater than 5.
2. Dexmedetomidine and Propofol Group (Group B): 30 patients were infused with Dexmedetomidine (1 mcg/kg) for over 15 minutes, followed by a Propofol bolus dose of 0.5 mg/kg to achieve RSS greater than 5.
3. Dexmedetomidine and Ketamine Group (Group C): 30 patients were infused with Dexmedetomidine (1 mcg/kg) for over 15 minutes, followed by Ketamine (1 mg/kg) to achieve RSS greater than 5.

In all groups, Propofol up to 0.5 mg/kg was used as a rescue drug if needed to achieve the desired sedation level (>5).

Monitoring and Parameters: Vital parameters, including MAP, SpO2 and HR, were monitored continuously throughout the procedure. Baseline values were recorded at the start (0th minute), and subsequent readings were taken at 5-minute intervals. Monitoring continued until the completion of the procedure. This continuous monitoring ensured early detection of any adverse events and timely interventions.

Adverse Events Management: Any adverse events during the procedure were promptly documented and managed. Hypotension was defined as a decrease in

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MAP greater than 20% from baseline, and it was treated with intravenous fluid boluses and Ephipres (3 mg aliquots). Bradycardia was defined as a HR below 55 beats per minute, and the intervention was IV Atropine (0.6 mg). Desaturation (SpO2 <94%) was addressed with basic airway maneuvers such as chin lift, jaw thrust, or use of a nasopharyngeal airway, and bag-mask ventilation if necessary. These interventions were taken to ensure patient safety and adequate sedation throughout the procedure.

Recovery and Satisfaction Assessment: The recovery time was defined as the duration from the end of the procedure until the patient achieved a RSS of 2 or lower. Once this was achieved, patients were shifted to the recovery room for observation. In addition to monitoring recovery, endoscopist satisfaction was evaluated using a Likert scale, with three categories: Grade 0: Satisfied; Grade 1: Procedure difficult but possible; Grade 2: Extremely difficult to perform

Depth of Sedation: The depth of sedation was assessed using the RSS, which is a widely used tool for evaluating sedation levels. The following scores were assigned based on patient responsiveness: Grade 1: Anxious, agitated, or restless; Grade 2: Cooperative, oriented, and tranquil; Grade 3: Responds only to commands; Grade 4: Brisk response to light glabellar tap or loud auditory stimulus; Grade 5: Sluggish response to light glabellar tap or loud auditory stimulus and Grade 6: No response.

Statistical Data Analysis: Categorical variables were presented as frequencies (n) and percentages, while continuous variables were expressed as means ± SD. Inter-group comparisons of continuous variables were made using ANOVA with Bonferroni's post-hoc test. For categorical variables, the Chi-Square test was used, with Bonferroni's adjustment for multiple comparisons. Normality was tested before ANOVA. Results were displayed in tables and graphs. A p-value <0.05 was considered statistically significant. All data were analyzed using SPSS ver 22.0 (IBM Corporation, USA).

RESULTS

In this study, 30 patients were included in each of the three groups (Group A, Group B, and Group C). The mean age of patients was 55.10 ± 9.05 years in Group A, 52.17 ± 10.82 years in Group B, and 49.97 ± 8.15 years in Group C, with no significant differences observed between the groups [Table 1]. The sex distribution was comparable across the groups, with 53.3% males in Group A, 63.3% in Group B, and 53.3% in Group C [Table 1]. Regarding ASA grades, 26.7% of Group A patients were graded as Grade I, 50.0% as Grade II, and 23.3% as Grade III. In Group B, 36.7% were Grade I, 50.0% were Grade II, and 13.3% were Grade III. Group C had 26.7% in Grade I, 66.7% in Grade II, and 6.7% in Grade III [Table 1]. The mean BMI was 24.35 ± 2.77 kg/m² in Group A, 25.04 ± 2.20 kg/m² in Group B, and 24.56 ± 2.02 kg/m² in Group C, with no significant differences between the groups [Table 1]. In terms of procedures, 60.0% of patients in Group A underwent ERCP, 16.7% underwent EBD, 20.0% underwent EVB, and 3.3% underwent CD. Group B had 60.0% undergoing ERCP, 16.7% undergoing EVB, 20.0% undergoing EBD, and 3.3% undergoing CD. In Group C, 66.7% underwent ERCP, 16.7% underwent EBD, 16.7% underwent EVB, and no patients underwent CD [Table 1]. No significant differences were found across the studied parameters (age, sex distribution, ASA grades, BMI, and procedures) between the three groups.

The distribution of mean heart rate at 0 min did not differ significantly across the three study groups (p>0.05 for all). At 5 min, 10 min, 15 min, 20 min, and 25 min, Group A showed significantly higher mean heart rates compared to Groups B and C. Additionally, the mean heart rate at 5 min, 10 min, 15 min, 20 min, and 25 min was significantly higher in Group C compared to Group B. Overall, Group A exhibited significantly higher mean heart rates compared to Groups B and C, and Group C had significantly higher mean heart rates than Group B [Table 2].

The mean MAP at 0 min, 10 min, 15 min, and 20 min did not differ significantly across the three study groups. However, at 5 min, Group A had a significantly higher mean MAP compared to Group B. Similarly, at 25 min, the mean MAP was significantly higher in Group A compared to both Groups B and C. Thus, the mean MAP was significantly higher in Group A compared to Group B and in Group C compared to Group B [Table 2].

The distribution of mean SpO_2 at 0 min, 10 min, 15 min, and 20 min among the cases studied did not differ significantly across the three study groups (P-value > 0.05 for all comparisons). However, at 5 min and 25 min, the mean SpO_2 was significantly higher in Group B compared to Group A.

Of the 30 cases studied in Group A, 20 (66.7%) experienced no adverse events, 5 (16.7%) had a fall in MAP, 4 (13.3%) had a fall in SpO_2, and 1 (3.3%) experienced both a fall in MAP and SpO_2. Similarly, in Group B, 21 (70.0%) cases had no adverse events, 5 (16.7%) had a fall in MAP, and 4 (13.3%) had a fall in SpO_2. In Group C, 24 (80.0%) cases experienced no adverse events, 4 (13.3%) had a fall in MAP, and 2 (6.7%) had a fall in SpO_2. The distribution of the incidence of adverse events among the three groups did not differ significantly [Table 3].

The mean ± SD of Propofol rescue doses was 5.07 ± 0.91 in Group A, 3.67 ± 0.66 in Group B, and 3.77 ± 0.68 in Group C. The minimum-to-maximum range of Propofol rescue doses was 4–7 in Group A, 3–5 in Group B, and 3–5 in Group C. The number of Propofol rescue doses was significantly higher in Group A compared to Groups B and C, while no significant difference was observed between Groups B and C [Table 3].

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The mean ± SD recovery time was 8.27 ± 2.36 minutes in Group A, 13.70 ± 2.96 minutes in Group B, and 12.70 ± 2.90 minutes in Group C. The minimum-to-maximum range of recovery time was 5–15 minutes in Group A, 9–20 minutes in Group B, and 7–19 minutes in Group C. The recovery time was significantly longer in Groups B and C compared to Group A. However, no significant difference in recovery time was observed between Groups B and C [Table 3].

The distribution of Endoscopist's satisfaction scores among the groups studied showed that in Group A, 15 cases (50.0%) had a score of 0 (satisfied), 11 cases (36.7%) had a score of 1 (Procedure difficult but possible), and 4 cases (13.3%) had a score of 2 (Extremely difficult to perform the procedure). In Group B, 18 cases (60.0%) had a score of 0, 9 cases (30.0%) had a score of 1, and 3 cases (10.0%) had a score of 2. In Group C, 20 cases (66.7%) had a score of 0, 8 cases (26.7%) had a score of 1, and 2 cases (6.7%) had a score of 2. The distribution of Endoscopist's satisfaction scores did not differ significantly across the three study groups [Table 3].

Table 1: Demographic and Clinical Characteristics of Patients Across the Three Study Groups.

Parameters	Group A	Group B	Group C
Age (years)	55.10 ± 9.05	52.17 ± 10.82 a^{NS}	49.97 ± 8.15 b^{NS}, c^{NS}
Sex Distribution			
Male	16 (53.3%)	19 (63.3%) a^{NS}	16 (53.3%) b^{NS}, c^{NS}
Female	14 (46.7%)	11 (36.7%) a^{NS}	14 (46.7%) b^{NS}, c^{NS}
ASA Grades			
Grade I	8 (26.7%)	11 (36.7%) a^{NS}	8 (26.7%) b^{NS}, c^{NS}
Grade II	15 (50.0%)	15 (50.0%) a^{NS}	20 (66.7%) b^{NS}, c^{NS}
Grade III	7 (23.3%)	4 (13.3%) a^{NS}	2 (6.7%) b^{NS}, c^{NS}
BMI (kg/m²)	24.35 ± 2.77	25.04 ± 2.20 a^{NS}	25.04 ± 2.20 b^{NS}, c^{NS}
Procedures			
ERCP	18 (60.0%)	18 (60.0%) a^{NS}	20 (66.7%) b^{NS}, c^{NS}
EVB	6 (20.0%)	5 (16.7%) a^{NS}	5 (16.7%) b^{NS}, c^{NS}
EBD	5 (16.7%)	6 (20.0%) a^{NS}	5 (16.7%) b^{NS}, c^{NS}
CD	1 (3.3%)	1 (3.3%) a^{NS}	0 (0.0%) b^{NS}, c^{NS}

The symbols in the figures represents comparison and statistical significance: 'a'- comparison between Group A and B, 'b'- comparison between Group A and C and 'c'-comparison between Group B and C whereas NS represents Non-significant data after comparison between the groups

Table 2: Comparison of Heart Rate (HR), Mean Arterial Pressure (MAP), and SpO_2 Across Study Groups Over Time

Groups	0 min	5 min	10 min	15 min	20 min	25 min	30 min
HR							
Group A	74.2 ± 7.8	81.7 ± 7.4	83.3 ± 6.3	83.3 ± 6.7	82.9 ± 7.3	79.3 ± 8.4	--
Group B	69.9 ± 7.4	68.3 ± 8.1	67.7 ± 8.2	67.3 ± 7.6	66.2 ± 6.2	65.0 ± 5.0	--
Group C	71.9 ± 5.7	73.8 ± 8.4	76.8 ± 9.4	74.4 ± 10.5	73.1 ± 10.1	71.2 ± 10.6	61.2 ± 10.9
Significance	a^{NS}, b^{NS}, c^{NS}	a^{***}, b^{**}, c*	a^{***}, b^{*}, c^{**}	a^{***}, b^{**}, c^{*}	a^{***}, b^{***}, c*	a^{***}, b^{*}, c^{*}	--
MAP							
Group A	83.3 ± 7.4	83.2 ± 9.2	78.9 ± 11	80.3 ± 9.6	79.6 ± 7.9	80.1 ± 6.8	--
Group B	79.5 ± 5.9	74.0 ± 8.1	72.6 ± 9.1	72.3 ± 6.5	73.6 ± 5.8	73.5 ± 5.4	--
Group C	82.5 ± 5.9	82.3 ± 7.4	78.8 ± 10.4	78.1 ± 7.6	77.1 ± 6.4	74.0 ± 6.4	69.5 ± 5.0
Significance	a^{NS}, b^{NS}, c^{NS}	a*, b^{NS}, c^{NS}	a^{NS}, b^{NS}, c^{NS}	a^{NS}, b^{NS}, c^{NS}	a^{NS}, b^{NS}, c^{NS}	a**, b*, c^{NS}	--
SpO_2							
Group A	98.5 ± 0.7	97.6 ± 1.6	96.6 ± 2.4	96.9 ± 1.7	97.4 ± 0.8	97.1 ± 2.3	--
Group B	98.8 ± 0.8	98.1 ± 1.7	97.7 ± 2.1	97.9 ± 1.8	97.9 ± 1.1	98.5 ± 0.8	--
Group C	98.9 ± 0.8	98.3 ± 1.1	97.8 ± 1.7	97.8 ± 1.8	97.7 ± 0.6	98.2 ± 0.7	98.7 ± 0.5
Significance	a^{NS}, b^{NS}, c^{NS}	a*, b^{NS}, c^{NS}	a^{NS}, b^{NS}, c^{NS}	a^{NS}, b^{NS}, c^{NS}	a^{NS}, b^{NS}, c^{NS}	a*, b^{NS}, c^{NS}	--

The symbols in the figures represents comparison and statistical significance: 'a'- comparison between Group A and B, 'b'- comparison between Group A and C and 'c'-comparison between Group B and C whereas NS- Non significant, *p<0.05, **p<0.01, ***p<0.001.

Table 3: Inter-group Comparison of Adverse Events, Propofol Rescue Doses, Recovery Time, and Endoscopist's Satisfaction Scores

Parameters	Group A	Group B	Group C
Adverse events			
None	20 (66.7%)	21 (70.0%) a^{NS}	24 (80.0%)b^{NS}, c^{NS}
Fall in MAP	5 (16.7%)	5 (16.7%) a^{NS}	4 (13.3%) b^{NS}, c^{NS}
Fall in SpO_2	4 (13.3%)	4 (13.3%) a^{NS}	2 (6.7%) b^{NS}, c^{NS}
Fall in MAP & SpO_2	1 (3.3%)	0 (0.0%) a^{NS}	0 (0.0%) b^{NS}, c^{NS}
No. of Propofol Rescue Doses	5.07 ± 0.91	3.67 ± 0.66 a***	3.77 ± 0.68 b***, c^{NS}
Recovery Time (min)	8.27 ± 2.36	13.70 ± 2.96a***	12.70 ± 2.90b***, c^{NS}
Endoscopist's Satisfaction Score			
Satisfied (Score 0)	15 (50.0%)	18 (60.0%) a^{NS}	20 (66.7%) b^{NS}, c^{NS}

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Procedure difficult but possible (Score 1)	11 (36.7%)	9 (30.0%) a^{NS}	8 (26.7%) b^{NS}, c^{NS}
Extremely difficult to perform (Score 2)	4 (13.3%)	3 (10.0%) a^{NS}	2 (6.7%) b^{NS}, c^{NS}

DISCUSSION

Various drug combinations are commonly used in endoscopic procedures to ensure efficacious and safe sedation. As outlined in pharmacology literature, these drugs has the potential for individual side effects, which is why they are often combined to counterbalance their adverse effects, providing safer and more effective sedation with synergistic benefits.[1,2,11] In our study, we observed that the age, BMI, sex distribution, and ASA grades across the three groups were comparable, with no significant differences noted. Additionally, the types of procedures performed were uniformly distributed among the groups, further ensuring that these factors did not bias the outcomes of our study. In terms of hemodynamic parameters, mean HR was significantly higher in Group A (ketamine + propofol) compared to Groups B (dexmedetomidine + propofol) and C (dexmedetomidine + ketamine) ($p < 0.05$). Additionally, Group C showed a higher mean HR than Group B. These findings align with Abdalla et al., who reported lower HR and MAP with the dexmedetomidine-propofol combination compared to ketamine-propofol in patients undergoing ERCP.[7] Regarding MAP, significant differences were observed at 5 minutes between Group A (ketamine + propofol) and Group B (dexmedetomidine + propofol). At 25 minutes, Group A had significantly higher MAP than Groups B and C. Although not clinically significant, the lower MAP in Groups B and C can be attributed to dexmedetomidine's sympatholytic effects, which reduce systemic vascular resistance through vasodilation.[7] These findings are consistent with Ajay Singh et al., who reported lower MAP and HR in dexmedetomidine-based combinations compared to ketamine-propofol.[7]

Regarding respiratory parameters, no significant differences in SpO_2 were observed across the three groups, indicating the safety of these drug combinations in maintaining respiratory function. This aligns with Abdalla et al., who reported no respiratory complications in dexmedetomidine-propofol or ketamine-propofol groups.[7] Similarly, Amer et al. (2020) found no significant differences in hemodynamics or endoscopist satisfaction between dexmedetomidine-propofol and dexmedetomidine-ketamine combinations during pediatric endoscopy.[12]

Our study found no significant differences in the incidence of adverse effects among the groups. However, Group C (dexmedetomidine + ketamine) showed a lower incidence of side effects, with 80% of patients experiencing no adverse events such as falls in MAP or SpO_2. This may be due to the lack of respiratory depression typically associated with both dexmedetomidine and ketamine. These findings align with Algharabawy et al., who observed that dexmedetomidine and ketamine provided effective sedation and greater respiratory and hemodynamic stability compared to propofol and ketamine during UGIE in hepatic patients. Despite longer induction and recovery times, this combination demonstrated comparable outcomes for adverse effects, ketamine consumption, MMSE scores post-recovery, and patient and endoscopist satisfaction, making it a viable alternative for sedation in hepatic patients.[3]

In contrast, a study comparing dexmedetomidine-remifentanil (DR) and propofol-remifentanil (PR) combinations during endoscopic submucosal dissection found that the DR group had a lower heart rate, with no oxygen desaturation events reported in either group.[13] In our study, the mean number of propofol rescue doses was significantly higher in Group A (ketamine + propofol) compared to Groups B (dexmedetomidine + propofol) and C (dexmedetomidine + ketamine). This suggests that combinations involving dexmedetomidine are more effective, likely due to its superior pharmacological properties, including its sedative and analgesic effects.

Our findings align with Tekeli et al., who compared dexmedetomidine + propofol and ketamine + propofol combinations during upper gastrointestinal endoscopy in 60 adult patients. Their study found that the dexmedetomidine + propofol combination provided better sedation, stable hemodynamics, maintained oxygen saturation, and fewer side effects, with no significant differences in RSS, patient tolerance, or endoscopist satisfaction.[10] Other studies also suggest that endoscopists prefer dexmedetomidine for its ability to reduce gastric motility, improving procedural efficiency.[13] Additionally, a study comparing continuous propofol infusion with bolus injections found that the former led to higher endoscopist satisfaction without increasing adverse effects, though it required a higher total dose and longer induction time.[14]

Koruk et al. (2020) compared midazolam + propofol and dexmedetomidine + propofol combinations in ERCP patients, focusing on hemodynamic and respiratory parameters. Their study, involving 40 adults aged 20-78, found that the dexmedetomidine + propofol combination resulted in a shorter recovery time with comparable sedative effects and adverse events, making it a safe and effective alternative for sedation in ERCP.[15] Similarly, Liu et al. conducted a meta-analysis on 238 patients, finding no significant differences in induction and recovery times between dexmedetomidine and propofol. While dexmedetomidine had a lower risk of hypoxia and a higher risk of bradycardia, both drugs showed similar efficacy and safety profiles for gastrointestinal endoscopy.[16]

Ajay Singh et al. concluded that the ketamine + dexmedetomidine combination provided a safer respiratory profile during ERCP sedation, though

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endoscopist satisfaction was higher in the ketamine + propofol group.[2] Our findings align with this, showing that both the ketamine + dexmedetomidine and dexmedetomidine + propofol combinations offered better efficacy and fewer adverse events compared to the ketamine + propofol group. This supports the use of dexmedetomidine-based combinations for safe and effective sedation in therapeutic endoscopic procedures.

Regarding recovery time, our study found it significantly longer in Groups B and C compared to Group A, aligning with Algharabawy et al.'s results, which showed longer recovery times in the dexmedetomidine + ketamine group compared to propofol + ketamine.[3] This can be attributed to the longer half-life of dexmedetomidine (2-3 hours) compared to propofol's shorter half-life (30-60 minutes).

A study comparing ketamine-propofol (ketofol) with midazolam-meperidine in elderly patients found that the ketamine-propofol group had fewer complications and shorter recovery times than the midazolam-meperidine group.[17] Similarly, Tekeli et al. compared dexmedetomidine + propofol and ketamine + propofol combinations, finding that the ketamine + propofol group had shorter recovery times, likely due to the shorter duration of propofol's action.[10]

However, our findings contradict Abdalla et al.'s study, which reported shorter recovery times with dexmedetomidine + propofol compared to ketamine + propofol during ERCP. This discrepancy may be due to the different administration methods, Abdalla's study used continuous propofol infusion, while our study utilized bolus doses following an initial loading dose.[7] This highlights how dosing strategies can influence recovery outcomes.

A meta-analysis by Weihua Liu et al. comparing dexmedetomidine and propofol found no significant difference in recovery times between the two, attributing variations to discrepancies in study populations.[16] In contrast, our study found shorter recovery times for the ketamine + propofol group, likely due to the shorter half-life of propofol and the use of bolus doses and rescue doses rather than continuous infusion.

Similarly, Amer et al. compared dexmedetomidine and propofol when combined with ketamine for pediatric endoscopy. While no significant differences in hemodynamics were observed, the propofol + ketamine group exhibited shorter recovery times compared to the dexmedetomidine + ketamine group. However, the dexmedetomidine group required fewer rescue doses, demonstrating its efficacy in minimizing the need for additional medication.[12]

In contrast, Hassan's study comparing dexmedetomidine (D) with ketofol (ketamine + propofol) for sedation during ERCP found both groups achieving a sedation level of 4 on the RSS. While heart rate during recovery was significantly lower in the dexmedetomidine group, there were no significant differences in time to achieve RSS, Modified Aldrete Score (MAS), or Facial Pain Scale (FPS). Endoscopist satisfaction was higher in the ketofol group (92%) compared to dexmedetomidine (80%). The study concluded that ketofol provided better hemodynamic stability, likely due to the counteracting effects of ketamine and propofol, with propofol used as an infusion.[18]

In our study, endoscopists' satisfaction scores, assessed using a Likert scale, did not differ significantly among the groups. Similarly, Ajay Singh et al. found that overall endoscopist satisfaction was higher in the ketamine + propofol group compared to the ketamine + dexmedetomidine group,[2] with both studies employing a Likert scale for satisfaction evaluation. Conversely, a study by Eberl et al. reported that sedation with dexmedetomidine resulted in lower endoscopist satisfaction and prolonged hemodynamic depression compared to propofol following endoscopic esophageal procedures.[19] In our study, the same endoscopist performed all the procedures, eliminating subjective bias. This consistency likely contributed to the observation that different drug combinations used for sedation resulted in similar levels of endoscopist satisfaction by the end of the procedure.

Limitation of this study is the relatively small sample size, which may affect the generalizability of the findings to a broader patient population. Additionally, the study was conducted in a single-center setting, which could introduce bias due to institutional practices or patient characteristics.

CONCLUSION

Our study demonstrates that dexmedetomidine-based sedation combinations, specifically dexmedetomidine + propofol and dexmedetomidine + ketamine, offer effective sedation with minimal adverse effects in patients undergoing endoscopic procedures. These combinations provide stable hemodynamics, maintain oxygen saturation, and have a favorable safety profile compared to ketamine + propofol. While recovery times were longer with dexmedetomidine-based combinations, the lack of significant adverse events, especially respiratory complications, supports their use in clinical practice, particularly for patients with hepatic or other underlying conditions. Additionally, dexmedetomidine's ability to reduce the need for additional medications makes it a viable option for safe and efficient sedation. Future studies could explore the optimal dosing regimens of dexmedetomidine-based combinations to minimize recovery time while maintaining efficacy and safety. Additionally, patient-specific factors such as age, comorbidities, and procedural complexity should be considered in future research to further refine sedation protocols for diverse clinical settings.

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