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ORIGINAL ARTICLE

Nebulization of Either Dexmedetomidine or Ketamine as Adjuvant to Propofol Sedation in Upper GI Endoscopy: A Randomised Controlled Double Blind Study

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ABSTRACT

Background: Upper gastrointestinal endoscopy (UGE) often requires sedation to ensure patient comfort and procedural success. This study aimed to compare the effects of nebulized dexmedetomidine and ketamine, as adjuvants to propofol, on hemodynamics, sedation quality, and perioperative outcomes during UGE.

Methods: In this randomized controlled trial, 111 adult patients scheduled for UGE were assigned to receive nebulized dexmedetomidine (Group D)(n=37), ketamine (Group K)(n=37), or saline (Group C) (n=37), followed by propofol sedation. Repeated measurements of heart rate (HR), mean arterial pressure (MABP), respiratory rate (RR), and sedation scores were recorded. Propofol requirements, recovery time, agitation, and complications were also noted.

Results: Group D showed significantly lower HR, MABP, and RR compared to Groups K and C at all time points after drug administration ($p<0.05$). Sedation scores were significantly lower in Group D compared to Groups K and C across all intervals ($p<0.05$). Group D also required less propofol (1.13±0.65 mg/kg) than Group K (2.24±0.57 mg/kg) and Group C (2.8±0.54 mg/kg), and had a shorter recovery time (6.41±2.9 min) than both Group K (10.72±2.4 min) and Group C (12.4±1.74 min) ($p<0.05$ for all). Group D experienced the least percentage of severe emerging agitation (5.4%) and Group C the most (74.3%) ($p<0.001$).For sore throat and respiratory depression, there were no statistically significant differences between groups.

Conclusion: Compared to nebulized ketamine or saline, nebulized dexmedetomidine, when used as an adjuvant to propofol, offers improved sedation, better hemodynamic stability, and a faster recovery with less emerging agitation during UGE without increasing side effects.

Keywords: Dexmedetomidine, Ketamine, Propofol Sedation, Upper GI Endoscopy.

INTRODUCTION

Upper gastrointestinal endoscopy is a popular procedure to view the esophagus, stomach, duodenal bulb, and descending duodenum, and it is usually performed orally [1]. Ultraslim endoscopes with a 5 mm tip have been developed, allowing for transnasal endoscopy which may be more comfortable for patient and decrease the need for sedation; however, its use still limited [2].

Nebulization is increasingly recognized for its safety, ease of use, and ability to deliver medications directly to the lower airway while minimizing aspiration risk [3]. This process

disperses liquid medications into droplets of varying sizes—larger particles mainly settle in the mouth and throat, while smaller particles reach the airway [4]. Aerosolized nasal drug delivery is advantageous, offering improved patient acceptance, reduced oropharyngeal drug loss, and potentially more effective sedation [5].

Sedation for endoscopy spans a continuum, from minimal anxiolysis to deep sedation, with careful titration needed to balance safety and patient recovery [6]. Globally, sedation regimens vary: in the United States, most endoscopists prefer a combination of benzodiazepines and opioids, while propofol is also widely used, either alone or in combination. In Germany, midazolam and propofol are the most frequently used agents [7].

Dexmedetomidine, a highly selective α2-adrenoceptor agonist, offers sedative, analgesic, anxiolytic, and opioid-sparing effects. It is characterized by a unique ability to preserve patient cooperation and communication during procedures [8]. Conversely, ketamine, an NMDA receptor antagonist, serves as a dissociative anesthetic with analgesic properties, maintaining airway muscle tone and reducing total sedative requirements when used alongside propofol, albeit with a risk of delayed recovery [9]. Propofol itself acts rapidly as a hypnotic agent but can cause respiratory and cardiovascular depression, especially at higher doses or with rapid induction, and lacks intrinsic analgesic action [10].

While both dexmedetomidine and ketamine have been explored as adjuncts to sedation for various procedures, limited research directly compares their efficacy and safety when delivered by nebulization as adjuncts to propofol in upper GI endoscopy. There is a particular lack of data regarding their impact on hemodynamic stability, recovery profiles, and post-procedural complications using this non-invasive route. So, this research aimed to compare between either nebulized dexmedetomidine or ketamine as adjuvant to propofol sedation in upper GI endoscopy.

METHODS

This prospective randomized controlled clinical trial was conducted at the Department of Anesthesia, Intensive Care, and Pain Management, Faculty of Medicine, Zagazig University Hospitals over a period of six months from September 2024 to March 2025.

After institutional review board (IRB) approval (ZU-IRB# 11188-15/10-2023), all participants were asked to sign an informed consent. Human subjects research adhered to the guidelines set in the Declaration of Helsinki, which is part of the World Medical Association's Code of Ethics.

The inclusion criteria required patients to be aged 21-60 years and of both sexes, with American Society of Anesthesiologists (ASA) physical status I or II and BMI <30 kg/m², scheduled for upper GI endoscopy, and who consented to participate.

Patients were excluded if they had known allergies to study drugs, psychological or neurological disorders, chronic or recurrent use of sedatives or analgesics, upper respiratory tract infections, or Mallampati grade III–IV airways.

The calculated sample size was 111 patients, with 37 patients allocated to each group. Sample size determination was based on previous findings regarding mean arterial pressure (MABP) 20 minutes after intranasal drug administration, which showed a mean ± SD of 65.84 ± 4.62 for the dexmedetomidine group and 68.24 ± 3.23 for the ketamine group, at a 95% confidence interval and 80% power, using the OpenEpi software [11].

Eligible patients were randomly allocated to three equal groups using a computer-generated randomization table, in a 1:1:1 ratio. The randomization sequence was kept in sealed envelopes, which were opened by the research anesthesiologist immediately prior to the procedure. The three study arms were: Group C (nebulized with 4 mL normal saline), Group D (nebulized with dexmedetomidine 1 µg/kg), and Group K (nebulized with ketamine 1 mg/kg).

Prior to the procedure, all patients underwent a clinical assessment and were briefed regarding

the study protocol. Fasting guidelines were observed (8 hours for solids, 4 hours for juice, 2 hours for clear fluids). Baseline investigations included a complete blood count, coagulation profile, liver, and kidney function tests. Measures were taken to prevent hypothermia (the operation room ambient temperature should be at least 21 °C, use warming blanked under the patient, intravenous fluid and intraoperative irrigation fluids should be prewarmed to 38–40 °C).

Vital signs including heart rate, mean arterial pressure, oxygen saturation, respiratory rate, and body temperature were recorded throughout the procedure. Patient and the research team (attending anesthesiologists, and outcome assessors) were blinded to group allocation.

Group-specific interventions were as follows: **Group C:** Nebulized with 4 mL normal saline. **Group D:** Nebulized with dexmedetomidine 1 µg/kg, completed to 4 mL with saline. **Group K:** Nebulized with ketamine 1 mg/kg, completed to 4 mL with saline. All drugs were administered via face mask nebulizer for 15 minutes, followed by propofol 1 mg/kg in all groups after termination of the nebulization. The procedure was allowed to start When sedation score (MOAAS) fall to 2.

For all patients, supplemental propofol was given (50 mg) was administered if necessary due to patient movement or coughing, and total propofol dose was recorded. Monitoring included heart rate, MABP, pulse oximetry, and respiratory rate at 5-minute intervals for 30 minutes after drug administration. Sedation was assessed using the Modified Observer's Assessment of Alertness/Sedation (MOAAS) scale (Table 1) [12] at baseline and at 5-minute intervals for 30 minutes post-administration of propofol. Adverse effects monitored included: respiratory depression ($SpO_2 < 92\%$ or $RR < 10$), and sore throat.

Primary Outcomes

The primary outcomes focused on hemodynamic monitoring (mean arterial blood pressure, heart rate).

Secondary Outcomes

Secondary outcomes included depth and quality of sedation which were systematically evaluated at baseline and at 5, 10, 15, 20, 25, and 30 minutes following propofol administration, using the MOAAS scale to provide objective assessment [12].

Moreover, respiratory rate, oxygen saturation, and body temperature at baseline and at set of 5 minutes intervals up to 30 minutes after drug administration. Additionally, the total dose of propofol administered to achieve and maintain the target sedation level (at score 2 according to MOAAS scale) was calculated and recorded for each patient, allowing for comparison of sedative requirements between groups. Recovery time; time elapsed from last dose of supplementary propofol dose to readiness for discharge to post-anesthesia care unite "PACU" (at score 5 according to MOAAS scale) and the incidence of adverse effects as respiratory depression ($SpO_2 < 92\%$ or $RR < 10$), post-operative sore throat, and emergence agitation; assessed with a three-point scale (mild, moderate, severe) [13] (that managed by reassurance, supportive management and in severe cases intravenous 0.03mg/kg midazolam was given) was also documented.

Statistical analysis

A combination of qualitative and quantitative data was analyzed using IBM SPSS Statistics Version 22.0. The Kolmogorov-Smirnov test was used to check for normality, and all results were assessed for significance at the 0.05 level. For analysis, qualitative data relationships were assessed using the Chi-Square test, a non-parametric method and expressed as number (percentage). Quantitative data comparisons between groups utilized One-way ANOVA test for parametric data and expressed as mean ± SD. Bonferroni comparisons used to identify differences between each of the two groups when the difference was significant. A paired sample t-test was used to compare the averages within the same group. The significance of the

results was expressed in terms of p-values, categorized as non-significant ($P > 0.05$), significant ($P \leq 0.05$), and highly significant ($P < 0.001$), with all results reported as two-tailed probabilities.

RESULTS

One hundred and twenty patients scheduled for upper GI endoscopy were eligible for the current study. Of those, nine patients were excluded, seven due to uncontrolled hypertension and disturbed conscious level, and two patients refused to participate in the study. Finally, 111 patients completed flow up and considered for statistical analysis (Figure 1).

There were no statistically significant differences in age, BMI, sex, ASA grading and in duration of the procedure among the patients in the three studied groups ($P > 0.05$) (Table 2).

Repeated measurements of HR, MABP, and RR indicated that, following drug administration, Group D experienced a significant decrease in HR, MABP, and RR compared to both Group K and Group C at all time intervals. Additionally, Group C showed a significant reduction in these parameters compared to Group K across all intervals. Moreover, the repeated HR, MABP, measurements revealed a significant decrease in HR, MABP, and RR after drug administration in all groups compared to baseline ($P<0.05$ for all). No statistically significant difference was found in oxygen saturation or body temperature between groups across all intervals ($P > 0.05$) (Figure 2).

Repeated measurements of sedation scale indicated that, following drug administration, Group D experienced a significantly lower sedation scale compared to both Group K and Group C at all time intervals. Additionally, Group C showed a significantly lower sedation compared to Group K across all intervals. The repeated sedation scale measurements revealed a significant decrease in sedation scale after drug administration compared to baseline in all groups ($P<0.05$) (Table 3).

Propofol dose significantly decreased in Group D compared with Group K and Group C ($P<0.05$). In the same time, recovery time was statistically lower in Group D compared with Group K and Group C ($P<0.05$) (Table 4).

The emergence agitation outcomes revealed significant differences among the groups, where Group C demonstrated the highest incidence of severe agitation, with 74.3% of patients categorized as severe, while only 5.4% in Group D fell into this category ($P < 0.001$). Conversely, Group D had the highest proportion of mild agitation (75.7%), while Groups K and C reported 14.3% and 32.4%, respectively. Moderate agitation was most prevalent in Group K at 43.2% (Table 5).

The analysis of post-operative complications showed no statistically significant differences among the groups for respiratory depression or sore throat ($P > 0.05$) (Table 5).

Table (1): Modified Observer's Assessment of Alertness/Sedation Scale [12]

Grade	Assessment
6	Appears alert and awake, responds readily to name spoken in normal tone.
5	Asleep but responds readily to name spoken in normal tone
4	Lethargic response to name spoken in normal tone
3	Responds only after name is called loudly or repeatedly
2	Responds only after mild prodding or shaking
1	Does not respond to mild prodding or shaking

Table (2): Patients' characteristics and surgical data in studied groups

		Group C (N=37)	Group D (N=37)	Group K (N=37)	P value
Age (year)#		**43.44±9.13**	**42.17±10.20**	**40.99±11.82**	**0.601**
BMI (m^2/Kg)#		**23.07±3.51**	**22.71±3.33**	**24.02±3.28**	**0.228**
Sex^	**Male**	**21 (56.8%)**	**19(51.4%)**	**21(56.8%)**	**0.865**
	Female	**16(43.2%)**	**18(48.6%)**	**16(43.2%)**	
ASA^	**I**	**25(67.6%)**	**21(56.8%)**	**22(59.5%)**	**0.610**
	II	**12(32.4%)**	**16(43.2%)**	**15(40.5%)**	
Duration of the procedure (min)#		**21.22±5.056**	**22.35±5.702**	**22.05±5.158**	**0.636**

BMI: Body mass index, ASA: American Society of Anesthesiologist, Continuous data were represented as mean±SD, categorical data were represented as event (percentage), #: One-way ANOVA; ^: chi-square test

Table (3): Repeated measurements of sedation scale in all groups

Modified Observer's Assessment of Alertness/Sedation Scale	Group C (N=37)	Group D (N=37)	Group K (N=37)	P value	
Baseline	6±0.00	6±0.00	6±0.00	----	
5 minutes after nebulization	2.9±0.51	1.68±0.63	2.6±0.54	<0.0001**	P1<0.0001**, P2=0.046* P3<0.0001**
10 minutes	2.56±0.29	1.75±0.24	2.34±0.37	<0.0001**	P1<0.0001**, P2=0.006*, P3<0.0001**
15 minutes	1.2±0.54	0.46±0.13	0.76±0.25	<0.0001**	P1=0.000**, P2=0.000**, P3=0.042*
20 minutes	1.79±0.33	0.98±0.47	1.56±0.41	<0.0001**	P1<0.0001**, P2=0.044* P3<0.0001**
25 minutes	2.38±0.27	1.7±0.62	2.1±0.51	<0.0001**	P1<0.0001**, P2=0.04*, P3=0.0018*
30 minutes	2.64±0.56	1.41±0.86	2.27±0.39	<0.0001**	P1<0.0001**, P2=0.03*, P3<0.0001**
Differences within the same group	P value	P value	P value		
Baseline versus after 5 min	<0.001**	<0.001**	<0.001**		
Baseline versus after 10 min	<0.001**	<0.001**	<0.001**		
Baseline versus after 15 min	<0.001**	<0.001**	<0.001**		
Baseline versus after 20 min	<0.001**	<0.001**	<0.001**		
Baseline versus after 25 min	<0.001**	<0.001**	<0.001**		
Baseline versus after 30 min	<0.001**	<0.001**	<0.001**		

Continuous data were represented as mean±SD, General linear model adjusted with bonferonni test; P1: indicate the difference between group C and group D; P2: indicate the difference between group C and group K; P3: indicate the difference between group D and group K.; *: Significant (P<0.05) **: Highly significant (p≤0.001)

Table (4): Propofol dose and recovery time in all groups

	Group C (N=37)	Group D (N=37)	Group K (N=37)	P value	
Propofol dose (mg/kg)	2.8±0.54	1.13±0.65	2.24±0.57	<0.0001	P1<0.001**, P2=0.014* P3<0.0001**,
Recovery time (min)	12.4±1.74	6.41±2.9	10.72±2.4	<0.0001	P1<0.001**, P2=0.008* P3<0.0001**,

Continuous data were represented as mean±SD, One-way ANOVA; P1: indicate the difference between group C and group D; P2: indicate the difference between group C and group K; P3: indicate the difference between group D and group K.; *: Significant (P<0.05) **: Highly significant (p≤0.001)

Table (5): Three-point emergence agitation scale and Postoperative complications

		Group C (N=37)	Group D (N=37)	Group K (N=37)	P value
Three-point emergence agitation scale	Mild	5 (13.5%)	28 (75.7%)	12 (32.4%)	**0.000****
	Moderate	5 (13.5%)	7 (18.9%)	16 (43.2%)	
	Sever	27 (72.97%)	2 (5.4%)	9 (24.3%)	
Respiratory depression		7(18.9%)	4(10.8%)	8(21.6%)	0.536
Sore throat		6(16.2%)	8(21.6%)	9(24.5%)	0.73

Data were represented as event (percentage), chi-square test ** Highly significant (p≤0.001)

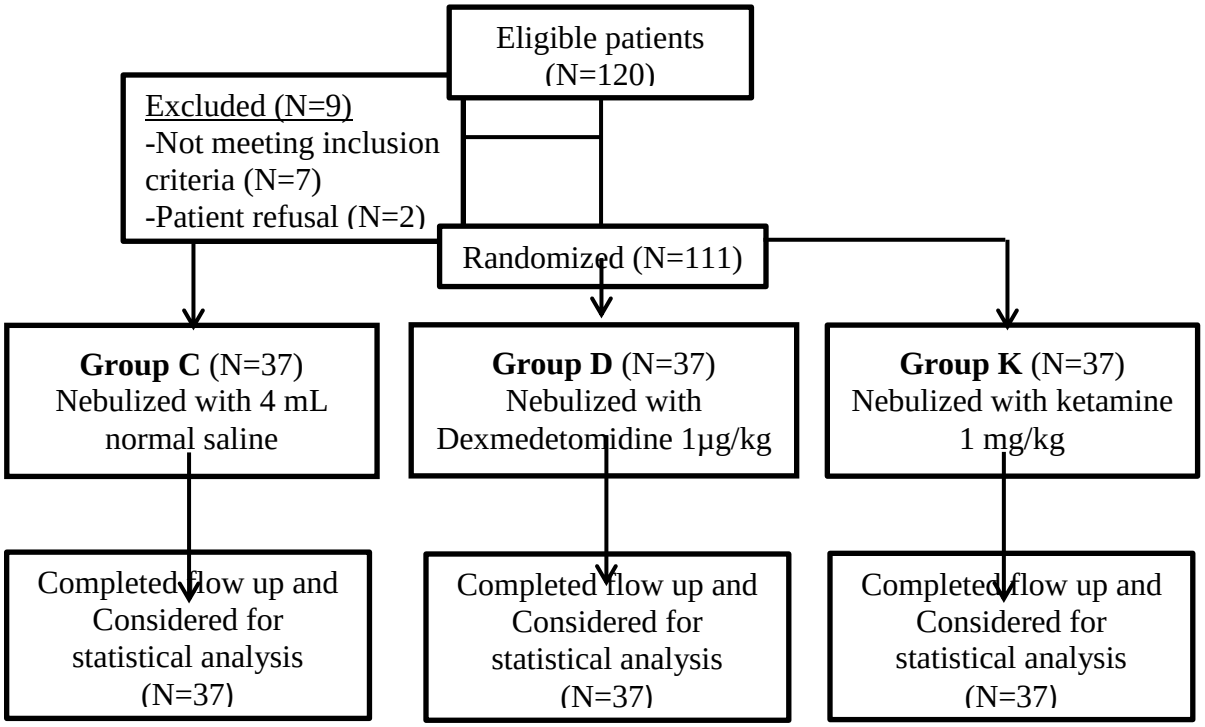

Figure (1): Flowchart of patients in the study

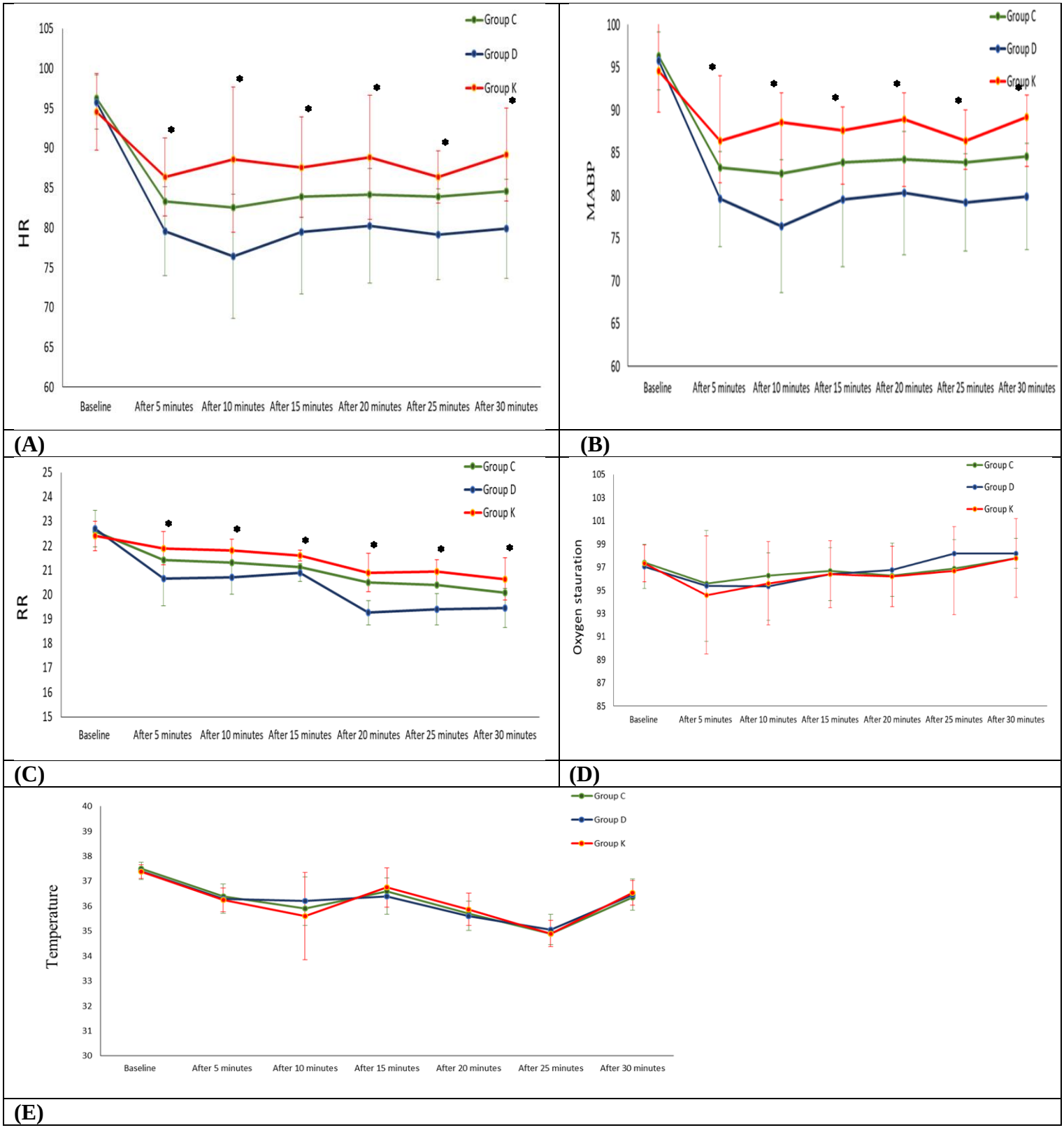

Figure (2): Line charts for repeated measurements of **(A):** HR in all groups, **(B):** MABP in all groups, **(C):** RR in all groups, (D): Oxygen saturation in all groups, (E): Body temperature in all groups. *: Significant

DISCUSSION

Upper gastrointestinal endoscopy is widely used for both diagnosis and therapy, yet it remains a source of significant discomfort and anxiety for many patients. The procedure frequently triggers gag reflexes and apprehension, which can compromise patient cooperation and satisfaction. These challenges highlight the importance of selecting effective sedation protocols that optimize patient tolerance and procedural success [14].

For sedation during UGE, propofol, a hypnotic with a quick onset and short duration, is frequently used. It is preferred due to its ability to offer a fast and easy recovery that allow for effective patient turnover and facilitate procedural workflow. However, propofol does not have intrinsic analgesic actions, so it cannot adequately control pain during endoscopy. Moreover, propofol can cause dose-dependent respiratory depression and cardiovascular instability, including hypotension and bradycardia, at high doses, especially with deep sedation or in patients with comorbidities [15].

In order to improve the quality and safety of sedation, there has been an increasing interest in mixing propofol with other drugs. Dexmedetomidine and ketamine are two examples of these adjuncts; that may be able to counteract the negative effects of propofol. Dexmedetomidine is a highly selective α2-adrenergic agonist, providing sedative, analgesic and anxiolytic effects without significant respiratory depression. Also, it has a sympatholytic activity, which is known to reduce the need for other anesthetic agents and preserve hemodynamic stability [8,16]. Conversely, ketamine is an NMDA receptor antagonist with strong analgesic and dissociative anesthetic properties. Unlike propofol, ketamine has sympathomimetic activity that can counteract hypotensive effects and maintains airway reflexes and spontaneous breathing, and its, although it may lead to transient tachycardia and hypertension [9,16].

Ketofol, which is a combination of propofol with ketamine, has been studied to benefit from advantages of both drugs. Some studies have found that this combination improves hemodynamic stability and depth of sedation when compared to using either drug alone. [16]. Nevertheless, while intravenous routes are well-studied, less is known about the efficacy and safety of nebulized administration of these agents in the context of UGE.

Nebulization is a non-invasive method that has obtained attention recently due to its pharmacokinetic benefits, such as its rapid onset and ability to avoid first-pass metabolism, as well as its safety and patient comfort. Nebulized dexmedetomidine has demonstrated the ability to suppress the gag reflex and improve patient compliance during endoscopic procedures [17]. Likewise, studies of nebulized ketamine highlight its potential for providing both sedation and analgesia, which could be valuable for short procedures such as UGE [17]. However, there remains a scarcity of head-to-head randomized trials directly comparing nebulized dexmedetomidine and ketamine as adjuvants to propofol for UGE in adult populations.

The present study was designed to fill this gap, aiming to evaluate and compare the effectiveness and safety of nebulized dexmedetomidine versus nebulized ketamine, each used as an adjunct to propofol, in adults undergoing UGE. Hemodynamic and respiratory stability, sedation quality, recovery times, and adverse events were the assessed data

Compared to the ketamine group, dexmedetomidine showed stable hemodynamics with less variation in MABP and HR. The sympathomimetic action of ketamine, on the other hand, is responsible for the transient elevation in HR and MABP that patients who received nebulized ketamine showed after taking the medication. Hemodynamic changes in this study are consistent with research by Segaran et al. [18],

who compared nebulized ketamine with nebulized magnesium sulfate and found that individuals receiving nebulized ketamine had increased cardiovascular responses (HR, systolic and diastolic blood pressure) in the post-nebulization period compared to pre-nebulization period. However, some researchers like Ahuja and his colleagues [19] and Thomas and associates [20] both compared nebulized ketamine with control group (nebulized with normal saline) and they did not detect any notable changes in hemodynamics following ketamine nebulization. This could be due to the fact that their investigations involved different operational circumstances (undergoing surgery under general anaesthesia) or lower fixed doses (50 mg ketamine in 5 ml normal saline). This variation emphasizes how crucial cautious dosage and patient selection are when using ketamine in clinical settings.

Ketamine and dexmedetomidine both effectively maintained respiratory function; neither group experienced any significant respiratory depression or desaturation events. This finding is especially significant because deeper propofol sedation is known to increase the risk of respiratory impairment [16,17]. In addition, the non-respiratory depressants, like ketamine or dexmedetomidine, can provide effective sedation without significant increase in the risk of hypoxemia.

According to the results of the current study, nebulized dexmedetomidine provided better sedation compared to nebulized ketamine when combined with propofol. Patients in dexmedetomidine group showed consistently lower MOAA/S scores at all measured intervals that indicate deeper levels of sedation. Furthermore, as comparison to the ketamine and control groups, the dexmedetomidine group needed much lower total doses of propofol to reach the desired level of sedation. These results are in line with previous studies showing that dexmedetomidine has a strong propofol-sparing effect in addition to improving sedation [21]. Because it may result in fewer adverse effects related to propofol and promote smooth recoveries, the decrease in the need for an anesthetic is very beneficial.

However, it is important to note that there is some inconsistency regarding the extent of the propofol-sparing effects that dexmedetomidine has been shown to have. For example, Bekker and his co-workers [22] studied the effect of intraoperative infusion of dexmedetomidine on quality of recovery after major spinal surgery and they found that surprisingly, the infusion of dexmedetomidine did not significantly reduced propofol requirement. This can be explained by variations in dosage schedules (they used 60 ml syringes containing dexmedetomidine 0.4 mcg/ml for intravenous infusion, while in the current study nebulized dexmedetomidine 1 μg/kg was used), or surgical settings (their work was after major spinal surgery, while this study was for sedation during GIT endoscopy).Additionally, the degree of sedation and drug absorption may also be influenced by the delivery technique (intravenous versus nebulized). In the current trial, nebulized dexmedetomidine had a stronger sedative effect than intravenous route probably because it avoids first-pass hepatic metabolism and improves mucosal absorption. [23].

The results of the current study support previous researches into the use of ketamine and dexmedetomidine as sedative adjuncts to propofol. Nebulized dexmedetomidine provides better sedative quality and patient comfort than nebulized ketamine, according to studies conducted in pediatric patients, including those by Singariya et al. [24] and Sabry et al. [25]. Furthermore, Goyal et al. [26] stated that ketamine and dexmedetomidine together produced a deeper level of sedation than dexmedetomidine alone, which may indicate the advantages of multi-drug regimens for certain individuals. However, it should be noted that a large number of previous studies were on non-endoscopic or pediatric procedures; emphasizing the importance of the current study in the adult UGE.

One of the important finding in this study was the significant decrease in emergence agitation among patients who received nebulized dexmedetomidine. In contrast to individuals in the ketamine or control groups, these patients experienced milder and less frequent episodes of agitation. On the other hand, patients in control group that was given only saline and propofol, showed the highest incidence of severe emerging agitation. The group receiving nebulized ketamine had more moderate levels of agitation. This superiority of dexmedetomidine in minimizing agitation is consistent with a recent meta-analysis by Wu et al. [27], which showed that dexmedetomidine significantly reduces the incidence of emergence agitation and delirium in various procedural settings. Similarly, Uusalo et al. [28] reported that intranasal dexmedetomidine effectively reduced postoperative agitation in elderly orthopedic patients without increasing the risk of respiratory depression. On the other hand, Liu et al. found that while both nebulized dexmedetomidine and ketamine provide comparable sedation quality in pediatric patients, ketamine is associated with a higher incidence of emergence agitation, echoing the current study findings.

Recovery times were also shorter for the dexmedetomidine group, allowing for earlier discharge readiness compared to patients in the ketamine or control arms. This faster recovery can be advantageous in outpatient settings where efficient turnover and patient throughput are desired. Koruk et al. observed that recovery time was significantly shorter in the propofol-dexmedetomidine combination than in propofol-ketamine in pediatric patients undergoing transcatheter ASD closure [30]. In the same line, Elghamry and others [31] studied the effect of ketamine versus dexmedetomidine on release of inflammatory mediators in laparoscopic hysterectomy and mentioned that recovery time was significantly longer in the ketamine group than in the control and dexmedetomidine group.

There are some limitations to the present study. It was single center with a relatively small sample size and excluded certain high-risk groups, which may affect generalizability and the detection of rare adverse events. Also, only short-term outcomes were evaluated. Future studies with larger, more diverse populations and multicenter designs are needed for broader validation.

Conclusion

The current study found that nebulized dexmedetomidine as an adjuvant to propofol provides better hemodynamic stability, deeper sedation, and faster recovery than nebulized ketamine in UGE, with both agents showing good safety profiles. Dexmedetomidine may be preferred for improving sedation quality and patient outcomes during upper GI endoscopy.

Conflict of interest: None
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REFERENCES

1. Khan MR, Saha M, Mamun MA, Salam KS, Chowdhury MS, Haque MM, et al. Upper GIT endoscopic evaluation and psychological state assessment of patients with globus sensation. Mymensingh Med J. 2019;28(2):405–9.
2. Mun EJ, Wagh MS. Recent advances and current challenges in endoscopic resection with the full-thickness resection device. World J Gastroenterol. 2023;29(25):4009–22.
3. Prasant NVSN, Mohapatro S, Jena J, Moda N. Comparison of preoperative nebulization with 4% lignocaine and ketamine in reduction of incidence of postoperative sore throat. Anesth Essays Res. 2021;15(3):316–21.
4. Abd Ellatif S, Mowafy S. Pre-emptive nebulized ketamine versus nebulized lidocaine for endoscopic nasal surgeries. Res Opin Anesth Intensive Care. 2019;6(4):408.
5. Lin J, Wu C, Zhao D, Du X, Zhang W, Fang J. The sedative effects of inhaled nebulized dexmedetomidine on children: a systematic review and meta-analysis. Front Pediatr. 2022;10:865107.
6. Das S, Ghosh S. Monitored anesthesia care: an overview. J Anaesthesiol Clin Pharmacol. 2015;31(1):27–9.
7. Triantafillidis JK, Merikas E, Nikolakis D, Papalois AE. Sedation in gastrointestinal endoscopy: current issues. World J Gastroenterol. 2013;19(4):463–71.

8. Liu X, Li Y, Kang L, Wang Q. Recent advances in the clinical value and potential of dexmedetomidine. J Inflamm Res. 2021;14:7507–52.
9. Bhavani SS, Abdelmalak B. Nonoperating room anesthesia: anesthesia in the gastrointestinal suite. Anesthesiology Clin. 2019;37(2):301–16.
10. Tang X, Huang Y, Zhang Z, Ma C, Yu L, Song R, et al. Efficacy and safety of sedation with dexmedetomidine in adults undergoing gastrointestinal endoscopy: a meta-analysis. Medicine (Baltimore). 2023;102:e38035–40.
11. Elshafeey A, Youssef G, Elsalam E, Saleh M, Mahrose R. Comparative study between intranasal dexmedetomidine and intranasal ketamine as a premedication for anxiolysis and sedation before pediatric general anesthesia. Ain-Shams J Anesthesiol. 2020;12:51.
12. Chernik DA, Gillings D, Laine H, Hendler JM, Silver JM, Davidson AB, et al. Validity and reliability of the Observer's Assessment of Alertness/Sedation Scale: study with intravenous midazolam. J Clin Psychopharmacol. 1990;10(4):244–51.
13. Yu D, Chai W, Sun X, Yao L. Emergence agitation in adults: risk factors in 2,000 patients. Can J Anaesth. 2010;57(9):843–8.
14. Lin O. Sedation for routine gastrointestinal endoscopic procedures: a review on efficacy, safety, efficiency, cost and satisfaction. Intest Res. 2017;15:456–66.
15. Kashiwagi K, Hosoe N, Takahashi K, Nishino H, Miyachi H, Kudo S, et al. Prospective, randomized, placebo-controlled trial evaluating the efficacy and safety of propofol sedation by anesthesiologists and gastroenterologist-led teams using computer-assisted personalized sedation during upper and lower gastrointestinal endoscopy. Dig Endosc. 2016;28:657–64.
16. Nishizawa T, Suzuki H, Hosoe N, Ogata H, Kanai T, Yahagi N. Dexmedetomidine vs propofol for gastrointestinal endoscopy: a meta-analysis. United European Gastroenterol J. 2017;5(7):1037–46.
17. Sriramka B, Awal S, Mallik D, Narayan J. Nebulised dexmedetomidine for patient's comfort and satisfaction during diagnostic upper gastrointestinal endoscopy: a double-blind randomised controlled study. Indian J Anaesth. 2023;67:825–7.
18. Segaran S, Bacthavasalame A, Venkatesh R, Zachariah M, George S, Kandasamy R. Comparison of nebulized ketamine with nebulized magnesium sulfate on the incidence of postoperative sore throat. Anesth Essays Res. 2018;12:885.
19. Ahuja V, Mitra S, Sarna R. Nebulized ketamine decreases incidence and severity of postoperative sore throat. Indian J Anaesth. 2015;59:37–42.
20. Thomas D, Bejoy R, Zabrin N, Beevi S. Preoperative ketamine nebulization attenuates the incidence and severity of postoperative sore throat: A randomized controlled clinical trial. Saudi J Anaesth. 2018;12(3):440-5.
21. Le Guen M, Liu N, Tounou F, Augé M, Tuil O, Chazot T, et al. Dexmedetomidine reduces propofol and remifentanil requirements during bispectral index-guided closed-loop anesthesia: a double-blind, placebo-controlled trial. Anesth Analg. 2014;118:946–55.
22. Bekker A, Haile M, Kline R, Didehvar S, Babu R, Martiniuk F, et al. The effect of intraoperative infusion of dexmedetomidine on the quality of recovery after major spinal surgery. J Neurosurg Anesthesiol. 2013;25:16–24.
23. Abdel-Ghaffar HS, Kamal SM, El Sherif FA, Mohamed SA. Comparison of nebulised dexmedetomidine, ketamine, or midazolam for premedication in preschool children undergoing bone marrow biopsy. Br J Anaesth. 2018;121:445–52.
24. Singariya G, Malhotra N, Kamal M, Jaju R, Aggarwal S, Bihani P. Comparison of nebulized dexmedetomidine and ketamine for premedication in pediatric patients undergoing hernia repair surgery: a randomized comparative trial. Anesth Pain Med. 2022;17:173–81.
25. Sabry MH, El Gamal N, Elhelw N, Ammar R. Comparison of the use of nebulized dexmedetomidine, ketamine, and a mixture thereof as premedication in pediatric patients undergoing tonsillectomy: a double-blind randomized study. Res Opin Anesth Intensive Care. 2020;7:70.

Grade	Assessment
6	Appears alert and awake, responds readily to name spoken in normal tone.
5	Asleep but responds readily to name spoken in normal tone
4	Lethargic response to name spoken in normal tone
3	Responds only after name is called loudly or repeatedly
2	Responds only after mild prodding or shaking
1	Does not respond to mild prodding or shaking

26. Goyal R, Singh S, Shukla RN, Patra AK, Bhargava DV. Ketodex, a combination of dexmedetomidine and ketamine for upper gastrointestinal endoscopy in children: a preliminary report. J Anesth. 2013;27:461–3.
27. Wu H, Wu P, Xiang L, Huang Q, Xiang Y, Zhang J, et al. Effect of different intranasal

dexmedetomidine doses on pediatric postoperative delirium and agitation: network meta-analysis. Pediatr Res. 2025.
28. Uusalo P, Seppänen SM, Järvisalo MJ. Feasibility of intranasal dexmedetomidine in treatment of postoperative restlessness, agitation, and pain in geriatric orthopedic patients. Drugs Aging. 2021;38:441–50.
29. Liu X, Lang B, Zeng L, Huang L, Chen S, Jia ZJ, et al. Comparison of the effects of ketamine via nebulization versus different pharmacological approaches in pediatric sedation: a systematic review and meta-analysis of randomized controlled trials. BMC Anesthesiol. 2023;23.
30. Koruk S, Mizrak A, Kaya Ugur B, Ilhan O, Baspinar O, Oner U. Propofol/dexmedetomidine and propofol/ketamine combinations for anesthesia in pediatric patients undergoing transcatheter atrial septal defect closure: a prospective randomized study. Clin Ther. 2010;32(4):701-9.
31. Elghamry M, Naguib T, AbdAlraheem T, Dawood L. Effect of Ketamine versus Dexmedetomidine on Release of Inflammatory Mediators in Laparoscopic Hysterectomy. A Randomized Trial. Open Anesthesiol J, 2024;18

Table 1: Modified Observer's Assessment of Alertness/Sedation(MOAAS)Scale

Citation

Abd Allah, M., Abaza, K., Mahmoud, H., Wahdan, R., Farrag, N. Nebulization of Either Dexmedetomidine or Ketamine as Adjuvant to Propofol Sedation in Upper GI Endoscopy: A Randomised Controlled Double Blind Study. *Zagazig University Medical Journal*, 2025; (4689-4700): -. doi: 10.21608/zumj.2025.402680.4047