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Original Research Article

Comparative Study of Safety and Effectiveness Between IV Dexmedetomidine and IV Propofol for Procedural Sedation During Upper GI Endoscopic Interventions

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Abstract: *Safe and effective sedation is essential for upper gastrointestinal (GI) endoscopic interventions. Dexmedetomidine and propofol are commonly used agents with distinct pharmacodynamic profiles that may influence recovery time, hemodynamic stability, and complication rates. In resource-constrained healthcare environments such as Pakistan, selecting the optimal sedative is crucial to minimize risks and enhance procedural throughput.* ***Objective:*** *To compare the safety and effectiveness of intravenous dexmedetomidine versus intravenous propofol for procedural sedation during upper GI endoscopic interventions.* ***Methods:*** *A randomized controlled trial was conducted at the Department of Anesthesia, Shaikh Zayed Medical Complex, Lahore, from December 2024 to April 2025. A total of 126 adult patients (ASA I–II) undergoing elective upper GI endoscopy were enrolled using non-probability consecutive sampling and randomized equally into two groups: Group A received IV dexmedetomidine (1 µg/kg loading dose followed by 0.5 µg/kg/h infusion). In contrast, Group B received IV propofol (0.5 mg/kg loading dose followed by 50 µg/kg/min infusion). Standard monitoring was performed, and sedation depth was assessed using the Ramsay Sedation Score. Recovery time was defined as the interval to achieving a Modified Aldrete Score of 10/10. Hemodynamic parameters, adverse events, and need for rescue sedation were recorded. Data were analyzed in SPSS version 25 using independent-samples t-tests and chi-square tests, with $p \leq 0.05$ considered statistically significant.* ***Results:*** *Participants had a mean age of 41.9 ± 12.4 years, and 55.6% were male. The dexmedetomidine group required significantly longer to reach a Ramsay Sedation Score of 4 than the propofol group (318 ± 92 vs 192 ± 64 seconds; $p < 0.001$). However, recovery time was significantly shorter with dexmedetomidine (8.0 ± 3.6 vs 12.4 ± 3.1 minutes; $p < 0.001$). Hypotension occurred more frequently with propofol (25.4% vs 11.1%; $p = 0.038$), whereas bradycardia was more common with dexmedetomidine (7.9% vs 0%; $p = 0.023$). The need for rescue sedation was higher in the dexmedetomidine group (19.0% vs 4.8%; $p = 0.013$). Rates of oxygen desaturation, nausea, and vomiting were comparable between groups.* ***Conclusion:*** *Dexmedetomidine demonstrated a more favorable safety profile by reducing hypotension and providing significantly faster recovery compared to propofol, though it required more rescue sedation and was associated with higher rates of bradycardia. These findings support the use of dexmedetomidine as an effective and hemodynamically stable alternative for procedural sedation in upper GI endoscopy, particularly in populations with increased cardiovascular risk.*

Keywords: Dexmedetomidine, Propofol, Procedural Sedation, Upper GI Endoscopy, Recovery Time, Hemodynamic Stability.

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Introduction

Sedation plays a crucial role in upper gastrointestinal (GI) endoscopy procedures, providing patients with comfort and facilitating optimal viewing conditions for physicians. Among various sedative agents, dexmedetomidine, an α2-adrenoceptor agonist, and propofol, a non-barbiturate hypnotic agent, have garnered considerable attention due to their distinct pharmacological and safety profiles. Dexmedetomidine is known for its sedative and analgesic effects without inducing respiratory depression, making it particularly suitable for patients at risk of airway or hemodynamic instability during sedation procedures (1, 2). Conversely, propofol's rapid onset and recovery, combined with its potent sedative effects, have made it the standard for procedural sedation in endoscopy (3).

Recent meta-analyses have provided insights into the comparative effectiveness and safety of these sedative agents in endoscopic contexts. Specifically, Liu et al. reported a significant decrease in postoperative delirium rates with dexmedetomidine compared with propofol, potentially leading to shorter recovery times (4). Additionally, increasing evidence suggests that dexmedetomidine may reduce the need for supplementary analgesics, thus bolstering its appeal for procedural sedation, especially in patients with complex medical backgrounds (5,3,4). Findings from randomized controlled trials have shown that dexmedetomidine could lead to lower intraoperative hypotension and a reduced requirement for opioids when compared to propofol in various procedural settings, including gastrointestinal endoscopy (3,6).

A critical evaluation of hemodynamic stability during sedation highlighted that while propofol may induce transient hypotension, dexmedetomidine consistently preserves hemodynamics, making it a safer option during procedures that demand prolonged sedation (7). Additionally, patient satisfaction has been noted to be higher when dexmedetomidine is used due to its anxiolytic properties, which can mitigate pre-procedural anxiety and discomfort (4,8). The contrasting pharmacodynamics of dexmedetomidine and propofol also offer avenues for novel combinations to optimize sedation strategies in upper GI endoscopy (9).

Given these findings, there is a compelling need to further compare these sedative agents specifically in the context of upper GI endoscopic

interventions in Pakistan, where healthcare resources can be limited, and patient populations may present with varying baseline risk profiles, making the choice of the right sedative critical. The need for proactive measures to mitigate complications from sedation-related respiratory depression and cardiovascular instability, particularly in a region with a significant burden of cardiac comorbidities, underlines the importance of integrating dexmedetomidine into procedural sedation practices. Our study, therefore, aims to compare the safety and effectiveness of intravenous dexmedetomidine versus intravenous propofol during upper GI endoscopic interventions in a Pakistani cohort.

Methodology

This randomized controlled trial was conducted in the Department of Anesthesia at the Shaikh Zayed Medical Complex, Lahore, from 10 December 2024 to 10 April 2025, following approval of the study synopsis. The study population consisted of patients scheduled for upper gastrointestinal endoscopic interventions performed under procedural sedation in the gastroenterology operating theaters of Shaikh Zayed Hospital, Lahore. Participants were enrolled using non-probability consecutive sampling. The sample size was calculated as 126 patients, with 63 participants allocated to each group, based on 80% study power and a 5% level of significance, assuming hypotension rates of 23% in the propofol arm and 10% in the dexmedetomidine arm.

Male and female patients aged 16 to 60 years with ASA physical status I or II who were undergoing elective upper gastrointestinal endoscopic interventions and required or requested sedation were eligible for inclusion. Patients were excluded if they were obstetric cases, had a known allergy to propofol or dexmedetomidine, had upper airway injury or pathology, required an emergency procedure, had obstructive sleep apnea, impaired ventricular function (left ventricular ejection fraction below 55%), abnormal liver function, or impaired renal function (GFR below 60 ml/min) or were receiving hemodialysis. Ethical approval was obtained from the Institutional Review Board of Shaikh Zayed Medical Complex, Lahore, and written informed consent was obtained from all participants before enrollment.

After recruitment, participants were assigned to one of two groups. Group A received intravenous dexmedetomidine administered as a loading dose of 1 microgram per kilogram over 10 minutes, followed by a continuous infusion of 0.5 microgram per kilogram per hour. Group B received intravenous propofol administered as a loading dose of 0.5 milligram per kilogram, followed by a constant infusion of 50 microgram per kilogram per minute. Before the start of the endoscopic intervention, an intravenous cannula was secured, the patients were appropriately positioned, and supplemental oxygen was provided via a nasal cannula at 3 to 5 liters per minute. Standard monitoring was established, and the assigned sedative infusion was initiated according to the allocated regimen. The time from initiation of the study drug to achieving a Ramsay Sedation Score of 4 was recorded in seconds.

Participants were monitored continuously throughout the procedure. Oxygen saturation was assessed every 5 minutes, and any episodes of oxygen desaturation were documented. Baseline heart rate was recorded, and heart rate and mean arterial pressure were subsequently measured every five minutes; clinically relevant deviations from baseline were noted. If the endoscopist judged sedation inadequate or additional personnel were required to restrain the patient, rescue sedation was provided with incremental intravenous propofol boluses of 10 to 20 mg, and the total number of rescue boluses was recorded. Intra procedural complications were managed according to predefined protocols: bradycardia, defined as a heart rate below 50 per minute, was treated with atropine 0.6 mg; hypotension was managed with intravenous fluids and or vasopressors; and oxygen desaturation was managed using a stepwise approach, including increasing oxygen flow, applying a jaw thrust, providing bag mask ventilation, and performing tracheal intubation when required.

After the endoscopic procedure, the sedative infusion was discontinued, and the recovery time was recorded in minutes. Recovery time was defined as the time required to achieve a Modified Aldrete Score of 10/10 during the postoperative period. Patients were transferred to the recovery area once fully awake and able to be aroused. They were monitored for two hours to document early postoperative adverse events, including nausea, vomiting, coughing, and respiratory depression, based on predefined criteria in the study proforma. The primary and secondary outcomes included recovery time, hypotension defined as a reduction in mean arterial pressure by more than 20% from baseline, bradycardia, oxygen desaturation, nausea, and vomiting.

All collected data were entered into a spreadsheet and analyzed using IBM SPSS version 25. Quantitative variables, including age and BMI, were summarized as means with standard deviations, while qualitative variables, including gender and ASA status, were reported as frequencies and percentages. Mean recovery time was compared between the two study groups using an independent-samples t-test. In contrast, categorical outcomes, including hypotension, bradycardia, oxygen desaturation, nausea, and vomiting, were compared using the chi-square test. Stratification for gender, age, and BMI was performed to control for potential effect modifiers, followed by post-stratification application of the independent sample t-test or chi-square test, as appropriate. A p-value of 0.05 or less was considered statistically significant.

Results

A total of 126 participants were included (63 in each arm). The overall mean age was 41.9 ± 12.4 years, and 70 (55.6%) participants were male. Baseline characteristics were comparable between groups. (Table 1)

Table 1. Demographic and baseline clinical characteristics of participants (n = 126)

Characteristic	Dexmedetomidine (n = 63)	Propofol (n = 63)	p-value
Age (years), mean ± SD	42.1 ± 12.2	41.7 ± 12.6	0.86
Gender, n (%)			0.71
Male	36 (57.1)	34 (54.0)	
Female	27 (42.9)	29 (46.0)	
BMI (kg/m²), mean ± SD	26.6 ± 3.8	26.9 ± 4.0	0.64
ASA grade, n (%)			0.83
ASA I	40 (63.5)	38 (60.3)	
ASA II	23 (36.5)	25 (39.7)	

Time to achieve Ramsay Sedation Score 4 (recorded in seconds as per protocol) and recovery time (time to Modified Aldrete Score 10/10) were compared between groups. Recovery time was significantly shorter in the dexmedetomidine group. (Table 2)

Table 2. Sedation onset and recovery outcomes (n = 126)

Outcome	Dexmedetomidine (n = 63)	Propofol (n = 63)	Mean difference	p-value
Time to RSS 4 (seconds), mean ± SD	318 ± 92	192 ± 64	+126 sec	<0.001
Recovery time to Modified Aldrete 10/10 (min), mean ± SD	8.0 ± 3.6	12.4 ± 3.1	-4.4 min	<0.001

Complications were recorded during the procedure and during early recovery monitoring. Hypotension, bradycardia, and oxygen desaturation were assessed according to the operational definitions in the synopsis. Hypotension was significantly more frequent with propofol, while bradycardia occurred more often with dexmedetomidine. (Table 3)

Table 3. Complications and adverse events (n = 126)

Event	Dexmedetomidine (n = 63)	Propofol (n = 63)	p-value
Hypotension, n (%)	7 (11.1)	16 (25.4)	0.038
Bradycardia, n (%)	5 (7.9)	0 (0.0)	0.023
Oxygen desaturation, n (%)	7 (11.1)	13 (20.6)	0.144
Nausea (first 2 hours), n (%)	6 (9.5)	4 (6.3)	0.510
Vomiting (first 2 hours), n (%)	2 (3.2)	3 (4.8)	0.648

As per protocol, rescue sedation with incremental IV propofol boluses was administered when sedation was considered suboptimal or patient restraint was required. The need for rescue sedation was higher in the dexmedetomidine group. (Table 4)

Table 4. Rescue sedation and airway supportive measures (n = 126)

Supportive intervention	Dexmedetomidine (n = 63)	Propofol (n = 63)	p-value
Rescue sedation required, n (%)	12 (19.0)	3 (4.8)	0.013
Increased oxygen flow only, n (%)	9 (14.3)	12 (19.0)	0.47
Jaw thrust, n (%)	3 (4.8)	6 (9.5)	0.30
Bag mask ventilation, n (%)	1 (1.6)	2 (3.2)	0.56
Endotracheal intubation, n (%)	0 (0.0)	1 (1.6)	0.31

Discussion

The present study aimed to compare the safety and effectiveness of intravenous dexmedetomidine versus intravenous propofol for procedural sedation in patients undergoing upper GI endoscopy. The findings indicate that while dexmedetomidine resulted in a significantly longer time to achieve a Ramsey Sedation Score (RSS) of 4, it was associated with a notably shorter recovery time compared to propofol. Specifically, the dexmedetomidine group required, on average, 318 seconds to reach RSS 4, compared with 192 seconds in the propofol group, yielding a mean difference of +126 seconds ($p < 0.001$). However, recovery time was shorter in the dexmedetomidine group, averaging 8.0 minutes compared with 12.4 minutes in the propofol group (mean difference of -4.4 minutes; $p < 0.001$). These results align with previous studies that have highlighted dexmedetomidine's advantage in improving recovery profiles while offering sedation with minimal respiratory depression (10).

Moreover, our study noted a higher incidence of hypotension in patients sedated with propofol (25.4%) compared to dexmedetomidine (11.1%) ($p = 0.038$), supporting the findings by Tekeli et al., who found that propofol tends to induce arterial hypotension more frequently than dexmedetomidine (11). Importantly, bradycardia was more prevalent in the dexmedetomidine group, occurring in 7.9% of cases ($p = 0.023$). This outcome resonates with previous research where dexmedetomidine tended to lower heart rate, thereby necessitating vigilant monitoring during sedation (12). Such hemodynamic stability with dexmedetomidine is advantageous in a population that may present with underlying cardiovascular conditions, as noted by Guo et al. in their work on elderly patients undergoing similar procedures (13).

Despite the need for rescue sedation being significantly greater in the dexmedetomidine group (19.0% compared to 4.8% in the propofol group; $p = 0.013$), it is crucial to contextualize this within the framework of procedural characteristics and patient-specific factors. In specific scenarios, suboptimal sedation levels leading to the application of rescue sedatives could be a reflection of the titration protocols rather than a limitation of the agent itself (14).

Contradictory evidence also exists in the literature. For instance, studies such as that by Zhang et al. suggest that dexmedetomidine does not consistently show advantages over propofol in terms of sedation depth or post-procedural outcomes (15). In a study by Johnson et al., dexmedetomidine did not significantly reduce propofol requirements in pediatric populations (16). These findings suggest that while dexmedetomidine may offer benefits, it can also lead to variability in outcomes across specific clinical contexts and individual patient factors.

Our study's results indicate that dexmedetomidine may reduce recovery time and improve cardiovascular stability during procedural sedation for upper GI endoscopy, while also highlighting the need for rescue sedation to achieve adequate sedation levels. Future studies should explore larger and more diverse patient populations to validate these findings further and refine sedation strategies tailored for optimal patient safety and satisfaction, especially in a population like Pakistan, where cardiovascular comorbidities might be prevalent.

Conclusion

This randomized controlled trial demonstrates that intravenous dexmedetomidine offers significant safety and recovery benefits over propofol for procedural sedation during upper GI endoscopy. Although dexmedetomidine required a longer time to achieve adequate sedation and was associated with more frequent bradycardia and rescue dosing, it significantly reduced hypotension. It enabled faster recovery, which is clinically valuable in busy endoscopy units. Given the hemodynamic stability and shorter recovery profile observed in this Pakistani cohort, dexmedetomidine represents a reliable and effective alternative to propofol, especially in patients with cardiovascular vulnerabilities. Future studies with larger sample sizes and diverse surgical settings may help refine sedation protocols and confirm these benefits across broader clinical populations.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
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The authors declared no conflict of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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