Section: Anaesthesiology

Original Research Article

COMPARISON OF INTRAVENOUS PARACETAMOL AND DEXMEDETOMIDINE IN REDUCING POSTOPERATIVE OPIOID REQUIREMENT IN ABDOMINAL SURGERIES

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Received : 26/06/2026
Received in revised form : 10/08/2026
Accepted : 24/08/2026

Keywords:
Dexmedetomidine, Intravenous paracetamol, postoperative pain, rescue analgesia, opioid-sparing analgesia, laparoscopic abdominal surgery.

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DOI: 10.47009/jamp.2026.8.4.294

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (4); 1729-1734

ABSTRACT

Background: Postoperative pain remains a major challenge following abdominal surgery and may increase opioid requirements and related adverse effects. Multimodal analgesia using opioid-sparing agents may improve postoperative recovery outcomes. This study aimed to compare the effects of intravenous paracetamol and dexmedetomidine on reducing postoperative opioid requirements following abdominal surgery. **Materials and Methods:** This prospective randomised study included 60 patients who were randomly allocated to Group P (n=30), receiving intravenous paracetamol 1 g over 15 min, or Group D (n=30), receiving dexmedetomidine 1 µg/kg over 10 min followed by 0.5 µg/kg/h infusion for 1 h. Perioperative haemodynamic parameters, oxygen saturation, VAS, rescue analgesia, time to first rescue dose, total analgesic dose, RSS, and PSS were assessed postoperatively. **Results:** Group D had lower heart rates than Group P at 1, 2, 4, 6, 12, and 24 h (all P=0.0005). SBP and DBP were also lower in Group D at all time points (P≤0.003). Rescue analgesia was significantly less frequent in Group D at 1 and 24 h (P=0.0005) and 24 hours (P=0.008, respectively). The time to first rescue dose was longer (4±1 vs. 1±0 h), while the total analgesic dose was lower (223±57 vs. 353±51 mg, both P=0.0005). RSS (2.3±0.6 vs. 1.4±0.5), PSS (6.7±1.3 vs. 2.8±1.4), and VAS scores at 1, 6, 12, and 24 h were significantly different, whereas VAS scores at 2 and 4 h were comparable. **Conclusion:** Dexmedetomidine provided superior opioid-sparing analgesia, better sedation, and satisfaction, with comparable oxygenation following laparoscopic abdominal surgery.

INTRODUCTION

Postoperative pain after abdominal surgery is a common clinical problem, and many patients experience moderate-to-severe pain in the early postoperative period. Failure to adequately control pain can lead to elevated sympathetic activity, more breathing problems, poor cough, delay in the ability to move around, longer hospitalisation, and chronic post-surgical pain. Therefore, effective postoperative analgesia is essential for patient comfort and recovery. Multimodal analgesia (utilising more than one drug with different mechanisms to enhance pain control) is now commonly used to achieve better pain control and lower opioid use.[1,2] Opioids continue to be important in the treatment of moderate to severe pain after surgery but have been associated with nausea, vomiting, ileus, respiratory depression, sedation, urinary retention, and delayed recovery. These effects may impact early mobilisation and gastrointestinal recovery. Therefore, the use of opioid-sparing strategies has become an important component of perioperative care. Multimodal analgesia principles involving a combination of non-opioid medications and regional techniques (such as nerve blocks and local anesthesia) should be used to limit opioid use and improve early recovery, which are recommended by ERAS protocols.[2-4]

Several non-opioid drugs are used for this purpose, including paracetamol, NSAIDs, gabapentinoids, ketamine, dexmedetomidine, intravenous lidocaine, and regional anaesthetic techniques. These drugs act on different pain pathways and may help decrease opioid use after surgery. IV Paracetamol is also a widely used drug that is opioid sparing and has an analgesic effect with a favourable safety margin, especially after major abdominal surgery.[3,5,6] It primarily acts as a central analgesic agent, from the central prostaglandin inhibitory action and by modulating descending serotonergic pathways. It can be taken for an extended period without causing gastrointestinal upset, has no bleeding tendencies, and does not depress the respiratory system, unlike NSAIDs. The use of intravenous Paracetamol has been found to be associated with reduced opioid dosage and opioid related side effects including nausea, vomiting and sedation.[7] However, differences between studies and surgical populations making comparative evidence required.[8]

Dexmedetomidine is another useful opioid-sparing agent. Dexmedetomidine is a highly selective Alpha-2 adrenergic receptor agonist that is analgesic, sedative, anxiolytic, sympatholytic, and has minimal respiratory depression effect. Perioperatively, it has been shown to be associated with lower scores of perioperative pain, delayed requirement for rescue analgesia, and decreased opioid consumption, but has been reported to induce bradycardia, hypotension, and excessive sedation, which must be carefully monitored.[9,10] Both drugs have been shown to have opioid-sparing effects, but most studies have compared them individually to placebo or to each other.[11,12] Most of this evidence is from cardiac, spinal, and orthopaedic surgery and has limited practical application to abdominal surgery.[13,14] There is also variation between studies in analgesic protocols, rescue-analgesia timing, opioid-consumption measures, patient satisfaction assessment, and adverse-event reporting. Direct randomized comparisons of intravenous paracetamol and dexmedetomidine in abdominal surgery remain limited.[7,10,15]

Aim

This study aimed to compare the efficacy of intravenous paracetamol and dexmedetomidine in reducing the effects of postoperative opioid use.

MATERIALS AND METHODS

This prospective randomised study included 60 patients who attended the Department of Anesthesiology, Government Stanley Medical College, Chennai. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants before study initiation.

Inclusion and Exclusion criteria

This study included patients of either sex aged 18-60 years with ASA physical status I and II undergoing elective laparoscopic abdominal surgeries under general anaesthesia, including laparoscopic cholecystectomy, hernioplasty, and appendicectomy. Patients with known hypersensitivity to paracetamol or dexmedetomidine, ASA physical status III and IV, duration of surgery less than 1 h or > 3 h, and those with psychiatric illness were excluded from the study.

Materials

The materials used in the study included intravenous paracetamol 1 g infusion, dexmedetomidine, tramadol, glycopyrrolate, midazolam, fentanyl, thiopentone, atracurium, desflurane, ondansetron, neostigmine, atropine, ephedrine, appropriately sized intravenous cannulae, cuffed endotracheal tubes, a working ventilator, standard monitoring equipment, and all necessary emergency medications.

Methods

Sixty patients were randomised into Group P (n=30), receiving intravenous paracetamol 1 g over 15 min, and Group D (n=30), receiving intravenous dexmedetomidine 1 μg/kg over 10 min followed by 0.5 μg/kg/h for 1 h, using a computer-generated randomisation list. Standard monitors were attached, and the baseline heart rate, blood pressure, and oxygen saturation were recorded. Patients received glycopyrrolate (5 μg/kg), midazolam (0.02 mg/kg), and fentanyl (2 μg/kg), followed by preoxygenation with 100% oxygen for 3 min. Anaesthesia was induced with thiopentone (5 mg/kg) and atracurium (0.5 mg/kg) and maintained with O_2 :N_2 O (50:50), desflurane (6 %), and atracurium (0.1 mg/kg). Hypotension was treated with ephedrine 6 mg when systolic blood pressure was <90 mmHg, and bradycardia with atropine 0.6 mg when heart rate was <50 beats/min. Ondansetron 0.1 mg/kg was given 20 minutes before surgery completion. Neuromuscular blockade was reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg), followed by extubation and transfer to the post-anaesthesia care unit. Postoperatively, heart rate, blood pressure, oxygen saturation, and VAS were recorded at 1, 4, 6, 12, and 24 h, and RSS was assessed. Rescue analgesia was intravenous tramadol 100 mg in 100 mL normal saline when VAS ≥4, repeated up to 400 mg within 24 hours. The time to first rescue analgesia, total rescue analgesic requirement, patient satisfaction at 24 h were recorded.

Statistical analysis

Data were presented as mean, standard deviation, frequency and percentage. Continuous variables were compared using the independent sample t-test and Mann–Whitney U test. Categorical variables were compared using the Pearson Chi-square test. Significance was defined by P values less than 0.05 using a two-tailed test. Data analysis was performed using IBM SPSS Statistics version 21.0 (IBM Corp., Armonk, NY, USA).

RESULTS

The mean age of the patients was 42 ± 8 years. Most patients were aged 41-50 years, 26 (43.3%), followed by 31-40 years, 22 (36.7%), above 50 years, 8 (13.3%), and up to 30 years, 4 (6.7%). Females comprised 33 (55%) and males 27 (45%) patients. [Table 1]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 1: Demographic characteristics of the patients

		N (%)
Age (years)	Up to 30 years	4 (6.7%)
	31-40 years	22 (36.7%)
	41-50 years	26 (43.3%)
	Above 50 years	8 (13.3%)
	Mean ± S. D	42 ± 8
Gender	Female	33 (55%)
	Male	27 (45%)

The age distribution differed significantly between the groups (P=0.019). Group D had 16 (53.3%) aged 31-40 years, 9 (30%) aged 41-50, 3 (10%) up to 30, and 2 (6.7%) above 50. Group P had 17 (56.7%), 6 (20%), 6 (20%), and 1 (3.3%), respectively. Females/males were 15 (50%)/15 (50%) in Group D and 18 (60%)/12 (40%) in Group P (P=0.436). [Table 2]

Table 2: Comparison of demographic characteristics between Groups

		N (%)		P Value
		Group D	Group P	
Age (years)	Up to 30 years	3 (10%)	1 (3.3%)	0.019
	31-40 years	16 (53.3%)	6 (20%)	
	41-50 years	9 (30%)	17 (56.7%)	
	Above 50 years	2 (6.7%)	6 (20%)	
Gender	Female	15 (50%)	18 (60%)	0.436
	Male	15 (50%)	12 (40%)	

The mean heart rate was lower in Group D than in Group P at all postoperative time points. At the 1st, 2nd, 4th, 6th, 12th, and 24th hours, values were 68.6 ± 6.7 vs 102.9 ± 8.1, 72.8 ± 7.3 vs 91.6 ± 6.2, 78.4 ± 9.9 vs 102.7 ± 12.5, 74.7 ± 9.0 vs 98.0 ± 12.5 77.8 ± 11.0 vs 109.4 ± 9.7 and 76.1 ± 9.7 vs 110.6 ± 11.1 beats/min, with significant difference (P=0.0005; P<0.01). [Figure 2]

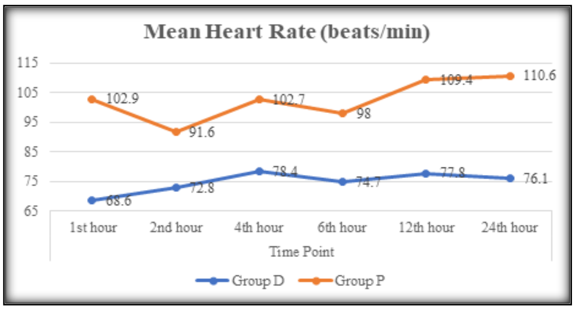

Figure 2: Comparison of mean heart rate between Groups at different time points

Mean systolic blood pressure was lower in Group D than Group P. At the 1st, 2nd, 4th, 6th, 12th, and 24th hours, values were 110.8 ± 8.1 vs 135.8 ± 9.4, 108.3 ± 8.3 vs 117.7 ± 10.6, 116.6 ± 8.0 vs 130.7 ± 9.3, 112.4 ± 7.2 vs 129.6 ± 11.7, 117.9 ± 8.0 vs 130.2 ± 10.8, and 116.8 ± 8.7 vs 128.7 ± 11.4 mmHg, with significant difference (P=0.0005; P<0.01) (Figure 3).

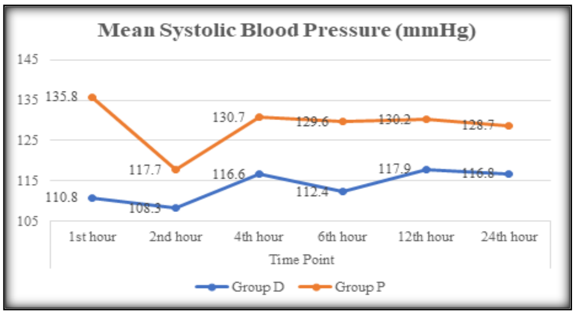

Figure 3: Comparison of mean systolic blood pressure between Groups at different time points

The mean diastolic blood pressure was lower in Group D than in Group P at all postoperative time points. At the 1st, 2nd, 4th, 6th, 12th, and 24th hours, values were 68.8 ± 7.0 vs 85.4 ± 7.3, 70.8 ± 5.5 vs 76.2 ± 7.8, 78.0 ± 5.6 vs 83.5 ± 7.8, 76.0 ± 6.8 vs 83.7 ± 6.7, 79.8 ± 8.5 vs 86.7 ± 5.4, and 78.3 ± 6.8 vs 84.7 ± 6.0 mmHg, with significant difference all time points (P=0.0005, except P=0.003 at 2 hours). [Figure 4]

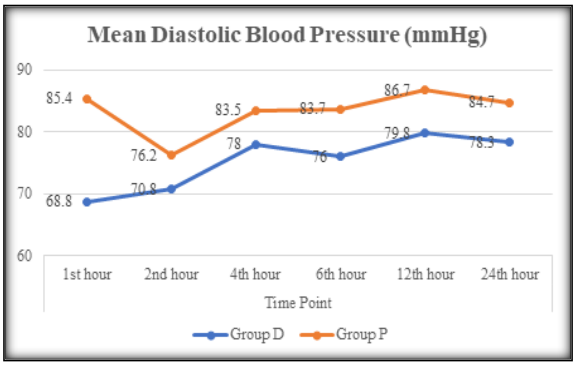

Figure 4: Comparison of mean diastolic blood pressure between Groups at different time points

ISSN (O): 2687-5365; ISSN (P): 2753-6556

The mean SpO_2 was comparable between Groups D and P, with no significant difference found at any time point (P>0.05). [Figure 5]

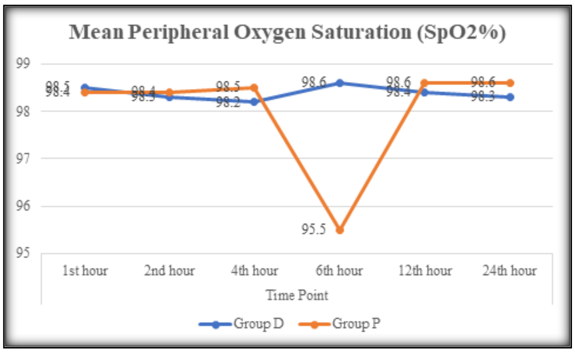

Figure 5: Comparison of mean SpO_2 between at different time points

Table 3: Comparison of postoperative rescue analgesia requirement between Groups

			N (%)		P Value
			Group D	Group P	
Rescue Analgesia	1st hour	Given	3 (10%)	27 (90%)	0.0005
		Nil	27 (90%)	3 (10%)	
	2nd hour	Given	6 (20%)	3 (10%)	0.472
		Nil	24 (80%)	27 (90%)	
	4th hour	Given	19 (63.3%)	16 (53.3%)	0.601
		Nil	11 (36.7%)	14 (46.7%)	
	6th hour	Given	10 (33.3%)	13 (43.3%)	0.426
		Nil	20 (66.7%)	17 (56.7%)	
	12th hour	Given	17 (56.7%)	24 (80%)	0.052
		Nil	13 (43.3%)	6 (20%)	
	24th hour	Given	12 (40%)	23 (76.7%)	0.008
		Nil	18 (60%)	7 (23.3%)	

Rescue analgesia was required in 3 (10%) versus 27 (90%) patients at the 1st hour (P=0.0005). At the 2nd hour, it was required in 6 (20%) versus 3 (10%) (P=0.472), and at the 4th hour in 19 (63.3%) versus 16 (53.3%) (P=0.601). At the 6th hour, the requirement was 10 (33.3%) versus 13 (43.3%) (P=0.426), while at the 12th hour it was 17 (56.7%) versus 24 (80%) (P=0.052). At 24 h, rescue analgesia was required in 12 (40%) and 23 (76.7%) patients (P=0.008) in Groups D and P, respectively. [Table 3]

The mean time to first rescue analgesia was 4 ± 1 versus 1 ± 0 hours, and total rescue analgesic dose was 223 ± 57 versus 353 ± 51 mg in Groups D and P, respectively (P=0.0005). RSS was 2.3 ± 0.6 versus 1.4 ± 0.5, while PSS was 6.7 ± 1.3 versus 2.8 ± 1.4, respectively (P=0.0005). [Table 4]

Table 4: Comparison of postoperative analgesic and sedation-related outcomes between Groups

	Mean ± S. D		P Value
	Group D	Group P	
Time of 1st dose of rescue analgesia (hours)	4±1	1	0.0005
Total rescue analgesia dose (mg)	223±57	353±51	0.0005
Ramsay Sedation Score (RSS)	2.3±0.6	1.4±0.5	0.0005
Patient Satisfaction Score (PSS)	6.7±1.3	2.8±1.4	0.0005

The mean VAS scores varied between the groups across the postoperative assessments. At the 1st hour, Group D had a lower score than Group P (1.0 ± 1.3 vs. 4.3 ± 1.2; Z=5.919, P=0.0005). At the 2nd and 4th hours, scores were 2.2 ± 1.2 vs. 2.0 ± 1.1 (Z=0.669, P=0.503) and 3.6 ± 1.0 vs. 3.9 ± 1.7 (Z=0.657, P=0.511), respectively. At the 6th, 12th, and 24th hours, scores were 2.6 ± 1.2 vs. 3.9 ± 1.6 (Z=2.694, P=0.007), 3.2 ± 1.3 vs. 4.9 ± 1.3 (Z=4.568, P=0.0005), and 3.0 ± 1.1 vs. 4.8 ± 1.3 (Z=4.741, P=0.0005), respectively (Figure 6).

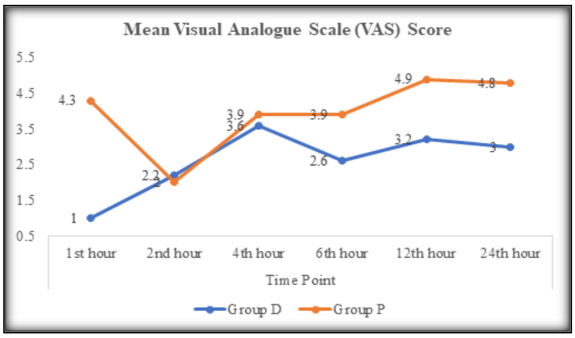

Figure 6: Comparison of mean VAS scores between Groups at different time points

DISCUSSION

The present study compared intravenous dexmedetomidine and paracetamol for postoperative analgesia, haemodynamic stability, sedation, and patient satisfaction. The findings showed differences between the groups in postoperative haemodynamic parameters, rescue analgesic requirement, pain scores, sedation, and patient satisfaction.

The mean age in our study was 42 ± 8 years, with most patients aged 41-50 years, followed by 31-40 years, above 50, and up to 30 years. Group D had more patients aged 31-40 years, whereas Group P had more aged 41-50 years. Female patients were more common, with no significant sex differences. Sarkar et al. studied 60 ASA I/II patients aged 18-65 years undergoing laparoscopic cholecystectomy or appendicectomy.[16] Sharma et al. included 100 ASA I/II patients aged 18-60 years undergoing laparoscopic cholecystectomy.[17] Kamali et al. studied 132 patients aged 18-70 years undergoing emergency or elective cholecystectomy, with a mean age of about 52 years in both groups and no significant sex difference (P>0.05).[18]

The heart rate was lower in Group D than in Group P at all postoperative assessments. This agrees with Sarkar et al., who reported bradycardia or hypotension in 20% with dexmedetomidine versus 3.3% with paracetamol (P=0.04).[16] Sarkar et al. reported the same rates, 20% versus 3.3% (P=0.04).[19] Junaid et al. reported heart rates of 91.25 ± 19.8 versus 103.12 ± 14.3 beats/min (P<0.05), falling to 82.80 ± 12.7 versus 98.75 ± 12.8 beats/min at 60 minutes.[20] These findings are consistent with its sympatholytic effect.

Systolic blood pressure was also lower with dexmedetomidine in the present study. Junaid et al. reported 114.35 ± 19.1 versus 122.58 ± 17.3 mmHg (P<0.05).20 Harshitha et al. found significantly lower intraoperative haemodynamic variables with dexmedetomidine than paracetamol (P<0.05), while Sharma et al. reported a better haemodynamic profile with dexmedetomidine.[21,17] In contrast, Kamali et al. found no significant difference in mean arterial pressure (P>0.05).[18] Differences in surgery, dose, timing, anaesthesia, and fluid management may explain these results. Diastolic blood pressure was also lower with dexmedetomidine. Harshitha et al. reported significantly lower haemodynamic variables with dexmedetomidine-containing regimens and significant differences between paracetamol and dexmedetomidine during surgery (P<0.0001).[21] Junaid et al. also reported lower blood-pressure measurements with dexmedetomidine.20 However, Kamali et al. found no significant difference in mean arterial pressure (P>0.05).[18] Dexmedetomidine was associated with lower systolic and diastolic blood pressure compared with paracetamol. Differences across studies may be related to variations in dosing, timing, anaesthesia, surgery, and fluid management.

Rescue analgesia was required less often with dexmedetomidine at selected time points, and the time to the first rescue dose was longer. Sharma et al. reported reduced postoperative analgesic requirement with dexmedetomidine (P=0.001).[17] Harshitha et al. reported time to first rescue analgesia of 5.52 ± 1.22 hours with dexmedetomidine, 4.35 ± 0.99 hours with paracetamol, and 9.06 ± 1.16 hours with the combination (P<0.0001).[21] In contrast, Sarkar et al. reported rescue analgesia in 40% versus 13.3% (P=0.02), with first rescue at 134.42 ± 12.67 versus 82.76 ± 9.38 minutes (P=0.001).16 These differences may reflect variations in drug dose, timing, surgery, and rescue criteria.

The total rescue analgesic requirement was lower with dexmedetomidine in our study. Srinithi et al. found greater rescue analgesic use with paracetamol alone than with the paracetamol-dexmedetomidine combination (P=0.005).[22] Junaid et al. reported rescue analgesia in 14% versus 29% (P=0.03).[20] Conversely, Sarkar et al. reported greater rescue requirement with dexmedetomidine, while Kamali et al. reported lower 24-hour opioid use with paracetamol.[16,18] Ramsay Sedation Score was higher with dexmedetomidine. Sharma et al. reported Ramsay scores of 3-5 in 62% of patients receiving the relevant dexmedetomidine protocol.[17] Srinithi et al. also found higher sedation scores with the paracetamol-dexmedetomidine combination through 10 hours.[22] Junaid et al. reported sedation scores of 2.00 ± 0.60 versus 2.20 ± 0.75 at 4 h and 1.80 ± 0.30 versus 2.00 ± 0.45 at 24 hours.[20] These findings support the sedative effect of dexmedetomidine.

In our study, patient satisfaction was higher with dexmedetomidine. Sharma et al. also reported better satisfaction with dexmedetomidine, whereas Harshitha et al. reported high satisfaction with a dexmedetomidine-containing regimen.[17,21] This may be related to better pain control, longer analgesia, less rescue medication, and sedation. VAS scores were lower with dexmedetomidine. Junaid et al. reported VAS values of 1.90 ± 1.10 versus 2.50 ± 1.25 at 4 hours and 1.40 ± 0.48 versus 1.50 ± 0.92 at 24 hours (P<0.05), with overall pain scores of 3.8 ± 1.2 versus 5.2 ± 1.5 (P=0.001).[20] In contrast, Sarkar et al. found a trend towards lower VAS with paracetamol, while Kamali et al. reported lower pain with paracetamol (P=0.04), although postoperative scores did not differ significantly overall (P>0.05).[16,18] Differences in dosing, timing, surgery, infusion duration, rescue criteria, and postoperative analgesia may explain these varied findings.

CONCLUSION

Intravenous dexmedetomidine is more effective than intravenous paracetamol in reducing postoperative opioid requirements after abdominal surgery. It prolonged the time to the first rescue analgesia and reduced the total rescue analgesic use. The VAS scores were lower with dexmedetomidine at the 1st, 6th, 12th, and 24th hours, but not at the 2nd and 4th hours. Heart rate and systolic and diastolic blood pressure were lower with dexmedetomidine, whereas SpO_2 remained comparable. Higher Ramsay Sedation and Patient Satisfaction Scores were also observed with dexmedetomidine. Dexmedetomidine provided better postoperative analgesia and opioid-sparing effects with comparable oxygen saturation.

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