Section:Anesthesiology

Original Research Article

COMPARISON BETWEEN INTRAOPERATIVE LOW DOSE INFUSION OF KETAMINE AND LOW DOSE INFUSION OF DEXMEDETOMIDINE AS ADJUVANTS FOR HEMODYNAMIC ASSESSMENT

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ABSTRACT

Background: Maintaining intraoperative hemodynamic stability is crucial for safe anesthesia practice. Low-dose infusions of ketamine and dexmedetomidine are widely used as adjuvants during general anesthesia; however, their comparative efficacy in terms of hemodynamic effects and anesthetic-sparing properties requires further evaluation. The objective is to compare the effects of intraoperative low-dose ketamine infusion versus low-dose dexmedetomidine infusion on hemodynamic parameters and anesthetic requirements in patients undergoing elective surgeries under general anesthesia.

Materials and Methods: This prospective, randomized, double-blind comparative study was conducted over a period of two years at a tertiary care center. Sixty patients aged 18–60 years, belonging to ASA physical status I–II and scheduled for elective surgery under general anesthesia, were randomly assigned into two groups (n=30 each). Group K received ketamine infusion (0.3 mg/kg/hr), while Group D received dexmedetomidine infusion (0.3 µg/kg/hr). A standardized anesthesia protocol was followed for all patients. Hemodynamic parameters were recorded at baseline, post-induction, at incision, intraoperatively at 15-minute intervals, and postoperatively. Secondary outcomes included intraoperative requirements of skeletal muscle relaxants and inhalational anesthetic agents. Data were analyzed using Student's t-test and Chi-square test, with $p < 0.05$ considered statistically significant.

Results: Demographic characteristics (age, weight, height, BMI), gender distribution, ASA status, and duration of surgery were comparable between the two groups ($p > 0.05$). No statistically significant differences were observed in HR, SBP, DBP, MAP, or oxygen saturation at any measured time points between the groups ($p > 0.05$). However, the dexmedetomidine group demonstrated a significant reduction in the requirement of skeletal muscle relaxants and inhalational anesthetic agents compared to the ketamine group ($p = 0.001$).

Conclusion: Low-dose infusions of ketamine and dexmedetomidine provide comparable intraoperative hemodynamic stability. Dexmedetomidine, however, offers a significant anesthetic-sparing effect, reducing the need for muscle relaxants and inhalational agents, which may contribute to improved recovery profiles. Larger multicentric studies are recommended to confirm these findings.

Keywords: Dexmedetomidine; Ketamine; Hemodynamic stability; General anesthesia; Anesthetic-sparing effect; Randomized controlled trial.

INTRODUCTION

General anesthesia plays a pivotal role in elective surgeries by providing a controlled state of unconsciousness, ensuring the patient remains unaware of the procedure while experiencing no pain. It involves the administration of anesthetic agents through inhalation or intravenous routes, tailored to meet the specific needs of the surgery and individual patient factors. The use of general anesthesia allows for muscle relaxation, suppression of reflexes, and precise management of physiological responses during the operation. Careful monitoring by anesthesiologists ensures the balance between safety and efficacy, minimizing risks and optimizing recovery outcomes. This approach is especially beneficial for complex surgeries requiring extensive manipulation of internal structures or prolonged durations.

Dexmedetomidine, a highly selective α2 adrenoreceptor agonist, has anxiolytic, sedative, anesthetic, and analgesic properties. It has limited side effects in terms of respiratory depression.[1] Because of these favorable properties, it is commonly used in a wide variety of procedures.[2]

Ketamine hydrochloride, a well-known anesthetic agent, has been in clinical use for more than four decades. Its antinociceptive-hypnotic effects are most likely the result of the noncompetitive antagonism at the N-methyl-D-aspartate (NMDA) receptor of the central nervous system.[3] Ketamine is used as an analgesic in low doses and as an anesthetic in high doses.[4] It is suggested that ketamine maintains analgesia and reduces postoperative opioid use, whether used alone or in combination with other anesthetic agents.[3,5]

Ketamine and another rarely used α2 adrenoceptor agonist, clonidine, have been compared for their effects on reducing pain and anesthesia requirements. According to our literature research studies, no similar studies have been found that compare ketamine and dexmedetomidine for the same effects.[6,7]

In our study, we aimed to compare the postoperative analgesic and adverse effects of dexmedetomidine and ketamine combined with general anaesthesia in patients undergoing elective surgical procedures.

Aim: Comparison between intraoperative low dose infusion of ketamine and low dose infusion of dexmedetomidine as adjuvants for hemodynamic assessment/

Objectives: Assessing between the two groups which is a better adjuvant to reduce the doses of anaesthetic agents and at the same time maintaining adequate depth and hemodynamic thereby better recovery, better outcome.

MATERIALS AND METHODS

Study Design: A prospective, randomized, double-blind comparative study was conducted to evaluate the hemodynamic effects of intraoperative low-dose infusions of ketamine and dexmedetomidine as adjuvants in general anesthesia.

Study Setting and Duration: The study was carried out at Shadan institute of medical sciences, over a period of 2 years.

Study Population: Patients aged between 18 and 60 years scheduled for elective surgical procedures under general anesthesia were recruited after obtaining written informed consent.

Sample Size: A total of 60 patients were enrolled and randomly assigned into two equal groups:

- Group K (Ketamine group) – Low-dose ketamine infusion (0.3 mg/kg/hr)
- Group D (Dexmedetomidine group) – Low-dose dexmedetomidine infusion (0.3 mcg/kg/hr)

The sample size was calculated based on prior studies to ensure a power of 80% and an alpha error of 5%.

Inclusion Criteria

- Age between 18 and 60 years
- ASA physical status I or II
- Undergoing elective surgical procedures under general anesthesia
- Willingness to provide informed consent

Exclusion Criteria

- ASA 3,4
- Known hypersensitivity to ketamine or dexmedetomidine
- History of psychiatric illness, cardiovascular disorders, or arrhythmias
- Pregnancy or lactation
- Emergency surgeries

Randomization and Blinding: Participants were randomized using a computer-generated table. Study drugs were prepared by an independent anesthesiologist not involved in intraoperative management. The administering anesthesiologist and the patient were both blinded to group allocation.

Preoperative Preparation:

- Standard fasting guidelines followed.
- Preoperative assessment and informed consent obtained.
- IV access secured.
- Baseline vital signs recorded.

Anaesthetic Protocol:

All patients received a standardized anesthetic protocol:

- Premedication: Midazolam and fentanyl
- Induction: Propofol and vecuronium
- Maintenance: Oxygen, nitrous, and sevoflurane
- Study Drug Infusion:

Group K: Ketamine 0.3 mg/kg/hr

Group D: Dexmedetomidine 0.3 mcg/kg/hr

Infusion commenced post-induction and continued until the end of surgery. Hemodynamic Parameters Monitored

- Heart Rate (HR)
- Systolic Blood Pressure (SBP).
- Diastolic Blood Pressure (DBP)
- Mean Arterial Pressure (MAP)

Timing of Measurements

- Baseline (pre-induction)

- Post-induction
- At surgical incision
- Every 15 minutes intraoperatively
- At the end of surgery
- Postoperative period (up to 2 hours) Other parameters monitored
- Which group (drug) amongst both required lesser top-up doses of skeletal muscle relaxant.
- Which group(drug) amongst both required minimal inhalation agent concentration on dial flow.

Statistical analysis: Data were analyzed using [SPSS version X or relevant software]. Continuous variables were presented as mean ± standard deviation (SD) and compared using the Student's t-test. Categorical data were analyzed using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 60 participants underwent various surgical procedures were enrolled based on eligibility criteria. These participants were allocated into 2 groups by randomisation, i.e. (i) 10 µg/kg/min ketamine and (ii) 0.5 µg/kg/h dexmedetomidine in the ratio of 1:1.

Table 1: Comparison of age; weight; height and BMI between the groups

Characteristics		Groups		P-value
		Ketamine	Dexmedetomidine	
Age (in years)	N	30	30	0.653
	Mean	36.06	35.31	
	Std. Deviation	5.86	7.35	
	Minimum	27.00	20.00	
	Maximum	45.00	45.00	
Weight (in kg)	N	30	30	0.765
	Mean	65.91	65.25	
	Std. Deviation	8.27	9.20	
	Minimum	52.00	48.00	
	Maximum	86.00	85.00	
Height (in cm.)	N	30	30	0.553
	Mean	157.66	156.56	
	Std. Deviation	7.77	6.90	
	Minimum	145.00	147.00	
	Maximum	170.00	170.00	
BMI (kg/m2)	N	30	30	0.941
	Mean	26.48	26.54	
	Std. Deviation	2.86	2.88	
	Minimum	20.20	20.70	
	Maximum	29.90	29.80	

There was no significant difference was observed in mean age on comparison between the two groups (36.06 v/s 35.31;p=0.653).
There was no significant difference was observed in mean weight on comparison between the two groups (65.91 v/s 65.25;p=0.765).
There was no significant difference was observed in mean height on comparison between the two groups (157.66 v/s 156.56;p=0.553).
There was no significant difference was observed in mean BMI on comparison between the two groups (26.48 v/s 26.54;p=0.941).

Table 2: Gender distribution among two groups

Gender	Groups			
	Ketamine		Dexmedetomidine	
	Count	Column N %	Count	Column N %
Female	18	60.00%	17	56.67%
Male	12	40.00%	13	43.33%
Chi-square test, p=0.637				

Among 60 patients; Female preponderance had been noted (60% v/s 56.67%) in both the group. But distribution of gender in both the groups had no significant difference (Chi square test; p=0.637).

Among distribution according to ASA grade, ASA II was found to be proportionally higher side (53.33% v/s 56.67%) but the distribution between the groups had no significant difference (Chi-square test; p=0.437).

Table 3: Surgical operative time at different time intervals

Surgical Operating time (in min.)			
Descriptive	Groups		Total
	Ketamine	Dexmedetomidine	
N	30	30	60
Mean	150.95	142.20	136.57
Std. Deviation	38.98	19.48	39.17

Independent t-test, p=0.523

There was no significant difference was noted in mean time taken during surgery (150.95 v/s 142.20; p=0.523) between the two groups. Then overall mean duration of surgery was 136.57±39.17 min.

Table 4: Heart Rate at different time intervals

Heart rate (in bpm)		**Groups**				**p**
		Ketamine		**Dexmedetomidine**		
		Mean	**SD**	**Mean**	**SD**	
0 min.	T0	73.8	12.8	78.1	12.1	0.56
10 min.	T1	87.1	13.2	84.7	11.5	0.46
20 min.	T2	71.8	12.8	82.1	12.1	0.24
30 min.	T3	86.6	12.3	82.1	11.4	0.65
40 min.	T4	86.7	11.5	89.6	12.3	0.73
50 min.	T5	84.7	11.7	88.2	11.4	0.64
60 min.	T6	84.7	13.3	87.4	12.3	0.23
70 min.	T7	74.3	12.2	86.6	11.5	0.34
80 min.	T8	86.6	12.3	82.1	11.4	0.71
90 min.	T9	87.1	13.2	84.7	10.8	0.65
100 min.	T10	73.8	12.8	82.1	13.2	0.25
110 min.	T11	88.2	13.7	89.6	12.8	0.72
120 min.	T12	87.4	11.4	84.7	13.7	0.62

There was no significant difference in the mean value of heart rate between the groups at time different points from baseline (T0) to 120 min. (T12); p>0.05.

Table 5: Systolic Blood Pressure at different time intervals

Systolic Blood Pressure (in mm Hg)		**Groups**				
		Ketamine		**Dexmedetomidine**		
		Mean	**SD**	**Mean**	**SD**	**p**
0 min.	T0	133.2	11.3	135.0	12.6	0.35
10 min.	T1	129.2	10.5	125.6	11.4	0.46
20 min.	T2	133.7	10.3	131.0	12.0	0.24
30 min.	T3	129.2	10.5	133.2	11.3	0.65
40 min.	T4	133.7	10.3	129.2	10.5	0.73
50 min.	T5	124.5	12.6	133.7	10.3	0.64
60 min.	T6	124.1	12.0	124.5	12.6	0.24
70 min.	T7	129.1	7.1	125.6	11.4	0.65
80 min.	T8	129.2	10.5	133.2	11.3	0.73
90 min.	T9	133.2	11.3	131.0	12.0	0.64
100 min.	T10	129.2	10.5	112.0	12.2	0.23
110 min.	T11	133.7	10.3	110.2	13.8	0.63
120 min.	T12	124.5	12.6	121.5	7.8	0.54

There was no significant difference in the mean value of Systolic blood pressure between the groups at time different points from baseline (T0) to 120 min. (T12); p>0.05.

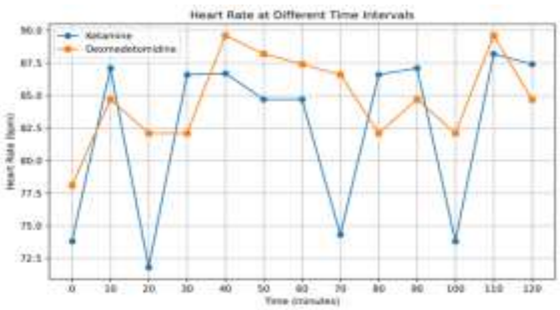

Figure 1: Line graph showing comparison of heart rate between ketamine and dexmedetomidine groups across intraoperative time intervals.

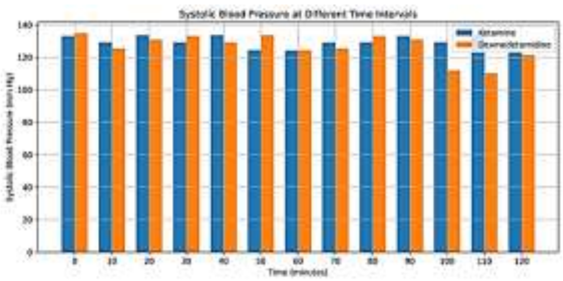

Figure 2: Bar graph showing comparison of systolic blood pressure between ketamine and dexmedetomidine groups across intraoperative time intervals.

Table 6: Diastolic blood pressure at different time intervals

Diastolic Blood Pressure (in mm Hg)		**Groups**				**p**
		Ketamine		**Dexmedetomidine**		
		Mean	**SD**	**Mean**	**SD**	
0 min.	T0	80.1	12.0	82.4	10.8	0.35
10 min.	T1	78.3	10.0	80.6	9.7	0.46
20 min.	T2	73.3	12.4	75.6	11.5	0.64

30 min.	T3	73.3	12.4	75.6	12.7	0.24
40 min.	T4	74.4	11.7	76.7	11.9	0.65
50 min.	T5	77.2	11.8	79.5	10.3	0.73
60 min.	T6	76.9	12.7	79.2	12.0	0.64
70 min.	T7	76.7	11.9	79	10.0	0.23
80 min.	T8	81.4	10.3	83.7	12.4	0.37
90 min.	T9	80.1	12.0	82.4	12.4	0.24
100 min.	T10	78.3	10.0	80.6	11.7	0.65
110 min.	T11	73.3	12.4	75.6	11.8	0.33
120 min.	T12	73.3	12.4	75.6	12.4	0.45

There was no significant difference in the mean value of diastolic blood pressure between the groups at time different points from baseline (T0) to 120 min. (T12); p>0.05.

Table 7: Mean Arterial Pressure (MAP) at different time intervals

Mean Arterial Pressure (in mm Hg)		Groups				p
		Ketamine		Dexmedetomidine		
		Mean	SD	Mean	SD	
0 min.	T0	91.3	15.0	86.5	9.2	0.48
10 min.	T1	92.3	11.8	80.4	12.1	0.46
20 min.	T2	93.6	11.6	80.4	12.1	0.23
30 min.	T3	92.5	12.1	81.2	10.1	0.14
40 min.	T4	91.1	11.5	83.6	8.9	0.36
50 min.	T5	83.6	8.9	80.4	12.1	0.65
60 min.	T6	83.2	8.4	77.9	11.3	0.48
70 min.	T7	92.5	12.1	81.2	10.1	0.64
80 min.	T8	91.1	11.5	83.6	8.9	0.24
90 min.	T9	89.9	10.2	83.2	8.4	0.34
100 min.	T10	83.6	8.9	83.6	8.9	0.73
110 min.	T11	83.2	8.4	83.2	8.4	0.47
120 min.	T12	81.2	10.1	86.5	9.2	0.61

There was no significant difference in the mean arterial pressure between the groups at time different points from baseline (T0) to 120 min. (T12); p>0.05.

Table 8: Oxygen saturation at different time intervals

Oxygen Saturation (in %)		Groups				p
		Ketamine		Dexmedetomidine		
		Mean	SD	Mean	SD	
0 min.	T0	98.9	1.1	98.3	1.2	0.47
10 min.	T1	99.0	1.0	98.8	0.9	0.45
20 min.	T2	99.4	0.8	98.5	1.4	0.65
30 min.	T3	99.1	1.0	98.1	2.8	0.46
40 min.	T4	98.5	1.4	98.7	1.4	0.64
50 min.	T5	98.1	2.8	98.9	0.9	0.24
60 min.	T6	98.7	1.4	98.3	1.2	0.62
70 min.	T7	98.9	0.9	98.8	0.9	0.48
80 min.	T8	98.3	1.2	98.5	1.4	0.64
90 min.	T9	98.8	0.9	98.1	2.8	0.63
100 min.	T10	99.3	0.8	98.7	1.4	0.62
110 min.	T11	99.3	0.7	99.3	0.8	0.48
120 min.	T12	98.9	1.1	99.3	0.7	0.64

There was no significant difference in the mean value of oxygen saturation between the groups at time different points from baseline (T0) to 120 min. (T12); p>0.05.

Table 9: Skeletal muscle dose relaxant

Descriptive	Groups		Total
	Ketamine	Dexmedetomidine	
N	30	30	60
Mean	150.95	120.20	126.57
Std. Deviation	38.98	19.48	35.17
Independent t-test, p=0.001			

It was found that mean dose of skeletal muscle relaxant (in mg) was significantly lower in dexmedetomidine group than ketamine group (150.95 v/s 120.20; p=0.001).

Table 10: Inhalational agent concentration on dial flow

Descriptive	Groups		Total
	Ketamine	Dexmedetomidine	
N	30	30	60
Mean	50.95	22.20	36.57
Std. Deviation	9.98	5.48	9.17

Independent t-test, p=0.001

It was found that mean dose of Inhalational agent concentration on dial flowwas significantly lower in dexmedetomidine group than ketamine group (150.95 v/s 120.20; p=0.001).

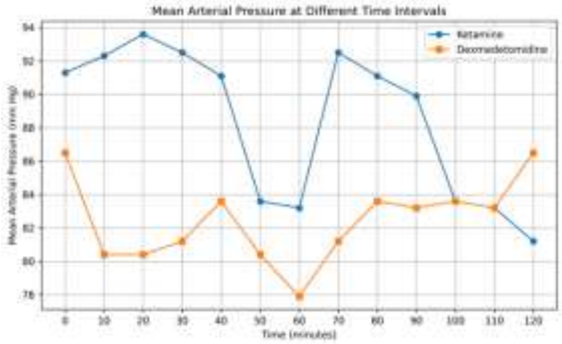

Figure 3: Line graph showing comparison of mean arterial pressure between ketamine and dexmedetomidine groups across intraoperative time intervals

DISCUSSION

This randomized prospective clinical study aimed to investigate the effects of low- dose dexmedetomidine or ketamine administration on hemodynamic assessment in subjects undergoing elective surgical procedures under general anesthesia. Additionally, we compared the time to extubation and total intra-operative fentanyl dose consumption between the dexmedetomidine and ketamine groups. A total of 60 patients aged between 18 and 60 years, scheduled for elective surgical procedures under general anesthesia, were enrolled and randomly assigned to two equal groups: (i) Group K (Ketamine group) – Low-dose ketamine infusion (0.3 mg/kg/hr) and (ii) Group D (Dexmedetomidine group) – Low-dose dexmedetomidine infusion (0.3 mcg/kg/hr). The baseline characteristics, such as age, weight, height, BMI, gender distribution, ASA status, and surgical operative time, were found to be comparable between the groups, which limits the confounding bias in this study.

The key findings of this study

The comparison of hemodynamic parameters between dexmedetomidine and ketamine groups was our primary objective. We found both groups are comparable for hemodynamic parameters like HR; SBP; DBP; MAP and oxygen saturation. Additionaly; we found the skeletal muscle relaxant does and Inhalational agent concentration on dial flow were significantly lower in dexmedetomidine group than ketamine group.

Insight of our observations

The sedative effects of dexmedetomidine, a potent α2-adrenergic agonist, are in part mediated through an increase in parasympathetic outflow and a decrease in sympathetic outflow from the locus ceruleus in the brain stem. Its sympatholytic effects are mediated through the activation of negative feedback receptors in the medullary vasomotor center, which results in reduced catecholamine release.[1,8] Due to the reduction of norepinephrine release and the possible baroreflex activation, bradycardia and hypotension can be observed during dexmedetomidine use. It has been reported that these side effects are related directly to the dose and/or technique of the administration of the agent and that they are caused by a high dose or short loading time.[2,9] At low doses, these side effects might be minimal or lacking.[8,10] Moreover, without a loading dose or a loading dose given over 20 minutes is suggested to maintain hemodynamic stability. However, in Gurbet et al.'s study,[11] none of the patients who received intraoperative dexmedetomidine infusion at a rate of 0.5 µg/kg/h developed clinically significant bradycardia, either during surgery or postoperatively. In another study by Efe et.al., they used the same dose and also did not observe any hemodynamic instability in our patients.[13]

Ketamine, a noncompetitive NMDA receptor antagonist, is a primary component of TIVA regimens. At low doses, it has numerous favorable effects such as the maintenance of airway reflexes and respiratory drive and a stable HR, blood pressure, and cardiac output.[4,14] However, it has cardiovascular stimulating and psychomimetic effects at high doses.[15] Bajwa et al,[16] demonstrated that a bolus IV injection of 1 mg/kg ketamine followed by an IV injection of 2.0 mg/kg/h ketamine and 2.0 mg/kg/h propofol maintained stable hemodynamics when compared to an IV infusion of 2.0 mg/kg/h propofol combined with 20 µg/kg/h fentanyl. In efe et. al. study, an IV 0.5 mg/kg bolus dose and 10 µg/kg/min infusion dose of ketamine was administered and no hemodynamic instability was observed.

Systemic administration of dexmedetomidine has been reported to cause sedative effects and reduce the requirement for anesthetic agents during the perioperative period. Ngwenyama et al. showed that the addition of dexmedetomidine to a propofol-remifentanil infusion during spinal fusion surgery reduced propofol infusion requirements by approximately 30%. Bajwa et al. also used dexmedetomidine as part of a TIVA regimen during scoliosis surgery and found that the amount of propofol required for the desired depth of anesthesia was reduced. Additionally, when compared to a control group, it was reported that in patients monitored with BIS, an IV bolus dose at 1 µg/kg of dexmedetomidine injected over 10 minutes followed by an IV infusion at 0.5 µg/kg/min of dexmedetomidine resulted in a significant reduction in both the desired induction dose of propofol and perioperative mean end-tidal sevoflurane concentrations. In the Efe et.al. study, the propofol requirement was also reduced in the dexmedetomidine group.

Ketamine, an anesthetic agent, when used in low doses, reduces the intraoperative requirement for other anesthetics. After an IV ketamine bolus of 0.5 mg/kg was administered for the induction of anesthesia in diagnostic gynecologic laparoscopic surgery, the dose of propofol was found to be reduced. In Efe et.al. study, the required dose of propofol was found to be lower in the ketamine group than in the control group.

Preoperative administration of ketamine should prevent central sensitization and may improve postoperative pain relief. A small dose of ketamine, given before skin incision, was shown to decrease postoperative pain, reduce morphine consumption, and delay analgesia requirement after laparoscopic gynecologic surgery.[5] However, as postoperative analgesia was not improved in patients who received ketamine after skin closure, it was suggested that the timing of ketamine treatment was critical in its analgesic efficacy. Taghinia et al,[17] compared the analgesic effect of a presurgical loading dose (0.5 mg/kg), followed by a continuous infusion (10 µg/kg/min) of ketamine with a single postsurgical dose (0.5 mg/kg). They found a significant reduction in PCA morphine consumption within 48 hours after surgery in the preemptive group. Adam et al found that in total knee arthroplasty procedures, a preemptive dose of ketamine 0.5 mg/kg IV followed by a 3 µg/kg/min infusion intraoperatively and a 1.5 µg/kg/min infusion for 48 hours postoperatively reduced PCA morphine consumption at a ratio of 35%. Ngwenyama et al also found that a lower postoperative pain score and a longer time to the first analgesic requirement were observed in the group that was administered 0.5 mg/kg IV ketamine during anesthesia induction. They suggested that this result was due to the preemptive analgesic effect of ketamine. Efe et.al. study also demonstrated that ketamine reduced postoperative PCA morphine consumption.

Because of the sedative effects of α2 agonists, dexmedetomidine may prolong anesthetic recovery time when used together with other anesthetics. Arain et al. found that BIS levels were significantly reduced 10 minutes after dexmedetomidine infusion. In a study that compared dexmedetomidine and remifentanil use during video laparoscopic surgery, the time to postoperative extubation and orientation was longer in the dexmedetomidine group, but there was no significant difference in the length of stay in the postoperative unit between the two groups.[18] It was reported that dexmedetomidine did not affect extubation time but modified Aldrete scores were increased.[2] Patel et al,[9] found significant sedation during the first two postoperative hours in the cases where dexmedetomidine was used. In this study, modified Aldrete scores were found to be higher in the dexmedetomidine group compared to the control group 30 minutes after extubation; however, after two hours, no significant difference was observed between these groups. The authors reported that because dexmedetomidine affected recovery time, close monitorization should have been conducted during the first few hours postoperatively. Although some authors observed sedation after dexmedetomidine use, they did not observe any respiratory failure presenting as desaturation or tachypnea. Tufanogullari et al., however, did not observe clinically significant sedation in any patients receiving an intraoperative IV dexmedetomidine infusion at a rate of 0.5 µg/kg/h. Furthermore, Efe et.al. did not observe significant sedation during the postoperative period with this same infusion dose of dexmedetomidine. Because they did not observe any desaturation or respiratory failure, the recovery quality of patients was considered normal.

Limitation of this study

Although there are some limitations, like not being a double-blinded study, having a low number of patients, and having different surgeons and anesthesiologists, this study is very original because it is the first one comparing the effects of dexmedetomidine and ketamine combined with general anesthesia in adult patients.

For more reliable results, future studies are needed to be conducted with double- blinding, a larger number of patients, pediatric or geriatric patients, specific patient groups, regional anesthesia, sedation, various agents and procedures, and the same surgeon.

CONCLUSION

Based on this original study, we strongly believe that combining dexmedetomidine or ketamine infusion with a general anestheia during the intraoperative period of elective surgical procedures is useful. Additionaly; we found the skeletal muscle relaxant does and Inhalational agent concentration on dial flow were significantly lower in dexmedetomidine group than ketamine group which could promote early extubation. Hemodynamic parameters were comparable between the groups. Larger sample size is needed to prove the superiority of dexmedetomidine, over the ketamine. Future studies should include double-blinding, larger patient groups, specific demographics like pediatric or geriatric patients, regional anesthesia, sedation, various agents and procedures, and consistent surgeons for more reliable results.

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