DOI: 10.7860/JCDR/2026/89227.23634

Original Article

Anaesthesia Section

Ketamine-propofol versus Ketamine-dexmedetomidine Infusion for Minimally Invasive Short Gynaecological Surgical Procedures: A Randomised Clinical Study

KARTHICKVEL MURUGAVEL[1], BHAGYAVARDHAN BOTTA[2], KALA BALASUBRAMANIAN[3], EMMIMA PRAISY[4]

ABSTRACT

Introduction: Total Intravenous Anaesthesia (TIVA) is increasingly preferred for minimally invasive short gynaecological procedures due to its predictable pharmacokinetics, rapid recovery profile, and avoidance of inhalational agents. Among commonly used regimens, Ketamine-Propofol (KP) and Ketamine-Dexmedetomidine (KD) combinations are widely utilised; however, their comparative effects on haemodynamic stability, recovery characteristics, and postoperative analgesia remain under ongoing clinical evaluation.

Aim: To compare the clinical effects of KP and KD infusion in minimally invasive short gynaecological surgical procedures.

Materials and Methods: This randomised, open-label clinical study included 100 adult female patients aged 20-50 years with American Society of Anaesthesiologists (ASA) physical status I or II undergoing elective minimally invasive short gynaecological procedures. Participants were randomly allocated into two groups (n=50 each). The KD group received intravenous ketamine 1 mg/kg and dexmedetomidine 1 µg/kg over 10 minutes, followed by maintenance infusion of ketamine 0.1 mg/kg/hour and dexmedetomidine 0.1 µg/kg/hour. The KP group received ketamine 1 mg/kg and propofol 2 mg/kg over 10 minutes, followed by maintenance infusion of ketamine 0.1 mg/kg/hour and propofol 0.1 mg/kg/hour. Haemodynamic parameters, Ramsay Sedation Score (RSS), Modified Aldrete Score, Visual Analogue Scale (VAS), and adverse events were recorded. Statistical analysis was performed using independent student's t-test and Chi-square test, with p-value <0.05 considered statistically significant.

Results: The mean age of participants in the KP and KD groups was 41.43±11.8 years and 43.65±9.05 years, respectively, with comparable baseline haemodynamic parameters (p-value >0.05). Intraoperative heart rate remained stable with no significant intergroup difference. The KD group demonstrated significantly lower Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Mean Arterial Pressures (MAP) from the third minute onward (p-value <0.001), without clinically significant hypotension. Recovery was significantly faster in the KP group (RSS <3: 14.66±2.27 minutes vs 17.36±3.02 minutes; p-value <0.001). Postoperative pain scores were significantly lower in the KD group at all measured time points (p-value <0.001 to 0.012), with delayed requirement for rescue analgesia. Adverse effects were minimal and comparable between groups.

Conclusion: Both KP and KD combinations provide safe and effective intravenous anaesthesia for minimally invasive short gynaecological procedures. KD offers superior haemodynamic stability and prolonged postoperative analgesia, whereas KP facilitates faster recovery. Selection of the anaesthetic regimen should be individualised based on procedural requirements and recovery priorities.

Keywords: Alpha2 agonist, GABA agonist, Postoperative analgesia, Procedural sedation

INTRODUCTION

Minimally invasive gynaecological procedures are widely performed in contemporary clinical practice and include interventions such as dilatation and curettage, hysteroscopy, polypectomy, diagnostic laparoscopy, tubal ligation, and suction evacuation [1]. These procedures are typically short in duration and increasingly conducted as day-care surgeries, thereby necessitating anaesthetic techniques that ensure rapid recovery while maintaining patient comfort and safety [2].

Unlike major surgical interventions requiring deep general anaesthesia and airway instrumentation, these procedures demand adequate analgesia and sedation with preservation of spontaneous respiration, airway reflexes, and haemodynamic stability [3]. TIVA has emerged as a preferred approach in this setting due to its predictable pharmacokinetics, precise titration, avoidance of inhalational agents, and facilitation of early postoperative recovery [4]. However, the selection of anaesthetic agents remains crucial, as inappropriate drug choice or dosing may lead to haemodynamic instability, respiratory depression, or delayed recovery [5]. An ideal sedative-analgesic technique should provide anxiolysis, hypnosis, and analgesia with predictable onset and offset, while minimising adverse cardiovascular and respiratory effects [6]. Various intravenous agents including benzodiazepines, opioids, propofol, ketamine, and alpha-2 adrenergic agonists, have been used either alone or in combination; however, no single agent fulfils all these requirements [7,8].

Ketamine, an N-Methyl-D-Aspartate (NMDA) receptor antagonist, produces dissociative anaesthesia with preservation of airway reflexes and spontaneous respiration. It offers potent analgesia and amnesia along with sympathomimetic effects that increase heart rate and blood pressure, making it advantageous in preventing hypotension [9]. In contrast, propofol, a GABA-mediated sedative-hypnotic agent, is characterised by rapid onset, smooth induction, and quick recovery, but lacks analgesic properties and is associated with dose-dependent hypotension and respiratory depression [10]. The combination of ketamine and propofol has been shown to provide balanced anaesthesia with improved haemodynamic stability and effective sedation compared to propofol alone [11].

Alternatively, dexmedetomidine, a selective alpha-2 adrenergic agonist, provides sedation, anxiolysis, and analgesia by reducing sympathetic outflow, while preserving respiratory function

[12]. When combined with ketamine, it offers complementary pharmacodynamic effects, though it may be associated with bradycardia and hypotension [13]. Recent evidence suggests that KD provides superior haemodynamic stability and prolonged postoperative analgesia, whereas KP is associated with faster recovery [14,15]. However, comparative data specifically in minimally invasive gynaecological procedures remain limited, highlighting the need for further evaluation [15].

Therefore, the present study aimed to compare KP infusion with KD infusion for TIVA in minimally invasive short gynaecological procedures, with the following objectives:

The primary objective was to compare haemodynamic stability between KP and KD infusion in minimally invasive short gynaecological surgical procedures. In addition, the study aimed to evaluate secondary outcomes including recovery characteristics, postoperative analgesia using the VAS, and sedation depth assessed by the RSS, along with the incidence of perioperative adverse events, in order to comprehensively assess the safety and efficacy of both anaesthetic regimens.

MATERIALS AND METHODS

This randomised, open-label clinical study was conducted at Sree Balaji Medical College and Hospital, affiliated to BIHER university, a tertiary care teaching hospital in South India, from August 2025 to December 2025, after obtaining approval from the Institutional Ethics Committee (Ref: 022254/SAHS/IHEC/2024 dated 23.04.2024). The study was prospectively registered with the Clinical Trial Registry of India (CTRI/2025/07/091419). Written informed consent was obtained from all participants prior to enrolment.

Study population: The study included 100 adult female patients aged between 20 and 55 years, classified as ASA physical status I or II, who were scheduled for elective minimally invasive short gynaecological surgical procedures.

Sample size calculation: Sample size was calculated based on the primary objective of comparing MAP between the two groups, using data derived from a previous study by Algharabawy WS [16].

The formula used was:

$$n=\frac{2(Z_{\alpha/2}+Z_{\beta})^2\sigma^2)}{d^2}$$

Where:

$Z_{\alpha/2}$=1.96 (for 95% confidence level)

Z_{β}=1.645 (for 95% power)

Standard Deviation (SD) (σ) = 3.59 mmHg

Mean difference (d) = 2.74 mmHg

Substituting the values:

$$n=\frac{2(1.96+1.645)^2\ (3.59)^2}{(2.74)^2}$$

n≈40 "participants per group"

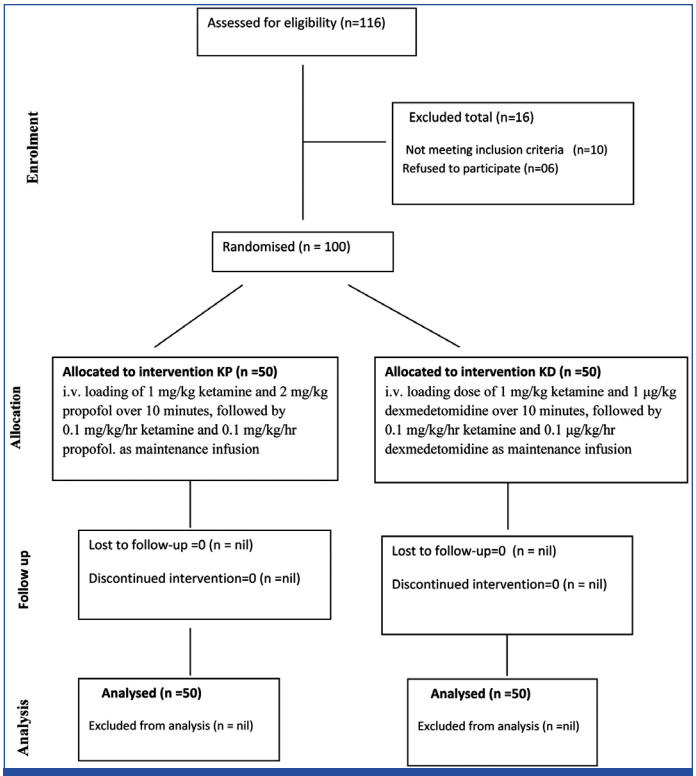
Considering an anticipated attrition rate of 20-25%, the total sample size was increased to 100 participants, with 50 participants in each group.

Inclusion criteria: Adult female patients aged between 20 and 50 years, classified under American Society of Anaesthesiologists (ASA) physical status I or II, scheduled for elective minimally invasive short gynaecological surgical procedures, and accepted to sign written informed consent for this study, were included in the study.

Exclusion criteria: Patients with known hypersensitivity to any of the study drugs, body mass index greater than 30 kg/m^2, or a history of significant cardiovascular disease including hypertension, congestive heart failure, or coronary artery disease. Cerebrovascular insufficiency, raised intracranial pressure, psychiatric illness or personality disorders, suspected or confirmed pregnancy, and current use of antipsychotic or sedative medications were excluded from the study.

Randomisation and Allocation

Eligible participants were randomly allocated into two groups using a computer-generated random number sequence (simple randomisation) [Table/Fig-1]. The randomisation sequence was generated by an independent statistician not involved in patient recruitment or data collection. Allocation concealment was ensured using sequentially numbered, opaque, sealed envelopes.



[Table/Fig-1]: CONSORT flowchart.

Participants were enrolled by the consultant anaesthesiologist, and group assignment was revealed after enrolment. Due to the nature of the intervention, blinding of the attending anaesthesiologist was not feasible; however, outcome assessment was performed by an independent observer blinded to group allocation to minimise observer bias. To reduce bias, standardised anaesthetic protocols, uniform monitoring, and identical postoperative assessment methods were applied to all participants.

Preanaesthetic evaluation: All patients underwent a detailed preanaesthetic evaluation including history, clinical examination, and laboratory investigations such as complete blood count, liver function tests, renal function tests, coagulation profile, and electrocardiogram.

Preparation of study drugs: Study medications were prepared by an anaesthesiologist not involved in intraoperative monitoring or outcome assessment, in 50 mL infusion syringes according to group allocation.

- The KD syringe contained ketamine 100 mg combined with dexmedetomidine 100 µg;
- The KP syringe contained ketamine 100 mg mixed with propofol 100 mg.

Anaesthetic management: Standard preoperative fasting guidelines were followed. Upon arrival in the operating theatre, an 18-gauge intravenous cannula was secured and Ringer's lactate infusion was initiated. Standard monitoring included electrocardiography, heart rate, non invasive blood pressure, respiratory rate, and peripheral oxygen saturation. Premedication consisted of intravenous midazolam 2 mg, glycopyrrolate 0.2 mg, and ondansetron 4 mg administered 10 minutes prior to induction. All patients were preoxygenated before induction.

Patients in the KD group received an intravenous loading dose of ketamine 1 mg/kg and dexmedetomidine 1 µg/kg administered

over 10 minutes, followed by maintenance infusion of ketamine 0.1 mg/kg/hour and dexmedetomidine 0.1 µg/kg/hour.

Patients in the KP group received ketamine 1 mg/kg and propofol 2 mg/kg over 10 minutes, followed by maintenance infusion of ketamine 0.1 mg/kg/hour and propofol 0.1 mg/kg/hour. These dosing regimens were selected based on previously published clinical studies and standard anaesthetic practice for procedural sedation [16,17].

During induction, ventilation was supported using a face mask and Bain circuit in case of transient apnoea. Once spontaneous respiration resumed, supplemental oxygen was administered via Hudson's mask at 4-6 L/min, maintaining SpO_2 between 98% and 100%. Airway compromise, if any, was managed with appropriate airway maneuvers and assisted ventilation.

Sedation depth was assessed using the RSS, and infusion rates were titrated to maintain adequate sedation while preserving haemodynamic stability.

Outcome Measures

Primary outcome: Heart rate, respiratory rate, SBP, DBP, MAP, and peripheral oxygen saturation measured at baseline, post-induction, at three minutes, at five minutes and then every five minutes for next 15 minutes, and every 10 minutes thereafter.

Secondary outcome: Sedation depth (RSS), recovery profile (Modified Aldrete Score), postoperative pain (VAS), and incidence of adverse events including nausea, vomiting, hallucinations, shivering, respiratory depression, hypotension, and bradycardia.

Postoperative recovery and analgesic management: After the completion of surgery, the study drug infusions were discontinued and patients were shifted to the recovery unit. Patients were shifted to the postoperative ward once a Modified Aldrete Score greater than nine was achieved. Postoperative pain was assessed using the VAS. Rescue analgesia was administered with intravenous tramadol when VAS score ≥4. The duration of postoperative analgesia was calculated from the time of recovery (RSS ≤ 3) to the time of administration of rescue analgesia.

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software, version 25.0 (IBM Corp., Armonk, NY, USA). Data following a normal distribution was expressed as mean±SD, while categorical variables were presented as frequency and percentage. Baseline demographic variables including age, weight, height, body mass index, haemodynamic parameters and duration of surgery were compared between the two groups using the independent Student's t-test. Categorical variables such as ASA physical status and distribution of surgical procedures were analysed using the Chi-square test or Fisher's exact test, as appropriate. Sedation depth as assessed by the RSS, recovery characteristics including time to recovery (RSS <3) and time to achieve Modified Aldrete Score ≥9, and postoperative pain scores measured using the VAS were compared between the two groups using the independent student's t-test. A p-value <0.05 was considered statistically significant for all analyses.

RESULTS

Baseline demographic characteristics were comparable between both groups with no statistically significant differences in age, weight, height, BMI, or ASA physical status (p-value >0.05), confirming homogeneity of study population [Table/Fig-2].

The distribution of surgical procedures and mean duration of surgery were similar in both groups (p-value=0.984 and p-value=0.190 respectively), indicating procedural comparability without confounding bias [Table/Fig-3].

Preoperative baseline vital parameters including heart rate, blood pressure, respiratory rate, oxygen saturation, and sedation score were comparable between groups (p-value >0.05), ensuring a uniform baseline for intraoperative comparisons [Table/Fig-4].

Demographic parameters	Group KP=50 Mean±SD	Group KD=50 Mean±SD	p-value
Age (years)	41.43±11.8	43.65±9.05	0.294
Weight (kg)	57.23±5.67	56.37±7.14	0.506
Height (cm)	156.76±3.45	157.51±2.53	0.218
BMI (kg/m^2)	24.59±1.68	24.72±1.58	0.691
ASA grading=I II n (%)	42 (84%) 08 (16%)	44 (88%) 06 (12%)	0.773

[Table/Fig-2]: Baseline demographic characteristics of the study population.
p-value <0.05 considered statistically significant. Independent Student's t-test was applied for (Mean±SD); Chi-square test applied for n (%)

Surgical interventions	Group KP (N=50) n (%)	Group KD (N=50) n (%)	p-value
D&C and biopsy	22 (44)	23 (46)	0.984
D&C and polypectomy	13 (26)	11 (22)	
Hysteroscopy	06 (12)	05 (10)	
Bartholin cyst removal	04 (8)	06 (12)	
Secondary suturing	03 (6)	03 (6)	
Cystoscopy	02 (4)	02 (4)	
Mean duration of surgery (mins)	35.34±3.36	36.12±2.48	0.190

[Table/Fig-3]: Distribution of surgical interventions and duration of surgery in both groups.
p-value <0.05 considered statistically significant. Independent student's t-test was applied for (Mean±SD); Chi-square test applied for n (%)

Vital parameters	Group KP (n=50) Mean±SD	Group KD (n=50) Mean±SD	p-value
Heart rate (per min)	78.53±10.04	76.50±11.91	0.359
Respiratory rate (per min)	15±2	15±2	1.000
SBP (mmHg)	118.52±12.30	117.23±14.22	0.629
DBP (mmHg)	72.82±8.44	71.13±8.85	0.331
MAP (mmHg)	86.53±8.14	84.46±8.94	0.229
SpO_2 (%)	99.60±0.39	99.24±0.76	0.904
RSS (baseline)	2 (all patients)	2 (all patients)	--

[Table/Fig-4]: Preoperative baseline vital parameters in Ketamine-Propofol (KP) and Ketamine-Dexmedetomidine (KD) Groups.
p-value <0.05 considered statistically significant. Independent Student's t-test was applied for continuous variables (Mean±SD); Chi-square test applied for categorical variables.

Intraoperative heart rate remained stable throughout the procedure in both groups with no statistically significant intergroup differences at any time interval (p>0.05), indicating effective haemodynamic control [Table/Fig-5].

Intraoperative HR (min)	Group KP=50 Mean±SD	Group KD=50 Mean±SD	p-value
1	74.32±12.18	75.78±12.23	0.554
3	74.87±13.19	76.68±15.46	0.532
5	75.12±11.71	75.37±14.62	0.925
10	73.97±10.95	74.21±11.03	0.913
15	73.39±12.50	74.34±10.28	0.679
20	72.64±11.42	72.06±8.74	0.776
25	71.21±9.09	73.07±6.15	0.234
30	72.80±8.75	73.88±6.46	0.484
40	74.68±10.65	74.15±6.84	0.768

[Table/Fig-5]: Comparison of intraoperative heart rate between Ketamine-Propofol (KP) and Ketamine-Dexmedetomidine (KD) groups.
p-value <0.05 considered statistically significant. Independent student's t-test was applied for (Mean±SD)

The SBP was significantly lower in the KD group from the third minute onwards (p-value <0.001), though values remained within clinically

acceptable limits, suggesting better haemodynamic attenuation with dexmedetomidine [Table/Fig-6].

Systolic Blood Pressure (SBP) (minute)	Group KP=50 Mean±SD mmHg	Group KD=50 Mean±SD mmHg	p-value
1	123.92±4.08	124.16±2.02	0.710
3	118.37±3.7	114.82±2.08	<0.001
5	116.24±3.5	110.32±3.68	<0.001
10	115.05±3.23	107.92±4.26	<0.001
15	117.36±3.46	115.42±2.02	0.001
20	118.32±2.84	114.50±3.4	<0.001
25	119.24±3.02	116.46±4.28	0.003
30	122.67±2.46	119.14±3.58	<0.001
40	123.34±3.28	120.46±2.24	<0.001

[Table/Fig-6]: Comparison of intraoperative Systolic Blood Pressure (SBP) between the study groups.
p-value <0.05 considered statistically significant. Independent student's t-test was applied for (Mean±SD)

Similarly, DBP was significantly lower in the KD group at intraoperative time points (p-value <0.001), indicating a consistent reduction in vascular tone without adverse hypotension [Table/Fig-7].

Diastolic Blood Pressure (DBP) (minute)	Group KP=50 Mean±SD mmHg	Group KD=50 Mean±SD mmHg	p-value
1	80.29±3.07	78.61±3.2	0.008
3	79.45±4.20	73.74±3.05	<0.001
5	77.58±3.35	75.34±3.32	0.001
10	78.11±3.56	75.96±2.42	0.001
15	77.84±4.02	70.66±3.08	<0.001
20	77.68±3.08	70.58±4.22	<0.001
25	78.13±3.53	71.84±4.64	<0.001
30	78.08±4.03	75.92±4.85	0.017
40	82.45±4.16	76.11±4.82	<0.001

[Table/Fig-7]: Comparison of intraoperative Diastolic Blood Pressure (DBP) between the study groups.
p-value <0.05 considered statistically significant. Independent Student's t-test was applied for (Mean±SD)

The MAP was also significantly lower in the KD group from third minute onwards (p-value <0.001), demonstrating superior haemodynamic stability compared to the KP group [Table/Fig-8].

Mean blood pressure (MAP) (minute)	Group KP=50 Mean±SD mmHg	Group KD=50 Mean±SD mmHg	p-value
1	90.9±2.34	90.83±2.63	0.889
3	93.1±2.07	88.5±2.06	<0.001
5	97.2±2.97	89.11±2.9	<0.001
10	92.7±4.26	87.1±4.58	<0.001
15	93.2±5.28	85.3±3.09	<0.001
20	93.1±4.38	83.96±2.77	<0.001
25	93.8±5.69	86.2±2.54	<0.001
30	92.38±4.27	87.8±4.64	<0.001
40	94.4±2.58	88.2±3.25	<0.001

[Table/Fig-8]: Comparison of intraoperative Mean Arterial Pressure (MAP) between the two study groups.
p-value <0.05 considered statistically significant. Independent Student's t-test was applied for (Mean±SD)

Respiratory rate showed minor variations, with slightly lower values in the KP group at certain intervals; however, no clinically significant respiratory depression was observed in either group [Table/Fig-9].

Time interval per minute	Group KP=50 Mean±SD R.R	Group KD=50 Mean±SD R.R	p-value RR
1	14±2	14±2	1.000
3	13±2	14±2	0.014
5	11±2	13±2	<0.001
10	11±2	11±2	1.000
15	12±2	12±2	1.000
20	12±2	14±2	<0.001
25	13±2	14±2	0.014
30	13±2	14±2	0.014
40	14±2	14±2	1.000

[Table/Fig-9]: Comparison of intraoperative respiratory rate between the two study groups.
p-value <0.05 considered statistically significant. Independent Student's t-test was applied for (Mean±SD)

Peripheral oxygen saturation remained well maintained (≥96%) in both groups throughout the procedure, with no significant differences or hypoxic episodes [Table/Fig-10].

Time interval per minute	Group KP=50 Mean±SD SpO_2%	Group KD=50 Mean±SD SpO_2%	p-value
1	98±2	98±2	1.000
3	97±2	98±2	0.014
5	96±2	98±2	<0.001
10	96±2	96±2	1.000
15	97±2	97±2	1.000
20	97±2	98±2	0.014
25	98±2	98±2	1.000
30	98±2	98±2	1.000
40	98±2	98±2	1.000

[Table/Fig-10]: Comparison of intraoperative peripheral O2 saturation between the study groups.
p-value <0.05 considered statistically significant. Independent student's t-test was applied for (Mean±SD)

Onset of sedation was significantly faster in the KD group (p-value=0.002), whereas recovery time (RSS ≤3) and time to achieve Modified Aldrete score ≥9 were significantly shorter in the KP group (p-value <0.05), indicating faster recovery with propofol-based regimen [Table/Fig-11].

Parameters	Group KP=50 Mean±SD	Group KD=50 Mean±SD	p-value
Time of onset (RSS ≥5) minute	1.88±0.34	1.68±0.37	0.002
Time of recovery (RSS ≤3) minutes	14.66±2.27	17.36±3.02	<0.001
Time for Aldrete score =9 (min)	17.22±4.08	19.66±5.02	0.04

[Table/Fig-11]: Comparison of onset of sedation and recovery characteristics between the study groups.
p-value <0.05 considered statistically significant. Independent Student's t-test was applied for (Mean±SD)

RSSs were comparable between both groups at all intraoperative and postoperative time points (p-value=1.000), indicating equivalent depth of sedation [Table/Fig-12].

Postoperative pain scores (VAS) were significantly lower in the KD group at all measured time intervals (p-value <0.05), with delayed requirement for rescue analgesia, demonstrating superior analgesic efficacy [Table/Fig-13].

Regarding adverse events, both groups showed minimal and comparable side-effects. One patient (2%) in the KP group experienced hallucinations, while one patient (2%) in the KD group had nausea. No cases of hypotension, bradycardia, respiratory depression, or shivering were observed.

Ramsay scale score (RSS) (minute)	Group KP=50 Mean±SD	Group KD=50 Mean±SD	p-value
0	2±0	2±0	1.000
5	5±1	5±1	1.000
10	5±1	5±1	1.000
20	5±1	5±1	1.000
30	5±1	5±1	1.000
45	3±1	3±1	1.000
60	2±0	2±0	1.000

[Table/Fig-12]: Comparison of Ramsay Sedation Scores (RSS) at various intraoperative and postoperative time points.
p-value <0.05 considered statistically significant. Independent student's t-test was applied for (Mean±SD)

Visual Analogue Scale (VAS)	Group KP=50 Mean±SD	Group KD=50 Mean±SD	p-value
Recovery Area-Immediate on arrival	3.27±0.42	2.17±0.68	<0.001
30 minutes	3.66±0.76	3.27±0.77	0.012
One hour after stopping TIVA	3.80±0.66	3.43±0.51	0.002
Four hours	3.90±0.53 (received Rescue analgesia)	3.46±0.48	<0.001
Six hours	-	3.90±0.80 (received Rescue analgesia)	-

[Table/Fig-13]: Comparison of postoperative pain scores {Visual Analogue Scale (VAS)} between the two study groups.
p-value <0.05 considered statistically significant. Independent student's t-test was applied for (Mean±SD)

DISCUSSION

The present randomised clinical study evaluated KP and KD as TIVA regimens for minimally invasive short gynaecological procedures. Both combinations provided effective procedural sedation; however, they demonstrated distinct differences in haemodynamic profile, recovery characteristics, and postoperative analgesia, reflecting their pharmacodynamic properties. Baseline demographic variables, duration of surgery, and preoperative haemodynamic parameters were comparable between groups, confirming adequate randomisation and minimising confounding bias. Intraoperatively, heart rate remained stable without significant intergroup differences, suggesting that ketamine effectively balanced the vasodilatory effects of propofol and the sympatholytic effects of dexmedetomidine. Similar findings have been reported by Zhang Y et al., and Choi EJ et al., supporting the cardiostabilising role of ketamine in procedural sedation [17,18].

In contrast, SBP, DBP, and MAP were significantly lower in the ketamine–dexmedetomidine group from the third minute onward. Despite statistical significance, these reductions remained within clinically acceptable limits, indicating effective haemodynamic attenuation without compromising perfusion. These findings are consistent with Gao PF et al., who demonstrated lower arterial pressures with KD compared to propofol without increased hypotensive events [19]. This effect may be attributed to reduced sympathetic outflow caused by dexmedetomidine, balanced by the sympathomimetic action of ketamine [20].

Respiratory parameters remained stable in both groups. Although minor reductions in respiratory rate were noted in the KP group, oxygen saturation remained consistently above 96%, and no episodes of respiratory depression were observed. These findings align with those of Shetabi H et al., and Abd Ellatif SE et al., demonstrating preservation of spontaneous ventilation with ketamine-based combinations [21,22].

Postoperative analgesia was superior in the KD group, as evidenced by significantly lower VAS scores and delayed requirement for rescue analgesia. This prolonged analgesic effect may be attributed to the combined action of NMDA receptor antagonism and alpha-2 adrenergic agonism. Comparable findings have been reported by Elsaeidy AS et al., who demonstrated improved postoperative pain control with KD combinations [23].

The onset of sedation was significantly faster in the KD group, likely due to the synergistic sedative effect of dexmedetomidine. However, recovery characteristics favoured the KP regimen, with shorter recovery time and earlier achievement of discharge criteria. This can be explained by the rapid redistribution and clearance of propofol. Similar observations have been reported by Choi EJ et al., and Qi J et al., reinforcing the suitability of propofol-based regimens for ambulatory procedures [18,24].

Adverse events were minimal and comparable between groups. A single case of hallucination was observed in the KP group, while nausea occurred in one patient in the KD group. No clinically significant hypotension, bradycardia, or respiratory depression was reported. These findings were consistent with Abd Ellatif SE et al., and Surabhi et al., supporting the safety of both regimens [22,25].

Overall, the findings demonstrate a clear clinical trade-off between the two regimens. KD provides superior haemodynamic modulation and prolonged postoperative analgesia, whereas KP ensures faster recovery and earlier discharge readiness. Therefore, the choice of anaesthetic regimen should be individualised based on procedural requirements and patient priorities.

Limitation(s)

The study was conducted at a single centre with a relatively modest sample size, which may limit the generalisability of the results to broader populations and different clinical settings. The open-label design may have introduced observer bias, particularly in the assessment of subjective outcomes such as sedation scores and postoperative pain using the VAS. The study population was restricted to ASA physical status I and II female patients undergoing short gynaecological procedures; therefore, the findings may not be directly applicable to higher-risk patients, males, paediatric populations, or longer and more invasive surgical procedures. Additionally, objective depth-of-anaesthesia monitoring tools such as bispectral index were not used, and long-term postoperative outcomes beyond the immediate recovery period were not evaluated.

CONCLUSION(S)

Both KP and KD combinations provided effective and safe TIVA for minimally invasive short gynaecological procedures. The KD regimen offered superior haemodynamic modulation and prolonged postoperative analgesia, with lower pain scores and minimal adverse effects, while the KP regimen was associated with faster recovery and earlier attainment of discharge criteria. These findings suggest that KD may be preferable when haemodynamic stability and postoperative analgesia are prioritised, whereas KP may be advantageous in settings where rapid recovery is desired. Selection of the anaesthetic regimen should therefore be individualised based on procedural requirements and patient priorities.

REFERENCES

[1] Stoelting RK, Hillier SC. Pharmacology & Physiology in Anesthetic Practice. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2015.
[2] Barash PG, Cullen BF, Stoelting RK, Cahalan MK, Stock MC, Ortega R. Clinical Anesthesia. 8th ed. Philadelphia, PA: Wolters Kluwer; 2022.
[3] Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Cohen NH, Young WL, editors. Miller's Anesthesia. 9th ed. Philadelphia, PA: Elsevier; 2020.
[4] Katzung BG, Trevor AJ, Masters SB. Basic & Clinical Pharmacology. 15th ed. New York, NY: McGraw-Hill; 2021.
[5] Tetzlaff JE. Cousins and Bridenbaugh's neural blockade in clinical anesthesia and pain medicine. Mayo Clin Proc. 2010;85(7):e51. Doi: 10.4065/mcp.2010.0230. PMCID: PMC2894732.
[6] American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists. Practice guidelines for sedation and analgesia by non-anesthesiologists. Anesthesiology. 2002;96(4):1004-17. Doi: 10.1097/00000542-200204000-00031. PMID: 11964611.

[7] Miner JR, Burton JH. Clinical practice advisory: Emergency department procedural sedation with propofol. Ann Emerg Med. 2007;50(2):182-87.e1. Doi: 10.1016/j.annemergmed.2006.12.017.
[8] Green SM, Roback MG, Kennedy RM, Krauss B. Clinical practice guideline for emergency department ketamine dissociative sedation: 2011 update. Ann Emerg Med. 2011;57(5):449-61. Doi: 10.1016/j.annemergmed.2010.11.030.
[9] White PF, Way WL, Trevor AJ. Ketamine-its pharmacology and therapeutic uses. Anesthesiology. 1982;56(2):119-36. Doi: 10.1097/00000542-198202000-00007.
[10] Kakarla A, Senapati LK, Das A, Acharya M, Sukanya S, Pradhan A. Intravenous dexmedetomidine–ketamine versus ketamine–propofol for procedural sedation in adults undergoing short surgical procedures: A randomized controlled trial. Cureus. 2023;15(6):e40676. Doi: 10.7759/cureus.40676.
[11] Esmaillian M, Kouhestani S, Azizkhani R, Heydari F, Safavi MR. Dexmedetomidine versus propofol: An effective combination with ketamine for adult procedural sedation. Am J Emerg Med. 2023;73:95-101. Doi: 10.1016/j.ajem.2023.08.025.
[12] Yılmaz Ş, Pay L, Coşkun C, Kalenderoğlu K, Çınar T, Hayıroğlu Mİ. Comparison of propofol and ketamine for sedation in patients undergoing radiofrequency ablation for atrial fibrillation. Turk Kardiyol Dern Ars. 2025;53(8):573-78. Doi: 10.5543/tkda.2025.16377.
[13] Oluş F, Babun H. Sedation applications in pedodontic procedures: Which one should we choose? BMC Oral Health. 2025;25(1):1559. Doi: 10.1186/s12903-025-06871-w.
[14] Rees EN, Hoade LM, Mattey L. Propofol-fentanyl versus propofol–ketamine sedation in gastrointestinal endoscopy: A systematic review and meta-analysis. Saudi J Anaesth. 2025;19(3):292-302. Doi: 10.4103/sja.sja_588_24.
[15] Kaasat A, Thakore S, Thakore N, Nalliboyina MK, Kaushik S. Comparative evaluation of dexmedetomidine-ketamine versus ketamine-propofol for procedural sedation during dilatation and curettage: A prospective randomized double-blind study. Medical Journal of Dr. D.Y. Patil Vidyapeeth. 2025;18(2):257-63. | Doi: 10.4103/mjdrdypu.mjdrdypu_264_24.
[16] Algharabawy WS. Comparison between ketamine-dexmedetomidine and ketamine-propofol for procedural sedation during short surgical procedures: A randomized controlled study. Egypt J Anaesth. 2021;37(1):364-72. Doi: 10.1080/11101849.2021.1961428.
[17] Zhang Y, Ou C, Bai X, Lai J, Huang W, Ouyang H. Efficacy and safety of propofol with S(+)-ketamine for procedural sedation in pediatric patients undergoing venous access port implantation. Front Pediatr. 2022;10:974917. Doi: 10.3389/fped.2022.974917.
[18] Choi EJ, Kim CH, Yoon JY, Kim EJ. Ketamine-propofol (ketofol) in procedural sedation: A narrative review. J Dent Anesth Pain Med. 2023;23(3):123-33. Doi: 10.17245/jdapm.2023.23.3.123.
[19] Gao PF, Li SY, Li Y, Zhao L, Luo Q, Ji Y. Comparison of ketamine–dexmedetomidine and ketamine-propofol for procedural sedation in pediatric patients: A meta-analysis. Heliyon. 2022;8(10):e11166. Doi: 10.1016/j.heliyon.2022.e11166.
[20] Jang YE, Joo EY, Lee JH, Kim EH, Kang P, Park JB, et al. Dexmedetomidine–ketamine versus chloral hydrate for pediatric procedural sedation: Study protocol. Trials. 2023;24(1):2. Doi: 10.1186/s13063-022-07033-x.
[21] Shetabi H, Shahhosseini S, Mohamadpour N, Shafa A. Low-dose ketamine added to dexmedetomidine or propofol for pediatric upper GI endoscopy. Anesth Pain Med. 2023;13(2):e134581. Doi: 10.5812/aapm-134581.
[22] Abd Ellatif SE, Mowafy SMS, Shahin MA. Ketofol versus dexmedetomidine for preventing postoperative delirium in elderly patients: A randomized study. BMC Anesthesiol. 2024;24:1. Doi: 10.1186/s12871-023-02378-5.
[23] Elsaeidy AS, Ahmad AHM, Kohaf NA, Aboutaleb A, Kumar D, Elsaeidy KS, et al. Ketamine-dexmedetomidine versus ketamine-propofol for procedural sedation: A systematic review and meta-analysis. Curr Pain Headache Rep. 2024;28(4):211-27. Doi: 10.1007/s11916-023-01208-0.
[24] Qi J, Luo M, Zong W, Zhang L, Chen B, Yang X, et al. Adjunctive esketamine in propofol-based sedation for gastrointestinal endoscopy: A systematic review. Front Pharmacol. 2025;16:1662057. Doi: 10.3389/fphar.2025.1662057.
[25] Surabhi, Kumari P, Kumar A, Sinha C, Kumar A, Singh VK. Dexmedetomidine versus ketofol in preventing emergence delirium in pediatric cleft surgery. J Anaesthesiol Clin Pharmacol. 2025;41(1):183-88. Doi: 10.4103/joacp.joacp_521_23.

PARTICULARS OF CONTRIBUTORS:
1. Postgraduate Student, Department of Anaesthesiology, Sree Balaji Medical College/BIHER, Chennai, Tamil Nadu, India.
2. Associate Professor, Department of Anaesthesiology, Sree Balaji Medical College/BIHER, Chennai, Tamil Nadu, India.
3. Professor, Department of Anaesthesiology, Sree Balaji Medical College/BIHER, Chennai, Tamil Nadu, India.
4. Intern, Department of Anaesthesiology, Sree Balaji Medical College/BIHER, Chennai, Tamil Nadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Kala Balasubramanian,
3083, Block 3A Banyan House, Appasamy Apartments, 471, MKN Road Alandhur, Chennai, Tamil Nadu, India.
E-mail: kalamhn@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 01, 2026
- Manual Googling: Apr 23, 2026
- iThenticate Software: Apr 25, 2026 (2%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Mar 23, 2026**
Date of Peer Review: **Apr 10, 2026**
Date of Acceptance: **Apr 28, 2026**
Date of Publishing: **Jun 01, 2026**