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Research Article

Randomized Controlled Evaluation of Intranasal Atomized Dexmedetomidine, Ketamine, and Their Combination for Premedication in Pediatric Surgical Patients

Dr Sandeep Mangla[1], Dr Trilok Chand[2], Dr Arpita Saxena[2], Dr Apurva Mittal[2], Dr Surbhi Gupta[3]

[1]Department of Critical Care Medicine, Amrita Hospital Faridabad
[2]Department of Anaesthesia- SNMC Agra
[3]Department of GI and HPB surgery, Max Hospital Vaishali

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Corresponding Author:

Dr Sandeep Mangla
Department of Critical Care Medicine, Amrita Hospital Faridabad.

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ABSTRACT

Background: Perioperative distress in pediatric patients often complicates anesthetic management and recovery. Intranasal atomization presents a well-accepted, needle-free route for administering sedative premedication.
Objectives: This trial compared the clinical performance and safety profile of atomized intranasal dexmedetomidine, ketamine, and a combined lower-dose formulation for premedicating children before elective surgery.
Methods: Sixty ASA I-II patients, aged 3–7 years, were randomly assigned to receive intranasal premedication 30 minutes pre-induction: Group K (ketamine 2 mg/kg), Group D (dexmedetomidine 2 µg/kg), or Group DK (ketamine 1 mg/kg + dexmedetomidine 1 µg/kg). A mucosal atomizer delivered the drugs. Assessed outcomes included sedation depth, cooperation during separation and procedures, mask acceptance, emergence behavior, satisfaction metrics, and adverse events.
Results: Group DK demonstrated the highest incidence of satisfactory sedation at 30 minutes. Optimal procedural cooperation and highest satisfaction scores were also observed in the combination group, with a low incidence of side effects.
Conclusion: The combined atomized intranasal regimen of dexmedetomidine and ketamine offers an effective and safe premedication strategy, facilitating better perioperative cooperation and higher satisfaction than either agent administered singly.

Keywords*: Pediatric premedication; intranasal sedation; alpha-2 agonist; dissociative anesthetic; drug synergism.*

INTRODUCTION

Significant anxiety is common in children facing surgery, manifesting during parental separation, intravenous access, and induction. Unmitigated distress can precipitate refractory induction, emergence agitation, negative behavioral changes, and increased postoperative pain medication requirements.[1]

Pharmacologic premedication is standard to ease perioperative stress in young patients. Ketamine provides sedation, analgesia, and amnesia via intranasal administration, which is rapid and avoids injections.[2] Dexmedetomidine induces a unique cooperative sedation with minimal respiratory compromise, leading to high caregiver acceptance.[3],[4]

Prior research on dexmedetomidine and ketamine for pediatric sedation via other routes hints at a beneficial interaction.[5],[6] However, data on their co-administration using intranasal atomization is sparse. This study was designed to directly compare the atomized intranasal delivery of these agents, both alone and in combination, for efficacy and tolerability as pediatric premedication.

SUBJECTS AND METHODS

With ethics committee approval and parental consent, this prospective, randomized, double-blind trial was performed. The sample size was determined from prior data using sedation level at 30 minutes as the key outcome measure.[5]

Eligible patients were aged 3–7 years, ASA I-II, scheduled for elective procedures under one hour. Exclusion criteria were drug allergy, significant cardiac history, neurodevelopmental delay, or current nasal obstruction.

Computer-generated randomization placed participants into three groups. All preparations were adjusted to a 1 mL volume with saline and administered equally between nostrils via a mucosal atomization device.[7,8]

Baseline observations and sedation status were tracked with the Modified Observer's Assessment of Alertness/Sedation Scale. Predefined numerical scales graded parental separation, venipuncture compliance, mask acceptance, emergence agitation (PediatricAnesthesia Emergence Delirium scale), and provider/parent satisfaction.

Data were analyzed using SPSS (v20.0). Continuous data were examined with ANOVA or non-parametric equivalents; categorical data were assessed with Chi-square or Fisher's exact tests. $P < 0.05$ defined statistical significance.

RESULTS

Patient demographics and operative times were similar across groups. The proportion achieving satisfactory sedation (MOAAS ≤4) at the 30-minute assessment was greatest in Group DK (Table 3).

Compliance during venipuncture and mask application was significantly superior in the combination cohort. Emergence agitation scores were most favorable in Group DK. Anesthesiologist and parental satisfaction ratings were highest for the combined regimen (Table 5).

Notable bradycardia and delayed awakening were confined to Group D. Postoperative nausea/vomiting occurred more often in Group K. The overall adverse event profile was favorable and comparable (Table 6).

Table -1- Scores used in the study

A. Modified observer assessment of sedation scale	6 Appears alert and awake, responds readily to name spoken in normal tone 5 Appears asleep but responds readily to name spoken in normal tone 4 Lethargic response to name spoken in normal tone 3 Responds only after name is called loudly or repeatedly 2 Responds only after mild prodding or shaking 1 Does not respond to mild prodding or shaking 0 Does not respond to noxious stimulus
B. Ease of Separation	1 Excellent patient unafraid, cooperative, or asleep 2 Good slight fear and/or crying, quiet with reassurance 3 Fair moderate fear and crying, not quiet with reassurance 4 Poor crying, need for restraint
C. Ease of venepuncture	1 excellent (no reaction) 2 good (minor resistance) 3 fair (uncooperative with success) 4 poor (uncooperative without success)
D. Facemask acceptance	1 excellent (unafraid, cooperative, and accepts mask readily) 2 good (slight fear of mask, easily reassured) 3 fair (moderate fear of mask not calmed with reassurance) 4 poor (terrified, crying, and combative)
E. Emergence agitation	1 calm 2 restless but calms to verbal instructions 3 combative and disoriented
F. Anaesthesiologist satisfaction	1 Extremely satisfied 2 Somewhat Satisfied 3 Undecided 4 Somewhat Dissatisfied 5 Extremely Dissatisfied
G. Parental satisfaction	0 Not satisfied 1 Satisfied

Table-2 Patient characteristic

Parameter	Group K	Group D	Group DK	P value
Age (yrs.)	5.4 ± 1.67	5.76 ± 1.44	5.34 ± 1.23	0.621
Sex (M/F)	14/6	15/5	16/4	0.120
Weight (kgs)	15.8 ± 4.02	17.8 ± 4.25	16.4 ± 4.19	0.437
ASA (I /II)	20/0	20/0	19/1	0.320
Surgery duration (mins)	49.4 ± 6.02	52 ± 3.32	54.4 ± 3.52	0.530

Scores expressed in mean ± SD

Table-3 - Sedation score at 30 mins

	Group K	Group D	Group DK	p value		
				K vs D	K vs DK	D vs DK
Modified OASS at 30 mins#	3.8 ± 0.8	4 ± .54	3.5 ± 0.61	**0.001**	**0.041**	**0.001**
Satisfactory sedation*	15 (75%)	12 (60%)	16 (80%)			

* Modified OASS≤ 4 at 30 mins, Modifies OASS expressed in mean ± SD; satisfactory sedation as percentage

Table -4- parameters of efficiency

	Group D	**Group K**	**Group DK**	**P–DK vs D**	**P–DK vs K**	**P- K vs D**
Ease of Separation	2.44 ±1.2	**1.62 ±0.67**	1.67 ±0.57	0.120	0.323	0.099
Ease of venepuncture	2.69 ±0.47	2.25 ±0.43	**1.73 ±0.45**	**0.001**	**0.037**	**0.048**
Face mask Acceptance	2.94 ±0.79	2.44 ±0.23	**1.80 ±0.55**	**0.001**	**0.013**	0.411
Emergence Agitation	1.31 ±0.48	2.00 ±0.78	**1.00 ±0.89**	**0.001**	**0.001**	0.208
Anaesthetist satisfaction	4.13 ± 1	2.9 ± 1.15	**1.75 ±0.91**	**0.001**	**0.001**	**0.041**

Scores expressed in mean ± SD

Table-5: parental satisfaction

Groups	Odds Ratio	95% Wald confidence limit	
DK vs D	6.5	1.467	28.804
K vs D	4.333	1.235	15.206

Table-6- side effects

Group	**K**	**D**	**DK**
Bradycardia	0	4	0
Delayed emergence	0	4	0
PONV	3	1	1
Total	**3**	**9**	**1**

Numbers denote actual number of incident

DISCUSSION

Effective premedication is fundamental for a calm perioperative experience in children. The intranasal route bypasses the distress of injections and, with atomization, improves drug dispersion and uptake.[7,8]

This trial found the dexmedetomidine-ketamine combination superior for sedation and cooperation, supporting earlier work suggesting synergism between these drugs.[5,9,10]

The favorable interaction may combine ketamine's rapid onset with dexmedetomidine's prolonged, stable sedative effect. Furthermore, ketamine's moderating influence on heart rate may counterbalance the bradycardic potential of dexmedetomidine, promoting cardiovascular stability.[4,11]

CONCLUSION

Atomized intranasal administration of combined dexmedetomidine and ketamine produces enhanced pre-operative sedation, smoother induction conditions, and greater satisfaction than equivalent monotherapy, without a rise in adverse effects. This approach represents a valuable premedication option for pediatricanesthesia.

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