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EFFECT OF KETAMINE AS SINGLE INDUCTION AGENT ON BLOOD GLUCOSE LEVEL IN PEDIATRIC AGE GROUP UNDERWENT APPENDECTOMY

[*1]Ahmed Sabah Hasan and [2]Alaa Hussein Al-Taei

[1]Baghdad- Al-Karkh Health Directorate, Baghdad, Iraq.
[2]Medical Cuty Complex, Baghdad, Iraq.

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***Corresponding Author: Ahmed Sabah Hasan**

Baghdad- Al-Karkh Health Directorate, Baghdad, Iraq.

ABSTRACT

Background: Both anesthesia and surgery has been reported to affect blood glucose levels in humans, therefore; it is necessary to identify the effects of anesthetic drugs on blood glucose to give an idea about the level of stress during appendectomy surgery. **Aim:** To demonstrate the effect of the ketamine on the blood glucose level during anesthesia of appendectomy in children of preschool age. **Patients and methods:** This simple randomized cross-sectional study was carried out in Medical City – Child well-form hospital and Child central teaching hospital between the period of the 1st of September 2020 till 15th of December 2020, American society of anesthesia I and II, pediatric age group with Appendectomy. All the 40 patients received IV 2 mg/kg ketamine as single induction agent with 1 mg/kg suxamethonium as muscle relaxant to facilitate intubation. For all of the patients, baseline random blood sugar was obtained before induction of anesthesia, 5 minutes and 30 minutes after induction**.** **Results:** The random blood sugar readings demonstrate that there was no significant changes between them. There was an increment in the pulse rate, systolic and diastolic blood pressure at 5 and 10 minutes from the induction. **Conclusion:** Induction by Ketamine in the preschool age groups increase the pulse rate, the systolic blood pressure and the diastolic blood pressure after 5 and 10 minutes from induction. Ketamine does not have influence on the glycemic level in pediatric age group.

KEYWORD: Ketamine, appendectomy, blood glucose.

INTRODUCTION

The development of modern anesthesia and surgical techniques prioritizes safe outcomes. Advances in knowledge of pathophysiology, newer drugs, perioperative monitoring, and postoperative care have significantly reduced morbidity and mortality.[1] Understanding the physiological stress response during surgery, including cardiovascular, metabolic, and electrolyte changes, has been pivotal. Anesthesia and surgery often influence blood glucose levels, increasing risks for diabetic patients due to stress-induced hyperglycemia and associated complications.[2] Hyperglycemia is linked to worse outcomes in critically ill patients, including increased mortality following stroke, myocardial infarction, and surgeries. Perioperative hyperglycemia elevates risks for mortality, cardiovascular, respiratory, neurologic, and infectious morbidities.[3-7] Despite its impact, aggressive glucose management strategies have not consistently improved outcomes, occasionally increasing mortality.[8-10] Stress, pain, dehydration, medications, and surgical factors can exacerbate intraoperative hyperglycemia. Severe hyperglycemia triggers immune dysfunction, increases infection risk, activates coagulation, and induces inflammation, worsening patient outcomes.[11,12] Ketamine, synthesized in 1962, produces dissociative anesthesia by blocking N-methyl-D-aspartate (NMDA) receptors. Unlike CNS depressants, it dissociates the thalamus from the limbic system, preserving reflexes while inducing anesthesia. Ketamine is metabolized in the liver, with major pathways involving N-demethylation to norketamine and further hydroxylation, followed by urinary excretion. Its rapid distribution (half-life: 11–16 minutes) and high clearance (890–1227 mL/min) lead to a short elimination half-life (2–3 hours).[13,14]

Pharmacodynamics and Organ Effects

1. Cardiovascular System: Ketamine increases arterial pressure, heart rate, and cardiac output by stimulating the sympathetic system, releasing catecholamines, and inhibiting norepinephrine

reuptake. This effect can strain the heart, increasing oxygen demand, especially after large doses or repeated use.[15]

2. Respiratory System: Ketamine minimally affects central respiratory drive but improves bronchial smooth muscle relaxation, aiding patients with reactive airway diseases.[16,17]
3. Central Nervous System: It increases cerebral blood flow and intracranial pressure, limiting its use in patients with intracranial lesions. However, ketamine offers analgesia, amnesia, and unconsciousness, with reduced emergence delirium when combined with benzodiazepines or propofol.[18]

Clinical Applications and Dosage

Ketamine serves multiple roles, including induction and maintenance of anesthesia, postoperative analgesia, and managing severe asthma. Dosages vary.

- IV induction: 1–2 mg/kg (effects last 5–10 minutes) with supplementary doses of 0.5 mg/kg.
- IM induction: 10 mg/kg (acts in 3–5 minutes, lasts 20–30 minutes).
- Sedation: 2–4 mg/kg IM or 1–2 mg/kg/h IV infusion.
- Adjunct to anesthesia: 0.5 mg/kg slow IV bolus before incision, followed by 0.125–0.25 mg/kg boluses every 30 minutes.
- Severe asthma: 0.5–2.5 mg/kg/h infusion.[19]

Understanding these principles ensures optimized glucose control and ketamine use, enhancing patient outcomes in surgical and critical care settings. AIM OF THE STUDY: To demonstrate the effect of IV ketamine on the blood glucose level during anesthesia of appendectomy in children at preschool age.

METHOD

A simple randomized cross-sectional study was conducted on 40 patients at Medical City – Baghdad Hospital and the Child Central Teaching Hospital between September 1, 2020, and December 15, 2020. The study adhered to ethical standards, receiving approval from the Iraqi Scientific Council of Anesthetic and ICU, and written consent was obtained from parents.

Inclusion Criteria

- ASA I and II patients aged 3–14 years undergoing appendectomy.

Exclusion Criteria

- Parental refusal, contraindications to ketamine, and diabetic patients.

Anesthetic Protocol: Baseline random blood glucose (RBG) was measured preoperatively. In the operating room, monitoring included pulse rate, blood pressure, and SpO_2. Patients were preoxygenated for five minutes before anesthesia induction. Preoperative 0.1 mg/kg IV metoclopramide was administered, followed by sedation with 0.05 mg/kg midazolam and induction with 2 mg/kg ketamine and 1 mg/kg suxamethonium. Muscle relaxation was maintained using 0.15 mg/kg rocuronium, and anesthesia was sustained with isoflurane (1.0–1.5%). Intraoperative analgesia was provided with 15 mg/kg IV acetaminophen, and fluids were administered based on the 4/2/1 rule and third-space losses.

RBG was measured pre-induction, 5 minutes, and 30 minutes post-induction using a capillary glucometer. Hemodynamic parameters were recorded every 5 minutes. At the end of surgery, reversal agents (atropine 0.01 mg/kg and neostigmine 0.05 mg/kg) were administered, and patients were extubated.

Statistical Analysis: Data analysis was performed using SPSS version 20 and Microsoft Excel. Categorical data were presented as means, standard deviations, and range values. T-tests assessed correlations between glucose levels at different time points. Statistical significance was set at $p < 0.05$. This study highlights the hemodynamic and glycemic effects of ketamine-based anesthesia in pediatric patients undergoing appendectomy.

RESULTS

The number of participant children were 40, aged from 3 to 14 years oldfrom both genders, male was 26 (65%) whereas female was 14 (35%). The distribution of study patients by general characteristics is shown in table (1). Study patient's age with mean of 50.85 years**.** Regarding gender, male proportion was higher in both groups, with non-significant difference (p-value > 0.05).

Table 1: Comparison in the general characteristics.

Variables	N	Mean	(S.D.)	S.E. Mean	p-value	
Age (years)	20	50.85	13.72	3.06	0.681	
	20	47.1	16.44	3.67		
Gender	Male No. (%)		11 (55%)		Male& Female =0.320	=0.185
	Female No. (%)		9 (45%)			
	Male No. (%)		15 (75%)		Male& Female =0.190	
	Female No. (%)		5 (25%)			

The pulse rate was slightly elevated after 5 and 10 minutes and this was due to laryngoscopy and intubation whereas the other parameter during the pulse rate recording with no clinical differences as seen in table 2.

Table 2: The pulse rate recording during operation.

Pulse rate	Mean	Minimum	Maximum	SD
0	89.72	71	117	11.83
5 min	91.06	73	120	12.43
10 min	91.26	73	120	12.47
15 min	89.84	71	118	12.11
20 min	90.04	72	119	12.42
25 min	89.94	72	119	12.27
30 min	89.86	72	118	12.08

There was a slight increase in the systolic blood pressure after 5 and 10 minutes from the baseline and this was due to laryngoscopy and intubation as shown in table 3.

Table 3: Systolic blood pressure during operation.

Systolic blood pressure	Mean	Minimum	Maximum	SD
0	131.78	108.00	150.00	14.10
5 min	138.20	113.00	157.00	14.75
10 min	142.48	117.00	162.00	15.24
15 min	139.64	114.00	159.00	15.05
20 min	138.26	113.00	158.00	14.83
25 min	139.00	114.00	158.00	14.85
30 min	137.82	113.00	157.00	14.87

The same was applicable on the diastolic blood pressure as there was a slight elevation in the diastolic blood pressure at 5 and 10 minutes from the induction and this was due to also to laryngoscopy and intubation as shown in table 4.

Table 4: The Diastolic blood pressure changes during operation.

Diastolic blood pressure	Mean	Minimum	Maximum	SD
0	77.30	60.00	95.00	9.59
5 min	82.52	64.00	102.00	10.32
10 min	86.10	67.00	106.00	10.71
15 min	88.74	69.00	109.00	10.97
20 min	86.92	67.00	107.00	10.85
25 min	88.74	69.00	109.00	10.97
30 min	86.22	67.00	106.00	10.60

The random blood sugar was obtained from the patient at baseline (RBS0 87.5 mg/dl), after 5 minutes from the induction (RBS5 86.74 mg/dl) and after 30 minutes from the induction (RBS 30 87.54mg/dl), there was no significant changes was seen between the three readings as shown in table 5.

Table 5: Relation between glucose levels at time intervals.

		Paired Differences					p value
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		
					Lower	Upper	
Pair 1	RBS0 - RBS5	0.760	6.912	0.978	-1.204	2.724	0.441
Pair 2	RBS0 - RBS30	-0.040	12.068	1.707	-3.470	3.390	0.981
Pair 3	RBS5 - RBS30	-0.800	6.484	0.917	-2.643	1.043	0.387

DISCUSSION

This study aimed to investigate the effect of ketamine on blood glucose levels in pediatric patients undergoing appendectomy. The mean age of participants was 5.52 years, with males constituting 60% and females 40% of the sample. The vital signs, including pulse rate and blood pressure, were monitored throughout the operation. Pulse rate increased significantly at 5 and 10 minutes after induction compared to baseline due to the effects of laryngoscopy, intubation, and the

sympathomimetic properties of ketamine. Similarly, systolic and diastolic blood pressures showed elevations at the same intervals, reflecting the combined effects of intubation and ketamine-induced sympathetic stimulation. Blood glucose levels were measured at three time points: baseline (before induction), 5 minutes after induction, and 30 minutes after induction. The baseline blood glucose level was 87.5 ± 6.91 mg/dL. At 5 minutes' post-induction, the glucose level slightly decreased to 86.74 ± 12.06 mg/dL, with no significant clinical or statistical difference (p = 0.441). The third reading, taken 30 minutes after induction, showed a value of 87.54 ± 6.48 mg/dL, again with no significant difference compared to baseline (p = 0.981) or the second reading (p = 0.387). The study found no significant effect of ketamine on blood glucose levels in humans. Few human studies exist on this subject, but V.O. Otoide et al. (2001) reported elevated blood glucose levels in two cases of cesarean delivery under intravenous ketamine anesthesia.[20] Animal studies provide additional insights. Joy K. Saha et al. (2005) demonstrated that ketamine (100 mg/kg) combined with xylazine (10 mg/kg) induced acute hyperglycemia in fed rats, with glucose levels peaking at 291.7 ± 23.8 mg/dL within 120 minutes. However, ketamine alone did not elevate glucose levels in fed rats, suggesting its effect may be dose-dependent or influenced by the co-administration of other agents.[21] Suleiman et al. (2009) investigated ketamine in varying doses in rats, finding that low doses (166.6 mg/kg) produced hyperglycemia, while higher doses (1–4 mg/kg) had no significant effect. This aligns with Saha et al.'s findings but contrasts with the current study, where no glucose elevation was observed even at a dose of 2 mg/kg in humans.[22]

CONCLUSION

Induction by Ketamine in the preschool age groups increase the pulse rate, the systolic blood pressure and the diastolic blood pressure after 5 and 10 minutes from induction. Ketamine had no influencive effect on the glycemic level in the preschool age group.

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