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The use of ketamine or ketamine–midazolam for adenotonsillectomy

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Summary

Background: Ketamin's role in clinical anaesthesia is developing as a result of the evolving concepts of its mechanism of action and the advantages of its alternative routes of administration. In this study, we aimed to investigate the frequency and severity of adverse effects, specifically emergence phenomena and vomiting, when ketamine with or without midazolam used as a sole anaesthetic.
Methods: One hundred children, aged between 3 and 10 years, scheduled for adenotonsillectomy were studied. Fifty ASA physical status I–II patients were administered ketamine and atropine intramuscularly (group K, $n = 50$). The remaining 50 children were given ketamine, atropine and midazolam by as the same route (group KM, $n = 50$). Noninvasive hemodynamic and oxygenation variables were monitored. Operative conditions and recovery profiles such as hallucinations, nightmares, awakening by crying agitation and retching–vomiting were investigated in 1st, 2nd, 15th, 30th and 60th days after the operation.
Results: A significant reduction in emergence reactions was demonstrated especially in group KM during the early postoperative period ($p < 0.05$). Retching–vomiting also reduced significantly in the group KM during the same time ($p < 0.05$).
Conclusion: As a sole anaesthetic ketamine with or without midazolam provided a calm and safe anaesthesia for paediatric patients in short term procedures. In addition, it must be noted that, a better postoperative early period was achieved by ketamine with midazolam.

1. Introduction

Ketamine is an old anaesthetic. It has been used for premedication, sedation, induction and maintenance of general anaesthesia since the second part of the 20th century. It has been used especially for

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trauma victims, patients with hypovolemic and septic shock, patients with pulmonary disease, and paediatric patients who have behavioural disorders. However, its usage as a sole anaesthetic agent was restricted because of the emergence phenomena resulted with psychological disorientation, hallucinations and nightmares, which are named emergence reactions in the postoperative period [1–3].

Ketamin's clinical usage has become more widespread with the increased understanding of its mechanism of action [2]. It has been recommended for use in a variety of areas including controlling pain, therapy of asthma, intracranial procedures, hemorrhagic or septic shocks [4].

Ketamine is often used with or without benzodiazepines or opioids for preventing preoperative or separation anxiety in paediatric patients [5–11]. There are few studies in which ketamine has been used as the sole anaesthetic [12,13]. Hypersalivation, induction of sympathetic activity, postoperative nausea vomiting are the classical adverse effects of ketamine which limits its usage [1–3,14].

As far as the adverse effects of use of ketamine are concerned; use of pharmaceutics such as benzodiazepines, physostigmine, droperidol [15], pentozosin [16] and dexmetadomidin [17] are recommended. Among them; midazolam, a commonly used benzodiazepine are claimed to be the most effective one [14,18–21]. It is the aim of this study to show whether or not midazolam is effective in preventing the adverse effects of ketamine in paediatric patients.

2. Methods

After ethical committee approval and informed consent we studied 100 ASA I–II patients (3–10 years old) undergoing adenotonsillectomy under general anaesthesia. Patients with psychiatric disorders, congenital or anatomical abnormalities, systemic diseases (hypertension, increased intracranial pressure, glaucoma) and allergic reactions to ketamine were excluded. The patients were randomly allocated to two groups. Group K received ketamine 7 mg kg^{-1}–atropine 0.015 mg kg^{-1}. Group KM received ketamine 7 mg kg^{-1}–atropine 0.015 7 mg kg^{-1}–midazolam 0.1 mg kg^{-1} intramuscularly. Following intramuscularly injection, the time period till the patient became unconscious was recorded and expressed as induction time. The patients were taken to the operation room immediately following their separation from their parents. Non-invasive blood pressure, heart rate and peripheral oxygen saturation were monitored throughout the study. In the operation room while they were breathing 100% O_2 spontaneously with a face mask, an i.v. cannula was inserted. Ringer lactate solution was infused at a rate of as determines by the 4:2:1 formula [22]. Intubation of the trachea was facilitated with vecuronium 0.01 mg kg^{-1}. Patients were ventilated with 65% N_2O/O_2 mixture using a pressure controlled mode to maintain an $ETCO_2$ between 30 and 35 mmHg.

Hypertension and tachycardia were defined as an >30% increase from the baseline values of blood pressure and heart rate. In case of additional anaesthetic requirement; ketamine 1 mg kg^{-1} i.v. was given to patients suffering from hypertension or tachycardia. Before tracheal extubation neuromuscular blockage was reversed by neostigmine 0.02 mg kg^{-1} and 0.015 mg kg^{-1}g atropine intravenously at the end of the surgery.

Finally, all patients received rectal paracetamol at the end of the surgery.

Assessment for emergence reactions at early postoperative period was performed for the first 4 h in a silent and dark room. Assessment of the severity of emergence reactions was scored as patient silent, sleepy, reactive for verbal stimuli (none), crying at intervals (mild), anxious and agitated, delirious at intervals (moderate), screaming with shrieks and cries, uncooperative (severe) by blind assessors.

Assessment for delayed emergence reactions was performed at 1st (face to face), 2nd, 15th and 30th days (contacted with their parents by phone). Four levels of reactions were graded. Patients who had silent and quiet sleep at night (none), who awaked but did not emphasize their anxieties and fears (mild), who waked up once or twice nightly, crying and screaming (moderate), who waked up similarly but cannot be able to sleep again because of nightmares (severe). Sixty days after ketamine administration we invited the patients with their parents to the hospital to evaluate the possible potential adverse effects of ketamine on patients during these periods such as whether or not they had nightmares, etc.

Assessment of vomiting was started at extubation and was performed for the first 4 h in a dark and silent room and then the patients were evaluated on the ward if they had retching–vomiting. They were assessed on a 2-point ordinal scale (1) none, (2) vomiting or two retching or more events. As children may find it difficult to describe nausea; no distinction was made between nausea and retching. Ondansetron 0.1 mg kg^{-1} i.v. was given when vomiting and retching occured.

Statistical analysis was performed using the Student's *t*-test; for age, weight and height and chi-square test for emergence reactions and vomiting. A *p*-value less than 0.05 was considered significant.