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**Original Article**

# Effectiveness of Intramuscular Ketamine as an Adjunct to Standard Care for Reducing Emergence Agitation in Nasal Surgery Patients

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## ABSTRACT

As patients awaken from general anesthesia, they experience restlessness and bewilderment known as emergence agitation. Contributory factors for Emergence agitation include smoking, inhalational anesthetic usage, particular surgical procedures, being young, and being a member of the male population. **Objective:** To examine the frequency and severity of anxiety attacks in patients having nasal surgery and to assess how well intraoperative ketamine and placebo reduced the incidence of EA. **Methods:** This study was conducted at Bacha Khan Medical Complex in Swabi. Seventy patients undergoing nasal surgery were divided into two groups in a double-blind trial. One group received intramuscular ketamine, while the other group received saline. A standardized agitation scale measured the incidence and severity of postoperative agitation. The statistical software SPSS for Windows (version 28.0; IBM Corporation) was used to conduct the analysis. **Results:** Just 5% of patients in the ketamine group experienced EA, compared to 56.3% in the saline group ($p \leq 0.001$). The risk of getting EA was 96.7% lower in those on ketamine. Also had much less discomfort following surgery ($p < 0.001$). Additionally, they reported much less discomfort following surgery ($p < 0.001$). There were no significant differences in postoperative nausea and vomiting across the groups. **Conclusions:** After nasal operations, intramuscular ketamine administered after the procedure was quite successful in avoiding EA. Although total prevention of EA is difficult, risk factors can greatly lower the incidence of EA. Longer procedures, OSRP surgeries, and ASA II physical condition were the primary risk elements for EA.

## INTRODUCTION

Emergence agitation is a post-anesthetic condition that appears early in the recovery from general anesthesia [1]. It is more common in children but can occur in adults affecting 4.7% to 21.3% of them [2, 3]. Restlessness, excitement, and perplexity are characteristics of Emergence Agitation (EA). It makes managing agitated patients challenging and its precise origin is unclear. Risk factors include young age, male gender, inhalational anesthesia, postoperative pain, postoperative nausea and vomiting, oral and ENT surgeries, smoking, and tracheal tube usage. While EA usually resolves on its own, it can lead to complications such as bleeding, self-extubation, prolonged hospital stays, patient traumas, and hazards for medical personnel [4]. EA can be avoided by lowering these risk factors and offering effective postoperative pain management. Research has indicated that EA is more frequent in adults and children following ENT procedures [5, 6]. Numerous drugs including opioids and alpha-2 receptor agonists like ketamine and dexmedetomidine have been investigated for their potential to prevent EA [7]. Rapid-acting anesthetic ketamine primarily blocks the NMDA receptor while it also affects other receptors. It can be administered orally, intramuscularly or by a variety of other routes. Ketamine administered intramuscularly is

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especially notable because of its adaptability and quick start of action peak plasma concentrations happen in a matter of minutes [8]. Ketamine has additional adverse effects as well such as liver damage, elevated intracranial pressure, respiratory depression, cognitive problems and changes in blood pressure or heart rate. It can also raise the risk of PONV. Additionally, it increases salivary secretions which may lead to laryngospasms however a tiny amount of atropine may be used to treat this. Those with schizophrenia, uncontrolled blood pressure and those who are pregnant or breastfeeding should not use ketamine [6]. In a recent study the effects of sub anesthetic dosages of intramuscular ketamine on emergence agitation during nasal surgery were investigated. It was found that ketamine significantly reduced the incidence of agitation compared to the control group. Additionally, administering Nefopam after the induction of anesthesia was also found to reduce the occurrence and severity of emergence agitation in adult patients undergoing nasal surgery [2, 6]. A case series study involving 15 patients suggested that acute agitation might benefit from a reduced intramuscular ketamine dosage. This study also shows that otorhinolaryngological procedures and EA are correlated. Numerous studies have shown a higher prevalence of EA in pediatric patients with tonsillectomy and strabismus surgery [9, 10]. However, a number of further studies connected the kind of surgery to EA [4, 11]. Adult patients with procedures related to the spine, musculoskeletal system, oral cavity, otolaryngology, breast or abdomen have a higher chance of acquiring EA [12]. A prospective cohort research including 521 kids between the ages of 3 and 7 discovered a relationship between EA and procedures related to ophthalmology and otorhinolaryngology. In particular surgeries linked to otorhinolaryngology were separate risk factors for EA [13]. Inhalational anesthetics with low blood gas solubility such as desflurane and sevoflurane are more frequently associated with EA than halothane, isoflurane, desflurane and sevoflurane [14]. This study is significant since nose surgeries are associated with a greater prevalence of endodontic and treating this disease well may improve patient outcomes significantly.

This study aimed to investigate the efficacy and safety of intraoperative ketamine in minimizing postoperative agitation with the goal of offering practical insights into enhancing postoperative care and increasing recovery for patients undergoing nose surgery. The aim of this study was to compare the incidence of allergic responses in patients undergoing nose surgery between intramuscular ketamine and placebo.

## METHODS

In this study, patients scheduled for nose surgery participated in a double-blind randomized control experiment at Bacha Khan Medical Complex/MTI, Swabi. The study began on June 15, 2023, and ran four months after the Gajju Khan Medical College's ethical committee accepted the research request with reference number 2245/Ethical Board/GKMC. Non-probability sampling, which is convenient, was used. A sample size of 70, a 5% margin of error, 4.75% were taken from study with a 95% confidence level were required by the WHO calculation [15]. Informed consent was obtained from each participant. Participants in the research ranged in age from 15 to 70. Individuals who fulfil the qualifying criteria must possess an American Society of Anesthesiologists classification of I or II. Age extremes, a Body Mass Index (BMI) of more than 30 kg/m2, a known ketamine allergy and the patient unwillingness to participate were among the exclusion criteria for the study. Patients having a history of head and neck radiation therapy, cardiac, neurological, or behavioral disorders, or glaucoma diagnosis will not be included in the trial. Following clearance from the ethics committee patients who met the inclusion criteria were informed about the study and asked for their agreement to participate. We obtained each person informed permission. Data on patients and hospital management was kept confidential and used only for this study. Data were collected through the designed questionnaire. Seventy individuals were randomly assigned to receive either an intravenous ketamine or a placebo. In Group A, the intervention group received IM ketamine (0.7 mg/kg body weight) diluted in the same medium whereas in Group B the control group received 3 ml of normal saline. Both groups received the treatment five minutes before they were extubated. Patients without previous medication were brought to the surgery room. Standard anesthetic monitors were employed. Anesthesia was induced with 2 mg/kg of propofol and 0.5 mg/kg of atracurium and the patient was kept unconscious with 2.5 L/min of a 50% oxygen and 1.2% isoflurane mixture. Nalbuphine at a dose of 0.1 mg/kg was used to relieve discomfort. To avoid postoperative nausea and vomiting all patients received 8 mg of dexamethasone and 8 mg of ondansetron after being intubated. By modifying the ventilator settings end-tidal CO2 levels were maintained between 30 and 35 mmHg. After the procedure 2 ml of normal saline was administered to Group B, and 2 ml of normal saline + 0.7 mg/kg of intramuscular ketamine was given to Group A. Every group received an injection in the lateral thigh. Every patient had nasal packs. After satisfying the extubation criteria patients were extubated and ventilated with 100% oxygen at a rate of 7 L/min. The patient's levels of agitation were measured before their transfer to the postanesthesia care unit using the. The patient in which agitation occurred, then rescue medication Midazalom (Dormicum) after proper follow-up. Richmond Agitation Score (RAS) used for agitation measurement. A RASS score of +2 or above

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indicated the presence of emergent agitation (EA). The pain was measured using a Numerical Rating Scale (NRS) of 0–10 where 0 represents no discomfort and 10 represents the highest level of pain. Patients receiving intravenous injections of one gram of paracetamol were those who scored five or higher on the pain scale. While frequency and percentages were provided for the categorical data mean ± standard deviation was used to illustrate the continuous variables. The chi-square of independence was used to look at the bivariate relationship between the category data. Continuous variables (Age, BMI, Pain Score) were compared using the independent t-test. A value was considered statistically significant if it was less than 0.05. The statistical analysis was performed using SPSS for Windows (version 28.0) from IBM Corporation.

## RESULTS

Seventy people with BMIs ranging from 21.10 to 29.00 with an average of 24.15 were enrolled in the research. Participants ages ranged from 16 to 66 years old with a mean age of 31.29. The average pain score was 3.60, with reported pain levels ranging from 2 to 7. With a mean score of 1.61 the agitation levels varied from 1 to 2. Every measurement applied to all seventy individuals. A t-test was used to compare the Group and ASA variables, and the results were displayed in the table. The Group variable has 69 degrees of freedom a two-tailed significance level of 0.000 and a t-value of 24.920. The mean difference was 1.500 with a 95% confidence interval that ranges from 1.38 to 1.62. The ASA variable's two-tailed significance level was 0.000 and its t-value was 24.076 with 69 degrees of freedom. The mean difference with a 95% confidence range between 1.14 and 1.35 is 1.243. This table compares a number of characteristics between people who were classified as agitated and non-agitated. Using a test value of 37.683 and a p-value of ≤0.000, the ketamine group (A) had a substantially larger proportion of non-agitated people (34) compared to the saline group (B) where more participants were agitated (26). With regard to gender there were 19 agitated and 19 non-agitated people among the male population and 24 agitated and 8 agitated people among the female population. This indicates a significant variance with a test value of 4.582 and a p-value of 0.032. With a test value of 0.0641 and a p-value of 0.800, the analysis based on ASA status showed no significant difference in agitation between ASA I and ASA II subjects. Likewise, there was no significant difference in age and BMI between the non-agitated and agitated groups (test values of 0.874 and 0.788, and p-values of 0.385 and 0.434, respectively), indicating that the kind of surgery did not affect agitation. With a test value of 3.704 and a p-value of 0.000, the two groups mean pain scores differed significantly with agitated individuals reporting a mean score of 4.33 ± 1.359 and non-agitated persons having a mean score of 3.14 ± 1.283 (Table 1).

**Table 1:** Comparison of Variables between Non-Agitated and Agitated Groups

| Variables | Category | Non-Agitated N (%)/(Mean ± SD) | Agitated N (%) /(Mean ± SD) | Test Value | p-Value |
|---|---|---|---|---|---|
| Study Group | A-Ketamine | 34 (79.1%) | 1 (3.7%) | 37.683 | 0.001 |
| | B-Saline | 9 (20.9%) | 26 (96.3%) | | |
| Gender | Male | 19 (44.2%) | 19 (70.4%) | 4.582 | 0.032 |
| | Female | 24 (55.8%) | 8 (29.6%) | | |
| ASA | ASA I | 33 (76.7%) | 20 (74.1%) | 0.064 | 0.800 |
| | ASA II | 10 (23.3%) | 7 (25.9%) | | |
| Type of Surgery | FESS | 20 (46.5%) | 15 (55.6%) | 0.764 | 0.858 |
| | Septoplasty | 20 (46.5%) | 10 (37.0%) | | |
| | Rhinoplasty | 2 (4.7%) | 1 (3.7%) | | |
| | Septorhino-plasty | 1 (2.3%) | 1 (3.7%) | | |
| Age | Mean ± SD | 30.09 ± 14.1 | 33.11 ± 13.968 | 0.874 | 0.385 |
| BMI | Mean ± SD | 24.30 ± 2.1182 | 23.9185 ± 2.1182 | 0.788 | 0.434 |
| Pain Score | Mean ± SD | 3.14 ± 1.283 | 4.33 ± 1.359 | 3.704 | 0.001 |

The research looked at two groups non-agitated and agitated and several kinds of nasal procedures such as Functional Endoscopic Sinus Surgery (FESS), Septoplasty, Rhinoplasty, and Sept rhinoplasty. FESS and Septoplasty were performed 20 times apiece in the non-agitated group, whereas Rhinoplasty and Sept rhinoplasty were performed 2 and 1 times apiece. FESS was done fifteen times Septoplasty ten times and Rhinoplasty and Sept rhinoplasty one each in the agitated group. With a p-value of.858a and a test value of.764 for these surgeries the statistical analysis of these frequencies. The gender distribution in both the agitated and non-agitated groups was examined in the study. Nineteen men and twenty-four women made comprised the non-agitated group. In contrast there were exactly the same number of men (19) but far fewer women (only 8) in the agitated group. There was a statistically significant difference in the gender distribution between the two groups as indicated by the test value of 4.582 and the p-value of.032a for this gender distribution (Figure 1).

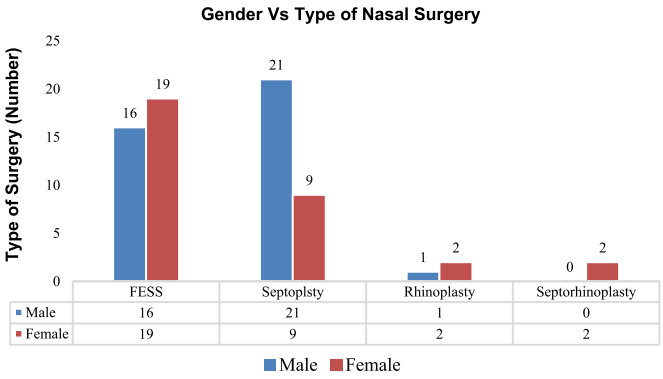


**Figure 1:** Gender-Wise Distribution of Nasal Surgical Patients

## DISCUSSION

The study findings show how effectively intramuscular ketamine at a lower dosage after surgery lowers the

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incidence of emergence agitation in patients who have had septoplasty or open sept rhinoplasty. Notably this intervention resulted in lower pain scores for the treatment group (Group B). These results were consistent with other research that highlights the hypnotic and analgesic properties of ketamine which increase its efficacy in lowering EA [14, 15]. Unlike some earlier studies that identified postoperative pain, male gender and youth to be substantial risk factors for EA our investigation did not find any significant differences in the incidence of EA between males and females [10, 16-17]. This divergence may be attributed to the fact that our study was carried out across various centres and encompassed a diversity of surgical teams, surgical methods and patient treatment practices. Despite this variability intramuscular ketamine injection remained a consistently effective approach across several centers suggesting the resilience of this intervention [10, 18]. Previous research has linked the use of tracheal tubes and urinary catheters, smoking, inhalational anesthesia, postoperative nausea and vomiting and these conditions to an increased risk of endodontic [19-20]. Our research yielded similar results showing that ASA II physical status and lengthier surgical periods were significant predictors of early anesthesia. Moreover, the kind and length of nose surgery were discovered to be significant risk factors defying previous studies that had not found these variables to be significant. This discrepancy may be explained and the risk of EA increased by include OSRP operations which often involve more extensive manipulation and longer operating times than simpler nasal procedures [19]. This study provides compelling evidence in favor of intramuscular ketamine administration at a lower dosage to successfully reduce the incidence of EA and pain ratings in individuals undergoing septoplasty or OSRP [2]. These findings emphasize the need for tailored anesthetic strategies to lower EA particularly in patients with established risk factors such as ASA II status and longer recovery periods. The findings demonstrate that EA and pain following surgery were two different clinical occurrences. However, distinguishing between EA and post-operative pain-induced behavioral changes may prove difficult. Adults with a greater prevalence of EA were found to be those who scored five on a numerical rating scale for postoperative pain. However, EA has the potential to exacerbate post-operative discomfort. Consequently, appropriate postoperative pain treatment may have an impact on when EA develops [10]. The limitations of the study should be considered when assessing the results. The multicenter design of the study introduces diversity in surgical methods patient management practices and anesthesia protocols which might affect the consistency of the results. Also the sample size and specific patient attributes may limit the data generalizability to broader populations. Moreover, the study did not completely account for known risk factors for EA such as the use of catheters and tubes smoking and PONV. In conclusion distinguishing between EA and postoperative pain can be challenging which may lead to an inaccurate interpretation of the data. Further research should focus on conducting larger-scale multicenter studies using established methods to improve the validity and generalizability of findings on the efficacy of intramuscular ketamine in reducing pain and anxiety. To further understand the influence of possible confounders on EA results thorough evaluations of patient characteristics including smoking status and the presence of tubes and catheters should be included.

## CONCLUSIONS

When ketamine was injected intramuscularly at a dosage of Comprehensive assessments of patient characteristics including smoking status and the presence of tubes and catheters should be included to better understand the impact of potential confounders on EA outcomes 7 mg/kg at the conclusion of the procedure it was highly effective in stopping EA following OSRP and septoplasty. Although complete prevention of EA was not possible it can be lessened when appropriate risk factors were changed. Even though injectable ketamine was a preventive treatment the three most risk factors for the development of EA were longer surgical durations OSRP surgery and ASA II physical status.

## Authors Contribution

Conceptualization: AT
Methodology: SN
Formal analysis: WK, KJ, BK
Writing, review and editing: KJ, BK, AR

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

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