



# Ketamine-induced generalized convulsive seizure during procedural sedation

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Ketamine is used widely in emergency departments for a variety of purposes, including procedural sedation for facial laceration in pediatric patients. The major benefits are its rapid onset of effects, relatively short half-life, and lack of respiratory depression. The known side effects of ketamine are hallucinations, dizziness, nausea, and vomiting. Seizure is not a known side effect of ketamine in patients without a seizure history. Here, we present the case of a patient in whom ketamine likely induced a generalized tonic-clonic seizure when used as a single agent in procedural sedation for facial laceration repair. The aim of this article is to report a rare and unexpected side effect of ketamine used at the regular dose for procedural sedation. This novel case should be of interest to not only emergency physicians but also plastic surgeons.

**Keywords:** Epilepsy, tonic-clonic / Ketamine / Seizures

## INTRODUCTION

Ketamine is an effective and versatile drug used commonly in the emergency department. It has been in clinical use since 1965 as a general anesthetic for humans and has an excellent medical safety profile [1]. Ketamine is desirable as an anesthetic in procedural sedation owing to its rapid onset of effects, relatively short half-life, and lack of respiratory depression. Additionally, it has been used for its antidepressant, analgesia, and anti-inflammatory effects, and in the treatment of schizophrenia. However, the side effects of ketamine include hallucinations, visual disturbances, dizziness, nausea, and vomiting, and it has potential for abuse [2]. Although literature regarding the convulsant potential of ketamine is currently unclear, some authors have mentioned that ketamine demonstrates anticonvulsant and neuroprotective properties and can be used as an effective medication for treating refractory status epilepticus [3].

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Despite recent reports on the use of ketamine for the treatment of seizures, we here report a case of a healthy 7-year-old male patient who underwent ketamine procedural sedation and developed a new-onset generalized tonic-clonic seizure.

## CASE REPORT

A healthy 7-year-old boy weighing 20 kg presented to the emergency department with a history of complaints of a 1-cm laceration on his nose. He had no past medical history. He was comfortable, and not distressed, and his initial vital signs were normal. Physical examination findings were normal, except for a laceration on his nose. After a discussion with the patient's parents, a decision was made to perform laceration closure under procedural sedation. Ketamine was chosen as the sedating agent for the procedure at a dose of 80 mg (4 mg/kg), which is in the accepted intramuscular dosage range. Consent for sedation was obtained from the patient's parents after a full discussion about the risks and benefits of procedural sedation and the known side effects of ketamine. Ketamine was administered as a one-time dose intramuscularly. The patient was on a cardiac moni-

tor with pulse oximetry and end-tidal carbon dioxide monitoring throughout the procedure, and he remained normoxic. About 5 minutes after ketamine injection, the patient suddenly developed twitches and stiffness followed by bilateral symmetrical rhythmic tonic-clonic movements with up-rolling of the eyeballs. The seizure lasted for about 90 seconds before it was terminated with two consecutive injections of lorazepam (1 mg intramuscular and 1 mg intravenous). The patient was admitted to the pediatric department for further observation and evaluation. Additional history taking at that time revealed no risk factors for seizures; normal growth and development; no history of febrile seizures, prior head trauma or other neurological disorders; and no family history of seizures. His vital signs were normal, and neurological examination showed no focal deficits, except a drowsy mental state. A post-ictal blood test revealed changes in the increased levels of lactate (3.5 mmol/L) and decreased levels of pH (7.294) consistent with recent convulsions. Complete blood count, chemical analysis, urinalysis, and chest radiography findings were normal, and he was fully awake for 10 hours after the event. Electroencephalography (EEG) was performed on the day after the event, and the results showed a normal waking record with no focal slowing area, epileptiform discharge, or electrographic seizure. He had no further seizure activity throughout his hospital stay, and he was discharged in a stable condition. Follow-up of the patient up to 1 year revealed no recurrence of seizure.

## DISCUSSION

Ketamine was introduced commercially in 1970 with the manufacturer's description of a "rapidly acting, nonbarbiturate general anesthetic" and with a suggestion that it would be useful for short procedures [3]. For more than 50 years, ketamine has been proven to be a safe anesthetic drug with potent analgesic properties [4]. It is considered relatively safe when used with proper precautions in the emergency department and has been successfully administered to patients for procedures, such as laceration repair. As plastic surgeons, we have become more comfortable with the use of this drug regularly for procedural sedation in pediatric patients because of its rapid onset of effects, relatively short half-life, and lack of respiratory depression [5]. Ketamine has been used for the treatment of delirium, depression, and schizophrenia, and for its analgesia and anti-inflammatory effects [2]. Furthermore, the anticonvulsant effects of ketamine have been demonstrated recently, and new reports showed that ketamine can effectively control refractory status epilepticus [6,7]. However, in our case, ketamine injection resulted in generalized tonic-clonic seizure activity in the absence

of any known predisposing factors of convulsion. This unusual case emphasizes the possibility of ketamine-induced seizures.

Various reports describe both the proconvulsant and anticonvulsant effects of ketamine. One potential reason is that ketamine exists as asymmetric molecules called enantiomers. This minor variation in the drug's structure may influence its affinity for a certain receptor binding site and produce different effects for each enantiomer [8]. For example, the S (+) isomer of ketamine is more potent and suppress epileptic activity in the EEG amplitude and frequency, whereas the R (-) isomer is less potent and unable to suppress the similar degree of EEG amplitude and frequency [9]. However, the exact etiology of the proconvulsant effect of ketamine remains unclear.

To manage the side effects of ketamine, the initial drugs recommended are benzodiazepines which are routinely administered along with ketamine to reduce hallucinations [10]. In our case, two consecutive injections of lorazepam (1 mg intramuscular and 1 mg intravenous) were used, and the seizure stopped. Only few reports have mentioned the association between ketamine administration and seizures in healthy individuals. To the best of our knowledge, this is the first case report of ketamine-induced seizure with literature review in Korea, aimed at helping recognize the uncommon side effect of ketamine and treatment option. Given the frequency at which ketamine is administered in the emergency department for facial laceration repair or other routine procedures, not only emergency physicians but also plastic surgeons should be aware that ketamine could potentially induce seizures even in healthy individuals.

## NOTES

### Conflict of interest

No potential conflict of interest relevant to this article was reported.

### Ethical approval

The study was approved by the Institutional Review Board of Bundang Jesaeng Hospital (IRB No. 2021-03-005) and performed in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained.

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### Author contribution

Conceptualization: JHK, CKL, BDM. Methodology: CEC, DCK. Investigation: JHK. Writing - original draft: JHK. Writing - review & editing: JHK, CKL, SHY, BDM.

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