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Unexpected consequences: A case of ketamine-induced seizure in procedural sedation

Adem Az^{1*}, Yunus Doğan²

¹Department of Emergency Medicine, Haseki Training and Research Hospital, University of Health Sciences, Istanbul, ²Department of Emergency Medicine, Mus State Hospital, Mus, Türkiye
*Corresponding author

Abstract:

This case report describes a 32-year-old male who underwent ketamine procedural sedation and experienced a generalized tonic-clonic seizure. Despite its rapid onset and favorable tolerance profile, this case emphasizes the potential convulsive side effects of ketamine, which is commonly used for procedural sedation. While ketamine has shown promise in treating acute pain, refractory status epilepticus, and treatment-resistant depression and schizophrenia, it is associated with side effects such as hallucinations, visual disturbances, dizziness, nausea, and vomiting. The patient in this case received a carefully titrated dose of 40 mg of ketamine intravenously and underwent successful shoulder reduction while under sedation. However, within 60 s of receiving the ketamine, the patient experienced a 60-s seizure that was stopped with the administration of 5 mg of diazepam intravenously. The patient was hospitalized for further evaluation, including an electroencephalography (EEG) that showed no abnormalities. This case highlights the need for health-care professionals to be aware of the potential convulsive side effects of ketamine and to carefully monitor patients who receive ketamine sedation.

Keywords:

Adverse effect, ketamine, procedural sedation, seizure

Introduction

Ketamine, a dissociative anesthetic, is widely utilized in the initiation and maintenance of anesthesia.^[1] Its ease of administration and favorable tolerance profile compared to similar anesthetics have led to its widespread use in emergency departments (EDs).^[2] It is particularly useful in situations where maintaining airway reflexes is important, such as in trauma cases or during endotracheal intubation.^[1] In addition, ketamine has potent analgesic properties, especially in situations of acute or chronic pain where other medications are less effective.^[1,2]

Ketamine's rapid onset of action, short half-life, lack of respiratory depression, and medical safety make it a desirable anesthetic for procedural sedation.^[1] Its dissociative properties make it particularly useful for painful procedures in EDs, pediatric units, and dental offices, among others.^[1-3] In addition, at subanesthetic doses, ketamine is a promising agent for treatment-resistant depression and schizophrenia, agitated delirium, and has also been recently suggested for use in refractory status epilepticus.^[1,3] Ketamine is known to cause hallucinations, visual disturbances, dizziness, nausea, and vomiting as common side effects. Moreover, it has the potential for abuse due to its euphoric and dissociative effects.^[4]

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ORCID:

AA: 0000-0002-7204-6185
YD: 0000-0002-9456-8777

Address for correspondence:

Dr. Adem Az,
Haseki Training and
Research Hospital, Ugur
Mumcu, Atatürk Street
54, Zip Code: 34265
Sultangazi/Istanbul,
Türkiye.
E-mail: adem.aaz@gmail.com



In this case report, a previously healthy 32-year-old man developed a generalized tonic-clonic seizure following ketamine procedural sedation. While ketamine is recommended as an effective treatment for refractory status epilepticus, this case highlights the potential convulsive side effects of the drug.

Case Report

A 32-year-old male was admitted to the ED with an acute posterior shoulder dislocation resulting from a fall while playing football. The patient had no concurrent medical conditions. On admission, he was in pain and distress, though his initial vital signs were unremarkable: Arterial blood pressure was 130/70 mmHg, heart rate was 88/min, respiration rate was 14/min, and peripheral oxygen saturation (SpO₂) was 98%. He was free of head or spinal injuries, and both neurological and physical examinations showed no abnormalities except for pain and a prominent coracoid process on the left shoulder. No neurovascular deficits were observed in the patient's left upper extremity. Anteroposterior and lateral X-rays of the left shoulder confirmed the diagnosis of a posterior dislocation. The patient exhibited sufficient pain tolerance at rest, thus he did not require the administration of additional medication or analgesics. However, due to severe pain during shoulder manipulation, procedural sedation was advised. The patient was informed about the risks and benefits of procedural sedation, as well as the potential side effects of ketamine, and obtained informed consent before administration. Given his weight of 70 kg, the appropriate dose of ketamine for procedural sedation was calculated at 0.5–1 mg per kg. After receiving a carefully titrated dose of 40 mg of ketamine intravenously (IV), the patient's shoulder was successfully put back into place while under sedation. Throughout the procedure, the patient's heart rate, oxygen levels, and breathing were continuously monitored. Unfortunately, within 60 s of receiving the ketamine, the patient experienced sudden bilateral symmetrical rhythmic tonic-clonic movements and upward rolling of the pupils. The seizure lasted approximately 60 s and ended within seconds after using 5 mg of diazepam administered IV.

A detailed medical history was taken, but no additional features or risk factors for seizure activity were identified in either the patient or their family history. There was no record of epileptic seizures in the patient's or family's medical history, and the patient did not use any medications or drugs. The postseizure blood gas analysis revealed an increase in lactate levels (3.9 mmol/L) and a decrease in pH levels (7.24), which are typical findings in cases of convulsions. Complete blood count, biochemical analysis, and neuroimaging were all unremarkable. After approximately 20 min, the patient fully regained

consciousness and both physical and neurological examinations revealed no abnormalities. The patient was informed of the seizure and admitted to the hospital for further evaluation and follow-up.

The next day, an electroencephalography (EEG) was performed, and the results showed a normal wake-up recording, with no focal slowing areas, epileptiform discharges, or electrographic seizures. The patient had no further seizure activity during their hospital stay and was discharged in stable condition. Informed patient consent has been obtained for the publication of this case report.

Discussion

Ketamine is an anesthetic drug with a high safety profile, exhibiting potent analgesic properties.^[1] In addition, the substance is commonly utilized within EDs for procedural sedation due to its rapid onset of action, short half-life, and noninducing respiratory depression.^[2] Recently, several reports have underscored the anticonvulsant properties of ketamine, complementing its sedative and analgesic effects.^[5,6] Borris *et al.* stated that ketamine effectively controls prolonged and drug-resistant status epilepticus in animal models.^[5] Moreover, Borsato *et al.*'s literature review of the National Library of Medicine supports the use of ketamine for treating refractory epilepsy.^[6] Although previous studies have highlighted ketamine's neuroprotective properties, our case reported a generalized tonic-clonic seizure induced by the ketamine.

Only one case of ketamine-induced seizure has been reported in the literature, similar to our case. Kim *et al.* documented the case of a 7-year-old child undergoing procedural sedation who also experienced a seizure.^[7] Modica *et al.* have noted that the administration of anesthetic or analgesic drugs during surgical procedures may result in simultaneous seizures. Furthermore, the authors pointed out that certain anesthetics possess both anticonvulsant and proconvulsant properties.^[8] The authors suggested that this adverse reaction may be related to the asymmetric nature of ketamine enantiomers.^[8] However, the precise etiology of ketamine's proconvulsant effect remains unclear.

A systematic review investigating the pro and antiepileptic properties of ketamine has highlighted that numerous studies on both human and animal subjects strongly suggest its antiepileptic effects.^[9] Nevertheless, among the 30 clinical studies analyzed, only four stated ketamine's potential to trigger seizure activity in patients predisposed to epilepsy. However, the precise mechanisms underlying its potential to trigger seizures are not fully understood.^[9] Although Shehata

et al. did not identify definitive evidence of ketamine causing generalized convulsions in epileptic patients, they advised exercising caution when administering ketamine during anesthesia to susceptible individuals. Furthermore, they recommended combining ketamine with a benzodiazepine agent or propofol in epileptic or sensitized patients undergoing procedural sedation.^[9]

Conclusion

Although ketamine has been recommended as an effective treatment for resistant status epilepticus, this case highlights its potential convulsive side effects. Health-care professionals must be aware of these risks and monitor patients receiving ketamine sedation carefully. Ketamine should only be administered for procedural sedation by trained health-care professionals equipped to manage any adverse effects. Further research is necessary to fully comprehend the relationship between ketamine and seizures.

Author contributions statement

AA: Data collection, data improvement, original draft writing, review writing, and editing, final approval. YD: Data collection, software, data improvement, review writing and editing, and final approval.

Conflicts of interest

None declared.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published

and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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