Review

Exploring the Major Triggers of Seizures Due to Drug Overdose and Their Corresponding Countermeasures

Ahmed Aljefri1*, Abdulrahman Alkhateeb2, Abdulrahman Alkhaibari3, Rawabi Gabban4, Osamah Alamin5, Fatimah Alrib6, Fahad Alanazi7, Tameem Abualiat8, Sarah Alshehab9, Ghada Aljuhani10, Aman Diqarshawi11, Abdulaziz Altalhi1, Adel Albeladi1

1 Department of Emergency Medicine, Al Thager Hospital, Jeddah, Saudi Arabia
2 Department of Emergency Medicine, King Fahad General Hospital, Al Ahsa, Saudi Arabia
3 Department of Emergency Medicine, King Fahad General Hospital, Medina, Saudi Arabia
4 Department of Anesthesia, Maternity and Children Hospital, Tabuk, Saudi Arabia
5 College of Medicine, Taibah University, Medina, Saudi Arabia
6 Department of Internal Medicine, Qatif Central Hospital, Qatif, Saudi Arabia
7 Department of Internal Medicine, Al Naqaha Hospital, Riyadh, Saudi Arabia
8 Department of Urology, Armed Forces Hospital Southern Region, Khamis Mushait, Saudi Arabia
9 College of Medicine, King Faisal University, Al Ahsa, Saudi Arabia
10 College of Medicine, Ibn Sina National College, Jeddah, Saudi Arabia
11 Alamjad United Polyclinic, Medina, Saudi Arabia

Correspondence should be addressed to Ahmed Aljefri, Department of Emergency Medicine, Al Thager Hospital, Jeddah, Saudi Arabia. Email: ahmad.jefri2011@gmail.com. Copyright © 2023 Aljefri, this is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Received: 12 December 2023, Accepted: 20 December 2023, Published: 24 December 2023.

Abstract

Seizures in the context of drug overdose present a complex challenge, primarily arising from central nervous system (CNS) stimulation, electrolyte imbalances, reduced seizure thresholds, drug interactions, hepatic impairment, and direct CNS toxicity. Commonly implicated substances include stimulants like amphetamines, cocaine, and ecstasy, as well as prescription medications like opioids and benzodiazepines. Management strategies include the use of benzodiazepines to reduce neuronal activity, fluid resuscitation, electrolyte replacement therapy, and specific interventions for drug interactions and hepatic impairment. The clinical manifestations of drug-induced seizures are diverse, including convulsions, altered consciousness, autonomic dysfunction, focal neurological deficits, and in severe cases, status epilepticus. These manifestations require swift and targeted clinical interventions to minimize patient morbidity and mortality. This comprehensive review addresses the significant public health concern of drug overdose-related seizures, focusing on the triggers and appropriate countermeasures. The management of drug overdose-induced seizures is a nuanced and multifaceted process. It demands a coordinated effort from healthcare professionals, integrating prevention strategies, patient-centered care, and continuous monitoring to ensure effective management and long-term recovery.

Keyword: Drug overdose seizures, Central nervous system stimulation, Anticonvulsant medications, Multidisciplinary management, Status epilepticus
Introduction

Drug overdose poses a public health concern that has reaching implications and one of the worrisome effects linked to it is seizures (1). Seizures resulting from drug overdose can lead to complications. Present a significant challenge, for healthcare professionals (2). The primary trigger for seizures in drug overdose is stimulation of the nervous system (CNS). Various substances, including stimulants and certain prescription medications can cause an over activation of neurons, which ultimately leads to the occurrence of seizures (3). For instance, amphetamines, cocaine and ecstasy are notorious for their ability to excessively stimulate the CNS, potentially resulting in seizures. To address this issue healthcare professionals, employ medications such as benzodiazepines to reduce neuronal activity and prevent seizure escalation. Another significant trigger is the disruption of balance caused by drugs. Electrolytes play a role in maintaining neuronal membranes and ensuring proper nerve conduction (4, 5). Opioids for example have been associated with seizures due to their potential to induce hyponatremia—a condition characterized by sodium levels (6, 7). To counteract this effect targeted interventions such as resuscitation and electrolyte replacement therapy are implemented to restore balance. Moreover, certain medications can have the tendency to decrease the seizure threshold, which can render individuals more vulnerable to experiencing convulsions (8). The withdrawal process from benzodiazepines is widely known for its association with seizures. Abruptly stopping these medications can cause the seizure threshold to rapidly decline (9, 10). To prevent this, it is recommended to reduce the dosage under supervision while also using antiepileptic medications to minimize the risk of seizures during the withdrawal process (11). Another factor that can trigger seizures is the interaction between drugs, especially when someone takes medications at the same time. This can lead to interactions that affect how drugs are processed in the body and potentially result in seizures. For example, combining antipsychotics and antidepressants has been linked to a seizure threshold. To mitigate this risk, it's important to manage medication use consider drug interactions and adjust doses accordingly (12, 13). The liver plays a role in clearing drugs from the body so any impairment, in liver function can significantly impact how medications are processed. In cases of liver failure caused by acetaminophen, overdose toxic metabolites can contribute to seizures. To counteract this, administering N acetyl cysteine has proven effective as it prevents the formation of metabolites and helps avoid seizures. Additionally, some drugs directly affect the CNS and have proconvulsant properties. Theophylline, which is frequently prescribed for ailments has the potential to cause seizures due to its impact on the CNS. The recommended approach, in some cases, involves stopping the use of the medication and providing appropriate supportive measures to handle seizures. If required antiepileptic drugs may also be administered as part of the treatment.

Apart, from the effects of drugs in causing seizures during an overdose the way they are administered also contributes to the occurrence. When drugs like heroin are injected intravenously there is a chance of introducing contaminants and infections into the body, which can lead to conditions such as endocarditis and encephalitis that may trigger seizures (14, 15). To counteract this, it is important to identify and treat any underlying infections while also providing antimicrobial therapy and supportive care. Furthermore, various factors related to the drug overdose context such as influences and coexisting medical conditions can affect the likelihood of seizures. For instance, individuals with a history of epilepsy or other preexisting neurological disorders may be more prone to experiencing seizures during a drug overdose situation complicating their management. To address this complexity, it becomes crucial to assess the patient’s history and implement tailored interventions that target both the drug overdose itself as well as any underlying neurological conditions. Consequently, managing seizures resulting from drug overdose requires a nuanced approach that takes into account factors. These include addressing stimulation in the CNS correcting electrolyte imbalances reducing seizure thresholds, managing potential drug interactions.
and hepatic impairment issues minimizing direct CNS toxicity risks, as well as considering contextual factors. By considering these aspects, we can effectively reduce the risk of seizures in cases of drug overdose. This literature review emphasizes the significance of healthcare professionals having an understanding of the triggers and appropriate countermeasures for drug overdose related seizures. The review aims to provide an overview of the triggers and their corresponding ways to prevent seizures caused by drug overdose.

**Discussion**

The conversation regarding the management of seizures caused by drug overdose emphasizes the need for a multidimensional approach. It is crucial to conduct a thorough assessment to lay the foundation for subsequent interventions with a focus on stabilizing life threatening complications. When dealing with challenges benzodiazepines are used to stop seizures followed by considering antiepileptic medications. Identifying and managing the underlying triggers is key in this management strategy. Various triggers, such as CNS stimulation, electrolyte imbalances, lowered seizure thresholds, drug interactions, hepatic impairment or direct CNS toxicity require responses tailored to each case (16). Integrating countermeasures like medications, fluid resuscitation, electrolyte replacement and using antidotes such as naloxone or N-acetylcysteine exemplify the range of approaches when dealing with drug induced seizures (17). It's essential not to overlook addressing coexisting conditions and behavioral manifestations. For individuals to have seizures due to discontinuation of benzodiazepines it requires careful tapering alongside administering antiepileptic medications. Taking an approach involves providing evaluation and creating a supportive environment while collaboratively managing substance use disorders, for long term prevention. Continuous monitoring, such as EEG surveillance allows for evaluation and adaptation of the treatment plan to achieve possible results. The collaborative approach to healthcare involving specialties and disciplines emphasizes the need for an effort in tackling the complex issues associated with seizures caused by medication.

**Clinical Manifestation**

Seizures that occur as a result of drug overdose can present with a range of symptoms each requiring a careful understanding, for effective medical management. These symptoms serve as indicators of the disruptions caused by drugs in the CNS. Drug induced seizures can manifest in ways encompassing signs and symptoms that healthcare professionals need to evaluate thoroughly in order to provide timely and targeted interventions. One prominent sign is the onset of convulsions. People experiencing drug induced seizures may show stiffening of muscles (tonic phase) followed by jerking (phase). These convulsions occur due to synchronized firing of neurons in the brain reflecting the impact of ingested substances (12). The intensity and duration of convulsions can vary, ranging from episodes to prolonged seizures requiring medical attention. Another significant manifestation associated with drug induced seizures is alterations in consciousness. Patients may experience loss of consciousness sometimes preceded by an aura or warning sign. This change in awareness occurs as a result of disrupted function, further complicating the clinical presentation and necessitating a comprehensive neurological assessment to determine the extent of CNS involvement (18). The length and characteristics of changes, in awareness, can give us information about how severe a seizure was and what complications might arise from it. Additionally, seizures caused by drugs often come with signs of dysfunction, which indicate that the autonomic nervous system is not functioning properly during the episode. Patients may undergo variations in their heart rate, blood pressure and breathing patterns. It's quite common for seizures to trigger responses such as increased heart rate, high blood pressure and irregular breathing. These responses highlight the stress caused by neural activity. It is essential to monitor and address these manifestations as part of the clinical management strategy to prevent any complications. Sometimes seizures induced by medications can lead to deficits during or after the seizure episode. These deficits can manifest as motor weakness, sensory disturbances or speech abnormalities depending on which specific regions
of the brain are affected by the seizure activity. These focal neurological manifestations do not help determine where the seizure originates from but play a significant role in guiding subsequent diagnostic investigations and treatment decisions. The clinical presentation of drug induced seizures becomes more complex due to the possibility of status epilepticus—a life threatening condition characterized by prolonged or recurrent seizures without any intervening periods of recovery. Status epilepticus requires intervention to prevent damage and systemic complications. The picture of status epilepticus may involve activity or a non-convulsive state underscoring the importance of vigilant monitoring and prompt therapeutic measures. In addition to all these factors drug induced seizures may also be accompanied by symptoms and behavioral changes. This adds another layer of complexity to their presentation. After experiencing a seizure, patients might display signs of confusion, restlessness or even psychological disturbances (6). The interaction between the effects of the substances we consume and their impact on our brains neurotransmitter systems contributes to these expressions. This highlights the importance of conducting an evaluation alongside a neurological assessment. It’s crucial to note that drug induced seizures don’t have a presentation across all substances. Different categories of drugs can cause types of seizures which in turn affect how they manifest clinically. For instance, stimulant drugs like cocaine and amphetamines can lead to hyperkinetic seizures whereas sedative hypnotic drugs such as benzodiazepines may result in more subdued and atonic seizures. Recognizing these substance differences is essential for diagnosis and customized treatment plans. In summary drug induced seizures exhibit a range of manifestations that require clinical judgment. These manifestations can vary from activity to subtle changes in consciousness disturbances in autonomic regulation focal neurological deficits and even psychiatric consequences. The possibility of status epilepticus adds a sense of urgency to the scenario. Therefore, healthcare professionals must conduct assessments of these expressions while having a solid understanding of the pharmacological triggers involved in order to develop effective interventions promptly and minimize the impact that drug induced seizures have on patient outcomes.

**Drug-Induced Seizures: Pharmaceuticals and Prevention**

Seizures caused by drug overdose are an emergency often triggered by various pharmaceuticals and drugs. Misusing or taking much of medications like opioids, benzodiazepines and antidepressants can significantly lower the threshold for seizures leading to uncontrolled firing of neurons (19). Opioids in particular pose a risk as they affect the nervous system and can induce seizures. While benzodiazepines are generally used to prevent seizures, taking much of them can paradoxically lead to seizures. Overdosing on antidepressant medications antidepressants may also cause seizures due to their anticholinergic effects (20). To address seizures caused by drug overdose promptly and effectively it is important to provide intervention such as administering antiepileptic drugs and offering supportive care while addressing the specific toxic effects of the substances ingested. Additionally, ensuring an airway providing support and using antidotes when available are crucial aspects of managing these situations. Understanding the properties of these drugs and implementing targeted interventions play a vital role, in reducing the risk of seizures associated with drug overdose.

**Management**

The careful handling of seizures caused by drug overdose requires an approach based on an understanding of the factors that contribute to them and the skillful implementation of clinical techniques. This complex procedure involves combining care, medication interventions and specific responses to identified triggers, in a manner. Effective management is dependent on swiftly and accurately carrying out each step to ensure the outcomes for those affected. When dealing with a patient experiencing seizures caused by medication, the initial assessment becomes of importance. It involves evaluating the patient’s airway breathing and circulation (ABCs) which then serves as a basis for actions. During this stage the
main focus is on identifying and addressing life threatening complications such as status epilepticus (prolonged seizures) distress or unstable heart rhythm. To achieve stabilization various strategies are employed including managing the airway providing oxygen and establishing intravenous access for fluid resuscitation if necessary. In cases where seizures continue or progress into status epilepticus the primary goal is to stop seizure activity. Benzodiazepines like lorazepam or diazepam are commonly used as frontline medications for this purpose. These drugs work by enhancing the effects of gamma aminobutyric acid (GABA) in the brain thereby reducing excitability of neurons and ultimately terminating seizure activity. While intravenous administration is preferred due to its onset of action alternative routes such as intramuscular or buccal may be considered when there are challenges with access. Once seizure activity has been terminated, attention shifts towards initiating or adjusting medications to prevent seizures. This consideration is especially important for individuals with a history of epilepsy or those at risk due to drug withdrawal. Medications such, as phenytoin, levetiracetam and valproic acid are frequently used to treat epilepsy. The choice of medication depends on factors, like the patient’s situation, any other medical conditions they may have and the possibility of drug interactions. Addressing and understanding the causes of seizures caused by drug use is a part of comprehensive management. When seizures are linked to overdose like cocaine or amphetamines the focus should be, on managing agitation controlling stimulation of the sympathetic nervous system and preventing further complications related to toxic effects of stimulants. On the hand if seizures are induced by opioids administering naloxone (a receptor antagonist) becomes necessary to reverse the effects of opioids and reduce ongoing seizure activity. Electrolyte imbalances often occur as a result of drug overdose. Require attention during management. Correcting hyponatremia (sodium levels) which is commonly associated with overdose involves using hypertonic saline solutions. Additionally, monitoring and correcting abnormalities such as hypomagnesemia or hypocalcemia are vital in preventing seizure recurrence and improving overall patient outcomes. Individuals who experience drug induced seizures often have coexisting conditions that require intervention. Hepatic impairment may need tailored approaches depending on the substance involved. For example, acetaminophen overdose necessitates administration of N acetylcysteine to prevent liver damage and related complications. Behavioral and psychiatric symptoms following seizures such as confusion or agitation should be given attention. Providing care and, when needed, assessing the patient’s health are crucial for their overall well-being. Creating a controlled setting plays a role in helping the patient overcome behavioral issues and aiding their recovery process. Preventing the recurrence of seizures is an objective when it comes to managing drug induced seizures in the term. It is important to identify and address the causes, such as substance use disorders. This requires an approach that includes counseling, rehabilitation programs and pharmacological interventions if necessary. Collaboration with addiction specialists and mental health professionals plays a role in the success of this multifaceted strategy. To track the patient’s status, vital signs and response to interventions continuous monitoring throughout the management process becomes essential. In cases where ongoing seizure activity is suspected regular electroencephalogram monitoring may be considered. The complexity involved in managing drug induced seizures emphasizes the need for an approach. By working emergency medicine physicians, neurologists, toxicologists, psychiatrists and addiction specialists can develop a cohesive strategy that addresses all aspects of care. Effective communication and coordination among healthcare professionals ensure a transition of care, from acute management to follow up and rehabilitation. To sum up, clinical management of seizures caused by drug overdose is a process that requires precision and a holistic perspective. The step, by step method described, which includes an evaluation stopping the seizure using drugs identifying triggers correcting electrolyte imbalances addressing other health conditions providing psychiatric care preventing future episodes constantly monitoring
the patients progress and coordinating all aspects of care forms the foundation of a comprehensive plan. By implementing each component of this plan we not manage the immediate seizure episode but also ensure long term recovery and prevent future seizures, for the patient.

**Conclusion**

In summary, managing seizures caused by drug overdose is an intricate process that requires a meticulous and comprehensive approach. Various factors, such as the use of medications, physiological aspects and environmental influences contribute to the triggers of seizures. As a result, a diverse range of measures must be taken to address these triggers. This includes terminating seizures using benzodiazepines and implementing targeted interventions to correct imbalances, hepatic issues and substance withdrawal symptoms. The management strategy for seizures is akin to orchestrating a coordinated symphony. The focus on prevention by addressing causes and coexisting conditions underscores the need for long term dedication in achieving outcomes. A holistic and effective management paradigm is achieved through monitoring, collaboration, among healthcare professionals. Adopting a patient centered approach. In a perspective this discussion highlights the significance of research and education in further refining our understanding and management capabilities regarding seizures associated with drug overdose. By improving our strategies healthcare professionals can better navigate the intricacies of drug induced seizures which ultimately leads to improved patient outcomes while addressing the public health concerns related to drug overdose consequences.

**References**


