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# Epileptic seizures: preclinical measures and management in the emergency room

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## Summary

Seizures are a frequent reason for a patient's presentation to the emergency room (ER). However, not every seizure is due to epilepsy and the clinical presentation of seizures varies considerably depending on the underlying pathology. In this report, we discuss the different causes of seizures and describe an evidenced-based practical approach to their differential diagnosis and treatment. We differentiate between preclinical measures and a patient's evaluation in the ER, as these differ considerably in practice. The article thus intends to provide emergency medical personnel and ER staff with a practical approach to the patient with a seizure.

Key words: epilepsy; seizures; emergency room

## Introduction

Seizures are a frequent reason to call for emergency medical services (EMS) and for presentation to the emergency room (ER). Between 5 and 10% of all adults experience a seizure during their lifetime [1]. The incidence strongly depends on age: around a third of all first seizures occur during childhood, with a steep decline between the tenth and the eighteenth year, while another third first presents after the age of 60 [2].

However, not every first seizure justifies a diagnosis of epilepsy. Epilepsy – as opposed to a single seizure – is characterised by at least one seizure, together with predisposition for further seizures [3, 4]. In clinical practice, this predisposition is often demonstrated by a second seizure more than 24 hours after the first [4]. While a seizure may in some cases be confidently diagnosed in a prehospital setting, the underlying pathology and a maintained predisposition can normally only be evaluated in an ER or outpatient setting. Thus, every first seizure requires the EMS to present the patient to an ER or qualified physician.

The clinical presentation of seizures, however, varies considerably depending on the underlying pathology. Patients may present with generalised muscle contractions, or with only temporarily impaired consciousness [5]. Furthermore, not all generalised muscle contractions are due to a true seizure but may be a consequence of syncope or a psychogenic attack.

## Differential diagnosis and classification

Seizures and pseudoseizures may have very different underlying causes. Table 1 presents common causes of seizure-like symptoms and important clinical features for their distinction.

**Table 1:** Clinical features of seizures and important differential diagnosis. Adapted from [6].

Differential diagnosis	Presentation	Duration	Eyes	Reorientation
<b>Epileptic seizure</b>	Highly variable ( <i>subjective symptoms [aura] to temporarily impaired consciousness to generalised muscle contractions</i> ) often constant for a given patient	Less than 2–3 minutes*	Open, non-fixating, empty, staring or looking upwards	Variable, typically slow
<b>(Convulsive) syncope</b>	High muscular tension before a tonic component or asynchronous muscle contractions, variable within the patient ( <i>often arm flexion together with leg extension</i> )	Brief (less than 10 seconds)	Open, often looking upwards	Fast
<b>Psychogenic attack</b>	Highly variable, often with loss of tension and/or arching of the back	Often more than 2 minutes	Often closed or pinched	Prolonged
<b>REM sleep abnormalities</b>	Restlessness periodic, often complex movements at night ( <i>mostly second half</i> )	Variable duration and intensity within attack	Closed	Often immediate memory of a dream

\* Seizures for more than 5 minutes present a status epilepticus and always require emergency treatment [12].

**Table 2:** Overview of frequent structural and metabolic causes for seizures. Adapted from [8]. Frequent causes and causes often associated with seizures in **bold**.

Traumatic	Mild traumatic brain injury Intracranial bleeding Postoperative <b>Severe traumatic brain injury</b>
Infectious	Encephalitis Meningitis Acquired immunodeficiency syndrome
Inflammatory	Vasculitis Lupus erythematosus
Metabolic	Electrolyte disorder <b>Diabetes mellitus</b> Hyperthyroidism Cushing syndrome Addison's disease Eclampsia
Toxic	Tricyclic antidepressants, ciclosporin, morphine, chloroquine, neuroleptic medication, theophylline, other medication
Withdrawal	<b>Alcohol</b> , benzodiazepines, barbiturates
Neoplastic	Brain tumours Meningioma Metastasis
Vascular	Intracranial bleeding <b>Stroke</b> Hypoxia Shock

Epileptic seizures used to be classified into idiopathic, symptomatic and cryptogenic. Newer classifications distinguish genetic, structural, metabolic or unknown causes [7]. While genetic causes for seizures are mostly multifactorial and lack options for causative treatment, seizures from structural or metabolic disorders are potentially curable. Table 2 provides an overview of structural and metabolic causes for seizures.

A second, clinically important distinction is between a seizure as a self-limiting attack of less than 2 minutes

and an epileptic status, which encompasses every longer seizure, typically lasting 5 or more minutes. Furthermore, while it may take a patient some time to fully recover from a seizure, all patients who fail to reach their preattack neurological status between two seizures suffer from an epileptic status by definition [12]. Diagnosing a status is especially complicated in nonconvulsive epilepsy.

### Preclinical measures

When called to the scene for “epilepsy”, the EMS is typically confronted with either an unconscious patient in a postictal state or with a patient in an epileptic status (since no EMS will arrive within 2 minutes and any seizure longer than that presents a status by definition). The two situations present very different challenges. Every epileptic status requires immediate pharmacological termination (using any one of the medications in table 3), together with protection of the patient from seizure-induced trauma. Administering medication to a convulsive patient may, however, be difficult and may require routes of access other than intravenous (see table 3).

On the other hand, it may be difficult to distinguish a patient in the postictal state undergoing slow recovery from a patient who is unconscious for possibly more threatening reasons. In this case, the EMS is limited to taking a history from any bystanders (or the person who called for the ambulance in the first place) and his or her examination skills. Typical findings include slowly improving Glasgow coma scale (GCS) score, pupils of equal size and reactivity to light, lateral tongue bite and possible loss of urine during a seizure.

**Table 3:** Anticonvulsive medication, dosage and route of administration. Adapted and extended from [9, 12].

Order of treatment	Drug	Dosage	Route of application	Comments
<b>Step 1 (prehospital or ER)</b>	Lorazepam (Temesta®)	0.1 mg/kg	i.v.	– Longer redistribution half-life than diazepam – First-line treatment [9] – Effective after 2–10 minutes
	Diazepam (Valium®)	0.2 mg/kg	i.v. or rectal	– Short redistribution half-life – Acts within 5 minutes – Rectal application when i.v. access cannot be established
	Midazolam (Dormicum®)	0.1 mg/kg	i.m. or buccal	When i.v. access fails
	Clonazepam (Rivotril®)	0.1 mg/kg	i.v.	Weak evidence
<b>Step 2 (ER or hospitalised patients)</b>	Phenytoin	15–20 mg/kg at less than 50 mg/minute	i.v.	– Monitor blood pressure and ECG – Cave: purple glove syndrome in ~2% – Terminates seizure in about 50% of patients where step 1 treatment failed [10]
	Valproate	Currently off-label use in Switzerland		
<b>Step 3 (intensive care unit)</b>	Phenobarbitone	Highly variable	i.v.	Administration by anaesthetist or ICU physician
	Propofol	Highly variable	i.v.	Administration by anaesthetist or ICU physician

Taking a detailed history is of critical importance for further treatment. Whether the current seizure is the first one (or a new seizure from already diagnosed epilepsy) is a key question since it implies the necessity of further diagnostic measures in a hospital. If the patient has an uncomplicated seizure, has already been diagnosed with epilepsy and is in a caring environment, it may not be necessary to take him or her to hospital.

The most common reason for seizures in patients diagnosed with epilepsy is the failure to take their prescribed medication [9]. In addition, EMS staff are required to estimate the likelihood of all possible causes for seizure listed in table 2. Taking a detailed history is then the key to a diagnosis. If blood glucose is measured in every patient, it is unlikely that hypoglycaemia will be overlooked; this may be either the cause or the consequence of a seizure.

In rare cases, cerebral infections (encephalitis) may first become evident through a seizure. Thus, any patient presenting with fever and a seizure has to be considered hazardous to EMS and ER staff until proven otherwise.

## Clinical management in the ER

The ER clinician responsible for a patient after a first seizure is confronted with a number of management questions. Arbeitsgemeinschaft wissenschaftlicher medizinischer Fachgesellschaften (AWMF) guidelines [6] provide the clinician with five questions which the authors consider key to further management of diagnosis and therapy.

### 1. Does the attack constitute a seizure at all?

When this question can be confidently answered on the basis of the history, typical clinical findings, EMS observations or a video recording of the attack, an EEG in the ER is usually not necessary [11], but often delays treatment [12]. It may, however, help to identify nonconvulsive status epilepticus (NCSE) in patients with persistently impaired consciousness or delirium [12].

### 2. Does this seizure have a treatable cause?

To answer this question, most guidelines now recommend magnetic resonance imaging (MRI) rather than computed tomography (CT), as a result of its higher sensitivity for most lesions causing seizure [6, 13, 14]. Although CT may be used rather than MRI, as it is more rapidly available in most ERs, especially for patients with trauma either prior to or during the seizure or where intracranial haemorrhage, sinus vein thrombo-

sis, vascular malformations or neoplastic causes are suspected. Metabolic, toxic or infectious causes are usually suspected on the basis of the patient's history and the clinical examination and are commonly diagnosed on the basis of laboratory findings.

### 3. Is this an acute symptomatic seizure?

While symptomatic seizures obviously require treatment of the underlying cause, the question as to whether, when and how this cause may be treated determines the necessity for anticonvulsive medication [6]. Patients with nonstructural causes (e.g., infectious, metabolic or toxic) or acute structural causes (traumatic or vascular) usually do not require anticonvulsive medication after a first seizure.

### 4. Is this the beginning of epilepsy?

As mentioned above, epilepsy is characterised by at least one seizure, together with a maintained predisposition for further seizures [3]. This predisposition is commonly established through MRI or EEG findings. A normal MRI and EEG render epilepsy highly unlikely [6].

### 5. Can the seizure be assigned to an epilepsy syndrome?

Although this question is highly relevant to the selection of an appropriate anticonvulsive medication, it cannot commonly be answered in the ER, but requires consultation by a specialised neurologist. This question is particularly relevant in paediatric ERs, since most epilepsy syndromes first present in young patients.

Besides these questions for patients with first seizures, ER staff are often confronted with the question of how to terminate status epilepticus or NCSE. Table 3 provides a stepwise regimen based on expert consensus [9, 12]. It is important to notice that once patients reach step 2 of the regimen they require hospitalisation, possibly on an intensive care unit (ICU) (from step 3 on).

Once epilepsy has been diagnosed and the patient is ready to be discharged (either with or without anticonvulsive medication as determined by a neurologist), it is important to inform patients about required behavioural changes. For example, death by drowning is 20 times more common in epileptic patients than in the general population [6], so patients should avoid swimming and should take showers rather than baths. Likewise, driving cars or working with large machinery becomes more dangerous and should be avoided (for driving authorisations, see the updated directive of the Swiss League against Epilepsy [15]).

## Conclusion

Seizures must be differentiated from other forms of convulsive or nonconvulsive attacks, and this can be challenging for EMS and ER staff. In this case, a detailed history and examination is key to the diagnosis. Not every patient with a first seizure is suffering from epilepsy, but every first seizure requires neuroimaging, usually MRI, in order to evaluate the maintained predisposition and to identify potential causes. In patients already diagnosed with epilepsy, the failure to take their medication is the most common cause for a seizure. Status epilepticus and especially NCSE are serious complications and require medical termination. Treatment should follow a stepwise approach. Patients should be instructed on behavioural changes before discharge, once they are diagnosed with epilepsy.

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