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# Dissociative seizures in the emergency room: room for improvement

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**ABSTRACT**

**Background** Dissociative seizures, also known as functional or psychogenic non-epileptic seizures, account for 11%–27% of all emergency seizure presentations. Misdiagnosis as epileptic seizures is common and leads to ineffective and potentially harmful treatment escalations. We assess the potential for diagnostic improvement at different stages of emergency workup and estimate the utility of benzodiazepines.

**Methods** A retrospective study of all emergency presentations with a discharge diagnosis of acute dissociative seizures seen at a university hospital 2010–2022 was performed to assess clinical characteristics and emergency decision-making.

**Results** Among 156 patients (73% female, median 29 years), 15% presented more than once for a total of 203 presentations. Half of seizures were ongoing at first medical contact; prolonged seizures and clusters were common (23% and 24%). Diagnostic accuracy differed between on-site emergency physicians and emergency department neurologists (12% vs 52%). Typical features such as eye closure, discontinuous course and asynchronous movements were common. Benzodiazepines were given in two-thirds of ongoing seizures, often in high doses and preferentially for major hyperkinetic semiology. Clinical response to benzodiazepines was mixed, with a minority of patients remaining either unaffected (16%) or becoming critically sedated (13%). A quarter of patients given benzodiazepines by emergency medical services were admitted to a monitoring unit, 9% were intubated.

**Conclusions** Improved semiological assessment could reduce early misdiagnosis of dissociative seizures. Although some seizures seem to respond to benzodiazepines, critical sedation is common, and further studies are needed to assess the therapeutic ratio.

**WHAT IS ALREADY KNOWN ON THIS TOPIC**

⇒ In emergency care, functional/dissociative seizures are common, but are often misdiagnosed and treated as epileptic seizures, which can have deleterious consequences.

**WHAT THIS STUDY ADDS**

⇒ Our analysis of 203 emergency presentations suggests that improved semiological assessment could reduce the high rates of misdiagnosis at the prehospital phase, and that benzodiazepines have mixed effects that require further study.

**HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY**

⇒ Our study suggests that training of emergency personnel regarding dissociative seizures is urgently needed, and that acute treatment alternatives to sedation need to be developed and tested prospectively.

emergency deployments, 11%–27% of patients initially treated for epileptic seizures are later diagnosed with dissociative seizures.<sup>3–5</sup> Even in status epilepticus treatment trials, where diagnostic workup and management are strictly regimented, 5%–10% of patients are later diagnosed with dissociative seizures.<sup>3,6</sup>

Whether misdiagnosed or not, patients with dissociative seizures regularly attend and reattend emergency rooms.<sup>7–9</sup> Finding the right approach, workup and treatment has only recently become the subject of inquiry.<sup>10,11</sup> There are, at present, no evidence-based guidelines for the acute treatment of dissociative seizures, owing in part to the lack of data on current practices and epidemiology. Open questions include opportunities to reduce misdiagnosis, and the risk–benefit ratio of using benzodiazepines. This study audits the clinical decision-making in emergency care for acute dissociative seizures.

**METHODS****Study design and patient sample**

Patients who received the primary discharge diagnostic code F44.5 or F44.88 representing dissociative seizures or psychogenic seizures in the German version of the International Statistical Classification of Diseases and Related Health Problems Version 10 between 1 January 2010 and 31 December 2022 were identified from the electronic health records

**INTRODUCTION**

Dissociative seizures, also known as functional or psychogenic non-epileptic seizures, are paroxysms of impaired awareness and motor control.<sup>1</sup> They can be triggered by intense affect and entail autonomic and cognitive symptoms of arousal including dissociation. Associated movement patterns include innate defensive behaviours and cultural idioms of distress. They are experienced as involuntary but can be responsive to social interactions.<sup>2</sup> When attacks are characterised by reduced responsibility and tremulous or convulsive movements they are often misdiagnosed as epileptic seizures. In emergency care, where seizures make up 3%–5% of all



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of the University Hospital Knappschaftskrankenhaus Bochum in Germany. All patients with an acute seizure within 24 hours of presentation were included, regardless of the mode of arrival and further care. Patients who presented for other reasons and later had a dissociative seizure as well as those arriving as transfers from other hospitals were excluded.

### Setting

In Germany, prehospital emergency care is provided by paramedics and, in potentially life-threatening situations, an emergency physician who arrives on scene and accompanies the patient to the hospital. Once at the emergency department, hospital staff take over with an on-call neurology trainee or neurologist handling further care until discharge or admission. Hyperacute care in the emergency department is further supported by an on-call anaesthesia team when necessary. Our neurology department has an incorporated level 4 epilepsy centre with capabilities for on-demand long-term video-electroencephalography (EEG) monitoring. In 2014, our department organised regional training lectures for semiological diagnosis of seizures that were attended by a total of 120 emergency physicians.<sup>12</sup>

### Data collection and clinical parameters

Demographic, clinical and procedural data were extracted from all available documentation including archived emergency medical services (EMS) records. Glasgow Coma Scale (GCS) scores were extracted from EMS documentation and used to categorise initial impairment of responsiveness by severity as mild (13–15), moderate (9–12) or severe (3–8). Semiology of presenting seizures was derived from all available patient documentation including video-EEG and witness reports, and classified into the following categories: ‘major motor’, which includes hyperkinetic or convulsive seizures; ‘minor motor’, where motor signs are prominent but limited in spread and severity (eg, isolated tremulous movement of one leg); ‘akinetetic’, which includes syncope-like or stuporous presentations; ‘sensory’, which includes isolated subjective phenomena (eg, numbness) without motor manifestations or disruption of responsiveness.<sup>13 14</sup>

Informed by a literature search, we extracted semiological characteristics that are helpful in recognising dissociative seizures: duration >2 min, closed eyes, forced eye closure, eyelid flutter, fluctuating/discontinuous course, non-synchronous movements, pelvic thrusting, side-to-side head or body movement, ictal crying/weeping and preserved awareness during bilateral movements.<sup>15–17</sup> To quantify benzodiazepine use, diazepam equivalent doses were calculated according to published conversion factors.<sup>18–20</sup>

### Statistical analysis

Data analysis was performed using JASP version 0.15 and SPSS version 21.0. Demographic and clinical features were summarised through descriptive statistical methods. Associations between clinical parameters were further explored with logistic regressions.

## RESULTS

### Patient sample and clinical characteristics

We identified 203 cases of emergency presentations with a primary discharge diagnosis of F44.5 (82%, 168/203) or F44.88 (18%, 35/203) across 156 individual patients (73% female) with a median age at first presentation of 29 years (range: 17–80 years; mean: 34 years). Overall, 23 patients (15%) presented on multiple occasions: 17 presented 2 times and 6 presented 3–8 times.

In 23% (48/203) of cases, a seizure duration of more than 5 min was noted, and in 24% (44/203) seizure clusters were observed. Semiology was documented in sufficient detail to allow categorisation in 188 cases (93%). Of those, 37% were ‘major motor’, 35% were ‘minor motor’, 28% were ‘akinetetic’ and none were ‘sensory’ type.

Prehospital GCS scores were recorded in 76 instances, accounting for half of all 150 cases transported by EMS. Of those, 51% (39) had mild, 14% (11) moderate and 35% (26) severe impairment prior to treatment.

In 48% of cases (98/203) seizures had ceased before first medical contact. In the remaining cases, seizures were ongoing (or recurring) on initiation of medical care with 35% (72/203) ceasing after EMS arrival but before the ambulance reached the emergency department, and in 16% (33/203) only after admission to the emergency department.

### Pathways of care

A total of 74% of patients (150/203) were brought to the emergency department by EMS, 83% (124/150) of those accompanied by an emergency physician (figure 1). Self-referred walk-ins accounted for 45 cases, and mode of arrival was not documented in 8 cases.

Following emergency workup, 30% (60/203) were discharged from the emergency department, while the remaining 70% (143/203) were admitted as inpatients. Of all hospitalised cases, 87% (124/143) were admitted to a regular ward, while 13% (19/143) were admitted to an intermediate (n=5) or intensive care unit (ICU, n=14). Among those admitted to the ICU, 50% (7/14) were intubated.

### Diagnostic accuracy

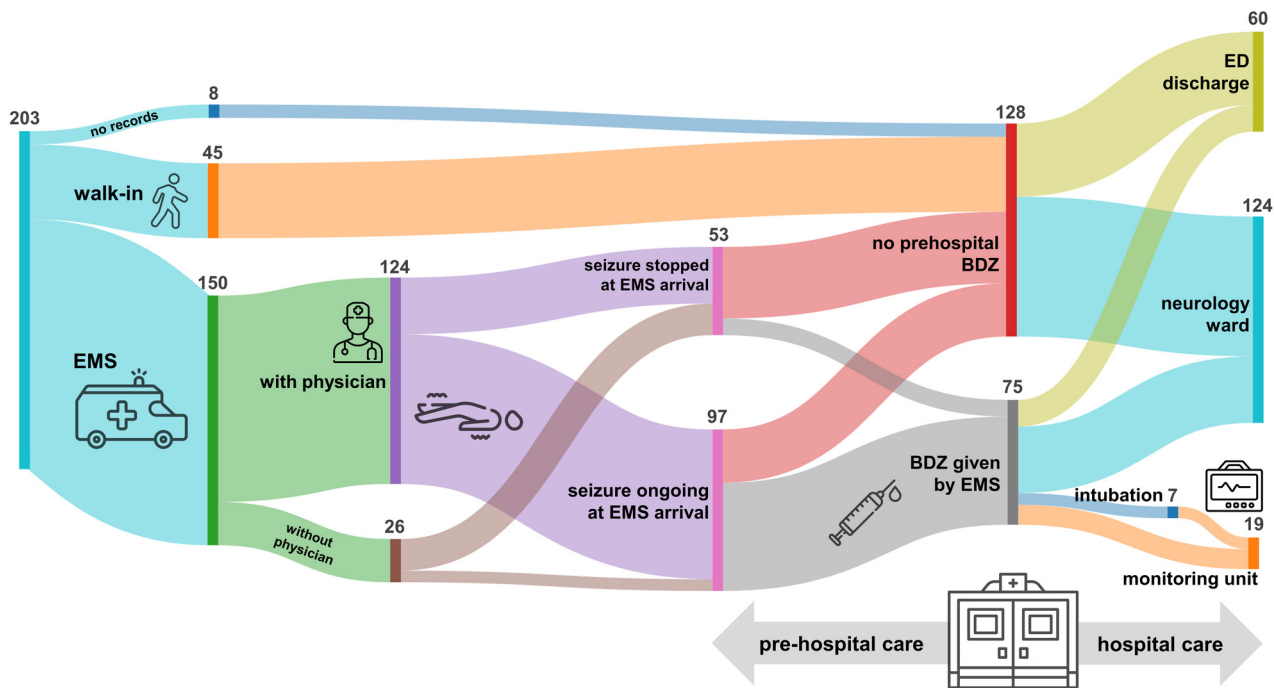
Provisional diagnoses were documented in EMS protocols in 86 instances. Dissociative seizure or an equivalent descriptor (non-epileptic, psychogenic) was noted in 12% (10/86), while epileptic seizures were assumed for 84% of cases (72/86). In four cases (5%), another diagnosis was recorded.

The working diagnoses made by on-call physicians (neurology trainees or specialists) at the end of acute management in the emergency department were available for 175 cases. Dissociative seizures were correctly diagnosed in 62%. Most remaining cases were labelled as epileptic seizures (35%) and 3% received other diagnoses such as syncope, alcohol intoxication and dystonia.

Looking only at cases with available diagnoses both from EMS records and emergency department notes, the rate of correct diagnosis rose from 12% (9/72) for EMS physicians to 52% (38/72) for emergency department physicians.

Final discharge diagnoses were classified according to the quality of semiological information available. In 50% of cases (101/203), only patient or witness reports were available, in 23% (47/203) a clinician with neurological expertise personally witnessed the seizure, and in 24% (49/203) an ictal video-EEG recording was available.

Full semiology of presenting seizures was extracted from all available records. Table 1 lists the rates of semiological characteristics across all 203 presentations, and separately according to working diagnoses recorded by EMS and emergency department physicians. Naturally, routine notes are incomplete; for example, if a seizure description does not explicitly mention ictal eye closure, this does not mean the patient necessarily had their eyes open. Thus, these data should be interpreted as minimal rates. Across all patients, 64% had at least one of the examined characteristics, which could have served as a diagnostic red flag



**Figure 1** Pathways of care after emergency presentation for acute dissociative seizures. BZD, benzodiazepines; ED, emergency department; EMS, emergency medical services.

(though no single characteristic can establish a diagnosis in isolation), and 28% had two or more.

To assess the potential for improving recognition of dissociative seizures through semiology training, we looked at a subset of patients whose seizures were observed by the emergency physicians (seizures ongoing at arrival of ambulance), and whose eventual discharge diagnoses were based solely on semiological assessment without ictal EEG to aid diagnosis (ie, patients whose seizure semiology was deemed diagnostically unambiguous by neurologists). Of the identified 16 patients, the emergency physicians documented the correct diagnosis in 25%.

**Acute treatment decisions**

Benzodiazepines were given acutely in 81 of all 203 cases (40%, figure 2). Interestingly, in 11 of those instances, benzodiazepines were administered after seizures had already stopped to manage agitation, as secondary prophylaxis or for unspecified reasons.

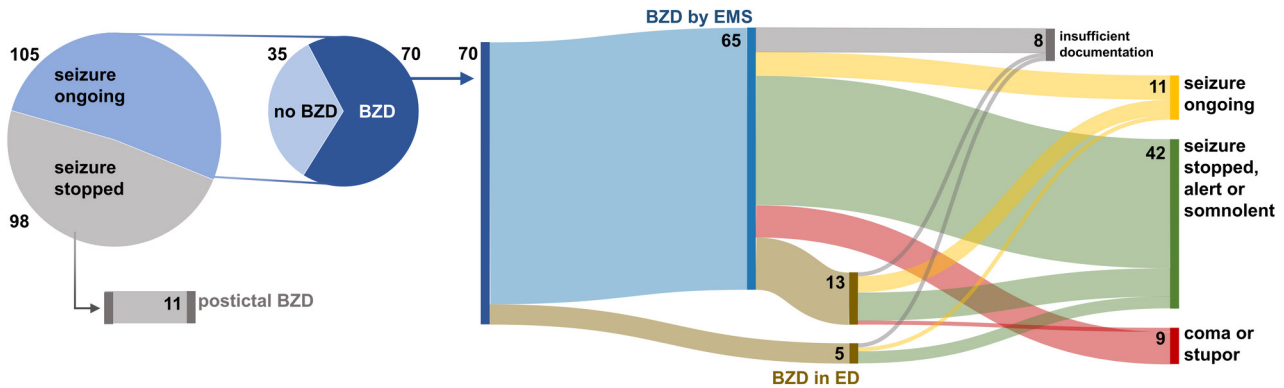
Among seizures that were ongoing during medical care (n=105), emergency physicians gave benzodiazepines in 65 cases, 13 of which received additional doses in the emergency department, and in 5 cases patients received benzodiazepines only from physicians in the emergency department. In total, 67% of patients with ongoing dissociative seizures (70/105) received benzodiazepines during emergency medical care.

In prehospital care, clonazepam (1–5 mg), lorazepam (1 mg), diazepam (5–10 mg) and midazolam (1–35 mg) were used alone or in combination, in most cases intravenously. The median cumulative dose of benzodiazepines given in prehospital care was 25 mg of diazepam equivalent (range: 3.8–131 mg). In addition, levetiracetam was given intravenously by EMS personnel in nine of 203 cases, with a median dose of 1000 mg (range 500–2000 mg). In one case, endotracheal intubation was performed in prehospital care after benzodiazepine administration.

**Table 1** Rates of documented semiological characteristics of presenting seizures that are considered indicative of dissociative seizures

Seizure characteristics	Total sample n=203	EMS working diagnosis:		ED working diagnosis:	
		Dissociative seizure (correct) n=10	Epileptic seizure (incorrect) n=72	Dissociative seizure (correct) n=109	Epileptic seizure (incorrect) n=61
Closed eyes	14%	20%	12%	14%	16%
Forced eye closure	3%	10%	2%	3%	3%
Eyelid flutter	1%	0	1%	0	1%
Fluctuating/discontinuous course	19%	20%	25%	19%	14%
Asynchronous movements	22%	10%	23%	20%	21%
Pelvic thrusting	0	0	0	0	0
Side-to-side head or body movement	4%	0	2%	5%	1%
Ictal crying/weeping	6%	10%	0	1%	3%
Preserved awareness during bilateral movements	6%	0	8%	8%	4%
Long duration (>2 min)	33%	40%	40%	33%	19%

Notes: Overlapping diagnostic samples as many patients received working diagnoses at prehospital and in-hospital level of care; patients with 'other' working diagnoses are included in total sample but are not listed separately as diagnostic categories.  
ED, emergency department; EMS, emergency medical services.



**Figure 2** About half of patients had ongoing seizures at first medical contact (primary pie chart), with two-thirds of cases with ongoing seizures receiving benzodiazepines (BZD, secondary pie chart). Sankey graph illustrates outcome after BZD given by emergency medical services (EMS) and/or by hospital physicians in the emergency department (ED) for ongoing seizures. See text for details.

In the emergency department, lorazepam (1–6 mg), diazepam (2 mg) and midazolam (2.5–5 mg) were administered intravenously in a total of 19 cases. The median cumulative dose (including preceding prehospital applications in 13 cases) was 28 mg of diazepam equivalent (range 8–142 mg). Levetiracetam was given in the emergency department in eleven cases with a median dose of 1000 mg (range 1000–2000). In six cases, endotracheal intubation was performed in the emergency department.

Changes in reported seizure activity and alertness could be inferred from documentation in most cases (figure 2). After benzodiazepine treatment, cessation of observable seizure phenomena with sustained alertness or somnolence was seen in 60% of cases (42/70); in 16% (11/70) benzodiazepines had no effect on ongoing seizures and alertness, while in another 13% (9/70) patients became stuporous or comatose.

To investigate the role of clinical responsibility, a binary logistic regression with benzodiazepine administration (yes/no) as dependent variable and GCS score as predictor was performed for all patients with available initial GCS and ongoing seizures at first contact (n=50). The regression model was statistically significant ( $\chi^2(1) = 3.944$ ,  $p=0.047$ ) and correctly predicted benzodiazepine use in 80% of cases. The odds of receiving benzodiazepine increased by 16% with every point decrease in GCS (OR 0.84, 95% CI 0.704 to 1.011,  $p=0.065$ ), however, this was not significant at conventional alpha levels.

To investigate the influences of patient age, gender and seizure semiology on the decision to administer benzodiazepines, a binary logistic regression analysis was performed with those patients who had ongoing seizures at first medical contact, and for whom data on seizure semiology was available (n=99). We investigated benzodiazepine administration (yes/no) as a dependent variable, and age, gender and seizure type as well as the interaction of gender and seizure type as predictors. The regression model was statistically significant ( $\chi^2(6) = 16.322$ ,  $p=0.012$ ) and correctly predicted benzodiazepine use in 74% of cases. Semiological seizure type was the only factor which predicted benzodiazepine administration significantly ( $p=0.015$ ): Individuals with ‘major motor’ seizures had an OR of 7.98 (95% CI 1.92 to 33.16);  $p=0.004$ ) of receiving benzodiazepines compared with ‘akinetic’ seizures, while individuals with ‘minor motor’ type seizures had a statistically not significant OR of 2.64 (95% CI 0.63 to 11.02,  $p=0.182$ ) compared with ‘akinetic’ seizures. Gender, age and the interaction of gender and seizure type did not have statistically significant effects on the administration of benzodiazepines.

To investigate whether in addition to benzodiazepine treatment initial responsiveness contributed to admission to an

intermediate or ICU, we performed a binary logistic regression with admission to monitoring unit as dependent variable, and benzodiazepine administration (yes/no) and GCS score at initial contact as predictors (only cases with available GCS, n=76). The regression model was significant ( $\chi^2(2) = 16.155$ ,  $p<0.001$ ). However, the initial GCS score did not predict admission to a monitoring unit (OR 0.94, 95% CI 0.82 to 1.08,  $p=0.783$ ). Benzodiazepine administration was a statistically significant predictor in the model ( $p<0.001$ ), but since it was the only predictor and no patient who did not receive benzodiazepines was admitted to a monitoring unit, the model did not yield a realistic OR.

Lastly, to probe for a potential educational effect of our 2014 semiology lecture on emergency management, we compared cases treated by emergency physicians in the 3 years before (2011–2013, n=18) and after (2015–2017, n=36). Since diagnosis documentation at EMS level was often missing in older cases, we looked at benzodiazepine use as a surrogate of diagnostic inaccuracy or uncertainty. The rate of benzodiazepine administration dropped from 78% to 41%.

## DISCUSSION

In 203 consecutive emergency presentations with a discharge diagnosis of dissociative seizures, we confirmed that patients are predominantly young and female, and are usually misdiagnosed as having epileptic seizures. This diagnostic error is common in prehospital care, but also, to a lesser extent, after neurology-led workup in the emergency room. It contributes to the frequent use of benzodiazepines (in high doses), especially when seizures are characterised by ‘major motor’ movement patterns and impaired responsiveness.

## Misdiagnosis

Dissociative seizures are a common reason for an epilepsy misdiagnosis both in the community and in specialised settings.<sup>21 22</sup> Such misdiagnoses lead to inappropriate medication and often take years to correct.<sup>23</sup> In our study, emergency physicians diagnosed dissociative seizures correctly in only 12% of cases. The neurology-led emergency department workup improved this diagnostic rate significantly, but not completely (52% or 62%, depending on sampling). This is in line with differences between emergency physicians and neurologists seen in video-based testing.<sup>24–26</sup>

Semiology is key to an early diagnosis, as EEG is often unavailable in emergency departments and is liable to ‘over-reading’.<sup>22</sup>

In a subset of our cases that were diagnosed based only on distinct semiology (expert assessment of personally witnessed seizures without ictal EEG), emergency physicians had previously recognised dissociative seizures in only a quarter of cases. Thus, if emergency physicians were taught to be as proficient in identifying dissociative seizures by their semiology as neurologists, misdiagnosis could be reduced dramatically.

At present, first responders are insufficiently trained in differentiating seizures. In an educational study aimed at improving medical students' semiological abilities using a set of 10 typical epileptic seizures and 10 typical dissociative seizures, 27 emergency medicine trainees with at least 4–5 years of professional experience served as a control group and achieved a pooled diagnostic specificity and sensitivity of just 64% and 61% respectively.<sup>27</sup> Similarly modest accuracy was determined in a study of 216 physicians across a wide spectrum of qualifications.<sup>28</sup> Another study including 34 emergency physicians showed marked improvements in diagnostic accuracy for dissociative seizures after a 30 min lecture.<sup>29</sup> Similarly, a single lecture with video demonstrations improved the diagnostic accuracy of emergency physicians for dissociative seizures from 30% to 88%.<sup>20</sup> As this lecture was organised by our department and was attended by 120 emergency physicians, many of whom were working locally, we looked at the diagnostic accuracy of emergency physicians in our dataset in the 3 years before and after the training. Benzodiazepine use, which we used as a surrogate of diagnostic uncertainty or inaccuracy, went down markedly from 78% to 41%. Although this crude analysis has obvious limitations, we consider it a glimmer of optimism that even small-scale educational efforts could have noticeable effects in the emergency management of acute dissociative seizures.

### Benzodiazepines

Benzodiazepines were given to two-thirds of patients with ongoing seizures at first medical contact. Viarasilpa *et al* similarly reported benzodiazepine use in 66% of 59 patients treated in the emergency department for what were eventually determined to have been dissociative seizures.<sup>30</sup> Looking only at very long-lasting dissociative seizures (>30 min), Mezouar *et al* reported that among 39 cases that led to ICU admissions, benzodiazepines were given beforehand in 79% of cases.<sup>31</sup>

In our study, the median cumulative dose of benzodiazepines given before arrival at the emergency room was 25 mg of diazepam equivalent, which exceeds the maximum dose of 20 mg recommended for status epilepticus, but is similar to previous observations.<sup>30</sup> In a case series of nine prolonged dissociative seizures, Holtkamp *et al* reported a median dose of 72 mg diazepam equivalent, after which 33% required mechanical ventilation.<sup>32</sup> In a post hoc analysis of the RAMPART trial, we previously found adverse effects to occur in 25% of 46 patients treated acutely with benzodiazepines for (misdiagnosed) dissociative seizures.<sup>6</sup> In summary, our current findings and the available literature suggest that benzodiazepines are used in most emergency presentations of dissociative seizures and at high doses, which can entail critical sedation, apnoea and ICU-related risks.<sup>33</sup>

Surprisingly, there are no systematic investigations regarding the potential efficacy of using benzodiazepines for dissociative seizures that could counterbalance the inherent risks. For this reason, we assessed the response to medication from routine notes, acknowledging that this methodology is imprecise and can only establish the most tentative of evidence. While some patients ended up critically sedated (13%), and others had no

relevant response either way (16%), in a 60% majority observable seizure phenomena ceased after benzodiazepine administration, leaving the patients alert or only mildly sedated. This positive outcome deserves recognition, but should not be taken at face value.

Besides being first-line anticonvulsants for ongoing epileptic seizures, benzodiazepines are also potent anxiolytics and are effectively used for a range of psychiatric emergencies.<sup>34</sup> Since dissociative seizures are often perceived as psychological events not dissimilar to panic attacks in certain aspects,<sup>35 36</sup> it seems reasonable to expect a therapeutic response in some patients. Indeed, it is our experience that even when dissociative seizures are explicitly suspected, emergency physicians will often opt for benzodiazepines because of their twofold efficacy: to be on the safe side regarding a potentially overlooked status epilepticus, and to help the patient 'calm down' otherwise. However, besides its anxiolytic effects, benzodiazepines can have a range of adverse psychological effects. In ongoing dissociative seizures, dissociation and impaired behavioural control can potentially be exacerbated through sedative and disinhibiting drug effects.

Another explanation of a positive response to benzodiazepines is that receiving intravenous medication in an imposing medical setting exerts a strong placebo effect, and dissociative seizures are susceptible to both immediate and long-term placebo effects.<sup>37 38</sup> This, however, should not in itself encourage the use of benzodiazepines, as placebo treatments are unethical, unsustainable and disempowering.

Lastly, it is entirely possible, and in our view most likely, that seizures will simply stop at some point after benzodiazepine use, irrespective of any pharmacodynamic or cognitive-behavioural effects. The high cumulative doses suggest that maybe seizures were not terminated through benzodiazepine action, but, conversely, incremental benzodiazepine administration was carried on with until eventually seizures subsided on their own. Future treatment trials should examine this null hypothesis.

Our results suggest that there are relevant risks with benzodiazepines, especially at high doses. There might be some rationale to trying them with caution (ie, single low dose) when anxiety or agitation appear to be components or drivers of the seizure. Even then, however, patients need to be debriefed and educated about more appropriate non-pharmacological interventions and referred for further treatment. Practicable guidelines and behavioural techniques for managing ongoing dissociative seizures are urgently needed and should be tested against the current practice of sedation.

### Limitations

The validity of our study is limited by its reliance on routine data from a single centre. Inclusion was based on diagnostic codes, so we could have missed patients in whom a comorbidity (eg, epilepsy) was coded as primary discharge diagnosis. Only half of discharge diagnoses were based on in-person semiological assessment, half of which had ictal video-EEG recording, so an increased risk of misdiagnosis has to be considered in the remaining cases.<sup>39</sup> Regarding the specificity of semiological diagnosis without ictal EEG, a study of smartphone video assessment showed that the chance of misidentifying epileptic convulsions as a dissociative seizure was just 1.6%.<sup>40</sup> The risk of misdiagnosing dissociative seizures based on detailed history and interictal EEG alone was less than 5% in a cohort study of 190 patients.<sup>41</sup> An audit of inpatients who received a first diagnosis of dissociative seizures at our department showed that in none of the cases with available long-term follow-up was the diagnosis overturned.<sup>42</sup>

Limiting our analysis to video-EEG-confirmed cases would have distorted our findings through a range of selection biases (eg, willingness and opportunity to undergo telemetry and having a diagnostic event during monitoring). Lastly, our data need to be interpreted in our regional context and might not reflect the epidemiology and EMS practices of other regions.

## CONCLUSIONS

Patients seen in an emergency room for acute dissociative seizures were mostly misdiagnosed and treated with benzodiazepines, often in high doses. This had mixed effects, sometimes requiring admission to monitoring units and intubation. Our findings highlight the urgent need for training of first responders in semiological diagnosis as well as the development and evaluation of management guidelines for acute dissociative seizures that provide a viable alternative to the current practice of escalating sedation.

**Contributors** OC extracted and analysed the data. JJ performed additional statistical analyses. OC, JJ, RM and JW edited the manuscript for content. SP conceived and supervised the study and wrote the first draft of the manuscript. SP serves as guarantor and accepts full responsibility for the work and the conduct of the study, had access to the data, and controlled the decision to publish.

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**Competing interests** SP receives royalties from Springer for a book on functional neurological disorders.

**Patient consent for publication** Not applicable.

**Ethics approval** This retrospective study of routine data involved human participants and was approved by the Ethics Commission of the Medical Faculty of the Ruhr University Bochum (Reg.-Nr.: 20-7038-BR).

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**Data availability statement** Data are available on reasonable request.

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## REFERENCES

- Popkirov S, Asadi-Pooya AA, Duncan R, et al. The aetiology of psychogenic non-epileptic seizures: risk factors and comorbidities. *Epileptic Disord* 2019;21:529–47.
- Wardrope A, Wong S, McLaughlan J, et al. Peri-ictal responsiveness to the social environment is greater in psychogenic nonepileptic than epileptic seizures. *Epilepsia* 2020;61:758–65.
- Lehn A, Watson E, Ryan EG, et al. Psychogenic nonepileptic seizures treated as epileptic seizures in the emergency department. *Epilepsia* 2021;62:2416–25.
- Fuest KE, Hofberger C, Lorenz M, et al. Excessive hospitalization of patients with seizures in the Germany prehospital emergency system: a retrospective cohort study. *Sci Rep* 2022;12:10866.
- Dickson JM, Dudhill H, Shewan J, et al. Cross-sectional study of the hospital management of adult patients with a suspected seizure (EPIC2). *BMJ Open* 2017;7:e015696.
- Jungilligens J, Michaelis R, Popkirov S. Misdiagnosis of prolonged psychogenic non-epileptic seizures as status epilepticus: epidemiology and associated risks. *J Neurol Neurosurg Psychiatry* 2021;92:1341–5.
- Ramamurthy S, Steven Brown L, Agostini M, et al. Emergency department visits and readmissions in patients with psychogenic nonepileptic seizures (PNES) at a safety net hospital. *Epilepsy Behav* 2021;122:108225.
- Lagrand TJ, Jones M, Bernard A, et al. Health care utilization in functional neurologic disorders. *Neurol Clin Pract* 2023;13:e200111.
- Kholi H, Vercueil L. Emergency room diagnoses of psychogenic nonepileptic seizures with psychogenic status and functional (psychogenic) symptoms: whopping. *Epilepsy Behav* 2020;104:106882.
- Popkirov S. Double vision. *Brain* 2023;146:2–3.
- Eilon T, Elkomos S, Ouzounian S, et al. The A to F of functional status in the acute setting: a scoping review. *Seizure* 2022;102:61–73.
- Grönheit W, Behrens V, Liakina T, et al. Teaching distinguishing semiological features improves diagnostic accuracy of seizure-like events by emergency physicians. *Neurol Res Pract* 2022;4:56.
- Magaudda A, Laganà A, Calamuneri A, et al. Validation of a novel classification model of psychogenic nonepileptic seizures by video-EEG analysis and a machine learning approach. *Epilepsy Behav* 2016;60:197–201.
- An D, Wu X, Yan B, et al. Clinical features of psychogenic nonepileptic seizures: a study of 64 cases in Southwest China. *Epilepsy Behav* 2010;17:408–11.
- Syed TU, LaFrance WC, Kahrman ES, et al. Can Semiology predict psychogenic nonepileptic seizures? A prospective study. *Ann Neurol* 2011;69:997–1004.
- Seneviratne U, Minato E, Paul E. How reliable is Ictal duration to differentiate psychogenic nonepileptic seizures from epileptic seizures? *Epilepsy Behav* 2017;66:127–31.
- Avbersek A, Sisodiya S. Does the primary literature provide support for clinical signs used to distinguish psychogenic nonepileptic seizures from epileptic seizures? *J Neurol Neurosurg Psychiatry* 2010;81:719–25.
- Ng K, Dahri K, Chow I, et al. Evaluation of an alcohol withdrawal protocol and a preprinted order set at a tertiary care hospital. *Can J Hosp Pharm* 2011;64:436–45.
- Divoll M, Greenblatt DJ, Ochs HR, et al. Absolute bioavailability of oral and intramuscular diazepam: effects of age and sex. *Anesth Analg* 1983;62:1–8.
- Barr J, Zomorodi K, Bertaccini EJ, et al. A double-blind, randomized comparison of l.v. lorazepam versus midazolam for sedation of ICU patients via a pharmacologic model. *Anesthesiology* 2001;95:286–98.
- Oto MM. The misdiagnosis of epilepsy: appraising risks and managing uncertainty. *Seizure* 2017;44:143–6.
- Amin U, Benbadis SR. The role of EEG in the erroneous diagnosis of epilepsy. *J Clin Neurophysiol* 2019;36:294–7.
- Kerr WT, Janio EA, Le JM, et al. Diagnostic delay in psychogenic seizures and the association with anti-seizure medication trials. *Seizure* 2016;40:123–6.
- Seneviratne U, Rajendran D, Brusco M, et al. How good are we at diagnosing seizures based on semiology? *Epilepsia* 2012;53:e63–6.
- Birca V, Keezer MR, Chamelian L, et al. Recognition of psychogenic versus epileptic seizures based on videos. *Can J Neurol Sci* 2021;2021:1–9.
- Wasserman D, Herskovitz M. Epileptic vs psychogenic nonepileptic seizures: a video-based survey. *Epilepsy Behav* 2017;73:42–5.
- Seneviratne U, Ding C, Bower S, et al. Video-based training improves the accuracy of seizure diagnosis. *J Neurol Neurosurg Psychiatry* 2014;85:466–70.
- O'Sullivan SS, Redwood RI, Hunt D, et al. Recognition of psychogenic non-epileptic seizures: a curable neurophobia. *J Neurol Neurosurg Psychiatry* 2013;84:228–31.
- De Paola L, Terra VC, Silvado CE, et al. Improving first responders' psychogenic nonepileptic seizures diagnosis accuracy: development and validation of a 6-item bedside diagnostic tool. *Epilepsy Behav* 2016;54:40–6.
- Viarasilpa T, Panyavachiraporn N, Osman G, et al. Intubation for psychogenic non-epileptic attacks: frequency, risk factors, and impact on outcome. *Seizure* 2019;76:17–21.
- Mezouar N, Demeret S, Rotge JY, et al. Psychogenic non-epileptic seizure-status in patients admitted to the intensive care unit. *Eur J Neurol* 2021;28:2775–9.
- Holtkamp M, Othman J, Buchheim K, et al. Diagnosis of psychogenic nonepileptic status epilepticus in the emergency setting. *Neurology* 2006;66:1727–9.
- Nilsson L, Pihl A, Tägsjö M, et al. Adverse events are common on the intensive care unit: results from a structured record review. *Acta Anaesthesiol Scand* 2012;56:959–65.
- Dubovsky SL, Marshall D. Benzodiazepines remain important therapeutic options in psychiatric practice. *Psychother Psychosom* 2022;91:307–34.
- Indranada AM, Mullen SA, Duncan R, et al. The Association of panic and hyperventilation with psychogenic non-epileptic seizures: a systematic review and meta-analysis. *Seizure* 2018;59:108–15.
- Goldstein LH, Mellers JDC. Ictal symptoms of anxiety, avoidance behaviour, and dissociation in patients with dissociative seizures. *J Neurol Neurosurg Psychiatry* 2006;77:616–21.
- Popkirov S, Grönheit W, Jungilligens J, et al. Suggestive seizure induction for inpatients with suspected psychogenic nonepileptic seizures. *Epilepsia* 2020;61:1931–8.
- Alessi R, Valente KD. Psychogenic nonepileptic seizures: should we use response to AEDS as a red flag for the diagnosis? *Seizure* 2014;23:906–8.
- Finkelstein SA, Popkirov S. Functional neurological disorder: diagnostic pitfalls and differential diagnostic considerations. *Neurol Clin* 2023.
- Tatum WO, Hirsch LJ, Gelfand MA, et al. Assessment of the predictive value of outpatient Smartphone videos for diagnosis of epileptic seizures. *JAMA Neurol* 2020;77:593–600.
- Kanemoto K, Tadokoro Y, Motooka H, et al. Prospective multicenter cohort study of possible psychogenic nonepileptic seizure cases—results at 1-year follow-up examinations. *Epilepsia Open* 2023;8:134–45.
- Popkirov S, Jungilligens J, Grönheit W, et al. Diagnosing psychogenic nonepileptic seizures: video-EEG monitoring, suggestive seizure induction and diagnostic certainty. *Epilepsy Behav* 2017;73:54–8.