Original Article

Frontal lobe epilepsy- why it matters in the emergency department

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Abstract

Frontal lobe epilepsy is an episodic neurological disorder characterised by recurrent seizures arising from one or both frontal lobes. Seizures may appear atypical and are easily misdiagnosed in the emergency department as nonepileptic attacks (psychological episodes) or parasomnias (sleep disorders). Given the multiple connections and functions of the frontal lobes, Frontal lobe epilepsy presentations are highly variable, including motor, psychic, behavioral or cognitive changes, with a wide differential diagnosis. Prompt diagnosis in the busy emergency department may be difficult, because of complex, often multiple but brief episodes, and sometimes bizarre manifestations; frequent nocturnal presentation, and a wide range of aetiologies. This narrative review summarises clinical and investigation features that help clinicians to reach an accurate and prompt diagnosis.

Keywords

frontal lobe seizures, parasomnias, nonepileptic attacks, misdiagnosis, emergency department

Key learning points

- Frontal lobe epilepsy is a diagnostic challenge in emergency departments because of variable and unusual presentations.
- Frontal lobe epilepsy may be confused with parasomnias, psychological attacks (nonepileptic attacks), temporal lobe seizures, or generalised seizures.
- A thorough history, with eye-witness accounts, and mobile phone recording where possible with patient consent, are of paramount importance.
- Awareness among ED physicians and prompt referral to neurology may prevent complications in these cases.
- MRI scan is the key investigation for FLE but not usually available urgently in the emergency department.

Introduction

Recurrent epileptic seizures arising from one or both frontal lobes are defined as Frontal lobe epilepsy (FLE). Seizures account for 1% of emergency department visits, with a higher incidence in paediatric population[1]. Temporal lobe epilepsy is the most common type of epilepsy[2] and the most common focal epilepsy. Arising from the largest lobe of the brain, FLE is the second most common type comprising 30% of focal epilepsies[3]. Causes include head trauma, neoplasia, vascular malformations, encephalitis stroke, and cortical dysplasia (cortical malformations arising during fetal development), as well as genetic syndromes and those with an unknown cause. Untreated seizures can cause injury, sudden death in epilepsy (SUDEP)[4], cognitive dysfunction affecting language, memory, behaviour, and mood[5]. The nature and severity of cognitive deficits vary, although impaired attention and executive functions are most frequent. The behavioural disturbances associated with FLE are also highly variable, although attention deficit/hyperactivity disorder seems most frequent in children. In 40% of children with FLE satisfactory seizure control could not be achieved. In a large series of 166 adults patients with FLE, seizure control was achieved in 68%[6]. Reflecting the large area of the frontal cortex and its diverse functions, frontal lobe epilepsy manifests in many forms. Seizure presentations reflect the area of cortex involved, which is not necessarily the site of origin of the seizure, given rapid propagation and a high level of connectivity[7,8]. As the majority of first frontal lobe seizures present to the emergency department, awareness regarding this type of seizure among acute care clinicians is very important.

Diagnostic clues in the emergency room

The variable presentations of frontal lobe seizures may result in diagnostic dilemmas in the emergency room, especially when expert neurological advice is not immediately available. Diagnosing this type of seizures is important for early treatment. In particular, frontal lobe seizures can be confused with parasomnias (sleep disorders), nonepileptic attacks, temporal lobe or generalised seizures. Frontal lobe seizures

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Type of seizures	Frontal lobe seizures	Temporal lobe seizures	Genetic generalised seizures (previously called idiopathic generalized epilepsy)
Time of day	Often nocturnal	Any time	Often early morning Often after sleep deprivation
Duration	Brief – often seconds	Variable	Variable
Common auras	Variable Nil if nocturnal	Déjà vu, epigastric sensation, fear, smell or taste hallucination	No aura
Common manifestations	Head or eye deviation to one side Bizarre Inco-ordinated violent movements (hyper motor seizures) Tonic clonic seizures	Dystonia (spasm) Automatic behaviours Tonic clonic seizures	Myoclonus (jerks) Absences Tonic clonic seizures
Post ictal	Often brief	Variable	Prolonged >10 minutes if tonic clonic seizure
MRI scan	Abnormal in 40%	Abnormal in 20-30%	Normal
EEG	Frequently normal	Often abnormal	Usually abnormal in childhood presentation Characteristic 3/second spike and wave activity

Table 1. |Key features of Frontal lobe seizures compared to most common other seizure types (adapted from Wee et al,[6] Harris et al[2]).

are characteristically brief (<30 seconds), followed by a short post ictal state, with frequent clustering, and are often nocturnal. Status epilepticus is not infrequent, and may take the form of continuous focal motor seizures (called epilepsia partialis continua), nonconvulsive status manifesting as a confusional state; or convulsive status (secondarily generalized tonic-clonic seizures)[9,10]. Frontal lobe seizures may be misdiagnosed as nonepileptic attacks as there may be bilateral motor phenomena with preserved awareness, and the ictal EEG can be normal, creating confusion in the emergency room[10]. Nonepileptic attacks (sometimes called dissociative seizures, psychogenic nonepileptic attack disorder and previously known as "pseudo seizures")[3,5] have a psychological or psychiatric trigger. Parasomnias are unwanted and involuntary sleep disturbances that take a variety of forms including abnormal movements, vocalisations, sleepwalking or night terrors[3]. Frontal lobe seizures with impairment of awareness are often characterized by hypermotor behaviours (involuntary, asynchronous, large amplitude movements). These can produce bizarre movements mistaken for nonepileptic attacks[11]. Bicycling automatisms as well as pelvic thrusting and other sexual automatisms, may also be features of FLE[12].

While seizure auras may occur in FLE, they are less common and less distinctive than in mesial temporal lobe epilepsy, and the sensation is often ill-described and typically does not include epigastric phenomenon. Fear and anxiety occur as seizure auras in both temporal lobe epilepsy and FLE.[13] Hemiclonic activity (unilateral limb shaking) is more common in focal unaware seizures (previously referred to as complex partial seizures[2]) of frontal origin than with those in temporal lobe seizures. Head deviation (involuntary twisting of the head to one side) at the onset of a seizure in the presence of normal consciousness is a strong indication of a contralateral mid frontal dorsolateral cortical focus[14]. Supplementary motor area seizures typically produce stereotyped asymmetric tonic movements with abrupt onset and offset, often with preserved consciousness at onset[3,5,6]. These may take the form of walking in circles, or the "fencing posture," in which the head and eyes deviate to the contralateral side, with extension of the contralateral arm and flexion of the ipsilateral arm. The most prominent tonic activity occurs contralateral to the seizure focus[15]. Brief superimposed clonic movements or vocalizations like laughing, yelling or speech arrest are common. Speech arrest may accompany seizures arising from the dominant hemisphere. There may be a somatosensory aura. Despite bilateral tonic movements, consciousness is often preserved unless there is secondary generalization, giving observers the false impression that the movements are volitional, and that the event is psychological.

Frontal absence seizures manifest with staring, trance-like states. When associated with altered emotion (usually unpleasant) and viscerosensory symptoms (perceptions arising from internal organs), misdiagnosis of a psychological disorder (nonepileptic attack) is common. These seizures originate from the frontopolar or medial frontal regions [14]. They may be more prolonged than other seizure types, often lasting

several minutes. Sometimes they evolve to focal status, lasting hours, or even days. Seizures arising from the operculum manifest with symptoms associated with head and digestion: repeated swallowing movements, salivation, mastication, and possibly gustatory hallucinations (such as metallic taste). Preceding the seizure person often has an epigastric aura (a rising sensation in the stomach) and fear. Usually there is little motor change, except for clonic facial movements. Speech arrest is frequent. Evolution to a bilateral convulsive seizure (secondary generalisation) may occur after any of the above initial ictal manifestations. A minority of patients have generalized seizures that occur without a recognisable aura.[5]

Characteristic clinical presentation is of paramount importance in diagnosis. Acute medical and emergency department physicians need a good working knowledge of this type of seizures, their multiple potential presentations and awareness of seizure mimics. A thorough history especially from the witnesses or family members is of paramount importance, and consented recordings from witnesses (for example on mobile phones) can be invaluable. Frontal lobe seizures are usually briefer, associated with less post-ictal confusion, with prominent motor features. They are more likely to evolve to secondary generalization, are less likely to demonstrate psychic/emotional/affective phenomena, are more likely to have a rapid onset and offset and to occur nocturnally than other focal seizures[3,5,6]. Occipital lobe epilepsy usually involves visual disturbances[16], while parietal lobe seizures are rare but can have localizing somatosensory symptoms (such as brief tingling in a limb)[17,18]. One of the challenges in diagnosing FLE is that it may not be revealed on electroencephalogram (EEG)[9], especially if the seizures are brief, and the seizure onset deep in the frontal lobe. Magnetic resonance imaging (MRI) brain is one of the more sensitive modalities for diagnosing frontal lobe epilepsy [9,15,16]. It is the only diagnostic tool that predicts surgical outcome, which may be a consideration in patients not responding to medication. Frontal lobe epilepsy makes up approximately 30 percent of patients undergoing epilepsy surgery[15].

Epileptic hypermotor movements are violent, asynchronous and purposeless, and may appear bizarre. Nonepileptic attacks (no longer called pseudoseizures) are often confused with hypermotor frontal lobe seizures. Misdiagnosis of FLE as nonepileptic attacks means the patient misses vital potentially life-saving treatments. Conversely, misdiagnosis of nonepileptic attacks as FLE leads to emotional distress, confusion, inappropriate use of antiepileptic medications, repeated emergency department visits and prevents access to psychological treatments. Prolonged nonepileptic attacks may be misdiagnosed in the emergency department as status epilepticus leading to inappropriate treatment putting patients at risk of potentially severe iatrogenic adverse consequences, such as intubation and ventilation. Nonepileptic attacks are often prolonged, associated with bizarre movements, affective vocalizations, and occurs usually in the presence of another person[19]. FLE, parasomnias and nonepileptic attacks may all be nocturnal and differentiating features are summarised in Table 3 below.[9,20-22]

Features	Frontal Lobe	Temporal Lobe
Onset	Abrupt	Gradual
Duration	Short	Longer
Frequency	Frequent	Less frequent
Automatisms	Not common	Common
Complex motor features	Early and prominent	Late, less prominent
Evolution	Rapid	Gradual
Vocalisation	Loud, Scream, grunt	Ictal speech
Secondary generalisation	Common	Uncommon
Post ictal confusion	Short, less prominent	Longer, more prominent

Table 2. Comparison between seizures arising from the frontal lobe and temporal lobe.

Features	Arousal parasomnias	Nocturnal frontal lobe seizures	Nocturnal nonepileptic attacks
Timing	NREM sleep	NREM or from awake state	Not from sleep
Distribution during sleep	Within two hours of sleep	Any time during sleep, may also occur during the day	Any time during the night
Frequency	One per night	Up to 30 per night	Variable
Duration	Brief	Very brief	Often prolonged
Onset	After arousal like phenomena	Abrupt	Often slow
Triggering stimulus	In 50%	In 8%	Presence of other people
Comprehensible Speech	Frequent	None	Frequent
Offset	Followed by NREM sleep in most patients	Seizures woke the patient	Often slow
Tachycardia	Present	May be present	Sometimes
Movement type	Similar	Stereotyped	Variable between events
EEG changes	EEG confirms NREM sleep No epileptiform changes	Epileptiform changes in only 40%	EEG confirms not from sleep, no epileptiform changes
MRI changes	Nil relevant	Relevant lesion in 40%	Nil relevant

NREM = non rapid eye movement; EEG = electroencephalogram, MRI = MRI brain scan

Table 3. Key features of Nocturnal frontal lobe seizures and the main differentials

Table 4. Key questions facing ED physicians in patients with possible frontal lobe seizures

When should I suspect the diagnosis of FLE?
• FLE is one of many transient neurological disturbances presenting to the emergency department. • Suggestive features – particularly brief episodes (<30 seconds), often nocturnal, multiple episodes in 24 hours, hypermotor movements (high amplitude, asynchronous, purposelessn often bizarre in appearance), usually rapid recovery with little or no postictal confusion.
What is needed in ED?[22,23]
• Document history, description from patient and witnesses (history is most accurate in the ED when clearest in the mind of eyewitnesses) • Ask family & carers to keep any records they made on their mobile phone for the neurology appointment (and try to record any further events) • Neurological examination, to include level of consciousness, speech and comprehension (can they give a history and follow requests?), fundoscopy, facial symmetry, limb strength (can they use their phone and walk?) • Investigations – as for "first seizure" patients – ECG (always), glucose, electrolytes, creatinine, calcium, magnesium, full blood count. • Senior review- emergency department consultant or neurologist (acute neurology review is ideal but uncommon in UK) • Give patient safety advice (see text), paper copy of discharge summary, follow-up plan (and who to contact if neurology appointment is not received) and safety netting. • Not usually CT head scan– this is only indicated if head trauma, haemorrhage, mass effect or acute stroke suspected. CT head scan will adequately pick up haemorrhage, acute brain trauma, large infarcts and large tumours, and lesions causing mass effect or hydrocephalus. MRI brain is the imaging of choice as it is more sensitive to more subtle frontal pathologies.
Does the patient need admission, can they be referred or discharged?
• Ideally, patients with FLE and other acute neurology would be seen by a neurologist in the emergency department. This happens infrequently, due to resource constraints. • Discharge once emergency management complete if the patients is alert and recovered, has people at home to look after them, and has no focal deficits, with safety netting (return if further episodes or focal weakness, headaches or drowsiness). • Neurology or medical review (if neurologist is not available) and admission is needed if the patient is drowsy, confused, prolonged (>5 minutes) or repeated seizures. • If a single seizure episode, antiseizure medication (antiepileptic medication) is usually not recommended unless known focal lesion • If multiple episodes, review or discussion of antiseizure medication with neurology or senior physician is mandated.
What about specialist assessment and investigations?
• NICE guidelines recommend neurology assessment within two weeks, and specialist investigations within four weeks. This target is rarely achieved. • Specialist investigations are usually done as an outpatient. • MRI brain is the preferred imaging modality for FLE and first seizures, as more sensitive than CT head scan.[21,22] • EEGs – are usually done as an outpatient. They have a lower yield in FLE than in other types of epilepsy. They are very useful in suspected encephalopathy or non-convulsive status epilepticus (which will present as confusion, reduced level of consciousness, without any focal or generalised shaking).[22]

Emergency department management

The most important step is to consider the diagnosis in patients with loss of consciousness or paroxysmal episodes, with one or more suggestive features (brief episodes, often nocturnal, hypermotor often asymmetrical movements, multiple brief attacks (<30 seconds) occurring in clusters).

Most patients with acute first seizure and full recovery can be discharged from the emergency department after assessment with a follow up neurology appointment. but baseline bloods and an electrocardiogram are needed in all patients. [3]

National Institute for Health and Care Excellence (NICE) guidelines in the United Kingdom recommend specialist Neurology follow up of all first seizure presentations within 2 weeks and completion of the specialist investigations (usually MRI brain and EEG) within 4 weeks. Due to resource limitations, these targets are not met in most United Kingdom hospitals nor world-wide. If there are multiple or repeated episodes, immediate review by neurology is best practice. If this is not possible, the case should be discussed with a neurologist on the phone, and a management plan agreed.

The key investigation is an MRI brain scan[5,21,22]. MRI brain scan is more sensitive than CT to many of the causes of frontal lobe epilepsy such as small tumours, cortical or vascular malformations and small vessel strokes. EEG is sometimes useful, but can be normal in people with FLE, as a large part of the frontal lobe is distant from the scalp, which reduces sensitivity to focal changes.[3]

If the patients recovered fully, has people at home to look after them, and has no focal deficits they can be discharged with safety netting (return if further episodes or focal weakness, headaches or drowsiness) with a firm plan for a Neurology outpatient appointment (and who to contact if neurology appointment is not received).

All patients and their carers or family should be given suggested safety advice before leaving the emergency department, this must be recorded in the notes and patients should be given a paper copy of these and their emergency department summary. This needs to be tailored to the individual but at minimum includes:

- Take showers, not baths
- Do not drive or operate heavy machinery until the driving regulator (DVLA or equivalent body) gives you permission (this is a legal requirement)
- Swim with other people, never alone
- Avoid bungie jumping, scuba, skiing downhill unless discussed with your specialist
- Discuss occupational issues with your medical team
- Signpost patient support – such as Epilepsy Action (UK), International League against Epilepsy

Key questions and decisions facing acute care physicians in patients with suspected FLE are summarized in Table 4.

Conclusions

Certain distinctive clinical features of FLE seizures alert ED staff to the possible diagnosis of FLE. The diagnosis needs input and confirmation by neurologists. Recognising this potential diagnosis allows prompt referral and positively affects cognitive performance. This can have a significant impact on the patient's safety, social interactions, vocation, and quality of life.

Conflict of Interest

none

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