Epilepsy enters the differential diagnosis of paroxysmal disorders of central nervous system function. The first step is to differentiate seizures from other common paroxysmal disorders, which are considered in another section (see p ii9). When the diagnosis of recurrent seizures is confirmed the next step is to diagnose the epilepsy syndrome in order to estimate prognosis and optimise treatment. The following guiding principles are useful in considering attack disorders.

- The paroxysmal nature of seizures creates significant limitations in diagnostic precision.
- The great majority of seizures cause an ictal scalp electroencephalogram (EEG) abnormality and the gold standard diagnosis is made by ictal electroclinical correlation. It is often said that epilepsy is a clinical diagnosis but that is only because seizures are usually too infrequent to obtain ictal electrophysiological corroboration. When the diagnosis is in doubt, the key is to record the ictus, ideally with video-EEG, but alternatively with ambulatory EEG monitoring and home video recording.
- The adage “wait and see” is often good counsel. The diagnosis may become clearer and in the meantime a diagnosis of “don’t know” may be better than an incorrect diagnosis of epilepsy with all its psychosocial consequences.

KEY CLINICAL QUESTIONS IN DIAGNOSING ATTACK DISORDERS

- Are all attacks the same? Organic attacks tend to be more stereotyped than psychogenic attacks.
- Is there any pattern to the circumstances under which they occur—for example, time of day (morning myoclonus), relation to particular activities (syncope) or acute emotional distress (psychogenic non-epileptic seizures)? Sleep deprivation, fever, and alcohol are common triggers of epileptic seizures in susceptible individuals.
- Do attacks occur from waking, sleep or both? Attacks arising from sleep are organic (though not always epileptic) but it may take an EEG to prove that the patient is asleep at the onset.
- Sometimes there is a history of mild and unexplained symptoms that the patient may consider irrelevant such as olfactory hallucinations or profound deja-vu. Myoclonus or falls on waking are under recognised symptoms that often have to be sought specifically.
- Did a witness try and communicate with the patient during the attack and what was the response?
- How long did recovery take and was there anything abnormal during the recovery period? A long recovery time is one of the best discriminators between epilepsy and syncope. Focal weakness or dysphasia point to focal epilepsy and may signify a significant structural lesion.

THE SO-CALLED “CLASSICAL” SYMPTOMS OF CONVULSIONS

Convulsive epileptic seizures are usually easy to recognise despite the provisos in diagnosis imposed by the episodic nature of the condition and lack of a diagnostic test. The evolution is illustrated in fig 1. Although several symptoms have the reputation of being “diagnostic” of epilepsy, the clinical picture of the blackout must be viewed as a whole: no single symptom is diagnostic but some are helpful.

Incontinence of urine is common in convulsive epileptic seizures but is not specific and occurs in up to 50% of syncope or any other collapse with a full bladder. Cyanosis implies an organic cause of the attack but a witnessed description of facial colour may be misleading. If a patient strains performing a Valsalva manoeuvre before syncope or in a psychogenic pseudoseizure the purple discolouration of their face may mimic cyanosis.

A severely bitten tongue is strongly suggestive that the attack was a seizure and the mouth should be inspected. Occasionally the tip of the tongue may be bitten in psychogenic non-epileptic seizures or syncope. Injuries may occur in any type of blackout if the circumstances are appropriate—for example, if a major fall occurs. Colles fractures or similar injuries of the outstretched hand imply initial retention of consciousness and make a seizure less likely. Significant burns and scalds are usually only seen if there is deep loss of consciousness, most commonly in epileptic seizures.

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Carpet burns to the face or trunk suggest rubbing against the carpet and indicate psychogenic pseudoseizures.1

Differential diagnosis of paroxysmal focal neurological symptoms

Paroxysmal focal neurological symptoms are most commonly caused by epilepsy, migraine, cerebral ischaemia or psychological causes, including hyperventilation. Again, the whole event needs to be evaluated and individual features in isolation are of more limited diagnostic value. Some important characteristics are:

- The timing, especially the speed of onset and the duration of the symptoms (fig 2).
- Positive symptoms (extra symptoms such as jerking of a limb) usually signify epilepsy. Negative symptoms (a loss of a function such as paresis) are usually caused by transient focal ischaemia. Migraine often causes a mixture of symptoms such as a tingling, heavy limb or flashing lights and blurred vision.
- Some specific symptoms are helpful—for example, déjà vu is not a feature of migraine or vascular disease, whereas diplopia is an exceptionally rare symptom in epilepsy.
- Altered awareness is much more common in epilepsy and psychogenic episodes.
- Multiple and stereotyped episodes are rare in transient ischaemic attack (TIA), except amaurosis fugax.
- The evolution of neurological symptoms in focal epilepsy and migraine suggest a pattern of spread inconsistent with vascular territories, contrasting with TIA.

Paroxysmal focal symptoms of epilepsy

Symptoms usually have an abrupt onset and are predominantly positive: tonic or clonic limb movements; hallucinations in any sensory modality; odd fragmentary thoughts, memories or experiences, such as déjà vu. The duration of the seizure is usually 1–3 minutes but very brief

Figure 1 The characteristic evolution of symptoms in a tonic-clonic seizure enables it to be differentiated from other forms of attack. A clear description or a home video may show the typical onset with fast, low amplitude jerks evolving to slower, higher amplitude jerks.

Figure 2 Focal epileptic symptoms are usually positive. They start suddenly and stop quickly but may leave a transient postictal deficit. Focal symptoms of ischaemia are almost always negative and start and finish quite abruptly. Migrainous symptoms are more gradual and have both negative and positive qualities—for example, a limb that tingles and feels heavy or a slowly enlarging bright spot that obscures central vision.
seizures lasting only seconds are well recognised, especially arising in the frontal lobes.

Focal seizure symptoms follow one of four general patterns that reflect different evolutions of the same initial process. Different patterns may occur at different times giving an erroneous impression of multiple seizure types.

- **Resolution** without additional symptoms.
- Spread of symptoms reflecting a *local march* of activation of the cerebral cortex, such as Jacksonian motor seizures.
- Spread of symptoms reflecting activation of distant *cerebral cortex*—for example, olfactory hallucinations, from anterior temporal seizure discharges evolving into dystonic posturing of the contralateral limb from motor pathway involvement.
- **Rapid evolution** into a tonic clonic seizure.

Postictally the seizure may cause a temporary reduction in function of the parts of the brain that were activated at the onset of the attack such as Todd’s paresis (motor cortex) or dysphasia (dominant temporal lobe). These symptoms usually resolve within 30 minutes, unless there are serial seizures, in which case they may cause a more persistent disturbance, mimicking a stroke.

Seizures may change over the years. Auras sometimes appear when seizure severity is lessened by treatment and sometimes they disappear later in the course of the epilepsy as seizure spread becomes more rapid.

### Less common seizure manifestations

**Negative symptoms of epilepsy**

Sometimes seizures may be very brief and the postictal negative symptoms dominate the clinical picture—for example, a brief absence followed by dysphasia. Occasionally, however, negative symptoms may occur as an ictal phenomenon (table 1). It can be difficult to tell whether the symptom is ictal or postictal.

**Confusional states caused by epilepsy**

Confusional states caused by status epilepticus (CSSE) are a rare first presentation of epilepsy and are less common than convulsive status epilepticus, except in the learning disabled, where they may affect up to 1% of epilepsy sufferers.

In practice the major diagnostic difficulties are firstly to think of the diagnosis and secondly to tell apart primary generalised from focal epilepsy. CSSE is also seen in malignant epilepsies of childhood (West syndrome and Lennox-Gastaut syndrome).

Clinical clues to CSSE are: (1) confusion in a patient with a past history of epilepsy; (2) confusion associated with more obvious epileptic events; and (3) confusion with major fluctuation and lucid periods. There is a previous history of epilepsy in 70% of focal CSSE patients compared to 96% of patients with generalised CSSE.

In older patients generalised CSSE may be a first presentation of epilepsy and is often caused by identifiable factors such as psychotropic medication or benzodiazepine withdrawal.

In association with the mental changes there may be more obvious periods of absence, motor manifestations, including myoclonus, automatisms or agitation. The motor manifestations are often subtle such as blinking or twitching of one side of the face.

Ictal EEG is always abnormal in CSSE, but there is little correlation between the EEG change and the severity of the clinical changes and it may be difficult to differentiate focal from generalised epilepsy.

Features suggesting that the cause is idiopathic generalised epilepsy include myoclonus, eyelid fluttering, spontaneous termination in a tonic clonic seizure, and rapid termination of CSSE by intravenous diazepam.

**Epileptic drop attacks**

While drop attacks may occur in epilepsy, other causes such as syncope are more likely. When drop attacks are epileptic, it is almost invariably in the context of established, severe epilepsy, and there is a history of other seizure types, which readily gives the diagnosis. Drop attacks are especially common in malignant epilepsies of childhood, refractory partial epilepsy, especially frontal lobe epilepsy, and myoclonic epilepsies.

Drop attacks may be associated with atonia (rare), myoclonus or hypertonia, but are difficult to tell apart without a video recording. In a typical fall, there is no warning and the patient drops to the ground. Incontinence and severe injuries, such as head injury, are common in tonic and atonic seizures. Providing there has been no such injury, recovery is usually rapid and confusion is minimal. Some patients who are scared by the experience may lie on the ground for some minutes to regain their composure.

If a patient has similar episodes occurring while seated or lying, and thus not leading to falls, this helps rule out a posturally related cause of the drop attacks such as carotid sinus hypersensitivity. Tonic seizures often cause some degree of posturing before or after the fall occurs. Myoclonic drops are usually associated with other myoclonic jerks that do not lead to falls.

### EEG diagnosis of epilepsy

Epilepsy cannot be diagnosed from an EEG alone. There must be a clinical description of episodes that are compatible with epilepsy. The value of the EEG in the diagnosis of epilepsy depends on when the EEG is done and the clinical pattern of the event under question. Interictal epileptiform discharges imply a potential to generate seizures. They are usually seen in patients with epilepsy and have a high positive predictive value but are not diagnostic.

- **False negative interictal results occur in 50% of routine recordings.** Repeating the recording reduces the false negative rate to 30% and a sleep deprived recording reduces them to 20%.
False positive interictal EEGs occur in up to 0.5–2% of healthy young adults. For patients with a strong family history of epilepsy, there is a much higher chance of coincidental and irrelevant epileptiform EEG abnormalities. Ictal recordings are needed to diagnose epilepsy with certainty. Attempts at ictal recording are generally unhelpful if the seizure frequency is less than one per week. An ambulatory EEG may be used to detect seizures. The number of electrodes used in many ambulatory systems is less than for a resting record and spatial sensitivity is less. Not all epileptic seizures can be detected with this system.

Ictal video-EEG-telemetry is the most sensitive and specific test for epilepsy. The EEG is abnormal during most but not all kinds of seizure and the clinical seizure pattern needs to be considered before interpreting the EEG. Video recording may be crucial to diagnose cases when the EEG is normal. Auras and focal motor seizures, including epilepsia partialis continua, may cause localised cortical disturbances that they do not manifest on ictal scalp EEG recordings. Frontal lobe epilepsies may cause muscle artefact on EEG with no diagnostic epileptiform changes. The video is also helpful in determining that the patient's habitual attack has been recorded. If the habitual seizures are different, the patient may have two diagnoses—for example, epilepsy and non-epileptic psychogenic seizures.

**Figure 3** There is significant overlap between the features of focal and generalised epilepsies. Combining the clinical features and results of investigations is essential to make an accurate syndromic diagnosis.

- Patients with definite epileptic seizures for the purposes of subclassification
- Patients with probable epilepsy (see caveats above)

**Indications for diagnostic ambulatory EEG or video-EEG monitoring**
- Patients with frequent attacks of uncertain nature

**Figure 4** Simplified scheme for diagnosing epilepsy, excluding acute symptomatic seizures.
Neuroimaging in epilepsy
The main purpose of neuroimaging is to identify a cause of the patient's epilepsy that needs treatment in its own right, such as a tumour. Computed tomographic scanning identifies most such lesions but magnetic resonance imaging (MRI) is more sensitive. MRI is needed to identify subtle lesions, such as cortical dysplasia or mesial temporal sclerosis, when evaluating patients for possible epilepsy surgery. Neuroimaging is not a diagnostic test for epilepsy. However, if a patient has attacks of uncertain nature and their neuroimaging reveals an epileptogenic lesion such as a malignant glioma, then a diagnosis of epilepsy becomes highly probable. Some lesions may be found that are incidental such as a pineal cyst. The significance and relevance of any abnormality needs to be carefully considered in the context of the clinical picture.

Classification of epilepsy
The epilepsies are syndromes classified according to a combination of characteristics including clinical seizure type, EEG, and aetiology. Generalised epilepsies are characterised by EEG discharges with generalised onset. Focal epilepsies are characterised by EEG discharges with focal onset. In symptomatic epilepsies the aetiology of the epilepsy is known. In cryptogenic epilepsies an aetiology is presumed but not established—for example, an adult with focal epilepsy and normal neuroimaging. In idiopathic epilepsies there is assumed not to be a major structural cause—a polygenic trait is considered important. Idiopathic epilepsies tend to have onset in childhood or adolescence and have characteristic electroclinical features (table 2). Most generalised epilepsies

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Demographics</th>
<th>Clinical features</th>
<th>EEG</th>
<th>Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Childhood absence epilepsy (generalised)</td>
<td>Onset age 3–10 years. Female &gt;&gt; male. 0.01–0.1% of children</td>
<td>Brief vacant spells occur many times per day and may present with school failure. Tonic-clonic seizures uncommon</td>
<td>Generalised spike and wave at 3 Hz. Nearly always triggered by hyperventilation. Photosensitivity uncommon</td>
<td>Remission in 75% by age 30</td>
</tr>
<tr>
<td>Juvenile absence epilepsy (generalised)</td>
<td>Onset age 7–16 years. Female &gt; male. 0.005–0.03% of children</td>
<td>Brief vacant spells occur infrequently. Tonic-clonic seizures in 90%</td>
<td>Generalised polyspike and wave at 3–4 Hz. Nearly always triggered by hyperventilation. Photosensitivity in 20%</td>
<td>Usually requires lifelong treatment</td>
</tr>
<tr>
<td>Juvenile myoclonic epilepsy (generalised)</td>
<td>Onset 7–30 years. Female 3:2 male. 3–12% of all epilepsy</td>
<td>Myoclonic jerks and tonic-clonic seizures in nearly all patients. Absences in 20%</td>
<td>Generalised polyspike and wave. Photosensitivity in 33%</td>
<td>Usually requires lifelong treatment</td>
</tr>
<tr>
<td>Epilepsy with tonic-clonic seizures on waking (generalised)</td>
<td>Onset age 6–30 years. Uncommon</td>
<td>Tonic-clonic seizures, sometimes preceded by myoclonic jerks</td>
<td>Generalised spike and wave in 40%</td>
<td>Usually requires lifelong treatment</td>
</tr>
<tr>
<td>Eyelid myoclonias with absence (generalised)</td>
<td>Onset age 3–10 years. Nearly all female. Some familial cases</td>
<td>Hundreds of seizures daily starting with 4–6 Hz clonic movements of eyes and eyelids. Tonic-clonic seizures usually develop later</td>
<td>Generalised spike and wave at 3–6 Hz. Extreme photosensitivity at onset in nearly all cases</td>
<td>Usually requires lifelong treatment</td>
</tr>
<tr>
<td>Benign epilepsy with centrotemporal spikes (focal)</td>
<td>Onset age 1–15 years. Male &gt; female. 10–15% of childhood epilepsy</td>
<td>Occasional nocturnal seizures start with drooling and twitching one side of face and spread to hemiconic or tonic-clonic seizures</td>
<td>Centrectemporal spikes usually occur in sleep and may switch sides</td>
<td>Usually remits after 3 years. Treatment often not required</td>
</tr>
<tr>
<td>Young onset benign occipital epilepsy (focal)</td>
<td>Median onset 5 years. Male = female. 13% of benign focal epilepsy</td>
<td>Infrequent seizures last up to 30 minutes. Headache and tonic deviation of eyes associated with vomiting may evolve to tonic-clonic seizures</td>
<td>Occipital paroxysms occur on eye closure</td>
<td>Median seizure number is 3 before remission</td>
</tr>
<tr>
<td>Older onset benign occipital epilepsy (focal)</td>
<td>Age of onset 3–16 years. Male = female. 5% of benign focal epilepsy</td>
<td>Seizures several times per day or week start with visual hallucinations or ictal blindness</td>
<td>Occipital paroxysms are blocked by visual fixation</td>
<td>Usually remits in late teens</td>
</tr>
</tbody>
</table>
are idiopathic but some severe childhood generalised epilepsies are symptomatic—for example, Lennox-Gastaut syndrome associated with tuberous sclerosis. Acute symptomatic seizures—for example, caused by metabolic encephalopathy or alcohol—is an additional category commonly causing seizures in adults. Each of the main diagnostic clues (aetiology, neuroimaging, clinical seizure pattern, and EEG) needs to be taken into account in differentiating focal and generalised epilepsy. The clinical manifestations of focal and generalised epilepsies may overlap (fig 3). For example, absence seizures caused by both focal or generalised discharges may cause similar automatisms and it may be difficult to tell the difference clinically or on the EEG. It may only be the presence of an epileptogenic frontal lesion on MRI that enables one to make a diagnosis of a focal epilepsy. Equally some generalised epilepsies such as juvenile myoclonic epilepsy may include some elements of focal motor activity such as head turning and focal features in the EEG.

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ASSESSMENT AND INVESTIGATION OF POSSIBLE EPILEPTIC SEIZURES

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