Of the 1,200,000 Americans with partial epilepsy, temporal lobe epilepsy (TLE) occurs in more than 400,000. Temporal lobe seizures are usually stereotypic in their symptoms and duration. A typical sequence is an aura followed by arrest of motor behavior, blank stare, and automatism. Patients with TLE often show impairments in attention, memory, mental processing speed, executive functions, mood, personality, and drive-related behaviors. Interictal depression occurs in approximately one third of TLE patients. TLE is diagnosed by a history of characteristic partial seizure symptoms. The diagnosis is confirmed by the capture of a typical episode during an electroencephalogram (EEG) or video-EEG, with epileptiform activity over one or both temporal regions. Video-EEG monitoring has revolutionized diagnosis and should be considered in patients in whom diagnosis is uncertain. TLE is treated with medications, resective surgery, and vagus nerve stimulation. Epilepsy surgery should be considered in all patients with refractory partial epilepsy.

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Key words: Epilepsy • Seizures • Video electroencephalography • Magnetic resonance imaging • Depression • Antiepileptic drugs • Surgery

Temporal lobe epilepsy (TLE) is a localization-related epilepsy syndrome. TLE is the most common form of epilepsy,1 and focal epileptiform discharges are most frequently recorded over the temporal region.2 Among patients with localization-related (partial, focal) epilepsy, 27% had TLE, and another 6% had both temporal and frontal foci.3 Thus, of the 1,200,000 Americans with partial epilepsy, TLE occurs in more than 400,000.
Patients with TLE can have simple partial, complex partial, or secondarily generalized tonic–clonic seizures. Conscious awareness is preserved during simple partial seizures (auras) that usually cause autonom- ic, sensory, emotional, or cognitive symptoms. Complex partial seizures impair consciousness and memory; most are associated with oral or hand automatisms. Secondarily generalized seizures can occur with or without prior simple or complex partial seizures.

In TLE, symptoms result from activation or inhibition of areas in the temporal lobe or, with ictal spread, in extratemporal areas with strong temporal connections. Functional anatomy defines the effects of lesions and seizures. The temporal lobes have auditory, olfactory, higher visual, memory, emotional, and social functions (Figure 1). They link past and present sensory and emotional experiences into a continuous self. The phylogenetically older medial (limbic) temporal cortex includes olfactory areas, amygdala, and hippocampus and parahippocampal gyrus. The amygdala modulates the flow of emotion, drive, and affective expression between the cortex and the hypothalamus/limbic midbrain. The hippocampus and parahippocampal gyrus are critical for learning and memory. These structures do not store memories but stamp neural templates in neocortex. The newer lateral (neocortical) temporal cortex is divided into anterior, superior, and inferior portions, each supporting different cognitive functions. Primary auditory cortex is on the transverse temporal gyrus. Supero- lateral neocortex processes linguistic (Wernicke’s area) and nonlinguistic (eg, musical) auditory data. Infero- lateral and basal neocortex is a visual association cortex mediating object recognition. The basal fusiform and lingual gyri contain the visual pattern template and color areas. The temporal pole is involved in object recognition and naming and in visual learning.

For individual patients, temporal lobe seizures are usually stereotypic in their symptoms and duration. A typical sequence is an aura followed by arrest of motor behavior, blank stare, and automatisms. Oral automatisms are most common. Hand automatisms suggest an ipsilateral focus, whereas dystonic hand postures suggest a contralateral focus. Seizures typically last from 30 to 180 seconds. Postictal confusion, tired- ness, and amnesia are common. Postictal symptoms can help lateralize the focus (eg, impairments in verbal memory and naming after left-sided seizures and geographic disorientation after right-sided seizures).

Physicians must differentiate simple and complex partial seizures to recommend whether a patient is safe to drive or operate dangerous equipment. Some patients are unaware of the mental lapses, denying any impairment in level of consciousness. Family members or friends should assess responsiveness and memory during seizures, because physicians rarely observe seizures. Many patients, usually men, do not report ongoing seizures so that they can maintain driving privileges; approximately 31% of patients with refractory epilepsy drive, endangering themselves and others. Alternatively,
unnecessary driving restrictions impose dire social and economic consequences. A consensus conference of the American Academy of Neurology, American Epilepsy Society, and Epilepsy Foundation recommended that people with epilepsy be allowed to drive if they are seizure free for 3 months. The physician’s knowledge of the individual case (eg, long-standing history of only nocturnal seizures, compliance, factors that contributed to a breakthrough seizure) should have an impact on the recommendation regarding driving. Physicians make recommendations; state departments of motor vehicles make decisions about driving privileges.

**Diagnosis**

TLE is diagnosed by the history of characteristic partial seizure symptoms. The diagnosis is strongly supported by the electroencephalogram (EEG) showing temporal lobe epileptiform activity and by the neuroimaging of a lesion. Many patients with TLE have normal routine EEG and magnetic resonance imaging (MRI) studies. The diagnosis is confirmed by the capture of a typical episode during an EEG or video-EEG with epileptiform activity over one or both temporal regions. Video-EEG monitoring has revolutionized diagnosis and should be considered in patients in whom diagnosis is uncertain or for whom seizures do not respond to several medical therapies. However, only approximately 25% of temporal lobe simple partial seizures have an EEG correlate, whereas more than 90% of temporal lobe complex partial seizures show paroxysmal changes on scalp EEG.

There are many challenges in diagnosing TLE. Is it epilepsy? The stereotypic brief paroxysmal behavioral changes of partial seizures must be distinguished from similar symptoms that accompany psychiatric and medical disorders. For example, brief episodes of anxiety, dizziness, and gastrointestinal discomfort can result from panic disorder, angina, pheochromocytoma, and TLE. Duration of symptoms is helpful. Most simple partial seizures last less than 2 minutes. In contrast, panic attacks usually last more than 10 minutes. When sensory or motor seizures spread (ie, Jacksonian march), it is over seconds, not minutes. In contrast, when migraine auras spread, it is over minutes. There are no pathognomonic simple partial seizure symptoms. Paroxysmal psychic and sensory symptoms are commonly reported by patients with bipolar, anxiety, psychotic, and other psychiatric disorders. Specific paroxysmal symptoms, such as a rising abdominal sensation, déjà vu, and depersonalization or derealization, strongly suggest the possibility of TLE.

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In many cases, MRI reveals treatable lesions that are not visualized on CT scans, including...
Temporal Lobe Epilepsy

Table 1
Medial and Lateral Temporal Lobe Epilepsy Syndromes

<table>
<thead>
<tr>
<th>Clinical feature</th>
<th>Medial</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age of onset (years)</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Identified etiology</td>
<td>85%</td>
<td>65%</td>
</tr>
<tr>
<td>Prolonged febrile seizures</td>
<td>25%-75%</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Head injury</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Low-grade tumor</td>
<td>&lt;5%</td>
<td>5%-10%</td>
</tr>
<tr>
<td>Meningitis/encephalitis</td>
<td>10%</td>
<td>15%-20%</td>
</tr>
<tr>
<td>Cortical dysplasia/malformation</td>
<td>&lt;5%</td>
<td>5%-20%</td>
</tr>
<tr>
<td>Latency (insult to habitual seizures):</td>
<td>Identified in 95%</td>
<td>Identified in 15%</td>
</tr>
<tr>
<td>Insult to habitual seizures</td>
<td>Average 7.5 years</td>
<td>Average 7.5 years</td>
</tr>
<tr>
<td>Simple partial seizures*</td>
<td>Identified in ~95%</td>
<td>Identified in 75%</td>
</tr>
<tr>
<td>Abdominal sensation</td>
<td>60%</td>
<td>25%</td>
</tr>
<tr>
<td>Fear</td>
<td>15%-20%</td>
<td>10%-15%</td>
</tr>
<tr>
<td>Déjà vu</td>
<td>5%</td>
<td>30%-40%</td>
</tr>
<tr>
<td>Depersonalization</td>
<td>&lt;5%</td>
<td>10%-20%</td>
</tr>
<tr>
<td>Olfactory-gustatory</td>
<td>15%-20%</td>
<td>10%-15%</td>
</tr>
<tr>
<td>Tinnitus/vertigo</td>
<td>&lt;5%</td>
<td>5%-10%</td>
</tr>
<tr>
<td>Language disorder</td>
<td>&lt;5%</td>
<td>10%-20%</td>
</tr>
<tr>
<td>Complex partial seizures</td>
<td>Contralateral hand dystonia 40%</td>
<td>20%</td>
</tr>
<tr>
<td>Early clonic activity after automatisms</td>
<td>20%-25%</td>
<td>5%-10%</td>
</tr>
<tr>
<td>Intercital EEG</td>
<td>Normal</td>
<td>5%-10%</td>
</tr>
<tr>
<td>Unilateral EA</td>
<td>50%</td>
<td>85%</td>
</tr>
<tr>
<td>Bilateral independent EA</td>
<td>40%</td>
<td>5%-10%</td>
</tr>
</tbody>
</table>

All percentages are approximate.

*Many patients had more than one simple partial seizure type; % for each specific symptom is derived from number of patients with identified simple partial seizures.

EEG, electroencephalogram; EA, epileptiform activity.

Data from French et al, Pfander et al, and Pacia et al.

Mesial temporal sclerosis (Figure 2A), cortical dysplasia (Figure 2B), low-grade gliomas (Figure 2C), and cavernous angiomas. When a patient with partial epilepsy is evaluated, prior CT or MRI scans should be reviewed to ensure that the study was of good quality and no lesions were missed. If films are not available, the quality is poor, or if seizure frequency or severity has increased since the last imaging study without identifiable cause (eg, noncompliance), MRI should be repeated.

Paroxysmal events, including seizures, should be diagnosed with caution. Errors and uncertainties are common among experts. Patients are often confused or unconscious during part of the event, and witnesses are often frightened, which can lead to inaccurate reports. Most stases, strange mental feelings, and jerks are not seizures. Nonepileptic paroxysms are common and can imitate any epileptic seizure. If episodes are not witnessed or recorded, rates of incorrect diagnoses are increased.

Referral to an epilepsy center should be considered when seizures are not fully controlled, because the diagnosis of epilepsy or seizure type might be incorrect.

Psychogenic episodes and syncope are often mistaken for epileptic seizures. Nonepileptic psychogenic seizures (NES) affect approximately 25% of patients diagnosed with uncontrolled seizures. Sexual and physical abuse and mild head injury are risk factors. Video-EEG confirmation of NES is essential, because the history can be misleading and no clinical feature is pathognomonic. Also, approximately 20% of patients with NES have a current or past history of epilepsy. Minor convulsive movements during syncope can falsely suggest a seizure.

Clinical Manifestations

TLE can be broadly divided into medial and lateral TLE syndromes (Table 1). Risk factors for the more common medial TLE include febrile seizures (frequently prolonged ones), meningitis, encephalitis, or head trauma. Mesial temporal sclerosis, the most common lesion, is usually refractory to medical therapy but can be surgically resected. There is often a latency of 5 to 10 years between the brain insult and onset of seizures. Minor convulsive movements during syncope can falsely suggest a seizure.
The initial symptom during a temporal lobe seizure helps identify the area where the seizure arises, and in some cases, the progression of sensory, autonomic, and experiential symptoms and objective signs reflect the ictal spread. In many cases, seizures arise in “silent” areas; initial symptoms reflect the area to where the seizure spread. The high frequency of simple partial seizures because some features were positive, whereas others are not pathological and involve areas of behavior (eg, religious or sexual interests) that are not routinely assessed. The frequency and specificity of a characteristic behavioral syndrome among TLE patients is controversial. Biologic factors (eg, brain lesions, epileptogenic process, localization and lateralization, recurrent seizures, family history), antiepileptic drugs (AEDs), and psychosocial factors contribute to cognitive and behavioral changes. Pathogenic factors interact, and their relative roles vary among different patients and are difficult to crisply define in an individual.

Disease and Behavioral Changes

Patients with TLE and other forms of epilepsy often show impairments in attention, memory, mental processing speed, executive functions, mood, personality, and drive-related behaviors (eg, libido, aggression). The range of cognitive and behavioral changes is very diverse. Geschwind and colleagues13,14 defined an interictal syndrome in TLE of deepened emotions, circumstantiality, altered religious and sexual concerns, and hypergraphia. They emphasized behavioral change rather than disorder recalling recently learned information, especially names and details but also memories of personal events, such as vacations. Left-sided temporal foci impair mainly verbal memory; right-sided foci impair mainly recently acquired visual, spatial, and geographic memories. Although neuropsychological tests with 30-minute delays reveal memory impairments, longer delays that correspond with the “real world” reveal even greater deficits.21 Short-term memory impairment can result from structural lesions,22 neuronal dysfunction or loss, interictal epileptic form discharges,23 recurrent seizures, and AEDs (eg, phenobarbital, topiramate).24,25

One of the greatest shortcomings in the care of TLE patients is the failure to diagnose and treat depression.

The initial symptom during a temporal lobe epilepsy suggests that symptoms can be generated in regions outside the focus. Either these habitual symptoms resulted from ictal spread, or originally arose in the resected seizure focus but through years of recurrent seizures were “imprinted” in areas with strong connections to the seizure focus.12 Seizures can also cause negative symptoms. For example, seizures arising in the dominant hippocampus–parahippocampal complex can impair short-term memory, and seizures arising in the dominant anterolateral cortex can impair naming.

Interictal Cognitive and Behavioral Changes

Patients with TLE and other partial and primary generalized epileptic syndromes.20

The behavioral spectrum in TLE is broad but results largely in functional impairments that lead to intellectual and emotional disorders. Impaired short-term memory is the most common interictal cognitive complaint. Patients report difficulty with antidepresants without their epilepsy being exacerbated.26 Anxiety disorders and psychoses are also common, highly morbid, and treatable behavioral disorders. Like depression, these are most often observed during the interictal period but can be most severe postictally.

TLE as a Progressive Disorder

Epilepsy can be a progressive disorder, in which seizures beget seizures,33 seizures become more refractory to
medical therapies, and behavioral and structural changes become more severe. In animals, brief seizures and excitotoxic lesions produce progressive hippocampal neuronal loss and memory deficits. Some TLE patients followed serially show evidence of increasing hippocampal atrophy and worsening cognitive function. Early structural injury can cause unilateral hippocampal atrophy, and subsequent generalized seizures can cause progressive neuronal loss. However, most patients with partial epilepsy show no MRI changes over brief intervals. Patients who have 20 seizures before therapy or who have an inadequate response to initial treatment with AEDs often develop refractory epilepsy. The long latency before intractable epilepsy develops suggests that preventive interventions could help patients at risk if the causative mechanisms are identified. Patients often ask their neurologist, “Are seizures bad for my brain?” The answer is almost always “No.” Yet the evidence suggests that recurrent tonic–clonic and prolonged complex partial seizures can cause structural and functional damage. Furthermore, years of intermittent complex partial seizures in susceptible individuals might also cause cognitive and behavioral disorders.

**Therapy**

Temporal lobe epilepsy is treated with medications, resective surgery, and vagus nerve stimulation. Half of patients respond to maximally tolerated doses of a single AED. If adverse effects do not permit the use of therapeutic doses (ie, mid- to high therapeutic trough levels), another monotherapy trial is usually tried. When seizures persist despite high plasma levels, a trial of two AEDs is recommended, although some experts prefer another monotherapy trial. When monotherapy fails, two AEDs will improve seizure control in more than one third of patients but will fully control seizures in only 10%. More recently introduced AEDs offer some patients improved seizure control or fewer adverse effects, although less than 10% of patients with refractory TLE become seizure free.

The morbidity of seizures and AEDs is often underestimated. For many physicians, patients are “stable” when they return for a routine follow-up and report a few complex partial seizures per month. However, these patients cannot drive, are often under- or unemployed, and have problems in cognitive, emotional, and social functions. After a single drug fails, therapeutic challenges multiply. When a second drug is added, the costs and benefits must be assessed after some interval. Consider a patient on carbamazepine monotherapy (1200 mg/day) who has three complex partial seizures per month. The neurologist gradually adds gabapentin (2400 mg/day), and the frequency of seizures decreases to two per month. If the combination therapy increases tiredness, dizziness, and mental fatigue, the adverse effects likely exceed the beneficial effects. This reduction in seizure frequency will not change

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**Main Points**

- In temporal lobe epilepsy (TLE), symptoms result from activation or inhibition of areas in the temporal lobe or, with ictal spread, in extratemporal areas with strong temporal connections.
- Temporal lobe seizures are usually stereotypic in their symptoms and duration. A typical sequence is an aura followed by arrest of motor behavior, blank stare, and automatisms.
- TLE can be broadly divided into medial and lateral TLE syndromes. Risk factors for medial TLE include febrile seizures, meningitis, encephalitis, or head trauma; lateral TLE is often caused by head trauma, low-grade tumors, cortical dysplasia, and infection.
- There are many challenges in diagnosing TLE. The stereotypic brief paroxysmal behavioral changes of partial seizures must be distinguished from similar symptoms that accompany psychiatric and medical disorders.
- The range of cognitive and behavioral changes in TLE is very diverse. The most common interictal cognitive complaint is impaired short-term memory: patients report difficulty recalling recently learned information, especially names and details.
- Interictal depression occurs in approximately one third of TLE patients. Among those with refractory epilepsy, depression can often impair quality of life more than seizures; half are depressed, and nearly 20% have suicidal ideation.
- TLE is treated with medications, resective surgery, and vagus nerve stimulation. Half of patients respond to maximally tolerated doses of a single antiepileptic drug. Epilepsy surgery should be considered in all patients with refractory partial epilepsy.
the patient’s life, but the increase in adverse effects will. The use of excessive numbers of medications and doses remains a significant problem.54

Epilepsy surgery should be considered in all patients with refractory partial epilepsy. Most neurologists wait too long, often decades, before a referral is made for surgical evaluation. Approximately 70% of good surgical candidates with TLE become seizure free, and many others enjoy significantly reduced seizure burden and improved quality of life.5,35,36

The vagus nerve stimulator (VNS) is an adjunctive therapy for TLE. Overall, approximately 20% of patients treated with the VNS enjoyed a greater than 50% reduction in seizure frequency compared with control subjects.5 Patients should understand that VNS rarely provides full seizure control; medication reductions, if any, are often modest. Transient hoarseness is the most common adverse effect.

The effects of TLE extend well beyond the seizures. Antiepileptic drugs, stigma and psychosocial problems, and cognitive and behavioral disorders combine to severely impair quality of life. Many treatable disorders, such as depression, escape recognition. The neurologist must focus on seizures and the adverse effects of AEDs but at the same time simply ask the patient how he truly feels, looking him in the eye as he responds and assessing the person behind the disorder.

References

22. Puliafito V, Kupka P, Jokelainen M. Motor and cognitive functions in newly diagnosed adult seizure patients before antiepileptic med-


