The EEG in Selected Generalized Seizures

Richard A. Hrachovy*‡ and James D. Frost Jr.*†

Abstract: This article reviews the ictal and interictal EEG findings associated with a select group of generalized seizures. These include absence seizures, myoclonic seizures seen in juvenile myoclonic epilepsy, idiopathic generalized tonic clonic seizures, infantile spasms, and atypical absence, tonic, and atonic seizures associated with the Lennox Gastaut syndrome.

Key Words: Electroencephalography, Ictal, Interictal, Generalized seizures, Epilepsy.

(J Clin Neurophysiol 2006;23: 312–332)

The purpose of this article is to briefly describe the interictal and ictal EEG patterns associated with a select group of generalized seizures. A detailed description of the clinical manifestations of the seizures is beyond the scope of this discussion.

IDIOPATHIC GENERALIZED EPILEPSIES

Of the various idiopathic generalized seizures, absence, myoclonic and generalized tonic-clonic seizures will be discussed.

ABSENCE SEIZURES

Interictal EEG Findings

The background activity is usually normal, although some degree of slowing of the background rhythms may be seen in up to one third of patients (Sato et al., 1983; Holmes et al., 1987). Paroxysms of rhythmic slow wave activity with a frequency of 2.5 to 3.5 Hz may occur in a generalized fashion or may be restricted to the occipital derivations (Fig. 1). This rhythmic slow activity is generally symmetric and usually blocks with eye opening. It may occur in isolated runs or may be coupled with the bursts of generalized spike and wave activity described below (Dalby, 1969; Holmes et al., 1987).

The interictal EEG in patients with absence seizures typically demonstrates brief bursts of 3 Hz spike-and-wave activity that are bilaterally synchronous and symmetric (Pennsylvania et al., 1975; Holmes et al., 1987). These bursts are usually frontocentral dominant; however, in some patients the bursts are restricted to, or maximally expressed in, the occipital regions. The discharges appear and disappear suddenly. The frequency of the spike-and-wave complexes frequently varies slightly during the burst. The first few complexes of the burst may occur at a frequency of 3.5 to 4 Hz, whereas, the last few may slow to 2.5 Hz (Niedermeyer, 1972; Daly, 1990; Fig. 2). Some of the bursts of spike-and-wave slow activity may be followed by brief runs of rhythmic 2.5 to 3.5 Hz activity in the frontal leads bilaterally (ringing effect). As soon as the 3 Hz spike-and-wave bursts stop, the background EEG activity immediately returns to the baseline state, with no postictal depression or slowing except for the ringing effect just mentioned. Three Hz spike-and-wave activity usually becomes more frequent with hyperventilation (Sato et al., 1983) and may be induced by photic stimulation (Wolf and Goosse, 1986).

During sleep, the spike-and-wave complexes become more fragmented, and bursts of polyspike-and-wave activity may appear (Niedermeyer, 1965; Ross et al., 1966; Sato et al., 1973). The frequency of the complexes may slow to 1.5 to 2.5 Hz. In some patients, the bursts consist of only single spike-and-wave complexes that may be low in voltage. These fragmentary bursts may occur in a generalized fashion or may lateralize to one hemisphere. The location of maximal expression of these fragmentary complexes often shifts from burst to burst and, in an occasional patient, these fragments seem to arise consistently from one region or hemisphere (Fig. 3). Such fragmentary bursts may be misinterpreted as representing focal epileptiform abnormalities. The amount of epileptiform activity increases with the onset of slow wave sleep and then waxes and wanes in close relationship to the sleep wake cycle. In most patients, REM sleep is associated with an attenuation or cessation of the spike-and-wave activity (Kellaway and Frost, 1983; Fig. 4). In a small number of absence seizure patients, the interictal EEG may exhibit benign centrotemporal spikes (Fig. 5).

ICTAL EEG FINDINGS

Both simple and complex absence seizures are associated with bursts of generalized 3 Hz spike-and-wave activity, which generally last less than 30 seconds in duration (Fig. 6). Clinical manifestations of bursts lasting less than 2.5 seconds in duration are difficult to detect, although specialized measurements of reaction times of patients with 3 Hz spike-and-wave activity...
FIGURE 1. Occipital rhythmic intermittent delta activity (ORIDA) in a 7-year-old patient with absence seizures.

FIGURE 2. Modulation of the frequency of the spike and slow wave complexes during a burst of 3 Hz spike-and-wave activity. The first few complexes occur at frequency >3 Hz whereas the frequency of the later complexes slows to <3 Hz.
FIGURE 3. NREM sleep in a 7-year-old patient with absence seizures demonstrating a burst of polyspike-and-wave activity (A) and fragmentary bursts of spike-and-wave activity (B).

FIGURE 4. Time modulation of 3 Hz spike and wave activity. Note the marked attenuation of the spike-and-wave activity during the REM sleep periods.
FIGURE 5. Centro-temporal spikes recorded during NREM sleep in a 9-year-old patient with absence seizures.

FIGURE 7. Bursts of 3.5 to 5 Hz spike-and-wave and polyspike-and-wave activity in a 12-year-old patient with juvenile myoclonic epilepsy.

FIGURE 8. Photoparoxysmal response in a 14-year-old patient with juvenile myoclonic epilepsy.
have shown that, regardless of its duration, 3 Hz spike-and-wave activity impairs performance (Mirsky and Van Buren, 1965; Goode et al., 1970; Porter et al., 1973; Browne et al., 1974). Thus, in the clinical setting, the number of absences occurring daily is often difficult to determine, and a precise count requires the use of long-term video/EEG monitoring.

**MYOCLONIC SEIZURES-JUVENILE MYOCLONIC EPILEPSY**

The EEG findings associated with myoclonic seizures vary depending on the underlying epileptic syndrome. In this section, only the EEG features associated with the myoclonic seizures seen in patients with juvenile myoclonic epilepsy (JME) will be discussed.

**INTERICTAL EEG FINDINGS**

As with other idiopathic generalized epilepsies, the background EEG activity is usually normal. There are bursts of frontocentral-dominant generalized spike-and-wave and polyspike-and-wave activity. The frequency of these bursts tends to be more irregular than the typical 3 Hz spike-and-wave bursts and varies between 3 and 5 Hz (Janz, 1957, 1985, 1989, 1990; Tsuboi, 1977; Delgado–Escueta and Enrile–Bascal, 1984; Fig. 7). The polyspikes may occur without the aftercoming slow wave. Frequently these bursts are fragmentary in appearance and are often restricted to the frontal regions. Typical 3 Hz spike-and-wave activity may occur in JME patients and such patients usually also exhibit clinical absence seizures.

During sleep, the bursts of spike-and-wave and polyspike-and-wave activity may decrease, particularly during deep slow wave sleep, and the bursts are markedly diminished, or absent, during REM sleep. Fragmentary bursts are frequently seen during sleep. Arousal from sleep is an extremely potent activator of spike-and-wave and polyspike-and-wave discharges (Tuchon, 1982). In some patients, this may be the only time epileptic activity is seen during a routine 30 to 60 minute EEG recording. Likewise, clinical seizures often occur on awakening. Hyperventilation may increase or induce epileptic discharges (Janz, 1985) and approximately one third of JME patients are photosensitive (Wolf and Goosses, 1986; Janz, 1990; Fig. 8).

**ICTAL EEG FINDINGS**

The myoclonic jerk seen in JME is typically associated with a burst of 3 to 4 Hz polyspike-and-wave activity (Janz, 1957; Delgado–Escueta and Enrile–Bascal, 1984). The jerk occurs simultaneously with the burst of spikes which usually have a frequency of 10 to 16 Hz. The spikes are followed by slow waves occurring at a frequency of 2.5 to 5 Hz (Fig. 9). The polyspike-and-wave pattern, which often persists beyond
the termination of the myoclonic jerk, may last up to several seconds (Fig. 10). The myoclonic jerks may occur in isolation or repetitively. As mentioned above, the arousal mechanism is a potent activator of the myoclonic seizures seen JME.

IDIOPATHIC GENERALIZED TONIC-CLONIC SEIZURES

Interictal EEG Findings
Since idiopathic generalized tonic-clonic seizures may occur with any of the primary generalized seizure disorders, the interictal EEG findings associated with these seizures are variable (see above). However, in all patients with idiopathic generalized tonic-clonic seizures, the interictal background EEG activity is usually normal, and the EEG may show brief bursts of generalized 2.5 to 3.5 Hz spike-and-wave and/or polyspike-and-wave activity. In most patients, these bursts last less than 2.5 seconds, and such bursts are frequently referred to as “abortive” spike-and-wave activity. It should be remembered that only about one half of patients with primary generalized tonic-clonic seizures will demonstrate spike-and-wave activity on a routine EEG. Conversely, it is also important to realize that not all patients whose EEG shows abortive generalized spike-and-wave activity will experience clinical seizures.

As with most primary generalized seizures, the bursts of spike-and-wave activity observed interictally in patients with idiopathic generalized tonic-clonic seizures typically become more frequent with the onset of slow wave sleep. The transition period from wakefulness to drowsiness is particularly important because, in some patients, this is the only time spike-and-wave activity may appear in a routine EEG. Thus, it is imperative that a sleep EEG be obtained in all patients in whom the diagnosis of seizures is being considered and that the awake-sleep transition period be recorded. Fragmentary bursts of spike and wave activity are also common during sleep in this condition.

ICTAL EEG FINDINGS
In the usual clinical setting, the background EEG activity is obscured by high voltage myogenic artifact during a primary generalized seizure. Digital high frequency filtering of the muscle artifact allows for adequate visualization of the EEG activity in some patients. The most informative data concerning the ictal EEG changes associated with primary generalized tonic-clonic seizures has been obtained from patients paralyzed with muscle
FIGURE 11. Photoparoxysmal response followed by a generalized tonic clonic seizure in a 9-year-old patient with a history of absence seizures. (A) Burst of 3 Hz spike and wave activity elicited by photic stimulation. The patient exhibited staring and unresponsiveness during the burst. (B) The spike-and-wave activity is replaced by rhythmic generalized alpha frequency activity (recruiting rhythm) which is associated with tonic posturing. (C) The recruiting rhythm persists for several seconds and then the background activity becomes obscured by myogenic artifact.
FIGURE 11. Continued.

FIGURE 12. Myoclonic seizures followed by a generalized tonic-clonic seizure in a 12-year-old patient with juvenile myoclonic epilepsy. (A) Burst of spike-and-wave and polyspike-and-wave activity associated with myoclonic jerks. (B) Bursts of spike-and-wave and polyspike-and-wave activity followed by the appearance of rhythmic generalized alpha frequency activity (recruiting rhythm) which is associated with tonic posturing. (C) The recruiting rhythm persists for several seconds and then the background activity becomes obscured by myogenic artifact.
relaxants. As the seizure begins, there may be recurrent high voltage polyspike-and-wave bursts which are associated with myoclonic jerks and/or a cry. Then, the EEG typically shows generalized voltage attenuation with superimposed low voltage fast activity (20–40 Hz). This attenuation and superimposed fast activity may not be seen at the onset of all generalized tonic-clonic seizures. The attenuation lasts a few seconds and is followed by the appearance of rhythmic generalized 10 to 12 Hz activity. This rhythmic alpha frequency activity progressively increases in amplitude over the next 8 to 10 seconds and is associated with the tonic phase of the seizure. Thereafter, the EEG shows generalized slower activity, which increases in amplitude but slows in frequency from 7 to 8 to 1 to 2 Hz. When the frequency of these waves reaches 4 to 5 Hz, the waves become mixed with polyspikes and these polyspike-and-
FIGURE 13. Hypsarrhythmia in a 23-month-old infant. (Reprinted from Hrachovy and Frost, 2003, with permission.)

FIGURE 14. Hypsarrhythmia with increased interhemispheric synchronization in a 22-month-old infant. (Reprinted from Hrachovy and Frost, 2003, with permission.)
FIGURE 15. Asymmetric hypsarrhythmia in a 13-month-old infant. (reprinted from Hrachovy and Frost, 2003, with permission.)

FIGURE 16. Suppression burst variant of hypsarrhythmia in a 3-month-old infant. (Reprinted from Hrachovy and Frost, 2003, with permission.)

FIGURE 17. Two variants of hypsarrhythmia. The suppression burst variant and a consistent focus of abnormal discharge (characterized by recurrent electrical seizure discharges in the right temporo-central region). (Reprinted from Hrachovy and Frost, 2003, with permission.)
wave complexes are associated with myoclonic jerks. As the seizure continues, the bursts of polyspike-and-wave activity become intermittent and between bursts the background EEG activity is suppressed. Following the last burst of polyspike-and-wave activity, the EEG shows a generalized voltage attenuation lasting several seconds. This attenuation is followed by irregular low voltage delta activity which gradually increases in frequency and amplitude (Gastaut and Broughton, 1972; Gastaut and Tassinari, 1975; Niedermeyer, 2005). The time required for the EEG to return to the baseline state is highly variable from patient to patient. The onsets of two generalized tonic-clonic seizures are shown in figures 11 and 12.

In conclusion, although each of the idiopathic generalized seizures is associated with a specific ictal EEG pattern, all of the seizures share two major interictal features: the background EEG activity is usually normal and there are bursts of synchronous and symmetric 2.5 to 3.5 Hz spike-and-wave and/or polyspike-and-wave activity. Thus, when a routine EEG shows these two interictal features, it can be strongly suggested that the findings are consistent with a diagnosis of an idiopathic generalized epilepsy.

CRYPTOGENIC OR SYMPTOMATIC GENERALIZED EPILEPSIES

The EEG features of infantile spasms and three common seizures associated with the Lennox Gastaut syndrome (i.e., atypical absence, atonic, and tonic) will be discussed in this section.

INFANTILE SPASMS

Interictal EEG Findings

The most common interictal EEG pattern associated with infantile spasms is hypsarrhythmia. This pattern consists of generalized high voltage, generally asynchronous, slow waves mixed with random high voltage multifocal spikes and sharp waves. At times, the spikes and sharp waves occur in a generalized fashion, but they do not occur in rhythmic, repetitive sequences such as the slow spike slow wave discharges seen in the Lennox Gastaut Syndrome (Vazquez and Turner, 1951; Gastaut and Remond, 1952; Kellaway, 1952; Alva–Moncayo et al., 2002; Frost and Hrachovy, 2003). Figure 13 illustrates the typical hypsarrhythmic pattern. However, in many infantile spasms patients, variations of this prototypical pattern are seen (Hrachovy et al., 1984; Frost and Hrachovy, 2003; Hrachovy and Frost, 2003):

1. Hypsarrhythmia with increased interhemispheric synchronization (Fig. 14). In this variant, the diffuse asynchronous slow wave activity and the multifocal spike and sharp wave activity are mixed with activity that exhibits a significant degree of interhemispheric synchrony and symmetry. Most commonly this activity takes the form of synchronous rhythmic frontal or occipital dominant delta activity or synchronous frontal domi-

FIGURE 18. Hypsarrhythmia comprised of high voltage slow wave activity with little spike or sharp wave activity. (Reprinted from Hrachovy and Frost, 2003, with permission.)
nant slow spike and slow wave activity. This synchronous activity usually occurs intermittently throughout the record. Most infants with hypsarrhythmia will show some degree of synchronization of the background activity if the disorder persists for many months, particularly those that transition to the Lennox Gastaut syndrome.

2. Asymmetric hypsarrhythmia (Fig. 15). This pattern is characterized by the presence of hypsarrhythmia, with a consistent voltage asymmetry between hemispheres. The pattern is also referred to as hemihypsarrhythmia or unilateral hypsarrhythmia. This pattern is associated with an underlying structural lesion of the brain and may be expressed over either the more normal or abnormal hemisphere.

3. Hypsarrhythmia with episodes of generalized or lateralized voltage attenuation (Fig. 16). This variant is characterized by a hypsarrhythmic pattern that is interrupted by recurrent episodes of generalized or lateralized voltage attenuation. Such episodes of attenuation are most commonly seen during slow wave sleep, however, in some patients they occur in a continuous, unremitting fashion. In this latter instance, the pattern is referred to as the suppression burst variant of hypsarrhythmia. The electrodecremental episodes are also one of the ictal EEG patterns associated with infantile spasms.

4. Hypsarrhythmia with a consistent focus of abnormal discharge (Fig. 17). In this variant, a consistent focus of spike or sharp wave activity is superimposed on a hypsarrhythmic background. In some patients, focal electrographic seizure discharges may occur which do not disrupt the ongoing hypsarrhythmic activity.

5. Hypsarrhythmia with little or no spike or sharp wave activity (Fig. 18). This is the least common of the variants and consists of asynchronous and synchronous high voltage generalized slow activity with little or no spike/sharp transients.

In addition to these variants, transient alterations occur in the hypsarrhythmic pattern throughout the day. During slow wave sleep, the voltage of the background activity usually

FIGURE 19. REM sleep modulation of the hypsarrhythmic pattern. The awake tracing reveals an asymmetric hypsarrhythmic pattern. During REM sleep, the hypsarrhythmic pattern disappears. (Reprinted from Hrachovy and Frost, 2003, with permission.)
FIGURE 20. One of the most common ictal changes associated with infantile spasms: a period of generalized voltage attenuation with superimposed fast activity. (Reprinted from Hrachovy and Frost, 2003, with permission.)

FIGURE 21. Burst of 1.5 to 2 Hz slow spike-and-wave activity in a 15-year-old patient with the Lennox-Gastaut syndrome.
increases and often there is a grouping of the multifocal sharp wave and spike activity, resulting in a quasi-periodic pattern (Hrachovy et al., 1981, 1984; Watanabe et al., 1993). As noted previously, episodes of generalized voltage attenuation frequently occur during slow wave sleep. Conversely, during REM sleep there is a marked reduction or total disappearance of the hypsarrhythmic pattern (Hrachovy et al., 1981, 1984, Fig. 19). Furthermore, on arousal from sleep, the hypsarhythmic pattern is frequently markedly reduced or abolished and this change may last from seconds to many minutes. Finally, the hypsarrhythmic pattern may also disappear or be greatly reduced during a cluster of spasms, only to return immediately after cessation of the spasms (Hrachovy et al., 1984).

Although hypsarrhythmia and its variants are the most common patterns seen with infantile spasms, other interictal
patterns may be seen. These include diffuse slowing, focal slowing, focal or multifocal spikes and sharp waves, paroxysmal slow or fast activity, slow spike-and-wave activity, and continuous fast and spindling. These patterns may occur in isolation or in various combinations. In rare instances, the interictal EEG may be normal. This situation is most often encountered when hypsarrhythmia disappears following treatment, although clinical spasms may continue. However, normal interictal background may be seen shortly after the onset of the disorder. In such instances, hypsarrhythmia will usually be seen on subsequent EEG recordings.

**ICTAL EEG FINDINGS**

Video/EEG monitoring studies have identified 11 different ictal EEG patterns that occur with infantile spasms (Kellaway et al., 1979; Yamatogi and Ohtahara, 1981; King et al., 1985; Donat and Wright, 1991; Fusco and Vigevano, 1993; Haga et al., 1995a, 1995b; Wong and Trevathan, 2001). These include: (1) a high voltage, frontal dominant, generalized slow wave transient; (2) a generalized sharp and slow wave complex; (3) a generalized sharp and slow wave complex followed by a period of voltage attenuation; (4) a period of voltage attenuation only (electrodecremental episode); (5) a generalized slow wave transient only; (6) a period of voltage attenuation with superimposed fast activity; (7) a generalized slow wave transient followed by a period of voltage attenuation with superimposed fast activity; (8) a period of attenuation with rhythmic slow activity; (9) fast activity only; (10) a sharp and slow wave complex followed by a period of voltage attenuation with superimposed fast activity; and (11) a period of voltage attenuation with superimposed fast activity followed by rhythmic slow activity. The most common ictal pattern seen is a period of generalized voltage attenuation (Fig. 20). The duration of the ictal events can range from less than a second to more than 100 seconds. There is no close correlation between specific types of clinical events (e.g., flexor, extensor, or mixed spasms) and specific ictal EEG patterns. Also, as noted above, episodes of voltage attenuation frequently occur during slow wave sleep in the absence of clinical spasms. Also, no significant correlation has been found between the various ictal EEG patterns and underlying cause, response to therapy, or long term developmental outcome (Haga et al., 1995a, 1995b). However, as with the asymmetric hypsarrhythmic pattern, an asymmetric ictal EEG pattern does correlate with focal or lateralized structural lesions. Asymmetric spasms frequently occur in association with asymmetric ictal patterns (Donat and Lo, 1994; Gaily et al., 1995, 2001).

The ictal discharges frequently occur in clusters near the end of REM sleep periods. If the patient awakens from REM sleep during this cluster, the ictal complexes may become associated with clinical spasms (Hrachovy et al., 1981).
**FIGURE 25.** Generalized voltage attenuation associated with a tonic seizure in a 15-year-old patient with the Lennox-Gastaut syndrome.

**FIGURE 26.** Generalized voltage attenuation with superimposed fast activity associated with a tonic seizure in a 3-year-old patient with the Lennox-Gastaut syndrome.
FIGURE 27. Generalized voltage attenuation associated with head drops (atonic seizures) in a 4-year-old patient with the Lennox-Gastaut syndrome. The asynchronous slow wave transients occurring during the attenuation episodes represent movement artifacts.

FIGURE 28. Polyspike-and-wave activity followed by a brief period of generalized voltage attenuation in a 3-year-old patient with a history of atonic and generalized tonic-clonic seizures. This complex was associated with a drop attack (atonic seizure).
LENNOX GASTAUT SYNDROME

(Atypical Absence, Tonic And Atonic Seizures)

Interictal EEG Findings

The EEG usually shows moderate to severe slowing of the background activity (Gastaut et al., 1966; Chevrie and Aicardi, 1972; Markand, 1977, 2003; Bauer et al., 1983). The characteristic interictal EEG pattern in the Lennox Gastaut syndrome is the slow spike-and-wave discharge. Although the frequency of this discharge may vary from 1 to 4 Hz, the typical frequency is 1.5 to 2.5 Hz (Blume et al., 1973; Markand, 1977, 2003; Fig. 21). The frequency, amplitude, distribution, and morphology often vary between bursts and during bursts of slow spike-and-wave activity. Shifting asymmetries of the discharge are common. If patients have large unilateral hemispheric lesions, the slow spike-and-wave activity is generally higher over the good hemisphere with corresponding suppression of the background activity over the abnormal hemisphere (Markand, 1977, 2003).

There is a marked variation in the duration of the slow spike-and-wave bursts between patients and across serial EEGs in a given patient. Bursts may last only a few seconds or they may occur in long runs. In some patients, the discharge may be virtually continuous and it is often difficult to determine in such patients whether the discharge is associated with a clinical seizure (Gastaut et al., 1966; Blume et al., 1973; Markand, 1977, 2003).

Slow spike-and-wave activity is generally not influenced by hyperventilation or photic stimulation. However, slow wave sleep dramatically increases the number of bursts and duration of the discharges and the slow-spike-and-slow-wave complexes frequently become intermixed with polyspikes. Electrodecremental periods lasting from 2 to 4 seconds may occur during slow wave sleep and, if prominent, may produce a suppression burst pattern (Gastaut et al., 1966; Blume et al., 1973; Markand, 1977; Fig. 22). Also common in Lennox Gastaut syndrome patients is the presence of bursts of fast activity during slow wave sleep (Gibbs and Gibbs, 1952; Brenner and Atkinson, 1982; Beaumanoir and Dravet, 1992; Markand, 2003; Fig. 23). The frequency of this fast activity is 10 to 25 Hz, and it is typically generalized, although it is usually maximally expressed in the frontal and central regions. These bursts of fast activity may last up to 10 seconds and may be associated with tonic seizures (see below). During REM sleep, the bursts of slow spike-and-wave activity are greatly diminished (Blume et al., 1973; Amir et al., 1986; Horita et al., 1987).

In addition to the generalized slow spike-and-wave discharges, focal, or multifocal spike and sharp wave discharges may be seen (Blume et al., 1973; Markand, 1977, 2003).

Ictal EEG Findings

Patients with Lennox Gastaut syndrome experience multiple seizure types, both generalized and focal. The ictal EEG changes associated with three generalized seizures commonly encountered (atypical absence, tonic, and atonic) are briefly discussed here.

Atypical Absence Seizures

Atypical absence seizures are accompanied by bursts of high amplitude generalized 1.5 to 2.5 Hz activity basically indistinguishable from that seen interictally (Markand, 1977; Fig. 24). Less commonly, bursts of fast activity (10-20 Hz) have been reported to accompany atypical absence seizures (Blume et al., 1973, Markand, 2003). In general, the impairment of consciousness that occurs with atypical absence seizures is progressive and not abrupt like that which occurs with 3 Hz spike-and-wave activity. Likewise, recovery of consciousness at the end of the seizure is gradual. Thus, in severely retarded individuals, the detection of atypical absence seizures at bedside may be extremely difficult. The occurrence of drooling, changes in postural tone and myoclonus of the eyelids or perioral musculature may aid in the clinical identification of the seizures. However, in many patients, long runs of slow spike-and-wave discharges frequently occur without any apparent change in the patient’s clinical state.

Tonic Seizures

The EEG during tonic seizures may show generalized voltage attenuation or so-called electrodecremental change, bursts of rhythmic fast activity (15-25 Hz), or attenuation followed by rhythmic fast activity (Gastaut and Tassinari, 1975; Markand, 1977; Horita et al., 1987; Figs. 25, 26). A generalized slow spike-and-wave complex may precede these ictal patterns. Following the ictal event, the EEG may show generalized delta activity for several seconds before returning to the baseline state (Markand, 2003). As mentioned previously, bursts of fast activity frequently occur during slow wave sleep and may or may not be associated with clinical seizure activity. Some of the clinical seizures occurring during sleep are subtle (e.g., eye opening and minimal upward eye deviation) and may be easily missed without video/EEG monitoring.

Atonic Seizures

Atonic seizures have been associated with a variety of ictal EEG patterns (Markand, 2003) including generalized spike-and-wave activity, generalized polyspike-and-wave activity, generalized voltage attenuation (Fig. 27), and runs of low or high voltage fast activity. These patterns can occur alone or in various combinations (Fig. 28).

REFERENCES


