Epileptic drop attacks in partial epilepsy: clinical features, evolution, and prognosis

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Abstract

Objectives—Sudden falls have been described in patients with partial epilepsy. However, no study has detailed the clinical, EEG, and evolutive features of partial epilepsies with drop attacks.

Methods—In a consecutive series of 222 patients with partial epilepsy admitted for uncontrolled seizures over a 10 year period, 31 patients presented with epileptic drop attacks during evolution of their illness. Twenty two patients had frontal, five temporal, and four multifocal or undefinable lobe epilepsies; 74% of the cases showed an EEG pattern of secondary bilateral synchrony during evolution. A statistical comparison of some clinical and EEG features between the patients with epileptic drop attacks and patients with partial epilepsy without drop attacks (control group of 191 patients) was carried out.

Results—Seventy four per cent of patients had a poor prognosis and 45% were mentally retarded; 52% of patients with epileptic drop attacks continued to have epileptic falls associated with partial seizures and mental deterioration at the end of the follow up. These characteristics of patients with epileptic drop attacks were significantly different from the control group.

Conclusion—Almost all literature reports concur that the physiopathogenetic substrate of epileptic drop attacks is a mechanism of secondary bilateral synchrony. A localised epileptic focus may lead to a process of secondary epileptogenesis involving the whole brain, causing a progressive cerebral disturbance with worsening of the epileptic seizures and higher cerebral functions.

Keywords: partial epilepsy; epileptic drop attacks; secondary bilateral synchrony; prognosis

Falling may occur during an epileptic seizure and is typical of some epileptic syndromes—namely, epilepsies with grand mal seizures, myoclonic-astatic seizures, and atomic and tonic seizures in generalised cryptogenic or symptomatic epilepsies. Falling is also possible in partial seizures, when secondary generalisation follows the partial onset or when the motor ictal pattern causes a loss of postural control leading to a fall. A sudden drop has been described in patients with partial epilepsy and has been considered an ominous predictive sign. Epileptic drop attacks are extremely disabling, both because of the continuous traumatic risk and for the need for patients to be accompanied or move only in a wheelchair or when wearing a helmet. There is no consensus on the site of origin of epileptic drop attacks. Geier et al. describing falls as the ictal clinical manifestation in 81% of patients with frontal lobe epilepsy, suggested several mechanisms to explain this kind of seizure. Falls may result from an atonia in postural muscles, or a clonic jerk, or a tonic contraction of axial and leg muscles leading to a loss of balance. Other authors described drop attacks followed by confusion and reactive automatism as of probable frontal lobe origin. Palmieri et al. found a high incidence of drop attacks in patients with neuronal migration disorders involving the central region, thus supporting the hypothesis of a spreading of the ictal discharge from mesial epileptic foci to frontal areas bilaterally through callosal pathways as the cause of falls. Epileptic drop attacks have also been described in temporal lobe epilepsy. The aim of the study was to detail clinical, EEG, and evolutive features of the partial epilepsies with epileptic drop attacks.

Method

We reviewed the clinical history of all adult patients with cryptogenic or symptomatic partial epilepsy admitted consecutively as inpatients to our Institute for uncontrolled seizures over a 10 year period. A total of 222 patients entered the study, of whom 31 experienced epileptic drop attacks during evolution of their illness. All patients were followed up for at least two years after admission to hospital. During stays in hospital and follow up different antiepileptic drug regimens were given to improve their clinical status. Diagnosis was made on the basis of anamnestic, clinical, radiological (CT and MRI), and electrophysiological data. The EEG machines used were two 17 channel Nihon Koden polygraphs. Nineteen electrodes were placed according to the 10–20 international system in anteroposterior and coronal montages. Sphenoidal leads were added in most patients. The EEG focus was defined as phase reversal in bipolar montage on scalp EEG. Secondary bilateral synchrony was defined as the coexistence in the same EEG of focal and bilateral synchronous discharges after the focal onset within 200 ms. All patients had repeated and prolonged video-EEG recordings while stretched out in
an armchair. Some patients had EEG for prolonged periods while standing up. In these cases patients wore a safety jacket secured to the ceiling with a cable to avoid traumatic injury in the case of a fall.

Epileptic drop attacks were defined as a sudden fall without warning, accompanied or not by loss of consciousness. For each patient we evaluated sex and age, family history of epilepsy, aetiology and presence of neuroradiological focal lesions, age at seizure onset, seizure frequency and semiology, neurological examination, ictal and interictal EEG, and clinical outcome.

We defined frontal or temporal or extratemporal lobe seizures on the basis of seizure semiology, interictal scalp EEG, and video-EEG recording of seizures. We defined as drug resistant patients whose seizures, at the end of the follow up, recurrent more than once a week despite multiple antiepileptic drug trials, with monotherapy or polytherapy, at the highest tolerable dose.

Statistical analysis was performed with student’s t test or χ² test when appropriate.

### Results

Our epileptic drop attacks group consisted of 20 men and 11 women aged from 20 to 55 (mean age 33 years, table 1). Mean duration of epilepsy was 22 years. We found a positive family history for epileptic disturbances in nine patients (29%); 16 patients (52%) had symptomatic partial epilepsy: two had anamnestic pre- and perinatal pathology, and 14 had neuroradiological focal lesions (four focal atrophy and gliosis, four peritumoral lesions, three cortical calcified lesions, one focal pachygyria, one hippocampal sclerosis, one brain tumour). Age at the onset of seizures was from 1 to 45 (mean 12 years) and was under 10 years in 16 (52%) cases. Age at onset of epileptic drop attacks was from 3 to 45 (mean 19 years). Drop attacks occurred in 26 patients (84%) from one to 34 years after onset of epilepsy. Seizures in the other five cases (patients 5, 8, 22, 25, and 27) were characterised from the beginning by both drop and partial attacks (three patients with frontal epilepsy and two patients with temporal lobe epilepsy). Seizure frequency during the first two years of illness was more than one a week in 18 (58%) patients.

Fourteen (45%) patients showed mental disability; three of these were mentally retarded and 11 showed a progressive intellectual deterioration.

Interictal EEG focus (table 2) was frontal or frontotemporal in 19 (61%) patients (frontal in 12, frontotemporal in seven), mid-temporal in two (6%), parietal or occipital in one (3%), and multiple independent in nine (29%); secondary bilateral synchrony was present in 23 patients (74%). Focal abnormalities in patients

<table>
<thead>
<tr>
<th>Patient No</th>
<th>Type of epilepsy</th>
<th>Aetiology or neuroradiological lesion</th>
<th>Seizure semiology</th>
<th>Outcome</th>
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<tr>
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<tr>
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<td>F</td>
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Type of epilepsy: F=frontal; T=temporal; TPO=temporoparietal-occipital; I=undefined; MF=multipolar. Seizure semiology: PA, CP1, CP2, CP3, CP4: see text for explanation; SP=simple partial; SGTC=secondary generalised tonic-clonic; RSE=recurrent status epilepticus. Outcome: DR=drug resistant; NDR=not drug resistant. Interictal EEG focus: F=frontal; T=temporal; FT=frontotemporal; PO=parieto-occipital; MI=multiple independent; SBS=secondary bilateral synchrony; R=right; L=left; Bil=bilateral.
with secondary bilateral synchrony were frontal or frontotemporal in 13, temporal in one, parietal or occipital in one, multiple independent in eight. Therefore there was no close correlation between the site of focal cerebral lesion, the EEG focus, and the presence of secondary bilateral synchrony.

All patients had other seizures besides drop attacks. In 23 patients we recorded 91 seizures during video-EEG monitoring (table 2). From a semiological standpoint we divided the recorded seizures into five groups: pseudoabsence attacks with very brief loss of contact with staring and minimal automatisms sudden in onset and cessation (PA: 19 patients); loss of contact with complex oral-oral automatisms with or without abdominal rising aura (CP1: four patients); vocalisation, tonic extension of head, neck, and trunk with impaired consciousness followed by oral-oral automatisms (CP2: 16 patients); asymmetric tonic fit with impaired consciousness (CP3: two patients); nocturnal complex motor automatisms involving both legs, arms, and trunk, pelvic up-down movements; and bipedal movements similar to bicycling (CP4: one patient). Reviewing

Figure 1  Interictal EEG of patient 16. Focal spikes on the right temporal region spread bilaterally in diffuse spike and wave complexes.
videopolygraphic documents and anamnestic data we hypothesised that PA, CP2, and CP3 seizure types could result, while standing up, in a sudden fall. We recorded 11 drop seizures while standing up in four patients (patients 10, 16, 29, and 31). Polygraphic features of falls show that in one patient the drop was due to a brief atonia of antigravitational muscles (patient 10) and in three patients to an asymmetric tonic contraction of four limbs and trunk muscles (patients 16, 29, 31). Figure 1 shows the interictal EEG and figure 2 the clinical sequence (A).

Figure 2  Video-polygraphic recording of a drop seizure in patient 16. (A) Clinical sequence of the seizure. (1) The patient is standing up. He wears a safety jacket to prevent him hitting the floor. (2) A tonic contraction of the facial, axial, and upper limbs muscles appears. The patient bends his head and trunk slightly forwards. (3–5) One second later he begins to drop. The tonic posture is still evident. (6–7) The patient remains unresponsive, motionless, for 31 seconds. He is supported by the completely jacket. (8) He begins to get up without help. (9) The seizure is over. The seizure lasts 51 seconds. (B) Simultaneous polygraphic recording. The number indicates the sequence of the photographs in (A).
and the polygraphic recording (B) of a drop seizure in patient 16.

The electrical seizure begins with a burst of spike and wave activity, synchronous on both hemispheres but with a higher amplitude on the anterior regions. The clinical onset (2) coincides with the appearance of a high amplitude slow wave, with a superimposed high frequency activity and followed by a recruiting rhythm (3) lasting seven seconds. Polygraphically the fast EEG activity of the beginning of the seizure is accompanied by a tonic activation of the axial and upper limb muscles. The contraction of the legs appears one second later and is asymmetric. Once he has dropped, the patient maintains a muscle tone in the upper limbs. The tone is absent in the legs. During the unresponsive state the EEG shows a continuous spike and wave
activity more evident over the anterior regions. After the drop bradydardia occurs provoked, in our opinion, by the Valsalva manoeuvre secondary to the tonic contraction and the squatting position.

According to ictal semeiology and EEG features we defined 18 patients with frontal lobe epilepsy, two with temporal lobe epilepsy, and three with multifocal or undefinable onset epilepsy. We were unable to record seizures in eight patients (patients 12, 15, 19, 25, 26, 27, 28, and 30); we hypothesised a frontal lobe onset in four patients, temporal in three, and undefined onset in one patient according to the anamnestic semeiological features and the interictal EEG, so we had 22 patients with frontal lobe epilepsy, five with temporal lobe epilepsy, and four with multifocal or undefined epilepsy (table 1).

The clinical outcome (table 1) was unfavourable (drug resistant epilepsy) in 23 patients (74%) of whom 17 had frontal, three had temporal, and three had multifocal or undefined lobe epilepsy; 19 out of the 23 drug resistant patients showed an EEG pattern of secondary bilateral synchrony. At the end of follow up 16 patients (52%) still had epileptic drop attacks (12 with frontal, two with temporal, and two with multifocal or undefined lobe epilepsy); they were all drug resistant, 10 had mental deterioration (eight with frontal, one with temporal lobe epilepsy, and one with undefined epilepsy), whereas among the 15 patients without epileptic drop attacks (10 with frontal, three with temporal, and two with temporoparieto-occipital lobe epilepsy) only seven were drug resistant and three were mentally retarded.

We made statistical comparisons of some clinical and EEG features between our patients with epileptic drop attacks and those without (control group; table 3). Among the variables analysed those strongly linked to epileptic drop attacks (p<0.002) were mental deterioration, changes in seizure type during evolution of illness (more than two types of seizures), drug resistance, and presence of secondary bilateral synchrony on interictal EEG.

**Discussion**

From the general clinical features of our population with epileptic drop attacks we did not find any predominant characteristic; family predisposition was not relevant, age at onset of epilepsy ranged from 1 to 45 years, and lesional factors were documented in about half of our patients. Only five of our patients began having epileptic drop attacks at the beginning of their epilepsy, always associated with other kinds of seizures. The large majority of our series added epileptic drop attacks during evolution of their illness with a delay of one to 34 years.

Intractable epileptic drop attacks are a disabling seizure type characteristic of patients with Lennox-Gastaut syndrome. In this condition falling is due to tonic, atonic, or myoclonic-astatic seizures. Epileptic falls, however, have been described in partial epilepsies, especially of frontal lobe origin. Other authors have hypothesised a temporal lobe origin. In our series 71% of the patients had a frontal lobe epilepsy. As recently reported by other authors, we found that the fall in our patients is due to a sudden, asymmetric tonic contraction of axial and limb muscles or, in other patients, to a sudden atonia involving the postural muscles. Irrespective of the site of origin of the ictal discharge, almost all literature reports concur that the physiopathogenetic substrate of the epileptic drop attacks is a mechanism of secondary bilateral synchrony. This consists of a rapid spread of the focal ictal discharge via the corpus callosum and the hippocampal commissure. For other investigators, the focal discharge via the corticoreticular pathways involves the pontine reticular formation, producing a motor inhibition such as in cataplectic attacks. Neurosurgical series confirm the efficacy of callosotomy and patients with an EEG pattern of secondary bilateral synchrony, drop attacks, and partial seizures had a better outcome than patients with generalised epilepsy. Seventy four per cent of our patients showed a typical EEG pattern of secondary bilateral synchrony during evolution. This pattern has been considered a negative EEG prognostic factor in partial epilepsy.

It is not yet clear which physiopathological mechanisms support the appearance of secondary bilateral synchrony but we think, as previously suggested, that a progressive cerebral disturbance from a localised epileptic focus leads to a process of secondary epileptogenesis involving the whole brain. We hypothesise that a focal cortical discharge, mainly frontal, abruptly spreads to both hemispheres via the corpus callosum (secondary bilateral synchrony mechanism) subsequently acting on structures
Epileptic drop attacks in partial epilepsy

controlling the postural tone in an activatory 
(tonic) or inhibitory (atonic) manner.

Seventy four per cent of our patients had a 
poor prognosis and 45% were mentally re-
tarded. Mental retardation significantly differs 
for patients with epileptic drop attacks and the 
c group. In our opinion therefore, the 
mental deterioration depends on the poor out-
come, the frequent drops, and the process of 
secondary epileptogenesis.

Fifty two per cent of patients with epileptic 
drop attacks continued to present drops more 
than once a week at the end of the follow up 
and all of them were drug resistant. These 
characteristics, together with the presence of 
secondary bilateral synchrony on EEG and the 
variability of seizures during evolution of the 
illness, are statistically different from our 
control group. The high seizure frequency 
added to the continuous danger of a sudden 
fall makes the daily life of these patients 
extremely difficult.

Among patients with partial epilepsies pro-
spective studies must distinguish the popula-
tion at risk of developing epileptic drop attacks 
during evolution. Furthermore, vide-
opolygraphic studies are needed to analyse the 
different motor sequences leading to the falls 
depending on the different site of origin and 
diffusion of the ictal discharges. The possibility 
of documenting the way each patient falls will 
be useful to teach patients and their families 
the effect of the drops and therefore improve 
preventive strategies as features of different 
helmets, knee-pads, and other protective de-
ices.

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