Outcome at Adulthood of the Continuous Spike–waves During Slow Sleep and Landau–Kleffner Syndromes


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Summary: Purpose: The aim of this study was to determine the clinical, social, and/or professional and cognitive outcomes in adulthood of the continuous spike–waves during slow sleep (CSWS) and Landau–Kleffner syndromes, which are two rare epileptic syndromes occurring in children.

Methods: We enrolled seven young adults, five who had a CSWS syndrome, and two, a Landau–Kleffner syndrome in childhood. We evaluated their intellectual level as well as their oral and written language and executive functions.

Results: This study confirmed that the epilepsy associated with these syndromes has a good prognosis. Only one patient still had active epilepsy. However, the neuropsychological disorders particular to each syndrome persisted. Only two patients had followed a normal pathway in school. Three of the five patients with a CSWS syndrome during childhood remained globally and nonselectively mentally deficient. We found no evidence of the persistence of a dysexecutive syndrome in this study group. The intellectual functions of the two patients with Landau–Kleffner syndrome were normal; however, their everyday lives were disrupted by severe, disabling language disturbances. We discuss the role of some prognostic factors such as the location of the interictal electric focus and the age at onset of CSWS.

Conclusions: These two epileptic syndromes of childhood are very similar in many respects, but their clinical outcomes in adulthood are different. Key Words: Epilepsy with continuous spikes and waves during slow sleep—Landau–Kleffner syndrome—Executive functions—Long-term outcome.

The continuous spikes–waves during slow sleep (CSWS) and Landau–Kleffner syndromes are two rare epileptic syndromes occurring in children (1–4). In the International Classification of Epilepsies, they are included in the group of epileptic syndromes whose focal or generalized origin remains undetermined (5). A number of authors today consider that these two syndromes are different clinical expressions of the same pathologic entity because both are age dependent and are characterized by the association of epilepsy with abnormal paroxysmal electroencephalographic (EEG) discharges activated by sleep and neuropsychological disorders (2,6–8). Whereas the epilepsy most often disappears in adulthood, the prognosis is frequently poor because of the associated neuropsychological disorders (2,4).

CSWS is defined by the presence of electrical status epilepticus during slow sleep characterized by a spike–wave index > 85% (1). Some authors have reported the existence of an interictal focus, which is often frontal or temporal on the waking EEG (2,8–10). Diverse neuropsychological disorders have been documented during the active phase: attention disorders, mental retardation, language disorders, temporal and spatial orientation disturbances, and memory impairment (10–12). Behavioral disorders such as hyperactivity, aggressiveness, problems with interpersonal contact, and emotional instability (9,11–13) or even psychotic behavior (14) are sometimes also seen. Other disturbances, for example, language that is affected in content but intact in its structure, perseverations during the coding subtest (15), difficulties in abstraction, and problems in the temporal organization of narrative tasks or in picture arrangement (15) have led some authors to consider that a dysexecutive syndrome also is present (11,16). To date, little has been published on the outcome of these neuropsychological disturbances (16–20).

The Landau–Kleffner syndrome, also called acquired epileptic aphasia, is characterized by the loss of acquired language, sparing the nonverbal intellectual functions (3) associated with epilepsy in 72–80% of the cases (4,7). The EEG shows focal or multifocal spikes or spike–waves
OUTCOME AT ADULTHOOD OF CSWS AND LKS

predominating in the temporal or parieto-occipital regions (4), which are activated by sleep (4–6). The prognosis is variable and depends on the persistence of language disorders at adulthood, which are often severe (4,21).

The aim of our study was to determine the effects of paroxysmal abnormalities occurring in childhood on cognitive function by studying the clinical, cognitive, and social and/or professional outcome in patients diagnosed as having the CSWS and Landau–Kleffner syndrome during childhood. We studied their intellectual level and language and paid particular attention to looking for a dysexecutive syndrome, which has been described during the active phase in CSWS patients (11,17). Finally, we also attempted to study the role played by some of the characteristic features of the syndromes during the active phase to establish a long-term prognosis.

MATERIALS AND METHODS

Patients

We enrolled seven young patients (five men and two women: no. 1–7; see Table 1) whose ages ranged from 16 to 26 years (average age, 20 years 3 months). According to a neuropsychiatrist, subjects 1–5 had been diagnosed as having the CSWS syndrome, and subjects 6 and 7 fulfilled the ILAE criteria (5) for the Landau–Kleffner syndrome. Two additional patients were lost to follow-up. We learned from the parents of one of the two patients lost to follow-up that he had committed various criminal acts and had been hospitalized in a psychiatric unit because of his violent behavior. The clinical and therapeutic data were obtained from the patients’ medical records and are presented in Tables 1 and Table 2, respectively. We also studied their EEG recordings and cerebral magnetic resonance imaging (MRIs; see Table 2).

Methods

We asked each patient whether his or her epilepsy was active or inactive and for how long it had been present, the current medical treatment, and the school or professional pathway. We used the WAIS-R (15) to evaluate each patient’s intellectual level and the DO 80 test (22) to study naming. Sentence comprehension was analyzed by using the Token Test (23), and fluency (categorical and phonemic) was evaluated with the Cardebat test (24). To assess written language skills, we had the patients read a text in 3 min, “l’Alouette” (25). This test is standardized in French and allowed us to quantify their reading level. We studied their level for regular and irregular meaningless words (L2MA) (26). Writing skills were evaluated by using a dictation (L2MA) (26). Patients who had a history of the Landau–Kleffner syndrome were classified according to the Boston Diagnostic Aphasia Examination (BDAE), which contains five different levels (27).

Executive functions were studied with the classic tests: the Trail Making Test (28) in which part B studies conceptual flexibility, and the Stroop Test (29), which studies the ability for inhibition.

We also analyzed their performance in certain WAIS-R subtests, in particular, the Similarities, Picture Arrangement, and Coding subtests, which explore damage to the anterior frontal region (30).

RESULTS

Clinical outcome

In the CSWS group, only patient 3 still had active, treated epilepsy at the time of assessment. Patient 1 was still receiving treatment in spite of the absence of any epileptic seizures for >1 year. The two patients in the Landau–Kleffner group had remained seizure free for ≥5 years (see Table 1). None had any major behavior or psychiatric disorder.

Social–professional integration

Patients 2 and 4 had followed a normal pathway in school, although one of them had been left back twice. The remaining three in the CSWS group dropped out of school early and quickly enrolled in vocational technical training classes (see Table 1).

Integration into the normal school circuit had been difficult in the Landau–Kleffner group (patients 6 and 7). Patient 6 was in a special class and then enrolled in a center for vocational training, whereas patient 7 was attending a special learning center for deaf children, where he had learned sign language for the deaf. Their social contacts were limited to a close circle of friends. Both children’s parents accompanied them when we interviewed them; they explained the difficulties encountered in finding an employer for their children because of their language difficulties.

Intellectual functions

Psychometric tests showed that patients 1, 3, and 5 were mentally deficient (their respective IQs were 56, 59, and 59). The deficiency was homogeneous in patients 1 and 5 and heterogeneous in patient 3, because the nonverbal level was <45, whereas the verbal level was 70. Patients 2 and 4 were intellectually normal (see Table 3).

The Block design and Object-assembling subtests were pathologic in three of four patients in the CSWS group, suggesting the presence of a visual-constructive disorder. Because of the severity of the residual language disturbances in the Landau–Kleffner group, we were able to assess only their nonverbal intellectual level (WAIS-R). Their IQ results were normal. The digit symbol test was the only pathologic subtest (grade <5).

Language

Naming scores were normal in the CSWS group. Patients 6 and 7 had very pathologic results (−9 SD and −16 SD, respectively) with severe difficulties in word finding, many semantic paraphasias, visuospatial errors in reading,
TABLE 1. Summary of clinical data at follow-up

<table>
<thead>
<tr>
<th>Case/sex</th>
<th>Antecedents</th>
<th>Premorbid age onset of epilepsy</th>
<th>Epilepsy: Type of seizure</th>
<th>Duration of epilepsy (yr)</th>
<th>Neuropsychological data at the active phase</th>
<th>School and/or professional status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M</td>
<td>None</td>
<td>Normal</td>
<td>Partial motor</td>
<td>3</td>
<td>PIQ = 88 Pragmatic language disorders Visual-constructive disorders Attention and behavior disorders</td>
<td>Adapted school</td>
</tr>
<tr>
<td>2/F</td>
<td>Neonatal distress (Apgar 3, unilateral pneumothorax)</td>
<td>Normal</td>
<td>Partial motor</td>
<td>2</td>
<td>VIQ = 106 PIQ = 112 Attention disorders Impulsiveness</td>
<td>High school</td>
</tr>
<tr>
<td>3/M</td>
<td>None</td>
<td>Normal</td>
<td>Atypical absence, generalized tonic–clonic</td>
<td>Still active (last seizure 15 days before the assessment)</td>
<td>VIQ = 65 PIQ = 56 Logorrhea Pragmatic language disorders Visual-constructive disorders Attention and behavior disorders</td>
<td>Horticulture apprenticeship</td>
</tr>
<tr>
<td>4/F</td>
<td>None</td>
<td>Normal</td>
<td>Atypical absence, partial complex, generalized tonic–clonic</td>
<td>3</td>
<td>VIQ = 82 PIQ = 68 Temporal and spatial orientation disorders Visual-constructive disorders Attention and behavior disorders</td>
<td>High school (kept back twice)</td>
</tr>
<tr>
<td>5/M</td>
<td>Toxemia of pregnancy with acute fetal distress (Apgar 10), neonatal meningitis</td>
<td>Normal</td>
<td>Atypical absence, partial complex</td>
<td>9</td>
<td>VIQ = 68 PIQ = 76 Word loss Organization and narrative disorders Visual-constructive disorders Attention disorders</td>
<td>Restoration apprenticeship</td>
</tr>
<tr>
<td>6/M</td>
<td>Prematurity</td>
<td>Normal</td>
<td>Atypical absence, partial motor, generalized tonic–clonic</td>
<td>4</td>
<td>PIQ = 110 VIQ impossible to assess Isolated auditory-verbal agnosia (onset at 3 yr 4 mo)</td>
<td>Building maintenance</td>
</tr>
<tr>
<td>7/M</td>
<td>None</td>
<td>Normal</td>
<td>Atypical absence, generalized tonic–clonic</td>
<td>3</td>
<td>PIQ = 109 VIQ impossible to assess Isolated auditory-verbal agnosia (onset at 3 yr 8 mo)</td>
<td>Apprenticeship in house painting</td>
</tr>
</tbody>
</table>

VIQ: verbal I.Q.; I.Q: performance I.Q.; y: years; m: months.

and the use of generic words. The verbal fluency score was pathologic in two of five patients in the CSWS group (patients 1 and 5) and in one in the Landau–Kleffner group (patient 7). Patient 6 was unable to perform the test.

Three patients had difficulty in sentence comprehension (patients 1, 4, and 5). In the Landau–Kleffner group, the patients were unable to perform the test.

All of the patients in the CSWS group except patient 2 were deficient in reading and writing. In the other group, the results of the words-reading test were pathologic. Other tests such as dictation and text reading could not be performed because of the severity of the language disorders. The two Landau–Kleffner patients were rated 1 of 5 on the BDAE aphasia severity scale (see Table 3).

**Executive functions**

Patient 6 in the Landau–Kleffner group was unable to take both the Stroop Test and the Trail Marking Test because of the severity of his language disorder. None of the other patients demonstrated any sensitivity to interference (see Table 3). Patient 7 manifested pathologic slowness.

We paid particular attention to the WAIS–R nonverbal subtests (Fig. 1) in the CSWS group to look for elements suggesting a dysexecutive syndrome. The subtests “information,” “vocabulary,” and “comprehension” were voluntarily avoided because they are highly dependent on general knowledge. All the subtest scores were below average (standard grade, 10). The coding subtest was pathologic in four of five patients. The Similarities and Picture arrangement subtests, which evaluate the ability to categorize, reason, and form concepts, were pathologic in only two patients in the CSWS group. Finally, four of five (patients 1, 3, 4, and 5) demonstrated slow thinking, an attention disorder, and, in their speech, an inability to control their thoughts properly (inappropriate comments, most often by associating ideas).

**DISCUSSION**

Isolated case reports have addressed the outcome of the CSWS and Landau–Kleffner syndromes in adulthood (16–19), and most of them only over short periods
TABLE 2. EEG features, MRI results, and therapeutic data

<table>
<thead>
<tr>
<th>Cases/sex</th>
<th>Age at which CSWS was discovered</th>
<th>Duration of CSWS period (mo)</th>
<th>Intercital EEG features</th>
<th>Brain MRI</th>
<th>Type of treatment</th>
<th>Age treatment began (mo)</th>
<th>Duration of treatment (mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M 6 yr 4 mo</td>
<td>15</td>
<td>Slow-waves focus in the right parietal and occipital areas and focal spikes discharges in the right occipital area</td>
<td>Right hemispheric atrophy</td>
<td>Clobazam</td>
<td>5 yr</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stiripentol</td>
<td>6 yr 9 mo</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ethosuximide</td>
<td>7 yr 8 mo</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Valproic acid</td>
<td>13 yr 6 mo</td>
<td>Still taking</td>
<td></td>
</tr>
<tr>
<td>2/F 6 yr 3 mo</td>
<td>29</td>
<td>Generalized spikes and waves discharges at 2–3 Hz</td>
<td>Normal</td>
<td>Clobazam</td>
<td>9 yr 1 mo</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ethosuximide</td>
<td>9 yr 9 mo</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prednisone, 70 mg (2 mg/kg)</td>
<td>9 yr 9 mo</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>3/M 4 yr 8 mo</td>
<td>14 (fluctuating)</td>
<td>Slow-waves focus in the right occipital area and focal spikes discharges in the right occipital and central areas</td>
<td>Normal</td>
<td>Clobazam</td>
<td>4 yr 8 mo</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prednisone, 70 mg (2 mg/kg)</td>
<td>4 yr 8 mo</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ethosuximide</td>
<td>9 yr 9 mo</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Valproic acid</td>
<td>9 yr 9 mo</td>
<td>Still taking</td>
<td></td>
</tr>
<tr>
<td>4/F 9 yr 4 mo</td>
<td>30</td>
<td>Generalized spikes and waves discharges or focal spikes and waves discharges in the right parietal and occipital areas</td>
<td>Normal</td>
<td>Valproic acid</td>
<td>5 yr 2 mo</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stiripentol</td>
<td>9 yr 4 mo</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ethosuximide</td>
<td>7 yr 11 mo</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>5/M 8 yr 3 mo</td>
<td>16</td>
<td>Focal spikes and waves discharges in the right occipital area, and right frontal slow-waves focus</td>
<td>Bilateral frontal lesions in periventricular areas</td>
<td>Valproic acid</td>
<td>2 yr</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prednisone, 50 mg (2 mg/kg)</td>
<td>8 yr 7 mo</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>6/M During 12 mo PA density &lt;85% of non-REM sleep time</td>
<td>Generalized spikes and waves discharges or focal spikes and waves discharges in the left temporal and central areas</td>
<td>Normal</td>
<td>Valproic acid</td>
<td>8 yr 7 mo</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stiripentol</td>
<td>9 yr 8 mo</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ethosuximide</td>
<td>11 yr 2 mo</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>7/M During 120 months, PA density &lt;85% non-REM sleep time with exception of two nonconsecutive recordings with a PA density &gt;85%</td>
<td>Focal spikes discharges in the left temporal and central areas</td>
<td>Normal</td>
<td>Valproic acid</td>
<td>4 yr 5 mo</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ethosuximide</td>
<td>5 yr 3 mo</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Carbamazepine</td>
<td>5 yr 8 mo</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diazepam</td>
<td>6 yr 1 mo</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

CSWS, continuous spike–waves during slow sleep; REM, rapid eye movement sleep; MRI, magnetic resonance imaging; PA, paroxysmal anomaly.

(9,13,31). Veggiotti et al. (20) recently reported the outcome in five patients and described three prognostic factors: duration, age at onset of the CSWS, and location of the interictal focus (20). A number of authors suggest that the two syndromes have a common pathogenic origin (6–8). The results of this study on the long-term outcome of these two specific epileptic syndromes imply that we present and discuss them separately.

TABLE 3. Neuropsychological results

<table>
<thead>
<tr>
<th>Patients (age)</th>
<th>Case 1 (16 yr)</th>
<th>Case 2 (16 yr)</th>
<th>Case 3 (23 yr)</th>
<th>Case 4 (17 yr)</th>
<th>Case 5 (20 yr)</th>
<th>Case 6 (26 yr)</th>
<th>Case 7 (24 yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance IQ</td>
<td>45</td>
<td>104</td>
<td>&lt;45</td>
<td>85</td>
<td>58</td>
<td>88</td>
<td>98</td>
</tr>
<tr>
<td>Verbal IQ</td>
<td>64</td>
<td>110</td>
<td>70</td>
<td>78</td>
<td>57</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>DO 80</td>
<td>73 (−1.6 SD)</td>
<td>79</td>
<td>80</td>
<td>76</td>
<td>73</td>
<td>49 (−9 SD)</td>
<td>63 (−1.6 SD)</td>
</tr>
<tr>
<td>Categorical fluency</td>
<td>20 (−1.3 SD)</td>
<td>35 (m)</td>
<td>30 (m)</td>
<td>20 (−0.86 SD)</td>
<td>9 (−2.6 SD)</td>
<td>Not performed</td>
<td>14 (−1.9 SD)</td>
</tr>
<tr>
<td>Phonemic fluency</td>
<td>2 (−2.7 SD)</td>
<td>28 (m)</td>
<td>15 (−0.41 SD)</td>
<td>10 (−1 SD)</td>
<td>1 (−3 SD)</td>
<td>Not performed</td>
<td>11 (−1 SD)</td>
</tr>
<tr>
<td>Token test</td>
<td>46</td>
<td>60</td>
<td>59</td>
<td>38</td>
<td>47</td>
<td>27</td>
<td>38</td>
</tr>
<tr>
<td>Reading level</td>
<td>8 yr 5 mo</td>
<td>Not performed</td>
<td>7 yr 4 mo</td>
<td>8 yr 5 mo</td>
<td>6 yr 7 mo</td>
<td>Not performed</td>
<td>Not performed</td>
</tr>
<tr>
<td>Dictation (70)</td>
<td>58 (1 SD)</td>
<td>66 (1 SD)</td>
<td>29 (−2.5 SD)</td>
<td>38 (−2 SD)</td>
<td>20 (−3 SD)</td>
<td>Not performed</td>
<td>Not performed</td>
</tr>
<tr>
<td>Reading (L2MA)/(40)</td>
<td>35</td>
<td>40</td>
<td>33</td>
<td>36</td>
<td>—</td>
<td>Not performed</td>
<td>11</td>
</tr>
<tr>
<td>TMT A (s)</td>
<td>75 (&lt;p10)</td>
<td>25 (p75)</td>
<td>60 (&lt;p10)</td>
<td>45 (p10–25)</td>
<td>51 (p10)</td>
<td>65 (&lt;p10)</td>
<td>33 (p50)</td>
</tr>
<tr>
<td>TMT B (s)</td>
<td>134 (&lt;p10)</td>
<td>67 (p5–10)</td>
<td>113 (p10–25)</td>
<td>95 (p25)</td>
<td>124 (p10–25)</td>
<td>159 (&lt;p10)</td>
<td>&gt;120</td>
</tr>
<tr>
<td>Stroop W</td>
<td>54 (−2 SD)</td>
<td>112 (m)</td>
<td>55 (−2 SD)</td>
<td>66 (−2 SD)</td>
<td>43 (−3 SD)</td>
<td>Not performed</td>
<td>66 (−2 SD)</td>
</tr>
<tr>
<td>Stroop C</td>
<td>47 (−2 SD)</td>
<td>83 (m)</td>
<td>38 (−2 SD)</td>
<td>61 (−1 SD)</td>
<td>26 (−3 SD)</td>
<td>Not performed</td>
<td>69 (−1 SD)</td>
</tr>
<tr>
<td>Stroop WC</td>
<td>14 (−3 SD)</td>
<td>38 (m)</td>
<td>22 (−2 SD)</td>
<td>24 (−2 SD)</td>
<td>28 (−1 SD)</td>
<td>Not performed</td>
<td>43 (m)</td>
</tr>
<tr>
<td>Interference</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
</tbody>
</table>

SD, standard deviation; p, percentile; m, mean.
Patients 1 and 5 showed MRI abnormalities suggesting symptomatic CSWS (32,33). Abnormal neuroradiologic signs are not exceptional and are found in about one third of cases (2). In this study, the two patients who had neuroradiologic abnormalities had a poor outcome, but the small sample size prevents us from drawing any generalized conclusion.

Epilepsy during these syndromes was considered severe and required a combination of antiepileptic agents (AEDs). The epilepsy of all our patients except one (whose seizures reappeared after a seizure-free interval) eventually disappeared, as has been described in the literature (2,8,12).

In the CSWS group, the results led us to distinguish two different groups. The first comprised two intellectually normal patients who were socially and professionally well integrated. The second was made up of three patients who were poorly integrated because of neurologic and psychological aftereffects. One of them had homogeneous mental deficiency, whereas in the two others, the deficiency was heterogeneous (their nonverbal level was ≥10 points lower than their verbal level). Our findings are similar to those found in the literature because the prognosis is reported to be poor in half of the cases, and affected patients remain behind in school (2).

With respect to oral language, their speech was devoid of any disturbance in phonology or syntax. A few patients had written-language disorders that suggested dyslexia or anorthography. However, these findings must be interpreted with caution because their intellectual level was low, and they were behind in school.

We failed to discover any arguments in favor of a dysexecutive syndrome. For example, none of the patients was sensitive to interference. Only two of five patients had pathologic scores during the similarities subtest, whereas three of them had pathologic block design subtest scores (15). Roulet-Perez et al. (11) reported the association of behavior disorders (lack of attention, hyperactivity, impulsiveness, loss of the sense of danger, absence of inhibition, aggressiveness) and neuropsychological disorders (difficulties in verbal and nonverbal reasoning, alteration in temporal sequences, perseverations, reduction in verbal fluency, and echolalia) in four patients, suggesting frontal dysfunction (11). One of the patients, who was followed up into adulthood, had difficulties performing the GO/No-GO test (17). The recent concept of executive functions should be preferred to the anatomic designation of the frontal syndrome. It refers to a group of processes (inhibition, planning, flexibility, control) whose main function is to help subjects adapt to new situations (34). Although all the elements in favor of a dysexecutive syndrome may not have been present, during the patient assessment, we found speech disorders in four of the CSWS group suggesting a pragmatic language disorder, which could be an after-effect of a dysexecutive syndrome (35).

Because we failed to discover any convincing arguments in favor of a dysexecutive syndrome, we wonder whether the tests we used were sensitive enough. The Stroop and Trail Making Tests are classically used, but they are not very sensitive (36). The actual tendency is to develop so-called ecologic tests using tasks that are similar to everyday tasks to circumvent the lack of sensitivity in traditional tests (36). These so-called ecologic tests are more sensitive than traditional tests, but their specificity remains to be determined.

The second factor that can explain the absence of a dysexecutive syndrome is related to the topography of interictal foci. Patients described in the literature who had neuropsychological disorders suggesting a dysexecutive syndrome (17) had a frontal interictal focus during the active phase. None of our patients had a frontal interictal focus.

We assessed certain prognostic factors that have been reported in the literature (20). In our study sample, we found that the duration of the CSWS did not appear to be correlated with the severity of the disorders persisting into adulthood. However, the small sample size prevents us from drawing any generalized conclusion.

In the group we studied, the age at which CSWS was first discovered did not appear to be a clear indication of long-term prognosis. In the two patients with a poor long-term prognosis, CSWS first appeared early in one (4 years 8 months) and later (8 years 3 months, patient 5) in the other. However, it is often difficult to affirm the age at which CSWS first appears because the diagnosis requires a sleep polygraph (2), prompted by a change (worsening) in either behavior or epilepsy.

The topography of an interictal focus during the active phase seems to constitute a main prognostic factor. The two patients who had the best long-term prognosis were those without a clear-cut focus on waking EEG. In contrast, all the other patients had a slow focus and/or focal spikes during the acute phase, indicating focal and/or multifocal problems. Patients 1, 3, and 5 continued to
have disorders in visual construction, whereas the inter- 

tival focus was either occipital or parieto-occipital. This 

uggests that additional factors, and not simply the hy- 

pthesis of focal frontal dysfunction evoked in some case 

reports (17), are involved. Perhaps the observed neuropsy- 

chological and visuospatial disorders are associated with 

a focal occipital or parieto-occipital dysfunction during a 

ritical period of development. Nevertheless, the cognitive 

defect remains global, and its cause is certainly a number 

of factors.

The duration of epilepsy seems to be a significant prog- 

nostic factor because its duration in two of the patients 

with the most severe outcome was longer than in those 

who had a better prognosis.

The role played by medications must be considered. 

All of the patients we studied received a single or multi- 

ple AEDs, and only two were treated with corticosteroids. 

Their outcomes were similar. Studies on the effects of 

AEDs on cognitive functions and behavior often give 

contradictory results, related to methodologic difficulties 

(37,38). Thus it is difficult to assess the role played by 

treatment. Two patients were still receiving AEDs when 

the neuropsychological assessment was performed, and 

we cannot exclude an unfavorable influence that treatment 

may have had.

In the Landau–Kleffner group, one of the two who were 

assessed had learned sign language but remained poorly 

integrated socially. With respect to cognition, their non- 

verbal intellectual level was normal but still demonstrated 

severe, isolated language disorders, making communica- 

tion difficult. For example, despite considerable effort 

to understand, their oral comprehension was deficient. Their 

verbal expression demonstrated massive problems with 

phonology and syntax, rendering them almost impossi- 

ble to understand although they possessed the pragmatic 

aspects of language. These language abnormalities were 

associated with a left temporal interictal focus.

Similar to published reports, these two patients had im- 

portant language after-effects with preservation of their 

nonverbal intellectual efficiency. Their outcome can be 

classified in Dugas’ category P2 (39): “Unfavourable out- 

come: inability to communicate, with unintelligible or 

markedly reduced oral language, poor social and profes- 

sional integration.” It should be noted that the language 

disorder seen in our two patients first began before the 

age of 4 years, constituting a poor prognostic factor (7,40). 

Even if patient 7 had had CSWS according to Patry’s def- 

inition, their prognoses were similar. We did not expect to 

encounter so severe a language handicap as we observed 

because published cases report varying outcomes (21). It 

would be interesting to test them with a battery for aphasic 

adults completed by an assessment of their skills in sign 

language and to compare the two. It would also be useful 

to observe them in their everyday family environment and 

with their friends and colleagues at work to get a clearer 

idea on how well they communicate outside of a test situ- 

ation and the better to assess their social and professional 

integration.

The CSWS and Landau–Kleffner syndromes are two 

epileptic disorders confined to children, which share a 

certain number of features. The social and professional 

outcome of the CSWS syndrome at adulthood is vari- 

able. Neuropsychological deterioration remains global 

and nonselective when present during the active phase 

(2,41). No stereotyped neuropsychological profile was 

noted. For the authors, the location of an interictal focus 

during infancy constitutes an important factor condition- 

ing the persistence of a number of neuropsychological 

disorders at adulthood. The prognosis of the Landau– 

Kleffner syndrome is also variable, and its outcome de- 

pends on the persistence of language difficulties in spite 

of a normal intellectual level. The neuropsychological diff- 

iculties involve only language; nonverbal intelligence re- 

mains normal. The disorders are associated with a left 

hemispheric interictal focus.

The pathophysiology of these syndromes is complex 

and far from being elucidated. A direct role of parox- 

ysmal anomalies has been suggested, based on experi- 

mental findings showing their deleterious effects (41,42). 

The relation between the density of paroxysmal anomalies 

(PAs) and neuropsychological regression is based on clin- 

ical findings, notably, the parallel between PA duration 

and ultimate neuropsychological outcome, as well as be- 

tween the neuropsychological disturbances and the loca- 

tion of the interictal epileptic focus (8–10,12,43). Finally, 

the most convincing theory maintains that focal epileptic 

activity produces a disturbance in the maturation of corti- 

cal zones, mainly in the associative areas. Consequently, 

patients with the CSWS and Landau–Kleffner syndromes 

require regular and prolonged clinical and EEG follow-up 

until adulthood.

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