**Online case descriptions:**

**Patients
Case 1**: A 4-year-old boy developed progressive focal neurological deficits and seizures. He was diagnosed with bilateral RE based on the clinical symptoms, radiological findings (Fig. 1) and histopathologic analysis from brain biopsies derived from both hemispheres. He initially developed focal neurological deficits, which gradually progressed. At examination prior to surgery, he presented with reduced general physical condition and neurologically with fixation interrupted by frequent interspersed gaze deviation to the right due to focal seizure activity, right facial palsy and generally reduced facial movements also on the left, interspersed myocloni of the right lid and angle of the mouth as well as groaning and forced ventilation, which were all interpreted as focal seizures. He could manipulate objects and toys with the left hand, while the right side showed a flaccid hemiparesis with residual movements in the right shoulder. Brisk tendon reflexes at both lower extremities, Babinski positive on both sides, but more pronounced on the right. Left-sided fixed plantar flexion of the left foot, and reduced strength also in the left upper extremity (M3). Sensory- and fine motor function testing were not possible. Due to the pronounced dysarthria, his speech was not understandable. He talked in single words, which were comprehensible to the mother, but not to others. The mother reports that he uses yes and no appropriately in the brief periods, during which he is free of focal seizure activity.

The following seizure types were observed:

- Epilepsia partialis continua since 2/2013 with clonic movements of the right foot, sometimes the entire right leg and also the right hand, continuing during sleep. Later, the clonic movements also occurred in the right angle of his mouth and eyelid. At that time, the clonic jerks of the extremities had ceased.

- Absence-like freezing with loss of tone in the neck region, subsequently turning of the head to the right and upward gaze deviation, infrequent myoclonic movements of the eyelid. These episodes lasted approximately 8 seconds and had their maximum end of 2012.

- Clonic focal seizures in right upper extremity, infrequently also weakness of the left lower extremity, often transition to a tonic phase including the right upper extremity. During these episodes, he was aphasic, speech was maintained if only the right foot was involved.

Repeated EEG testing over several months showed left central sharp-slow-waves, sometimes with secondary synchronization of the right hemisphere, and during the seizure rhythmicity over electrode c3. Later, in addition left centro-parietal sharp-waves, right temporo-parietal and rhythmic spikes over the right hemisphere, which are sometimes synchronized with the left central discharges. Slowed activity over the right centro-parieto-occipital areas, sharp-slow-waves without clinical correlate.

Maximum of the sharp-wave activity and general slowing left centro-parietally and epilepsy-typical discharges with secondary synchronization to the right. Since 01/2013: General slowing of the activity of the left hemisphere with maximum over temporo-parietal areas, sharp-waves in part with rhythmicity left fronto-central. Poor correlation between the EEG pathology and the epilepsia partialis continua.

A long-time EEG recording 03/2013 showed: multiregional spikes over the left hemisphere, multiregional seizure patterns, clonic seizures of the right foot, leg, shoulder and arm.

Summary of EEG findings: Consistent with his age, the EEG shows a 7/sec base rhythm, which can be distinguished during short intervals in the parieto-occipital areas. The age-related physiologic elements of vigilance can be observed over the right hemisphere, and on the left sleep-spindles can be distinguished. The left-sided graphoelements cannot be judged due to the superimposed EEG slowing. The cloni in the context of the epilepsia partialis continua (EPC) with maximum in the right lower extremity show a rhythm of 2-3/seconds, and rarely the clonic movements also include the right upper extremity in combination with truncal instability. There is no clear association with a time of the day, and the EPC can be recognized equally during wake periods and sleep. In summary, there are signs for severe cerebral dysfunction of the left hemisphere in combination with highly active, multiregional epileptic activity, several subclinical seizure patterns from different regions of the left hemisphere as well as highly frequent clinically apparent seizures and dissociation of clinical and electrophysiological findings. Clinically, non-classifiable seizures and EPC with maximum of the right lower extremity are seen. Both from the electroencephalography and clinical findings, a symptomatic focal epilepsy and clinical status consistent with Rasmussen encephalitis are observed. In the months prior to surgery, the beginning of a left-sided reduction of movements with preserved use of the left arm and hand are reported.

Post-hemispherotomy, the immediated disappearance of the epilepsia partialis continua are noted, while simple partial seizures in the left lower extremity persisted. Furthermore, the patient's alertness and times awake increased significantly, and it was easier to maintain contact.

Cerebrospinal fluid (CSF) studies revealed normal cell numbers, normal glucose and albumin quotient, normal IgG index, no oligoclonal bands and was negative for neurotropic viruses, B. burgdorferi and mycoplasma. The CSF was tested 10 months later again and was normal except for the presence of oligoclonal bands. Serum was tested and was negative for paraneoplastic antibodies, namely antibodies against NMDAR, AMPA, GABA (B), mGluR1, mGluR5, LGI1 and Caspr2. The CSF was also tested and was negative for antibodies against Hu, Ri, Yo, Amphiphysin, CV2 (CRMP5), Ta/Ma2, Ma1, SOX1 and GAD, LGI1, Caspr2 and NMDAR.

**Case 2:** A 36 year old male underwent a MRI showing findings consistent with RE: hyperintense signal in the left cortical and subcortical area with cortical atrophy and enlargement of the lateral ventricle. A brain biopsy was consistent with RE and included in the study.

**Case 3:** A female patient with RE underwent a partial resection of the right hemisphere at the age of seven to treat status epilepticus. Because of drug resistant epileptic activity the patient underwent a functional hemispherotomy at the age of 25. The brain biopsy of the latter operation was included in this study and was consistent with RE. The brain biopsy from the first operation was not available.