

Letter to Editor

Hypsarrhythmia and triphasic waves seem to be akin(similar) age-dependent responses of the brain to different insults

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Dear Editor,

Hypsarrhythmia (Hyps) as well as triphasic waves (TWs) is seen in patients with almost similar etiology, with the only variable being (developing) brain in Hyps and matured (developed) brain in TWs. Hyps is exclusively reported in the first 2 years of life and TWs are rarely seen at this age.

Both Hyps and TWs were described in 1950s within a gap of 3 years.^[1,2] Original description of Hyps by Gibbs was “random high voltage waves and spikes which vary from moment to moment, both in time and in location. Mostly generalized but at times originate from multiple foci”^[2] [Figure 1]. On continuous video EEG monitoring, five variants of Hyps were identified.^[3] These five variants include Hyps with increased interhemispheric synchronization, asymmetric Hyps, Hyps with consistent focus of abnormal discharge, Hyps with voltage attenuation, and Hyps with little spikes or sharp activity.^[3]

TWs are three phased wave forms mostly generalized but can be atypical based on configuration.^[4,5] Typical TWs are rhythmic, symmetrical, synchronous and generalized as in hepatic encephalopathy (HE) of chronic liver disease [Figure 2] and atypical are focal or asymmetric [Figure 3], seen in other metabolic, degenerative, and cerebrovascular diseases of the brain.^[4,5] Raised intracranial pressure (cerebral edema) in acute liver failure modifies and attenuates the T-waves.^[6]

Hyps is exclusively seen in infancy, however, has also been reported in initial half of the 2nd year of life and in extreme ages of 3 months–5 years.^[7] In contrast TWs are rarely seen in infancy. PubMed and Google search showed only two articles related to TWs in infancy.^[8]

Little is known about pathophysiology of Hyps.^[9] With limited availability of human tissues, study on various genetic animal models has revealed multifocal abnormalities of the brain.^[9] Increasing number of diverse animal models

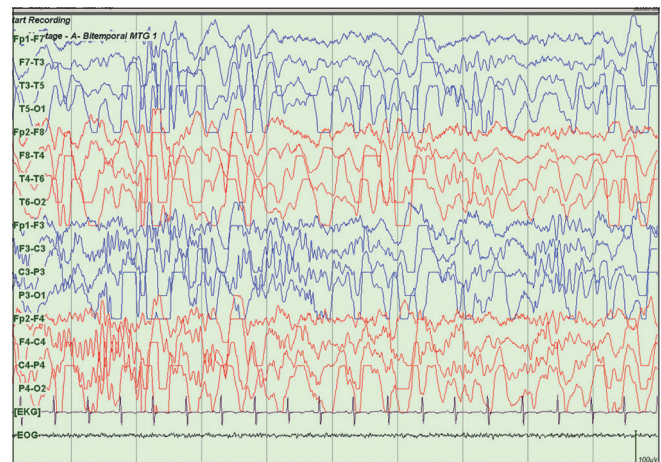


Figure 1: Nine months female child with infantile spasms shows typical hypsarrhythmia pattern with sleep spindles.

available will help in future to find out pathophysiology and treatment options for Hyps and infantile spasms.^[10] Hyps originates from a cortical lesion with subsequent spread to subcortical and upper brainstem structures which in turn project to lower brainstem and spinal cord resulting spasms.^[10]

The origin of TWs is not well known. Even Kaplan published an article titled “what are these mysterious TWs, affair with them.”^[4,5] Several locations in the brain like frontal lobes, cingulate gyrus, and thalamus have been thought to be the places of their origin.^[11] Recently, TWs were reported in the white matter disease of the brain.^[12] Activation of midline thalamic nuclei resulting thalamo-cortical firing similar to spindle waves may be the mechanism for production of TWs.^[4] To further prove their origin, there are difficulties to produce animal models for TWs.^[4]

Both Hyps and TWs indicate encephalopathy, former epileptic and later metabolic/epileptic? Hyps is seen in any brain insult during infancy and causes vary from perinatal

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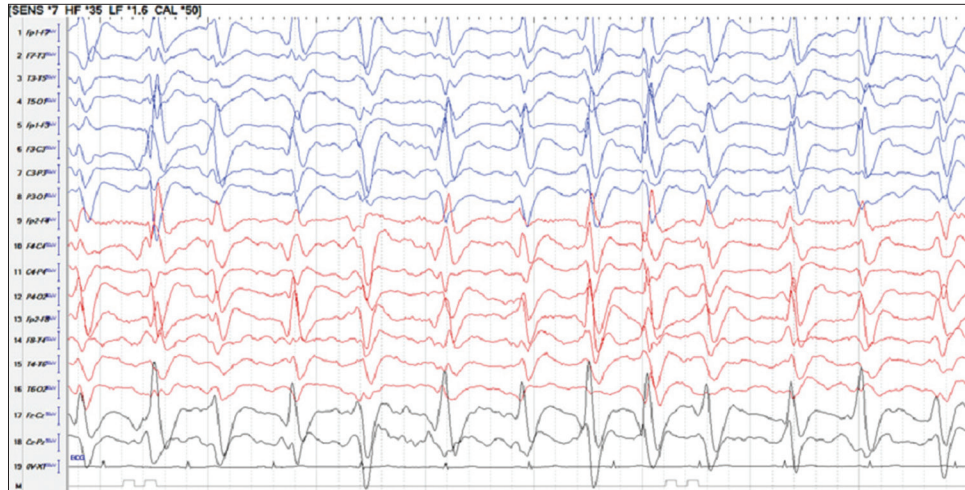


Figure 2: Fifty year man with ethanol related chronic liver disease and hepatic encephalopathy shows generalized 1/s T waves.

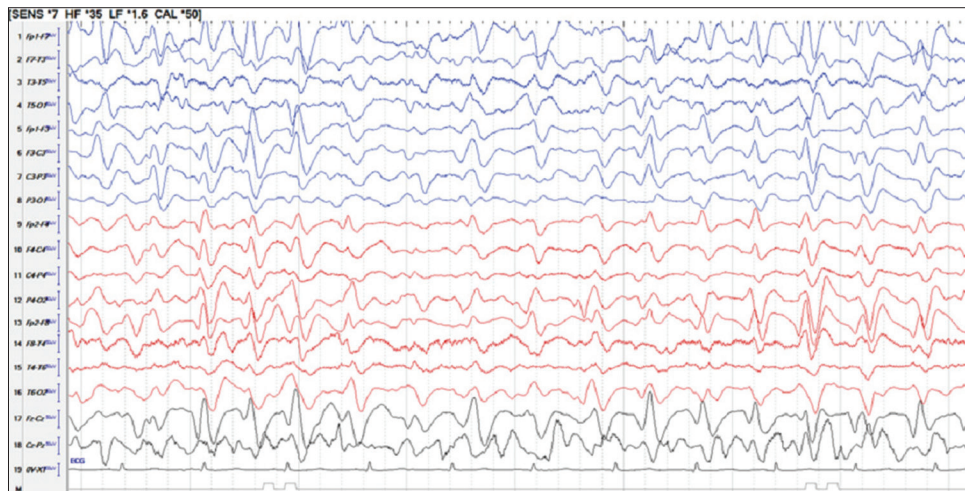


Figure 3: Sixty-two year man with chronic liver disease and hepatic encephalopathy shows asymmetric T waves.

insults including asphyxia, prematurity, intracranial hemorrhage, or hypoglycemia, neuronal migration disorders, genetic conditions, head injury, tuberous sclerosis, central nervous system infections including TORCHs, inborn errors of metabolism and immunizations.^[13] The underlying etiology for Hyps is identified in about 95% cases; however, 5–15% remain cryptogenic.^[13] Most children have neurocognitive delays, motor developmental delays, and refractory seizures.^[13]

TWs were initially thought to be diagnostic of HE, however, have now been seen in metabolic, toxic, anoxic conditions, structural lesions, and even with drugs.^[14-16] Hence, TWs are not mysterious anymore, but they represent brain response to various insults.^[14] Hyps is known to be epileptic encephalopathy and responds partially to

immunomodulation and antiseizure medications.^[17,18] TWs indicate some form of subclinical or nonconvulsive status epilepticus.^[19,20] There are several publications stating that TWs are a form of nonconvulsive seizures and have reported anti-seizure medications in them.^[20] O'Rourke *et al.* reported response to antiseizure medications (benzodiazepines and other antiseizure medications) in 40% of their patients.^[20] The authors recommend the use of antiseizure medications in all patients.^[20] TWs may present as generalized periodic pattern of 1–2/s and Chong *et al.* too recommend anti-seizure medications.^[21] Our experience too suggests trial of antiseizure medications in all patients with TWs in periodic pattern.

Hyps changes or modifies into different epileptic pattern by 2–4 years of age irrespective of underlying etiology. TWs also

change depending on the underlying cause, may disappear in mild metabolic causes, and worsen in underlying severe conditions not responding to the treatment.

Mortality in both Hyps and TWs is related to the control of the underlying condition and underlying cause. A very high mortality is associated with the grade three and four HE associated with generalized periodic pattern of the TWs.^[6]

TWs are not mysterious but represent brain response to various insults to the developed/mature brain while Hyps is the response of immature/developing brain to various insults.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflict of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author confirms that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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