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Original article

Central tegmentum tract hyperintensities in pediatric neurological patients: Incidence or coincidence

Uğur Işık [a,*], Alp Dinçer [b]

[a] Acıbadem University, Department of Pediatrics, Division of Pediatric Neurology, Kozyatağı Acıbadem Hastanesi, İnönü Cad. Okur Sok. No: 20, Kozyatağı, Istanbul, Turkey

[b] Acıbadem University, Department of Radiology, Kozyatağı Acıbadem Hastanesi, İnönü Cad. Okur Sok. No: 20, Kozyatağı, Istanbul, Turkey

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Abstract

Aim: The central tegmental tract hyperintensities (CTTH) have been found in many different pediatric neurological conditions. There is only scarce data about the value of this radiological phenomenon. In this study we aimed to show the neurological conditions associated with this radiological finding.

Materials and methods: We performed a retrospective analysis of all pediatric brain MRI's between 2013 and 2015. After finding those patients with CTTH, we evaluated them in the pediatric neurology clinic.

Results: There were 41 out of 1464 brain MRI's with CTTH with 2.8% prevalence. Thirty four patients (23 male, age range 3 months–98 months) were available for evaluation. CTTH were present in mainly younger age group. There were many different neurological conditions associated with CTTH. These included brain tumors, epilepsy, developmental delay, metabolic disorders and genetic syndromes.

Conclusion: CTTH is found in many different pediatric neurological conditions. Further neuropathological and prospective MRI and clinical studies are needed to better understand this interesting radiological finding.

Keywords: Central tegmentum tract hyperintensity; Children; Epilepsy; Metabolic disorders; Genetic syndromes

1. Introduction

The central tegmental tract (CTT) is a bundle of efferent fibers between the red nucleus and the olivary nucleus. It also includes afferent fibers from the rostral nucleus solitarius that terminate in the thalamus [1]. Recent advancement in neuroradiology has enabled identification of symmetrical lesions restricted to the CTT. It usually cannot be identified as discrete signal intensity on T2-weighted images (T2WI) or diffusion-weighted images (DWI) Magnetic Resonance Imaging (MRI) [2]. However in certain neurological disorders, central tegmental tract hyperintensities (CCTH) have been described. The clinical conditions associated with CTTH include cerebral palsy, epilepsy, antiepileptic drug use and metabolic disorders [2–11]. The significance of this MRI finding and its clinical correlation are still unclear. In this study, we aimed to delineate the causes and medical conditions associated with CTTH.

* Corresponding author.
E-mail addresses: ugur.isik@acibadem.com.tr (U. Işık), alp.dincer@acibadem.com.tr (A. Dinçer).

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2. Material and methods

We performed a retrospective review of all pediatric brain MRI's between 2013 and 2015 (age range 0–18 years) at Kozyatağı Acıbadem Hospital, an affiliated hospital of Acıbadem University, School of Medicine, in Istanbul. It is a tertiary center taking care of many pediatric neurologic and neurosurgical patients from Turkey and neighboring countries. After obtaining an informed consent from the parents, history taking and neurological examination were performed. Those children who could not be reached either because they lived abroad or had no contact information, or refused to participate to the study were excluded. This study was approved by the ethics committee of Acıbadem University, School of Medicine. In all children the cause of their clinical problem e.g. epilepsy, developmental delay, dysmorphic features were evaluated with appropriate tests. In addition to MRI, all children with a seizure, had an hour-long sleep and awake EEG. All children with dysmorphic features were evaluated by a pediatric geneticist and all children with developmental delay had appropriate metabolic tests; plasma amino acids, tandem mass screening, ammonia, lactate, liver and kidney function tests, glucose, uric acid, thyroid hormones, vitamin B12 level and urine organic acids. Some of the children had advanced tests e.g. CGH array, specific gene tests like Angelman syndrome, urinary oligosaccharides etc. according to their needs. All the MRI's were examined by the same experienced neuroradiologist with 24 years of experience and by the same pediatric neurologist with 14 years of experience in their fields.

2.1. MRI imaging technique

All patients had a routine 3 Tesla cranial MR examination (Siemens, Magnetom Trio, Germany) including DWI sequences. It includes axial Turbo Spin Echo (TSE) T2, T1, Fluid attenuated inversion recovery (FLAIR), coronal/sagittal TSE T2, DWI with b0, b1000 and b2000. In some cases, volumetric T1 and FLAIR images were obtained using 3D sampling perfection with application optimized contrasts using different flip angle evolutions (3D SPACE FLAIR) and Turbo Fast Low Angle Short (TurboFLASH) T1. Sedation was routinely given to all patients below the age of 6 years. We defined a CTT lesion as an area of bilateral symmetrical hyperintensity in the tegmentum on both T2WI and DWI in more than two slices as described by Yoshida et al. [2].

3. Results

There were 41 children out of 1464 MRI's performed with 2.8% prevalence. History and physical examination were available for 34 children, the parents of seven children refused to participate in the study. All patients between 0 and 18 years who had brain MRI between years 2013–2015 at Kozyatagi Acibadem Hospital in Istanbul were examined. The radiological diagnoses of 1464 patients are represented in Table 1 and the demographics, clinical and radiological features of 34 patients with CTTH are represented in Table 2.

3.1. Clinical features

One thousand four hundred sixty four patients who had MRI of the brain between 2013 and 2015 were classified and represented in Table 1. Among them were 23 male and 11 female patients with CTTH. The oldest patient was 98 months old (8 years) and the youngest was 3 months old (mean age; 21 months and median age; 16,5 months). There were very different neurological conditions among the patients. The neurological diagnoses are presented in Table 2. The etiology was heterogenous. Among the specific diagnoses were two patients with metabolic disorders (glutaric aciduria type 1 and mitochondrial disease), two patients with genetic disorders (Angelman Syndrome and Noonan Syndrome), three patients with congenital hydrocephalus, three patients with malformations of cortical development (one bilateral occipitotemporal pachygyria, one frontotemporal polymicrogyria, one temporal lobe cortical dysplasia), one patient with cerebral palsy, three patients with brain tumors (one hypothalamic chiasmatic optic glioma, one pons/medulla glial tumor, one ependymoma), two patients with sylvian arachnoid cyst, and one patient with Sturge-Weber Syndrome (SWS). None of the patients had palatal myoclonus or tremor in their examination. Seizures were present in 10 patients. Seven patients had a diagnosis of epilepsy, one generalized, 6 partial. Three patients had either febrile or afebrile seizures but did not fulfill the

Table 1
Radiological diagnoses of 1464 patients who had brain MRI between 2013 and 2015.

Diagnosis	Number n:1464	Number (%) of CTTH n:34
Malignant brain tumors	263	3(1.1%)
Low-grade tumors	102	0
Metabolic disorders	58	2(3.4%)
Sequelea of hypoxia lesions	65	1(1.5%)
Normal MRI, mild abnormalities not diagnostic	494	19(3.8%)
Abscess	2	0
Stroke	14	0
AVM/aneurysm	88	0
Demyelinating lesions	29	0
Malformations of cortical development	121	3(2.4%)
Hydrocephalus	149	3(2%)
Arachnoid cysts	35	2(5.7%)
Traumatic brain lesions	44	1(2.2%)