

CASE REPORT

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Restricted diffusion of the corpus callosum in extensive neonatal hypoxic–ischemic encephalopathy**Gunay Rona¹, Meral Arifoglu¹, Hediye Pinar Gunbey¹, Ufuk Yukselmiş²**¹University of Health Sciences, Kartal Lutfi Kirdar Training and Research Hospital, Department of Radiology, Istanbul, Turkey²University of Health Sciences, Kartal Lutfi Kirdar Training and Research Hospital, Department of Pediatrics, Istanbul, TurkeyReceived 29 July 2020; Accepted 02 November 2020
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Content of this journal is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.**Abstract**

Hypoxic-ischemic encephalopathy (HIE) is a devastating brain injury that may result in death and severe neurologic deficits. Corpus callosum (CC) involvement, especially its entire involvement, is very rare in HIE. A 41-week-old male term neonate had a difficult delivery and developed cardiac arrest after birth. His Apgar scores were low in the first 10 minutes. The magnetic resonance imaging (MRI) showed high signal intensity in bilateral basal ganglia, bilateral thalami, temporofrontal cortex, subcortical white matter, periorlandic region, and the entire corpus callosum in T1 sequences. Restricted diffusion was noted on the diffusion-weighted imaging (DWI) images of all these regions. CC is affected in cases of severe and advanced brain injury, and especially splenic lesions have poor outcomes. Entire CC involvement may lead to worse clinical presentation and can serve as an early neuroradiologic marker.

Keywords: Hypoxic ischemic encephalopathy, corpus callosum, Magnetic Resonance Imaging(MRI), restricted diffusion**Introduction**

Neonatal hypoxic-ischemic encephalopathy (HIE) is a serious condition that develops as a result of decreased cerebral blood flow and decreased blood oxygenation, resulting in death or deep neurological deficit.

In severe hypoxia, metabolically more active regions such as deep gray matter structures (basal ganglia and thalamus) are earlier and more severely affected by oxidative stress. In the case of partial hypoxia, where blood oxygenation is prolonged and partially decreased, blood flow is directed through shunting towards the brainstem, cerebellum, hippocampus, and deep gray matter, which are more vital structures of the brain, and these regions are protected. The cerebral cortex and white matter, which are metabolically less active, are affected, and the involvement is observed especially in more hypoperfused inter-vascular boundaries (watershed zone) [1,2]. The corpus callosum and particularly the splenic region are sensitive to hypoxia. Corpus callosum involvement is more common in severe and advanced HIE cases.

The corpus callosum is the major pathway of association fibers between the two cerebral hemispheres. Various pathologies such as neonatal seizures, hemolytic-uremic syndrome with encephalopathy, neonatal hypoglycemia, an antiepileptic drug, therapy, epilepsy, viral encephalitis, demyelinating disorders, and many other conditions can affect the corpus callosum and cause restricted diffusion in the corpus callosum.[3,4].

In the literature, corpus callosum involvement has been rarely addressed in HIE cases. In most cases, some components of the corpus callosum, especially the splenic region, are involved, whereas very few cases of its entire involvement have been reported in articles.

Case report

A 41-week-old term male neonate was referred to our clinic with suspicion of perinatal asphyxia and HIE after birth. It was learned from the patient's history that he had a difficult and prolonged vaginal delivery. His 1-min Apgar score was noted as 3, 5-min Apgar score as 4, and 10-min Apgar score as 7. His birth weight was 3635 g and his clinical examination was evaluated to be consistent with asphyxia. Immediately after birth, he was resuscitated and initiated on treatment in intensive care conditions.

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His bedside cranial ultrasound (US) examination performed on a postpartum day 1 revealed obliterated sulci and cisternae consistent with diffuse cerebral edema, narrow CSF space, and ventricles, and disrupted gray-white matter junction. No intracranial hemorrhage was visualized. In addition to the US findings, the cranial computed tomography (CT) obtained after birth showed a pseudo sac and white cerebellum signs consistent with cerebral edema. No hemorrhage was noted on the CT examination (Figure 1).

The MRI examination performed on a postpartum day 6 showed a diffuse signal increase in bilateral basal ganglia, bilateral thalami, bilateral temporofrontal cortical and subcortical white matter, perirolandic region, and corpus callosum on the T1-weighted images (Figure 2). Again, in these regions, there was a signal increase consistent with diffusion restriction on the DWI images, and a signal decrease in the apparent diffusion coefficient (ADC) map (Figure 3). A large area of caput succedaneum was present in the fronto-parieto-occipital junction on the right. The clinical history, examination, and imaging findings of the patient were evaluated to be consistent with HIE.

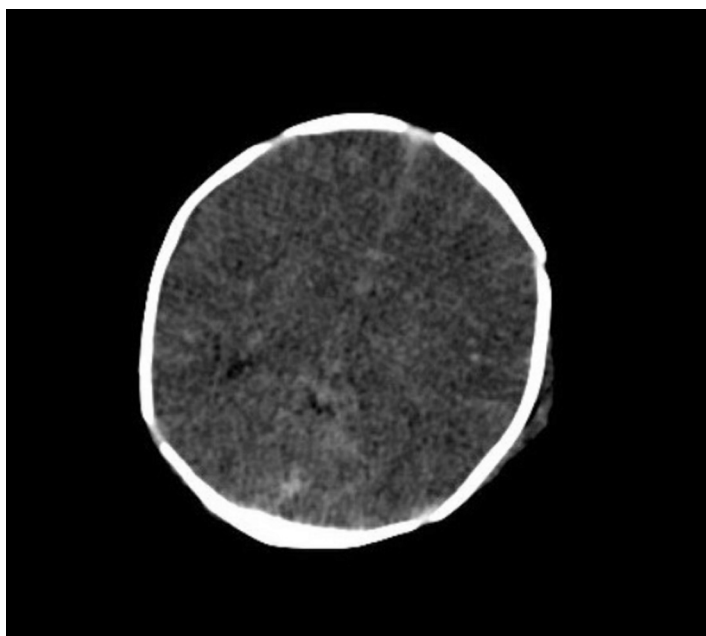


Figure 1. The CT findings demonstrated effacement of hemispheric cortical sulci, narrowing of lateral ventricles, disruption in the separation of White and gray matter compatible with CT brain edema, and pseudo sac appearance in the interhemispheric fissure.

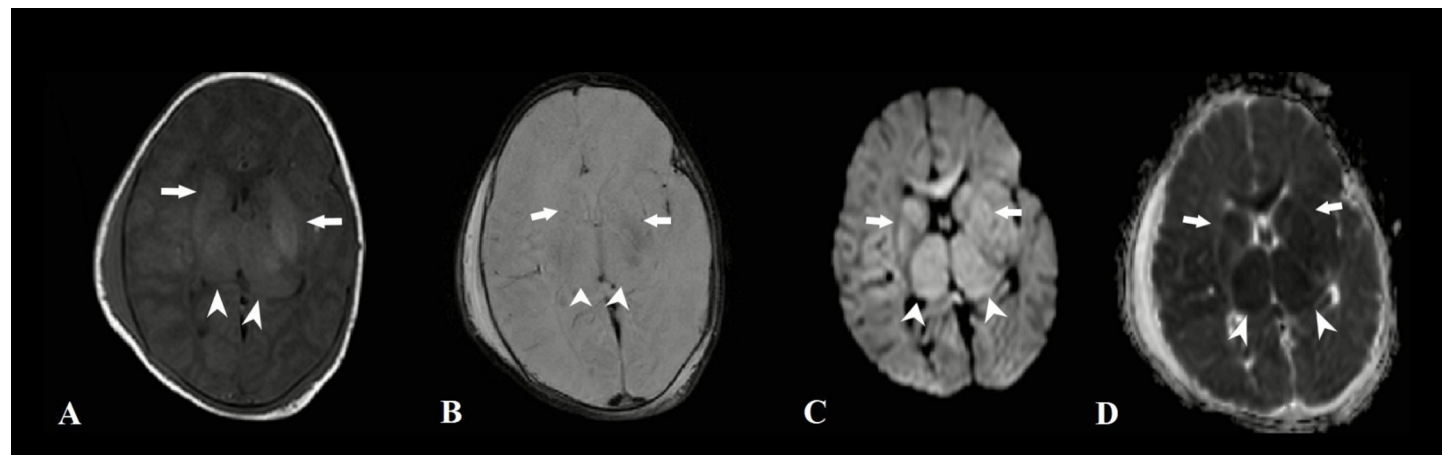


Figure 2. Bilateral basal ganglia (arrows) and thalamus (arrowheads) signal changes as hyperintense on T1W (A), iso-hypointense on T2W (B), hyperintense on DWI (C), and hypointense on ADC (D) images.

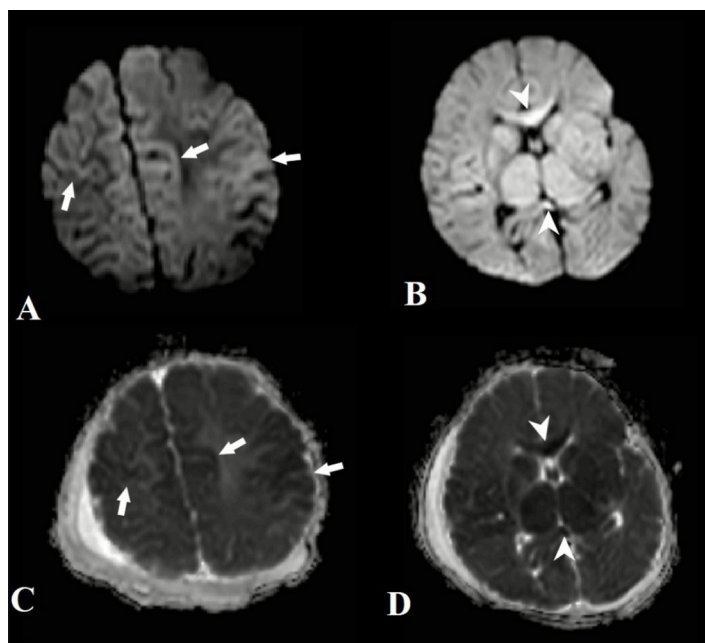


Figure 3. Diffusion restriction of perirolandic area (arrows, A, C) and corpus callosum (arrowheads, B, D) with DWI hyperintense and ADC hypointense signal changes.

Discussion

In HIE cases, corpus callosum involvement is an indicator of severe neurological deficit and death[5,6]. Takenouchi et al. found diffusion restriction in the splenium of the corpus callosum in 29% of the HIE patients in their study. They observed that these patients had a worse prognosis than those without diffusion restriction in the splenium [7]. In our case, diffuse brain injury was present and the corpus callosum was entirely affected. In cases where the corpus callosum is entirely affected, it may lead to a much more severe clinical presentation compared to partial involvement [7].

As neonates with suspicion of HIE mostly require treatment in intensive care conditions. The US a portable examination, is the first-line modality. However, its low sensitivity, practitioner-dependency, and the low probability of demonstrating the lesions in the cerebral convexity reduce success. CT involves ionizing radiation and is not sensitive in detecting non-hemorrhagic injury. MR is the most sensitive modality among the examinations. MRI

examination should include at least T1, T2, DWI sequences, and ADC map. In the affected parts, high signal intensity is visualized in T1-weighted sequences. Diffusion-weighted images show restriction due to cytotoxic edema. Among the MRI sequences, diffusion-weighted images show the findings at the earliest; however, they may be negative in some cases. On DWI sequences the findings reach the maximum level of significance in 3-5 days [8-11].

Diffusion-weighted MRI manifests early in hypoxic encephalopathy and can detect more detailed involvement of corpus callosum, which is a sign of poor prognosis.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

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Patient informed consent

We took oral consent from patient's parents.

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