Case Report

REVERSIBLE POSTERIOR LEUKOENCEPHALOPATHY IN A CHILD WITH ACUTE GLOMERULONEPHRITIS: FOLLOW-UP MR IMAGING

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ABSTRACT

Hypertensive encephalopathy is the most common cause of reversible posterior leukoencephalopathy syndrome, which is quite rare in the pediatric age group. Diffuse vasogenic edema in the posterior circulation territories at the initial stages and complete disappearance of edema on follow-up imaging is the characteristic feature of this syndrome. Frontal and temporal lobe involvement is rarely seen. In this report we present the follow-up MR and diffusion weighted imaging findings of reversible posterior leukoencephalopathy syndrome in a pediatric case with this rare involvement in addition to characteristic involvement localization.

Key Words: Reversible posterior leukoencephalopathy, Glomerulonephritis, MR imaging.

INTRODUCTION

Reversible posterior leukoencephalopathy syndrome (RPLS) was first described by Hinchey et al in 1996. This syndrome is characterized by headaches, vomiting, altered mental status, seizures, visual disturbances, and motor signs (1, 2).The most common causes of RPLS are hypertensive encephalopathy (HE), renal decompensation, fluid retention, and treatment with immunosuppressive drugs (1). HE has been reported to be the most thoroughly studied (both clinically and experimentally) cause of RPLS but it is rarely reported in children (3). The rapid resolution of clinical and neuroradiologic abnormalities suggests vasogenic edema which is thought to result from impaired cerebrovascular autoregulation and endothelial injury (4). Fluid-attenuated inversion-recovery (FLAIR) MR imaging is reported to be the most sensitive sequence to the characteristic cortical and subcortical edema of RPLS (2). Early recognition of RPLS is of paramount importance because prompt control of blood pressure will cause reversal of the syndrome. Serial MR images are necessary to distinguish transient edema from permanent zones of infarction.

CASE REPORT

A 12-year-old boy presented with a severe headache, visual abnormalities, generalized

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seizures, confusion, facial and pretibial edema, and gross hematuria. He had acute hypertension (190/110 mmHg). Ophthalmologic examination revealed bilateral papilledema. The laboratory examinations revealed hematuria, proteinuria, high ASO and low C3. Electroencephalogram was normal. With a previous history of upper respiratory tract infection, acute onset of edema, gross hematuria, generalized seizures, hypertension and laboratory findings, he was diagnosed with acute glomerulonephritis (AGN) and HE. The patient was treated with penicillin G benzathine, nifedipine, phenytoin, and furosemide. The patient's blood pressure and all clinical findings improved in two and seven days, respectively.

Cranial CT was performed on the day following the onset of the symptoms. CT showed bilateral low-density areas in the parieto-occipital lobes. MR imaging was performed on a 1.5-T system (Philips, Gyroscan Intera, Netherlands) after two days. T1 weighted images (SE: TR: 560, TE: 15) were obtained in the axial and coronal planes (with 5 mm-thick slices). T2 weighted image (TSE: TR: 4530, TE: 100) was obtained in the axial plane. Fluid-attenuated inversion recovery (FLAIR) (TR: 7000, TE: 110, TI:2000) images in the axial and sagittal planes were obtained. T1 and T2 weighted images were unremarkable. FLAIR imaging revealed hyperintense bilateral lesions located in the cortical and subcortical white matter of the frontal, temporal, parietal and occipital lobes (Fig 1A). There was no enhancement after the injection of contrast material. Diffusion weighted (DW) images were normal. Seven days later, a follow-up MR imaging revealed almost complete resolution of the lesions in the frontal and occipital region (Fig 1B). In addition the size and signal intensity of the lesions in the temporo-parietal regions decreased. Follow-up FLAIR MR imaging, performed 4 weeks after treatment, showed complete resolution of the lesions (Figs 2A, B). DW images remained normal. These findings were consistent with those of hypertensive encephalopathy induced edema.

We present the follow-up MR and DW imaging findings of RPLS in a pediatric case with frontal and temporal lobe involvement, which is rare.

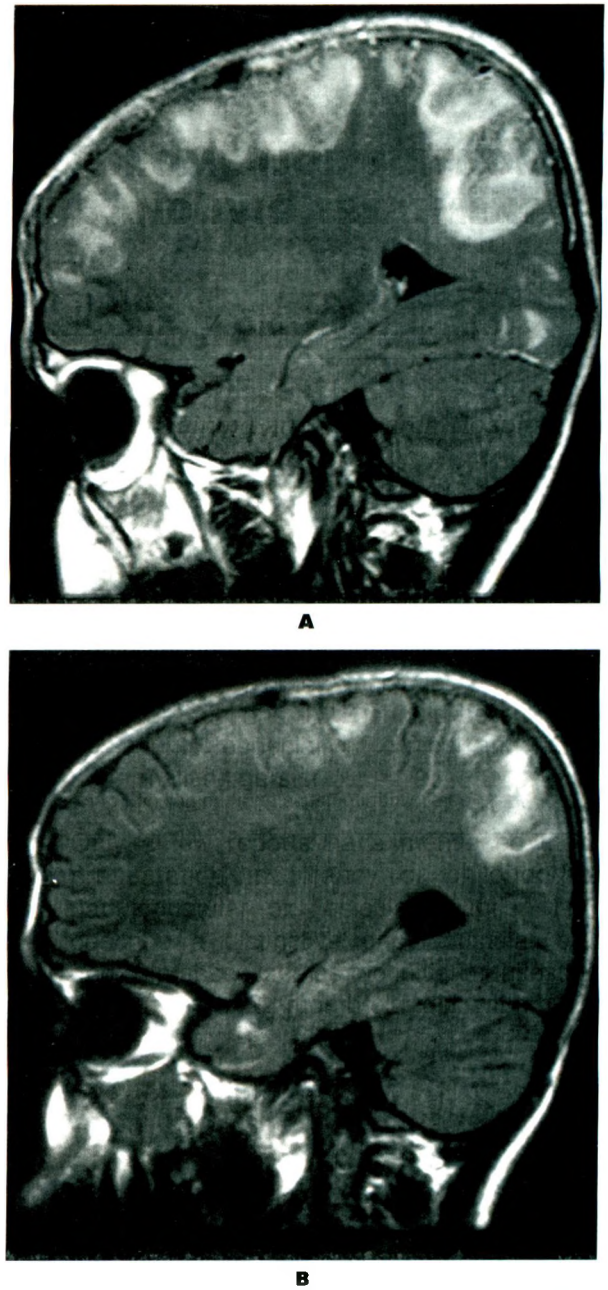
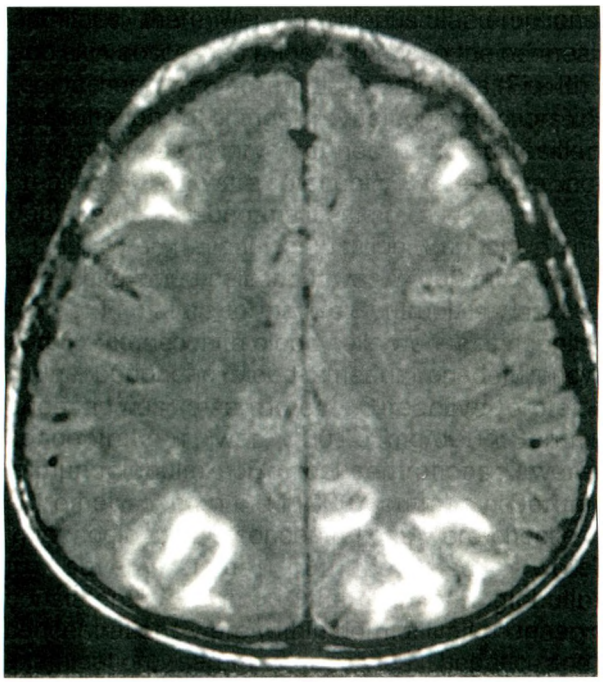


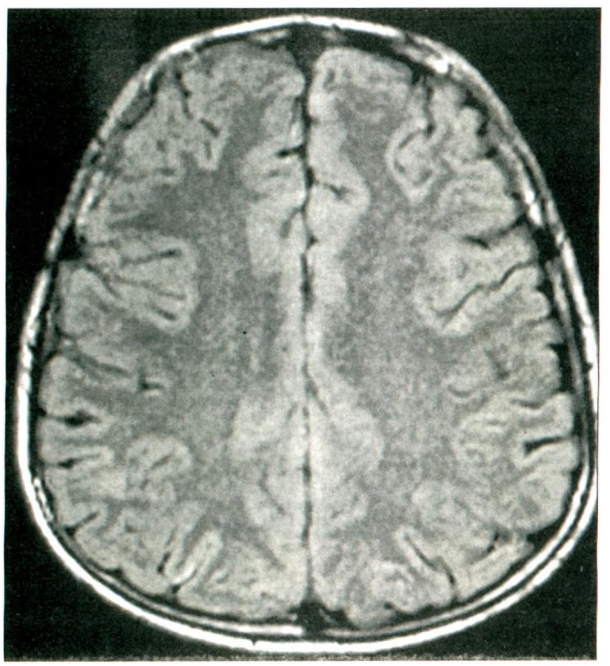
Fig. 1: Sagittal FLAIR image (TR: 7000, TE: 110, TI:2000) shows high signal intensities in the fronto-parieto-occipital lobes, representing vasogenic edema (A). Follow-up sagittal FLAIR image after 7 days reveals the disappearance of the lesions in the frontal lobes and significant reduction in size and signal intensity of the lesions in the parietal and temporal lobes (B).

DISCUSSION

RPLS may be suspected on the basis of history, but the clinical signs and symptoms are



A



B

Fig.2: Initial MR study, axial FLAIR (TR: 7000, TE: 110, TI:2000) image shows bilateral symmetric high signal intensities in the frontal and parietal lobes (A). Axial FLAIR image obtained at 5-week follow-up demonstrates complete resolution of the areas of high signal intensity (B).

nonspecific. When typical clinical risk factors are not present, or when the blood pressure is not dramatically elevated, improvement on follow-up

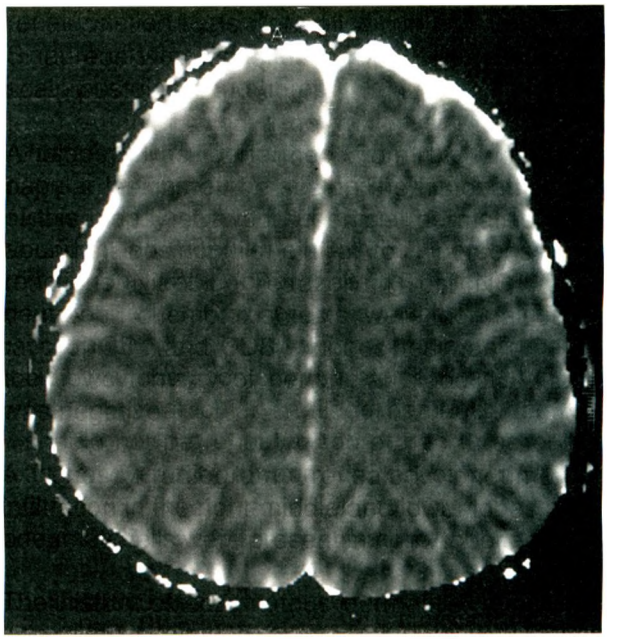


Fig.3: Diffusion ADC image is normal, indicating the absence of permanent brain damage.

MR studies may also be key in the diagnosis (2). RPLS, as such, includes HE as one cause of the clinical condition (5). HE is an important clinical entity to recognize early because the clinical and imaging findings are usually reversible.

Hypertensive encephalopathy is rare in the pediatric population. When present, it is usually related to renal diseases such as acute glomerulonephritis, renal vascular hypertension, or chronic renal failure (6). Children with HE had evidence of end-organ disease affecting the brain, eyes, and kidneys. Malignant hypertension has long been recognized in childhood and has been known to cause encephalopathy. Most patients are markedly hypertensive at presentation, although some have only mildly elevated or even normal blood pressure (1, 7). Acute elevation of blood pressure (several hours to days before the onset of symptoms) is the most common precipitant. Since the normal ranges of blood pressure values in pediatric patients are age-dependent, the requirement for blood pressure to exceed a particular value is inappropriate as the sole criterion for the diagnosis of hypertension (6).

Sympathetic innervation to the vasculature has been shown to initiate vasoconstrictive protection to the brain from marked increases in blood

pressure. Because the anterior circulation is better supplied with sympathetic innervation than the posterior circulation, it is theorized to be better protected during elevation of systemic blood pressure. Based on clinical and radiologic findings, the posterior brain region vasculature seems most vulnerable (1). The pathogenesis of HE is not yet definitely determined. Two diametrically opposed theories exist. According to one theory, hypertension-induced vasospasm of the medium and large intracranial arteries reduces cerebral perfusion and results in ischemia, cytotoxic edema, and infarction (8). According to the other theory, hypertension-induced breakdown of cerebral autoregulation, resulting in dilatation of arterioles, fluid extravasation, and vasogenic edema, has been recently favored (7, 9, 10). The increased perfusion pressure is sufficient to overcome the blood-brain barrier, allowing extravasation of fluid, macromolecules, and even red blood cells into the brain parenchyma (2).

Acute glomerulonephritis manifests with abrupt onset of hematuria, facial edema, hypertension and impairment of renal function. AGN may also present with one or more of its complications such as profound volume expansion with heart failure and HE (11). CT findings of RPLS were previously reported in a child with HE due to acute poststreptococcal glomerulonephritis (12).

The clinical signs and findings on neuroimaging in patients with RPLS are found to be consistent enough for this entity to be readily recognizable (1). Because the syndrome is reversible, prompt diagnosis is essential so that treatment can be directed at controlling the blood pressure (10). On CT and MR studies, edema has been reported in a relatively symmetrical pattern, typically in the subcortical white matter and occasionally in the cortices of the occipital and parietal lobes. These findings were reported to occur to a lesser degree in the temporal lobes, corona radiata, the pons, the cerebellum, and other locations (1, 2, 13). The lesions of RPLS are best visualized with MR imaging (2). MR imaging findings; confluent areas of signal abnormality are typically seen in a bilateral symmetric pattern that may be limited to the subcortical white matter but frequently also involves the overlying cortex. While occipito-parietal lobe involvement has been frequently reported in the literature, our patient had both frontal and temporal lobe involvements additionally.

FLAIR and DW imaging are useful modalities to differentiate RPLS from other central nervous system abnormalities such as infarction, multiple sclerosis, and central pontine myelinolysis (2, 14). FLAIR images are T2 weighted but have nulling of signal from cerebral spinal fluid (CSF) due to the inversion recovery technique. This allows for better detection of T2 hyperintense lesions of the cortex that are often obscured on conventional T2 images owing to adjacent hyperintense CSF (2). The FLAIR images show cortical lesions to be more common than previously thought. Recently, it was reported that there may be variations in cortical signal intensity on FLAIR images, depending on the age of the patient and the cortical location (2). In our case, frontal, temporal, parietal and occipital lobes were involved. While any lesion was not detected on T2 weighted image, FLAIR images revealed symmetric hyperintense lesions in the frontal region. This MR finding does emphasise the necessity for requesting FLAIR neuroimaging in such cases, particularly where this MR sequence may not be routinely employed.

DW imaging can be used to discriminate between cytotoxic and vasogenic edema. Cytotoxic edema has high signal intensity on DW images, due to decreased apparent diffusion coefficient (ADC). DW images may be normal or may demonstrate increased diffusion in these regions, supporting the concept of increased interstitial fluid in the white matter, not ischemia (4, 9). Previous studies have shown that lesions in RPLS are often isointense on DW images (15). In our case, DW images after treatment did not reveal high signal intensity, representing the absence of ischemia (Fig 3).

Early recognition of RPLS is of paramount importance because prompt control of blood pressure will cause reversal of the syndrome. Delay in the diagnosis and treatment can result in permanent damage to affected brain tissue (16). Reversible posterior leukoencephalopathy may develop in children who have hypertension secondary to acute glomerulonephritis. Although, it is reported that the lesions usually involve the parieto-occipital regions, we observed frontal and

temporal involvement in addition to parieto-occipital regions in our case.

Untreated hypertension can lead to progressive central nervous system failure with intracranial hemorrhage, irreversible cerebral infarction, coma, and death. Endothelial cell damage is the central pathophysiology of RPLS. Although reversible vasogenic edema due to cerebrovascular autoregulatory dysfunction is the underlying pathophysiologic mechanism, irreversible lesions resulting from cytotoxic edema can be found especially in the cerebral cortex. Because the history of hypertension or seizures may not always be present, the characteristic imaging findings should allow the radiologist to suggest the diagnosis and follow-up imaging in 1 to 2 weeks will usually show resolution of findings. FLAIR and DW imaging should be applied for early diagnosis and follow up of children with suspected RPLS accompanying AGN in order to prevent permanent brain damage.

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