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Clinical Observations

Neurogenic Pulmonary Edema in Pediatric Multiple Sclerosis: Patient Report and Summary of Cases

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ABSTRACT

BACKGROUND: Neurogenic pulmonary edema may be a complication of multiple neurological processes. Although there is debate regarding the underlying pathophysiology, the recognition of neurogenic pulmonary edema is vitally important because of the high-potential for mortality and need for treatment of the underlying disorder. **METHODS:** We present an example of recurrent neurogenic pulmonary edema in an adolescent boy with multiple sclerosis who was diagnosed with pneumonia at the time of initial presentation. We also review the presenting symptoms, physiologic parameters, and imaging findings from published reports of patients with multiple sclerosis presenting with neurogenic pulmonary edema. **RESULTS:** Although all 11 cases found via literature review presented with respiratory symptoms, cardiac dysfunction was variable, as was the presence of other neurological findings. All but one case had a documented medullary lesion. Corticosteroids were effective in resolving symptoms. Three patients were not treated with corticosteroids, and one of these died (onset of pulmonary edema during sleep). **CONCLUSIONS:** Awareness of these patients may expedite recognition and treatment of future patients, thus minimizing time to appropriate treatment and reducing mortality.

Keywords: pediatrics, multiple sclerosis, pulmonary edema, medulla

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Introduction

Neurogenic pulmonary edema is a recognized complication of neurological injury. It has been described in cases of intracranial hemorrhage, traumatic brain injury, meningitis, intracranial masses, and status epilepticus.[1] It is characterized by acute onset of respiratory symptoms after a neurological insult and typically resolves 48-72 hours after onset, but with a high risk of mortality.[2]

The pathophysiology of pulmonary edema after a neurological insult is debated. It is thought that an increase in output from the alpha-adrenergic system is responsible for an increase in intravascular hydrostatic pressure and increased capillary permeability.[1-3] The pathophysiology of this process, whether a direct result of the adrenergic surge or secondary to hemodynamic changes, is unclear. Suspected central nervous system pathways thought to be involved include the caudal medulla (areas A1 and A5), area postrema, and the solitarius tractus nuclei. These areas are involved in the sympathetic connections between the medulla and the hypothalamus. Fibers extending from area A5 project to the preganglionic centers for sympathetic outflow in the spinal cord.[1]

In a retrospective analysis of cases of pulmonary edema in human subjects, pulmonary fluid analysis suggested a hydrostatic mechanism in many of the patients (alveolar edema fluid to plasma protein concentration ratio of <0.65).[4] In cases of Takotsubo's cardiomyopathy, a state of depressed cardiac contractility after a neurological insult, patients are at risk for the development of pulmonary edema.[5] However, in individuals with multiple sclerosis and pulmonary edema, abnormal cardiac function was not uniform.

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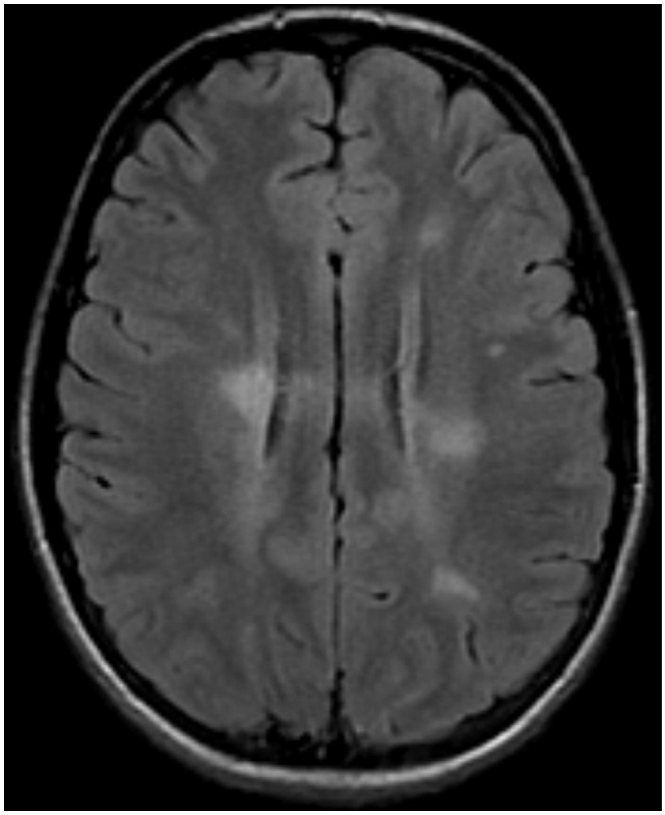

FIGURE 1.
Ovoid supratentorial lesions oriented perpendicular to the ventricular margins, consistent with MS on MRI (FLAIR) obtained prior to the patient's presentation with pulmonary edema.

In animal studies, it has been demonstrated that pulmonary edema induced by central nervous system insults was not reproducible by increasing pulmonary vascular pressures via insertion of a left atrial balloon. This leads to the thought that there is a direct neurological influence on the pulmonary endothelium.[6]

Acute pulmonary edema has been described in patients with known multiple sclerosis and as the initial presenting symptom.[7] We present a 14-year-old boy with previously diagnosed multiple sclerosis who presented with the acute onset of pulmonary symptoms (a few details of this patient's care were included in an earlier imaging review[8]). We also summarize patients from the literature.

Patient Description

This 14-year-old young man initially presented in June 2009 with intractable vomiting and dehydration. He had no other gastrointestinal symptoms and so a computed tomography of the head was performed, demonstrating a left parietal lesion. Magnetic resonance imaging (MRI) of the brain demonstrated multiple white matter lesions involving the supratentorial (including juxtacortical and periventricular lesions) (Fig 1) and infratentorial white matter, corpus callosum, and brainstem, including a lesion in the area postrema. There were no spinal cord lesions. Lumbar puncture (traumatic) revealed 15 leukocytes, 980 erythrocytes, glucose of 63, and protein of 29. There were 14 oligoclonal bands unique to the cerebrospinal fluid. Immunoglobulin G index was elevated at 1.02. His symptoms resolved with hydration, and he was discharged home with a plan for close follow-up.

At follow-up in October 2009, there were several new enhancing lesions on the brain MRI and one small lesion in the spinal cord at T6. A diagnosis of relapsing remitting multiple sclerosis was made, and therapy with interferon beta-1a was initiated. The patient had an exacerbation involving right-sided weakness in November 2009 but otherwise tolerated therapy well.

However, in early April 2010 he developed acute headache and body aches and felt overheated. Approximately an hour later, he developed shortness of breath, confusion, and lethargy, so his parents transported him to the emergency room. On presentation, he was cyanotic with copious pink, frothy secretions, hypothermic, and hypertensive with a temperature of 32°C and diastolic blood pressures greater than100. In the trauma bay, he had a pH of 7.2, bicarbonate of 21.8, and a base excess

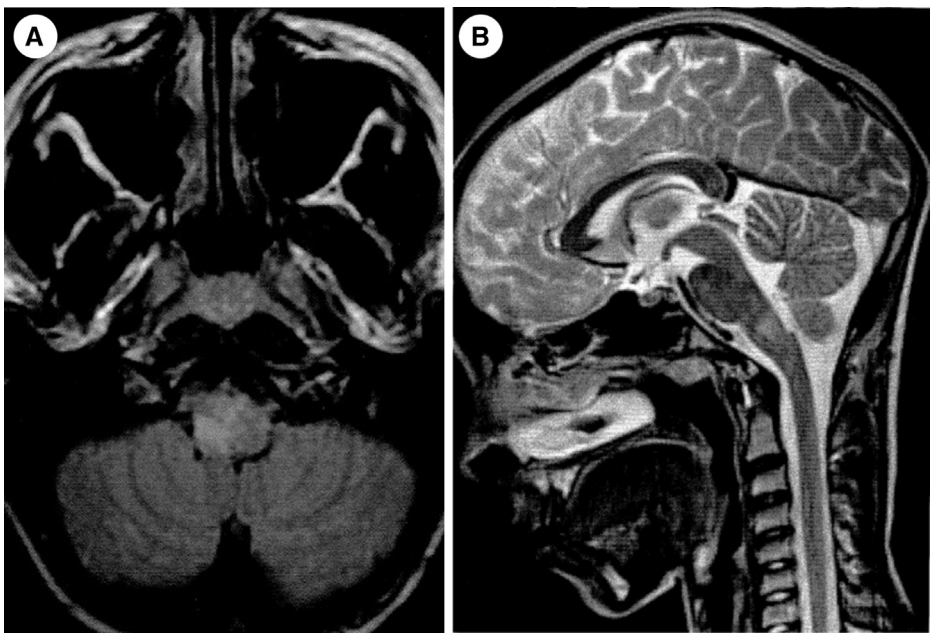

FIGURE 2.
Magnetic resonance imaging brain ([A] T_2/FLAIR axial; [B] T_2 sagittal) obtained during the patient's second admission for pulmonary edema, revealed an increase in areas of nonenhancing signal abnormality within the right medullary region and subtle increased signal in the pons.