Heat Hyperpyrexia-Induced Cerebellar Degeneration and Anterior Horn Cell Degeneration: A Rare Manifestation

Sir,

Hyperpyrexia can adversely affect almost any organ system, but the central nervous system (CNS) is particularly vulnerable. In the CNS, cerebellar Purkinje cells are most prone to hyperpyrexia-induced dysfunction. Other brain areas in decreasing order of vulnerability are the cerebral cortex, brain stem, and spinal cord. The extent of Purkinje cell loss correlates with the degree and duration of hyperthermia. Heat hyperpyrexia-induced cerebellar atrophy generally involves both the vermis and cerebellar hemispheres.

Cerebellar degeneration is well-known sequelae of heat stroke, but anterior horn cell degeneration is a rare manifestation.

We present a rare case of 23-year-old male who had exposure to high temperature while working in the field on the day of illness. He developed loss of consciousness, decreased sweating, and fever. There was no history of any psychiatric illness/antipsychotic medication or alcohol intake. Armpit temperature recorded at the time of admission was 106°F. His pulse rate and blood pressure were 120/min and 130/80 mmHg. Sensorium improved to some extent in next 3–4 days, though remained confused and fever lasted for approximately 8–10 days. After regaining consciousness, he remained mute for another 20–25 days. After that, severe cerebellar dysarthria developed which gradually improved partially, but quadriparesis improved minimally since then. On general physical examination, his higher mental functions were within normal limits without any fundus abnormality or nystagmus. Cerebellar dysarthria, dysdiadochokinesia, and titubation were present. Wasting of small muscles of the hands, forearms and both legs were noted with occasional fasciculation. Power in both upper limbs was 4/5 while in lower limbs it was 4(-)/5. Routine blood, biochemical investigations, and CSF examinations were within normal limits. Nerve conduction study (NCS) revealed mild prolongation of distal latencies in median and ulnar nerves along with attenuation of compound motor action potential (CMAP) and mild slowness of nerve conduction velocity. Electromyography (EMG) showed long duration, high amplitude, and polyphasic motor unit action potentials (MUAPs) without fibrillation and positive sharp waves, suggesting chronic widespread denervation and reinnervation due to anterior horn cell involvement. Magnetic resonance imaging (MRI) brain was also suggestive of diffuse cerebellar atrophy with preserved bilateral cerebral hemispheric and brain stem volume [Figure 1a-c].

When the core body temperature rises above 40°C, thermoregulation fails and multiorgan failure ensues.[1,2] Heat adversely affects almost all organ systems, with the CNS

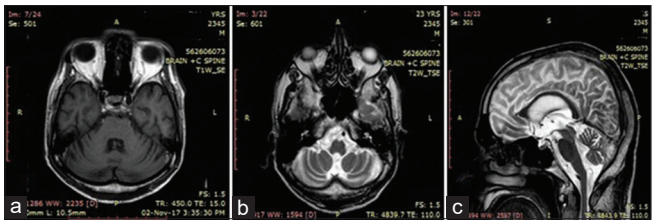

Figure 1: (a and b) Magnetic resonance imaging brain axial sections (T1-weighted image and T2-weighted image) and (c) sagittal section (T2-weighted image) suggestive of diffuse cerebellar atrophy

being particularly vulnerable. Lee *et al*.[3] reported that there may be selective vulnerability of cerebellar neurons to heat injury. Common neurological sequelae of heat hyperpyrexia are syndrome of ataxia, dysarthria, persistent hemiparesis, quadriparesis, seizure, and myelopathy. Heat stroke-induced cerebellar atrophy generally involves both the vermis and cerebellar hemispheres, with cerebral hemispheres being spared in almost all reported cases.[4] Heat is directly toxic to cerebellar Purkinje cells, which have the highest concentration of heat shock protein in order to counteract increased sensitivity.[5] A Purkinje cell loss occurs within 24 h of hyperpyrexia and the extent of damage correlates with the degree and duration of hyperthermia. Mild cases show subtle cell changes consisting of neuronal swelling, pyknosis, or focal deposits, while profound cell loss accompanies severe cases.

This case has severe cerebellar dysfunction characterized by dysarthria, dysdiadochokinesia, and titubation. Acute severe cerebellar dysfunction may manifest initially as mutism subsequently evolving into typical cerebellar dysarthria. Wasting of small muscles of the hands, forearms and both legs were noted with occasional fasciculation in this case which were not reported in previous studies. With anterior horn cell degeneration, there may be evidence of axonal loss in NCS evident by decreased CMAP. When larger and faster motor neurons are lost, some slowing of the conduction velocity and prolonged distal latency may occur. Polyphasic MUAPs on EMG were suggestive of anterior horn cell involvement. Diffuse cerebellar atrophy with preserved cerebral volume on MRI brain was suggestive of cerebellar neuronal loss. Niizato *et al.* (2006) have reported a single case of anterior horn cell degeneration in a schizophrenic patient who died from heat stroke. Neuropathological study of that patient showed severe loss of Purkinje cell with gliosis, neuronal loss in dentate nucleus, substantia nigra, and anterior horn cells of spinal cord and degeneration of bilateral pyramidal tract.[6]

We suggest hyperpyrexia-induced cerebellar and anterior horn cell degeneration in the spinal cord as the pathogenesis in the present case.

Extreme temperature should be considered as a medical emergency and treated effectively since it is predictor of poor outcome potential for cerebellar and other nervous system areas damage.

Although heat stroke-induced cerebellar degeneration is a well-known complication, only one case of anterior horn cell degeneration following heat stroke has been reported so far. Anterior horn cell degeneration in the spinal cord adds to the morbidity and has adverse prognosis.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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