Neurological MR imaging in Nutrition

N. Khandelwal, MD
Prof and Head Department of Radiology, PGIMER, Chandigarh-160012, India

Rakesh K Gupta, MD
Professor of Radiology, SGPGIMS, Lucknow-226014, India

Over as well as under-nutrition are responsible for the neurological manifestations in all age groups especially in children. Nutrition disorders can be caused either by over or insufficient intake of food and/or certain nutrients or due to inability of the body to absorb and use nutrients. Examples include obesity due to over intake; anemia due to insufficient intake of iron, and impaired sight because of inadequate intake of vitamin A.

Nutrition disorders can be particularly serious in children, since they interfere with growth and development, and may predispose to many health problems, such as infection and chronic disease. We will focus on the nutritional disorders which affect the central nervous system in this presentation.

Nutrition disorders related with under nutrition:

Dietary vitamins:

**Thiamine (Vitamin B1):** The deficiency of thiamine results in axonal loss, Wernicke's disease, peripheral neuropathy, alteration of memory and cerebellar degeneration. Neuroradiologic findings usually show symmetric signal intensity alterations in the mammillary bodies, medial thalami, and periaqueductal area. Selective involvement of the cranial nerve nuclei, cerebellum, red nuclei, dentate nuclei, fornix, splenium, cerebral cortex, and basal ganglia characterize nonalcoholic WE patients. Furthermore, symmetric basal ganglia alterations with involvement of the putamen have only been observed in children. Magnetic resonance spectroscopy (MRS) depicts lactate and decreased NAA and Choline resonances in MRI abnormal regions, accounting for carbohydrate metabolism derangement, neuronal damage, and reduced incorporation of lipids into the myelin, respectively.

**Vitamin B12:** Polyneuropathy, spinal cord involvement, Posterior column fiber loss, Mental retardation or encephalopathy in childhood syndromes, multifocal axonal loss and demyelination. It may appear as posterior column hyperintensity in the spinal cord, cord atrophy and areas of white matter demyelination or may be normal on imaging.

**Vitamin D:** Vitamin D is a fat soluble vitamin, it is unique because it can act as prohormone and body can synthesize. In body it regulates the level of calcium and phosphate in the bloodstream and promoting the healthy growth and remodeling of bone. Vitamin D also affects
neuromuscular function, inflammation, and influences the action of many genes that regulate the proliferation, differentiation and apoptosis of cells.

**Dietary minerals:** Calcium, Iodine, Selenium, Iron, Zinc may produce non specific changes in the brain parenchyma or may not show any imaging abnormality.

**Proteins/fats/carbohydrates:** Severe forms of childhood malnutrition are common in developing countries. The brain of the child is one of the most vulnerable organs affected during growth with potential morphological changes, which are detectable at autopsy and/or with neuroimaging studies which are now available. Previous brain imaging studies of the patients with protein energy malnutrition (PEM) have shown cerebral atrophy and ventricular dilatation as frequently encountered findings. Cerebral atrophy and ventricular dilation are also common findings in children suffering from kwashiorkor.

**Nutritional disorder related with over nutrition:**

Obesity is caused by consuming too many calories compared to the amount of exercise the body is performing, causing a distorted energy balance. It can lead to diseases such as cardiovascular disease and diabetes. Obesity is a condition in which the natural energy reserve, stored in the fatty tissue, is increased to a point where it is associated with certain health conditions.

The low-cost food that is generally affordable by the poor population in affluent countries is low in nutritional value and high in fats, sugars and additives. In developed countries, obesity is often considered a sign of poverty and malnutrition while in developing countries obesity is more associated with wealth and good nutrition. Other non-nutritional causes for unhealthy obesity include sleep deprivation, stress, lack of exercise, and heredity.

**Vitamins and micronutrients:**

Vitamin poisoning is the condition of overly high storage levels of vitamins, which can lead to toxic symptoms. The medical names of the different conditions are derived from the vitamin involved: an excess of vitamin A, for example, is called "hypervitaminosis A".

Hypervitaminosis A is a common cause of benign intracranial hypertension in children as well as adults.

**References:**


