Specialty area: Pediatric Neuroimaging

Speaker Name - Dr Niranjan Khandelwal; khandelwaln@hotmail.com

Highlights

- CNS infections result from a wide variety of pathogens viz. viruses, bacteria, fungi, protozoans and parasites.

- Imaging modalities e.g. computed tomography (CT) and magnetic resonance imaging (MRI), especially the latter help in characterizing these infections and diagnosing the complications.

- Specialized MR sequences like diffusion weighted (DW) imaging, susceptibility weighted imaging (SWI), MR spectroscopy, magnetization transfer contrast (MTC) imaging, etc often help in the identification of causative organisms.

Title: CNS Infections

Target audience: – Residents, fellows, practicing radiologists, pediatricians

OBJECTIVES: – The presentation will highlight the role of basic and advanced imaging in evaluating CNS infections. After this course talk, the listener would have an overview of the various organisms causing CNS infections, their brief clinical presentation and disease evolution and most importantly, how radiologists can lead to diagnosis at various stages of disease using different imaging tools.

PURPOSE: – Infections of the CNS form the major proportion of all neurological problems across all age groups, especially in developing countries. Timely medical/surgical intervention proves curative in a number of situations. Early diagnosis is thus a boon for these patients which prompted a dedicated session on this topic.

METHODS: – The course will describe the various CNS infections beginning from the neonatal period till adolescence. It will be based on an extensive imaging experience of over 30 years from datasets of a leading tertiary care teaching hospital in the Indian subcontinent.

RESULTS: – The various organisms leading to CNS infections are viruses, bacteria, fungi, protozoans and parasites. They can lead to acute manifestations in the form of sudden headache, fever and neurological symptoms like seizures, neurological deficits like paralysis, ataxia, etc. to chronic symptoms. Imaging modalities namely computed tomography (CT) and magnetic resonance imaging (MRI) currently form the primary diagnostic modalities in addition to laboratory parameters. Advanced MR techniques have tremendously improved the diagnostic capability. The characterization of the anatomical CNS manifestations due to these organisms like focal lesions, meningeal reaction, etc are easily possible with MRI along with secondary neurological and vascular complications.

DISCUSSION: - Focal lesions result as a result of lodgment of the infective agent into a part of the brain parenchyma. These lesions are often in the form of peripheral rings with central necrosis/liquefaction. According to their composition, they give specific character on specialized MR sequences like diffusion weighted (DW) imaging, MR spectroscopy, magnetization transfer (MT) sequences and susceptibility weighted imaging (SWI)) e.g. the paramagnetic fungal elements are often seen to cause blooming in the inner aspect of the wall of the ring of a fungal granuloma/abscess (Figure 1). MR spectroscopy helps us in assessing the metabolite composition of the lesions and is, many times, helpful in diagnosing specific infections (Table 1).

| Pyogenic anaerobic | Cytosolic aminoacids, lipids, alanine, acetate, succinate |

Pyogenic aerobic	Lactate, cytosolic aminoacids, lipids
Pyogenic streptococcal	Lactate
Pyogenic staphylococcal	Lipids & lactate
Tubercular	Lipids & Phosphoserine
Fungal	Lipids, lactate, trehalose
Nocardia	Cytosolic aminoacids & lactate
Cysticercus	Cytosolic aminoacids, lactate, alanine, acetate, succinate, & choline

Table 1: Etiological characterization of infectious causes of focal lesions on MR spectroscopy

The conventional and advanced MR sequences also help in the characterization of meningeal inflammation secondary to infective causes e.g. MT sequence helps in the identification of tubercular etiology of meningitis as meninges appear hyperintense in precontrast MT images often with low MT ratios as compared to other causes of meningitis.

CONCLUSION: – A thorough knowledge of the natural history of the disease with specific neurological manifestations helps a radiologist to tailor his/her diagnostic study so that he/she is able to identify and characterize the etiological agent of CNS infection and to prognosticate its future course. Advancements in diagnostic tools especially MR techniques (high field imaging and specialized sequences) have helped us to not only identify the neurological manifestations of certain diseases but many times to identify the causative organisms involved. Extensive research is being performed in the field of MR with the hope that these advancements may be inculcated into the routine algorithm of diagnosis of CNS infections as highly efficient non-invasive diagnostic tools.

REFERENCES: –

1. Kastrup O, Wanke I, Maschke M. Neuroimaging of infections of the central nervous system. *Semin Neurol*. 2008; 28: 511-22.

2. Barkovich AJ. Infections of the nervous system. In Barkovich AJ, Editor: *Paediatric Neuroimaging (4th ed)*. Philadelphia: Lippincott Williams and Wilkins; 2005: 801-805.

3. Khandelwal N, Gupta V, Singh P. Central nervous system fungal infections in tropics. *Neuroimaging Clin N Am.* 2011; 21:859-66.
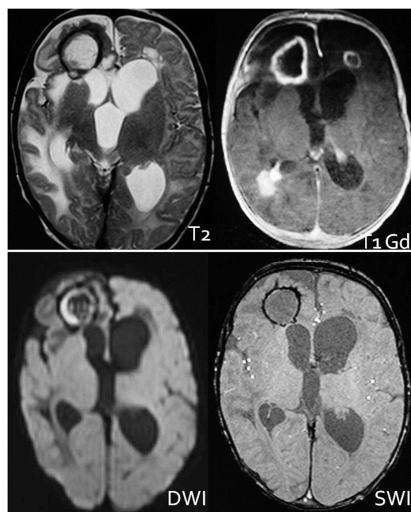
Figure 1: Multiparametric MR examination in an infant depicting ring enhancing lesions in bilateral frontal lobes with central liquefaction. DWI shows sub-peripheral diffusion restriction in the right lobe lesion with a hypointense rim on SWI. Histopathologically proven to be mucormycosis.