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EDITORIAL

Special Annual Issue on CNS Infections

Chandrashekhar Deopujari[1] · Sandip Chatterjee[2] · Dattatraya Muzumdar[3]

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Dear Editor:

The brain and the spinal cord are truly well protected from infections by the skull and the bony spine and are surrounded by layers of meninges which form a strong mechanical barrier. This defense is reinforced by the chemical filtering capacity of the blood-brain barrier. In spite of this, infections do occur in the central nervous system (CNS). When they do occur, it can lead to poor outcomes and exorbitant healthcare costs. Yet infections of the CNS have been known from ancient times as the article by Kobets and Goodrich describes. Although the epidemiologic transition from infectious to degenerative disease has been completed in developed countries, the former remains an important source of morbidity and mortality worldwide, especially in less-developed countries and immunocompromised patients in the developed world. Recent resurgence of infections even in the developed world has been also attributed to immigration trends and improper use of antimicrobial drugs.

Children form a more susceptible group as far as infections of the CNS are concerned, and these do not only cause temporary debility, but often leave behind a stigmata of permanent damage to the brain and spinal cord. This not only damages the individual child but also devastates the family and has serious implications in terms of the social cost of healthcare. It is with the aim of increasing awareness of this seldom discussed problem that this special annual issue is dedicated to the world's children afflicted at some time with various infectious diseases.

✉ Chandrashekhar Deopujari
d.chandrashekhar11@gmail.com

[1] Departments of Neurosurgery at Bombay hospital Institute of Medical Sciences and B. J. Wadia Chidrens' Hospital, Mumbai, India

[2] Park Clinic, Kolkata, India

[3] Seth G.S. Medical College and K.E.M. Hospital, Mumbai, India

Infections of the skull and bony spine represent a dichotomy between the developed and developing world. In the former, postsurgical infections are common, and in the latter, scalp and paranasal sinus infections represent the common sources [1]. Cranial epidural abscesses are the third most common localized intracranial suppuration after brain abscesses and subdural empyema. Medical therapy together with surgical drainage is required in the majority of cases together with eradication of the source of infection [2]. Subdural empyemas, like epidural abscesses occur mainly in the pediatric population and often after bacterial meningitis. Surgical management is mandated in most cases as elaborated in the article by Muzumdar et al., the only controversy being in the use of corticosteroids [3, 4]. Brain abscesses, which are in fact intracerebral suppurative collections, represent the most dangerous infection of the CNS, as described in the article by WT Seow and colleagues. Whereas contiguous spread is common in developing countries, the heart and lung represent sources of hematogenous spread and are more common in the developed world. In about 25% cases, no source can be found. Aspiration versus excision remains the unanswered debate, with the treatment depending on the stage of the abscess formation [5].

Pyogenic ventriculitis is another life-threatening form of infection occurring mainly in children. Intravenous antibiotics have often got to be supplemented by intrathecal antibiotics and more recently with ventricular lavage [6, 7], a treatment not only directed at the infection, but also at the ensuing hydrocephalus. The article by UV Thomale's group describes in details the procedure of ventricular lavage in this situation. It would appear that intraventricular administration of antibiotics would produce higher antibiotic concentrations in the fluid in the brain than intravenous administration alone and eliminate the bacteria more quickly. However, only one trial [8] exists, and this trial enrolling infants with gram-negative meningitis and ventriculitis, the use of intraventricular antibiotics in addition to intravenous antibiotics showed threefold increased risk for mortality compared to standard treatment with intravenous antibiotics alone. Based on this result, it would appear that intraventricular antibiotics should be

avoided. However, this may be because of more severe recalcitrant infections being treated by intraventricular antibiotics.

Tuberculosis of the brain, as covered in the chapter by Muzumdar et al., is still a difficult entity to deal with in pediatric practice, as tuberculomas can mimic various brain pathologies. But the infection which represents the true bane in a neurosurgeon's life is infection associated with ventriculoperitoneal and other shunts, and the frustration in the treatment of this condition finds resonance in the article by Kannagi and Chidambaram. The role of alternative endoscopic solutions is evaluated by Deopujari et al. Unusual infections like neurocysticercosis are common in certain regions as covered in the article by Salamao and South American colleagues along with Rajshekhar from India, and cerebral hydatid disease is well covered by Padayachy. Fungal infections (described by Caceres) are more common in the immunocompromised child (article by Fieggen et al.).

Infections of the vertebral body and disc space are clearly less common in children with the exception of tuberculosis where it exists on this planet. The spectrum of this disease in children is aptly covered in the article by Chatterjee and Banta. The etiology may also be bacterial, fungal, or parasitic, which are covered by Mohanty et al. *Mycobacterium tuberculosis* is common in developing countries; *Brucellosis* seen around the Mediterranean and fungal types are more common in the immunocompromised child. Hydatidosis is the most uncommon cause of spondylodiscitis, but is reported in endemic areas and is well covered by Muzumdar. The goal of treatment is to eliminate infection and to preserve the spinal stability and also to reduce delayed deformity [9, 10].

The other infection worth mentioning is the surgical site infection (SSI). The incidence of SSI in cranial surgery is reported to be below 15% and according to depth may be subgaleal, bony, epidural, subdural, or intracerebral. Risk factors may be patient related or procedure related [11]. In the spine, SSIs are divided into incisional or deep types and are defined to be occurring within 30 days of surgery or within 12 months of spinal instrumentation [12]. Bianchi and Tamburrini have specifically referred to the posterior fossa and spinal sites.

And finally the vexing question : Is there a role for prophylactic antibiotics in pediatric neurosurgery? The question is answered by Messing-Juenger and colleague. Prevention of infection seems to be the gold standard that one seeks, a point emphasized in the article by Ajay Sinha.

Infections and associated problems are often neglected from discussions on the scientific progress in pediatric neurosurgery, and this issue seeks to highlight those conditions which are most often swept under the carpet by us all. Hopefully, this will be relevant not only in the endemic areas of the developing world but also help in proper recognition and management of these problems which are sporadically seen in the developed world.

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