

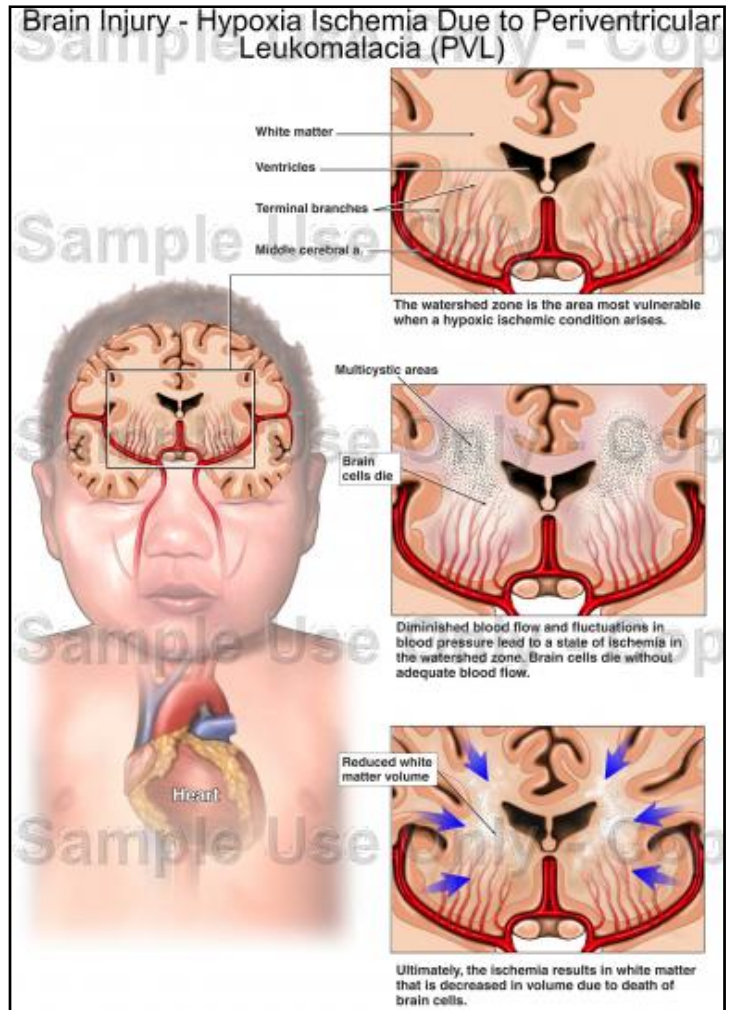
MEDICAL UPDATE

Cerebral Palsy Facts

About 8,000 babies and infants are diagnosed with cerebral palsy (CP) each year in the United States; Australia reports similar percentages. CP is a term used to describe a group of chronic conditions affecting body movement and muscle coordination. It is caused by damage to one or more specific areas of the brain, which usually occurs during fetal development, birth or infancy. The condition is not caused by problems in the muscles or nerves but is instead due to faulty development or damage to motor areas in the brain that disrupt the ability to control movement and posture.

Cerebral refers to the brain and *palsy* refers to muscle weakness. CP itself is not a progressive condition however secondary conditions such as muscle spasticity and orthopedic disorders typically emerge and progress over time. Early signs of CP usually occur before 18 months of age, and parents are often the first to suspect their infant is not developing motor skills normally. Infants with CP are frequently slow to reach developmental milestones, such as learning to roll over, sit, crawl, smile, or walk.

CP is characterized by the inability to fully control motor function, particularly muscle control and coordination. Muscle tightness, involuntary movement, difficulty swallowing, difficulty seeing, seizures, and problems with speech are often found in patients with CP. Other problems that may occur are difficulties in feeding, bladder and bowel control, problems with breathing, skin disorders, and learning disabilities.



What is Periventricular leukomalacia (PVL)?

Periventricular leukomalacia (PVL) is an inflammatory white matter disease of premature infants that frequently results in Cerebral Palsy

Inflammation in white matter: clinical and pathophysiological aspects

Ment Retard Dev Disabil Res Rev. 2006;12(2):141-6.

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While the central nervous system (CNS) is generally thought of as an immunoprivileged site, immune-mediated CNS white matter damage can occur in both the perinatal period and in adults, and can result in severe and persistent neurological deficits. **Periventricular leukomalacia (PVL) is an inflammatory white matter disease of premature infants that frequently results in cerebral palsy (CP).**

Clinical and experimental studies show that both **hypoxic/ischemic and innate immune mechanisms contribute to the destruction of immature oligodendroglia and of axons in the deep cerebral white matter in PVL.** No data are yet available as to whether there is any genetic predisposition to PVL or to its neurological sequelae.

Multiple sclerosis (MS) is an inflammatory white matter disease that often begins in young adulthood, causes multifocal destruction of mature oligodendroglia and of axons, and eventually leads to substantial cumulative neurological disability. Certain genetic polymorphisms contribute to susceptibility to MS, and adaptive immune responses to myelin-associated self antigens, or to exogenous antigens that mimic these self antigens, play a central role in the pathophysiology of this disease.

Emerging concepts in periventricular white matter injury

Semin Perinatol. 2004 Dec;28(6):405-14.

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Approximately 10% of newborns are born prematurely. Of these children, more than 10% will sustain neurological injuries leading to significant learning disabilities, cerebral palsy, or mental retardation, with very low birth weight infants having an even higher incidence of brain injury.

Whereas intraventricular hemorrhage was the most common form of serious neurological injury a decade ago, **periventricular white matter injury (PWMI) is now the most common cause of brain injury in preterm infants. The spectrum of chronic PWMI includes focal cystic necrotic lesions (periventricular leukomalacia; PVL) and diffuse myelination disturbances.**

Recent neuroimaging studies support that the incidence of PVL is declining, whereas diffuse cerebral white matter injury is emerging as the predominant lesion. **Factors that predispose to PVL include prematurity, hypoxia, ischemia, and inflammation. It is believed that injury to oligodendrocyte (OL) progenitors contributes to the pathogenesis of myelination disturbances in PWMI by disrupting the maturation of myelin-myelin-forming oligodendrocytes.** Other potential mechanisms of injury include activation of microglia and axonal damage. Chemical mediators that may contribute to white matter injury include reactive oxygen (ROS) and nitrogen species (RNS), glutamate, cytokines, and adenosine. As our understanding of the pathogenesis of PWMI improves, it is anticipated that new strategies for directly preventing brain injury in premature infants will evolve.

Hypoxia-ischemia induced neurological dysfunction and brain injury in the neonatal rat

Behav Brain Res. 2005 Nov 30;165(1):80-90. Epub 2005 Sep 2

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Experimental disruption of blood supply to the brain of rats resulted in an hypoxic event. Brain injury and myelination changes were examined and tests for neurobehavioral toxicity were performed followed by 10 or 15 min hypoxic insult resulted in mild and severe, respectively, brain injury, reduction in mature oligodendrocytes and tyrosine hydroxylase positive neurons and impaired myelination as indicated by decreased myelin basic protein immunostaining in the rat brain. **Hypoxia-ischemia also affected physical development (body weight gain and eye opening) and neurobehavioral performance, such as righting reflex, wire hanging maneuver, cliff avoidance, locomotor activity, gait analysis, responses in the elevated plus-maze and passive avoidance.** 15 min of hypoxia caused more severely impaired neurobehavioral performance as compared with 10 min of hypoxia in the rat. The overall results demonstrate that **hypoxia-ischemia-induced brain injury not only persists, but also is linked with neurobehavioral deficits in juvenile rats.** The present data also indicate that **the degree of brain injury and the deficits of neurobehavioral performance in the rat are dependent on the hypoxic-ischemic condition, i.e., the exposure time to hypoxia.**

Hyperbaric Oxygenation (HBOT) in the treatment of patients with cerebral stroke, brain trauma and neurologic disease

Noori S Al-Waili, Glenn J Butler, Jorge Beale, Mahdi S Abdullah, R W Bill Hamilton, Boke Y Lee, Paul Lucas, Michael W W Allen, Richard L Petrillo, Zev Carrey, Michael Finkelstein. J Spinal Cord Med. 2006 ;29:15-6;

Hyperbaric Oxygen (HBO) therapy has been used to treat patients with numerous disorders, including stroke. This treatment has been shown to **decrease cerebral edema, normalize water content in the brain, decrease the severity of brain infarction, and maintain blood-brain barrier integrity.** In addition, HBO therapy **attenuates motor deficits, decreases the risks of sequelae, and prevents recurrent cerebral circulatory disorders, thereby leading to improved outcomes and survival.** Hyperbaric Oxygen also **accelerates the regression of atherosclerotic lesions, promotes antioxidant defenses, and suppresses the proliferation of macrophages and foam cells in atherosclerotic lesions.** Although no medical treatment is available for patients with cerebral palsy, in some studies, HBO therapy has **improved the function of damaged cells, attenuated the effects of hypoxia on the neonatal brain, enhanced gross motor function and fine motor control, and alleviated spasticity.**

In the treatment of patients with migraine, HBO therapy has been shown to **reduce intracranial pressure significantly and abort acute attacks of migraine, reduce migraine headache pain, and prevent cluster headache.** In studies that investigated the effects of HBO therapy on the **damaged brain, the treatment was found to inhibit neuronal death, arrest the progression of radiation-induced neurologic necrosis, improve blood flow in regions affected by chronic neurologic disease as well as aerobic metabolism in brain injury, and accelerate the resolution of clinical symptoms.** Hyperbaric oxygen has also been reported to **accelerate neurologic recovery after spinal cord injury by ameliorating mitochondrial dysfunction in the motor cortex**

and spinal cord, arresting the spread of hemorrhage, reversing hypoxia, and reducing edema. HBO has enhanced wound healing in patients with chronic osteomyelitis. The results of HBO therapy in the treatment of patients with stroke, atherosclerosis, cerebral palsy, intracranial pressure, headache, and brain and spinal cord injury are promising and warrant further investigation.

MEDICAL UPDATE

Cerebral Palsy and Lokomat – Learning to Walk!

Robotic Assisted Body Weight Supported Treadmill Training (Lokomat) Of Neurologic Impaired Patients

Lokomat (Robotic Gait Assisted Walking) treadmill training is a *task-specific rehabilitation strategy* that enhances functional locomotion in patients with neurological impairments. **Gait ability is a complex motor activation pattern organized hierarchically, with the uppermost level (initiation of the movement) mediated through the primary cortex and the lowest levels (organization and execution of the movement) mediated through the spinal motor neurons.**

Children with normal development learn to walk; children with development delay and cerebral palsy states have to 'learn' to walk!

There is evidence that innate pattern generators in the spine produce the newborn stepping. During the first year of development the corticospinal tracts growth, there is a transformation of this innate ability towards a normal plantigrade stepping.

The deficit induced by a central nervous system lesion depends on which group of cells is damaged: lesions of the upper motor neuron let some muscle contractions even with an altered highest cortical control. Lesions of the lower motor neuron result in flaccid paresis without the ability to recover some movements.



Experiments conducted on spinalized cats demonstrated that treadmill walk was possible in this animal model suggesting evidence of a central gait pattern generator. Therefore central nervous system lesions produce different symptoms: paresis, somatosensory deficits which induce inactivity and loss of function. This inability to realize a movement combined with the neuroplasticity of the central nervous system may induce a secondary functional incapacity called the "learning non use". Active repetitive stimulation is required!

The Lokomat produces a constraint-induced movement therapy of a specific task the gait training with a pattern of muscle activation as physiologic as possible. **The alternating 'stance and swing phase' of the Lokomat generates afferent inputs which stimulate the spinal gait generator inducing a motor reorganization and acquisition of forgotten skills.** The partial body weight support allows patients to stand even with very weak muscles.

The device includes a treadmill, a body weight support system and two lightweight robotic arms strapped to the patients legs. The Lokomat is fully programmable, hip and knee joint angles trajectories are permanently controlled by software to achieve a gait pattern as physiological and comfortable as possible. Treadmill speed and guidance assistance provided to the patient are also adaptable. Many repetitions are known to improve necessary to perfect a movement if the motor system is intact.

It should be more accentuated if the motor system is damaged and more repetitive movements are necessary to restore activity especially walking function.

We reported the preliminary results of patients; we found that reflex stiffness and spasticity are significantly reduced; that range of motion, peak velocity and acceleration of voluntary movements are increased. Therefore the walking ability improves as well as independence.

HyperMED Patient Update

Nicholas North

Cerebral Palsy, epilepsy, ADHD, right sided hemiparesis, difficulty concentrating and lack of focus.

'Due to major difficulty during the birth; Nicholas suffered massive bruising on the top of his head as a result of attempted vacuum extraction and forceps. The first 3-months Nicholas suffered terrible colic and screamed most of the time. When I attended the Infant Welfare Nurse and local doctors I was told Nicholas was normal. However Nicholas was very active, quite dangerous and prone to being very violent. He was terribly impulsive and would only sleep if I drove him around in the car for an hour! I had to hold him down just to get him to sleep. After a lot of frustration eventually we gained referral to a Pediatrician who diagnosed Nick with severe ADHD. Eventually a CT scan was recommended at 3-years of age which revealed Nicholas had suffered a stroke which occurred at birth!



Not long after this Nick began to suffer seizures which often lasted for period longer than 45-minutes. EEGs showed a lot of activity around the area damaged by the stroke.

We have struggled with Nick, his behavior and the constant medication regime. We have also been informed that Nick may be autistic but I don't want another label! After many false starts eventually we got him off to school. He struggled and as he got older his level of disability got worse. He was wearing AFO's; receiving botox and we were told this is as good as it gets! Surfing the net I came across HBOT and cerebral palsy in the USA and eventually found Dr Hooper at HyperMED [Melbourne Hyperbaric]. Initially we started an initial 20hours of HBOT; everything seemed to happen quickly. Within 19-hours of HBOT we noticed a change in Nick – he said he felt fantastic and he was sleeping better. His teachers commented that he was 'more forward'. We gave Nick another 20-hours and by this stage Nick was sleeping better, exercising, his lung capacity and fatigue had improved tremendously; he was eating better and the improvement in his behaviors was amazing; his right hand had also lost its 'claw likeness!' Nick's father initially thought this was all a scam however he could see the improvements with Nick. Nick was now sleeping in his own bed – thank you!

Nick's right hand is now more relaxed; you would have to look twice to see any problem; after about 30-sessions his hand is much more active, stronger and he can make a fist without too much trouble. He is now using his right hand where as before most of his activity was limited to his left side. His seizure patterns have reduced significantly!

Nick's circulation has also improved – he always had cold hands and feet even in the summer months. Nick's teachers have noticed he is more settled and remains focused for longer periods.

We let things go with the Hyperbaric and Nicks behavior became more erratic and he became more up tight, needing less sleep and easily distracted even although he could see the changes. After the return of several minor seizures we decided to re-start HBOT and after the first day of HBOT Nick is back on track; he is calmer, more focused and sleeping better!

Our specialist was very pleased by Nick's progress and extremely surprised by the impact of HBOT; he said he would have to do his 'homework on HBOT'! He was amazed that Nick is no longer on dexamphetamine considering the last time he had seen Nick un-medicated Nick was manifesting all the extreme behaviors of ADHD! Our specialist recommended that we continue with what we are doing for the moment; he was also surprised by the fact that Nick's right hand was no longer clawed!' Fiona (mother).

From: Weed-M-Out [mailto:fmy61324@bigpond.net.au]

Sent: Thursday, April 19, 2007 5:01 PM

To: Dr Mal Hooper

'After commencing HBOT again (we had a year off due to unforeseen financial constraints) I am pleased to report that Nicholas is back on track and after only 31 hours everyone is noticing and commenting to me on the much quieter, more mature person Nicholas has become since Christmas. One parent at school even said "Gee what did you do to Nicholas over the christmas holidays, stand over him and beat him with a stick every time he played up". Perish the thought any wonder her children are bullies!

*He is back on track with his sleeping, he is placing his heel down again instead of toe walking and just seems a lot healthier and alert. Also noticed a strange and unboy like phenomena - he actually hears me when I answer his questions no more selective deafness, maybe I should book hubby in for some HBOT Another great thing I noticed is that he is doing more for himself (without me nagging) finally some independence (LOL for him and me).
Anyway Cheers Mal' – Fiona*