# Cerebral palsy research news

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## Interventions and Management

**1. Upper-extremity spasticity and functionality after selective dorsal rhizotomy for cerebral palsy: a systematic review**

Lisanne Merckx, Fauve Poncelet, Hannah De Houwer, Armand Laumen, Leen Peeters, Bart Nuttin, Petra Pauwels, Anja Van Campenhout, Els Ortibus, Philippe De Vloo

J Neurosurg Pediatr. 2023 Sep 15:1-13. doi: 10.3171/2023.7.PEDS22526. Online ahead of print.

Objective: Lumbosacral selective dorsal rhizotomy is a neurosurgical treatment option to reduce spasticity in the lower extremities in children with cerebral palsy. Surprisingly, concomitant improvement of spasticity in the upper extremities and functionality of the hands has been sporadically reported postoperatively. In this systematic review, the authors aimed to quantify the postoperative improvement in upper-extremity spasticity and functionality, identify predictors, and discuss underlying mechanisms. Methods: The authors searched the MEDLINE and Embase databases for studies reporting upper-extremity outcomes in cerebral palsy patients after selective dorsal rhizotomy that reported one or more of the following clinical scales: the Ashworth Scale (AS), the Modified AS (MAS), the fine motor skills domain of the Peabody Developmental Motor Scales (PDMS), the Quality of Upper Extremity Skills Test (QUEST), the self-care domain of the Functional Independence Measure for Children (WeeFIM), or the self-care domain of the Pediatric Evaluation of Disability Inventory (PEDI). The authors arbitrarily divided postoperative follow-up into short-term (< 6 months), medium-term (6-24 months), and long-term (> 24 months) follow-up. A 1-point change in MAS score has been reported as clinically significant. To assess bias, the Cochrane Collaboration's tool and ROBINS-I tool were used. Results: The authors included 24 articles describing 752 patients. Spasticity reduction of the upper extremities ranged from 0.30 to 0.55 (AS) and between 0 and 2.9 (MAS) at medium-term follow-up. This large variability may partially be attributed to a floor effect since patients with normal upper-extremity function would not be expected to have further improvement. QUEST improvement ranged from 2.7% to 4.5% at medium-term follow-up. The mean improvements in functional skills of the self-care domain of the PEDI were 4.3 at short-term and 7 at medium-term follow-ups and ranged from 10.8 to 34.7 at long-term follow-up. There are insufficient data to draw meaningful conclusions regarding the PDMS fine motor skills and the WeeFIM self-care domains. Conclusions: The literature suggests that a pronounced postoperative spasticity reduction in the lower extremities and a moderately severe preoperative upper-extremity spasticity may positively predict postoperative reduction in upper-extremity spasticity. There are at least 5 hypotheses that may explain the postoperative reduction in upper-extremity spasticity and functionality: 1) a somatosensory cortex reorganization favoring the hand region over the leg region, 2) a decrease in abnormal electrical transmission throughout the spinal cord, 3) an indirect result of improved posture due to improved truncal and leg stability, 4) an indirect consequence of occupational/physical therapy intensification, and 5) a maturation effect. However, all remain unproven to date.

PMID: 37877954

**2. Efficacy and influencing factors of cervical perivascular sympathectomy in children with cerebral palsy**

Junjie Wu, Baofeng Yan, Nurehemaiti Mutalifu, Qi Guan, Chao Bai, Jianglong Li, Xinping Luan

Childs Nerv Syst. 2023 Oct 23. doi: 10.1007/s00381-023-06191-w. Online ahead of print.

Background: There is a lack of research to determine the efficacy of cervical perivascular sympathectomy (CPVS) in children with cerebral palsy (CP). Objective: This study aimed to evaluate the efficacy of CPVS in children with CP and analyze the associated influential factors. Methods: Using the method of retrospective cohort studies, children who underwent CPVS were included in the CPVS group, whereas those who underwent selective posterior rhizotomy (SPR) were included in the SPR group. The Communication Function Classification System (CFCS) and Teacher Drooling Scale (TDS) were used to evaluate the communication function and salivation in the two groups before and 12 months after surgery and compare the surgical efficiency between the two groups, and the factors affecting the efficacy were screened by binary logistic regression. Results: The study included 406 patients, 202 in the CPVS group and 204 in the SPR group. No significant differences were observed in the baseline characteristics ($p > 0.05$). The surgical efficacy of the CPVS group (47.01%) was significantly higher than that in the SPR group (9.81%) ($\chi 2 = 71.08$, $p < 0.001$). Binary logic regression analysis showed that preterm birth and Gross Motor Function Classification System (GMFCS) grade were influencing factors of surgical efficacy. Eighteen patients developed postoperative complications. Conclusion: CPVS is a safe and effective surgery for cerebral palsy. Preterm birth and GMFCS grade are independent factors affecting the efficacy of surgery.

PMID: 37870563

**3. Predictors of Changes in Pelvic Rotation after Surgery with or without Femoral Derotational Osteotomy in Ambulatory Children with Cerebral Palsy**

Reiko Hara, Susan A Rethlefsen, Tishya A L Wren, Robert M Kay

Bioengineering (Basel). 2023 Oct 18;10(10):1214. doi: 10.3390/bioengineering10101214.

Asymmetry of pelvic rotation affects function. However, predicting the post-operative changes in pelvic rotation is difficult as the root causes are complex and likely multifactorial. This retrospective study explored potential predictors of the changes in pelvic rotation after surgery with or without femoral derotational osteotomy (FDRO) in ambulatory children with cerebral palsy (CP). The change in the mean pelvic rotation angle during the gait cycle, pre- to post-operatively, was examined based on the type of surgery (with or without FDRO) and CP distribution (unilateral or bilateral involvement). In unilaterally involved patients, pelvic rotation changed towards normal with FDRO ($p = 0.04$), whereas patients who did not undergo FDRO showed a significant worsening of pelvic asymmetry ($p = 0.02$). In bilaterally involved patients, the changes in pelvic rotation did not differ based on FDRO ($p = 0.84$). Pelvic rotation corrected more with a greater pre-operative asymmetry ($\beta = -0.21$, $SE = 0.10$, $p = 0.03$). Sex, age at surgery, GMFCS level, and follow-up time did not impact the change in pelvic rotation. For children with hemiplegia, internal hip rotation might cause compensatory deviation in pelvic rotation, which could be improved with surgical correction of the hip. The predicted changes in pelvic rotation should be considered when planning surgery for children with CP.

PMID: 37892944

**4. Functional Repetitive Neuromuscular Magnetic Stimulation (frNMS) Targeting the Tibialis Anterior Muscle in Children with Upper Motor Neuron Syndrome: A Feasibility Study**

Leonie Grosse, Anne C Meuche, Barbara Parzefall, Corinna Börner, Julian F Schnabel, Malina A Späh, Pia Klug, Nico Sollmann, Luisa Klich, Matthias Hösl, Florian Heinen, Steffen Berweck, Sebastian A Schröder, Michaela V Bonfert

Children (Basel). 2023 Sep 22;10(10):1584. doi: 10.3390/children10101584.

Non-invasive neurostimulation as an adjunctive intervention to task-specific motor training is an approach to foster motor performance in patients affected by upper motor neuron syndrome (UMNS). Here, we present first-line data of repetitive neuromuscular magnetic stimulation (rNMS) in combination with personalized task-specific physical exercises targeting the tibialis anterior muscle to improve ankle dorsiflexion (functional rNMS (frNMS)). The main objective of this pilot study was to assess the feasibility in terms of adherence to frNMS, safety and practicability of frNMS, and satisfaction with frNMS. First, during 10 training sessions, only physical exercises were performed (study period (SP) A). After a 1 week break, frNMS was delivered during 10 sessions (SPC). Twelve children affected by UMNS (mean age 8.9 ± 1.6 years) adhered to 93% (SPA) and 94% (SPC) of the sessions, and omittance was not related to the intervention itself in any case. frNMS was safe (no AEs reported in 88% of sessions, no AE-related discontinuation). The practicability of and satisfaction with frNMS were high. Patient/caregiver-reported outcomes revealed meaningful benefits on the individual level. The strength of the ankle dorsiflexors (MRC score) clinically meaningfully increased in four participants as spasticity of ankle plantar flexors (Tardieu scores) decreased in four participants after SPC. frNMS was experienced as a feasible intervention for children affected by UMNS. Together with the beneficial effects achieved on the individual level in some participants, this first study supports further real-world, large-scale, sham-controlled investigations to investigate the specific effects and distinct mechanisms of action of frNMS.

PMID: 37892247

**5. Symptomatic flatfoot in cerebral palsy**

Rachel L Lenhart, Christine M Goodbody

Curr Opin Pediatr. 2023 Oct 23. doi: 10.1097/MOP.0000000000001300. Online ahead of print.

Purpose of review: The purpose of this review is to evaluate the current literature and best practices in the evaluation and treatment of symptomatic flatfoot in cerebral palsy. Recent findings: While techniques to reconstruct the neuromuscular flatfoot and reestablish bony levers have remained similar over time, the concept of surgical dosing has helped guide appropriate interventions based on the magnitude of disease and functional level of the child. Moreover, the utilization of multisegment foot modeling in motion analysis has allowed quantitative description of such deformities and their impact on gait. Summary: Future research should focus on refining operative indications and interventions with larger, multicenter, prospective cohorts to provide more robust evidence in surgical decision making. Long-term data are needed to confirm and compare efficacy of procedures. Radiographic data alone are not sufficient for describing functional foot position. Gait analysis with foot modeling and pedobarography along with patient-centered subjective outcomes will be needed in such investigations to make conclusive recommendations.

PMID: 37872808

**6. Orthopaedic problems in the blind**

Abdul Qayyum Khan, Mohammad Baqar Abbas, M K A Sherwani, Mohammad Jesan Khan, Naiyer Asif, Danish Kamal

J Clin Orthop Trauma. 2023 Oct 13:45:102261. doi: 10.1016/j.jcot.2023.102261. eCollection 2023 Oct.

Background: Blindness is a common problem in every society and country. The problem ranges from complete blindness to partially sighted in the affected population. India has close to 12 million visually impaired people. Orthopaedic problems are not uncommon in blind. Orthopaedic Surgeons though had been aware of the postural and gait abnormalities in blind but very few published studies have systematically focused on the effect of blindness on the development of posture and gait. Methods: Case Control study done for the orthopaedic evaluation of the blind and partially sighted individuals. The study population included 242 students of Ahmadi School for the Blind, Aligarh Muslim University, Aligarh (India), as the cases and another matched set of 250 non-blind children. All the children were assessed for the orthopaedic problems like degree of ligamentous laxity, spinal alignment, foot morphology and alignment of hips, knees and ankles. Standing posture and gait were also examined and recorded. Ligamentous laxity was assessed according to the method adopted by Beighton et al.10 Chi-square test was applied using IBM SPSS 23.0. Results: 139 children (57.4 %) were found to have laxity of the ligaments. 72 children (29.7 %) had spine deformities, out of which kyphosis was present in 34 (47.2 %), scoliosis in 23 (31.9 %), lordosis in 13 (18.0 %), and meningomyelocele in 2 (2.9 %) children. 119 children (49.1 %) had foot deformities. 37 children (15.2 %) had knee deformity. 22 children (9.0 %) showed evidence of cerebral palsy. 216 children (89.2 %) had varying degrees of postural abnormalities. The data was statistically significant when compared with the control group ($P < 0.05$). Conclusion: Blindness causes a wide range of complicated sensory and motor problems that frequently forces people into isolation. Blind rehabilitation requires an interdisciplinary approach. Orthopaedic problems are quite common in blind individuals and should be dealt separately.

PMID: 37868096

**7. Effectiveness of Sensory Integration Therapy on Functional Mobility in Children With Spastic Diplegic Cerebral Palsy**

Vaishnavi B Warutkar, Rakesh K Kovela, Snehal Samal

Cureus. 2023 Sep 21;15(9):e45683. doi: 10.7759/cureus.45683. eCollection 2023 Sep.

Background A set of non-progressive brain abnormalities and nervous system dysfunctions are referred to as cerebral palsy (CP). Due to this, the child's mobility, eyesight, learning, and thought processes are affected. It can evolve before, through birth, or the first year of a child's life. The activity through which the brain organizes and analyses external sensations like touch, motion, body awareness, vision, hearing, and gravity is indicated as sensory integration. The use of sensory integration therapy (SIT) necessitates that the sensorimotor exercises target the specific parts of difficulties that the child experiences daily. This study aims to study the effectiveness of SIT on functional mobility in children with spastic diplegic CP. Methods In this study, 40 children of CP with spastic diplegic who met the inclusion and exclusion criterion were enlisted and were separated into two groups, with Group A (n=20) receiving SIT for 25 minutes along with conventional physiotherapy for 20 minutes, and Group B (n=20) were given conventional physiotherapy for 45 minutes. A four-week therapy plan was followed. Short sensory profile (SSP) and Gross Motor Function Classification System (GMFCS), Pediatric mini-mental state examination (MMSE), and Modified Ashworth Scale were taken as outcome measures. Results SIT along with traditional treatment is described in the study protocol which aids CP children to improve themselves. Following a four-week protocol, combined therapy of SIT and conventional physiotherapy show an effect on the motor function of the children. After therapy, scores in GMFCS and SSP

improved. By using Student's paired t-test, a statistically significant difference was found in GMFCS score at pre and post-test treatment in group A (7.28, p=0.0001) and group B (4.48, p=0.0001), in SSP score at pre and post-test treatment in group A (27.91, p=0.0001) and group B (11.31, p=0.0001), in MMSE score at pre- and post-test treatment in group A (6.89, p=0.0001) and group B (6.32, p=0.0001). The significance threshold was p<0.0001. Conclusion Under the study's experimental conditions, both groups showed substantial improvements in the functional mobility of children. When the efficacy of SIT along with conventional physiotherapy was examined, the impact resulted in a significantly greater improvement in the functional mobility of spastic diplegic CP children.

PMID: 37868525

**8. Clinical bone health among adults with cerebral palsy: Moving beyond assessing bone mineral density alone**

No authors listed

Dev Med Child Neurol. 2023 Oct 23. doi: 10.1111/dmcn.15789. Online ahead of print.

No abstract available

PMID: 37870978

**9. Interventions to improve physical function for children and young people with cerebral palsy: International clinical practice guideline**

No authors listed

Dev Med Child Neurol. 2023 Oct 27. doi: 10.1111/dmcn.15791. Online ahead of print.

No abstract available

PMID: 37897051

**10. Influence of aerobic exercise on inhibitory control of executive functions in children with hemiplegic cerebral palsy: A randomized controlled trial**

Nehad A Abo-Zaid, Amira M El-Gendy, Islam Hewidy, Mohammed Essam Ali, Ahmad Sabbahi

Clin Rehabil. 2023 Oct 26:2692155231208578. doi: 10.1177/02692155231208578. Online ahead of print.

Objective: This study investigates the influence of aerobic exercise training on inhibitory control of executive functions in children with hemiplegic cerebral palsy. Design: Single-blind randomized controlled trial. Setting: Outpatient Physical Therapy Clinic. Participants: Children aged 7-11 with left-sided hemiplegic cerebral palsy with emotional and behavioral dysregulation evidenced by scores >28 on Paediatric Symptom Checklist and GMFCS I or II (n = 60). Intervention: Participants were randomly allocated into two equal groups. The control group received standard-of-care physical therapy for 1 h, and the aerobic exercise group received standard-of-care physical therapy for 30 min and moderate-intensity continuous exercise on a bicycle ergometer for 30 min. All groups received treatment three times a week for 12 weeks. Main measures: The Eriksen Flanker test and Stroop Color-Word test were used to assess inhibitory control of executive function at the baseline and after 12 weeks. Results: Differences between pre- and post-treatment values in the exercise group showed significant improvement in Flanker response accuracy and Stroop response accuracy ($p = 0.001$) and significant decreases in Flanker congruent reaction time and Stroop congruent reaction time ($p < 0.05$). However, there were no significant differences between both groups in Flanker incongruent reaction time and Stroop incongruent reaction time ($p > 0.05$). Conclusions: Aerobic exercise has a promising effect on inhibitory control of executive function in children with left-sided hemiplegic cerebral palsy.

PMID: 37885221

**11. Hypoglossal Nerve Stimulation for Obstructive Sleep Apnea in a Patient with Cerebral Palsy**

Patrick Scheffler, Dana Eitan, Rupali Drewek, Sharon Gnagi

Case Reports Laryngoscope. 2023 Oct 26. doi: 10.1002/lary.31128. Online ahead of print.

Introduction: Obstructive sleep apnea (OSA) is common amongst patients with cerebral palsy in part due to significant hypotonia. Hypoglossal nerve stimulation (HGNS) is a novel tool used to treat sleep apnea when there is failure with CPAP. To our knowledge, the literature has not discussed HGNS as a treatment option for severe OSA in patients with cerebral palsy. Methods: Case report and literature review. Results: A 28-year-old male with cerebral palsy, neuromuscular deformity,

proximal junction kyphosis, and developmental delay presented with severe obstructive sleep apnea and was intolerant to CPAP and BiPAP. After HGNS implantation, a sleep study revealed improved ventilation and oxygenation at 2.4 V; AHI decreased from baseline of 112 to 12 events per hour with only mild intermittent snoring. The patient's family reported increased utilization compared with previous CPAP use. Conclusion: HGNS can be a safe and effective treatment modality for OSA in this patient population. Laryngoscope, 2023.

PMID: 37882417

**12. Neuromuscular adaptations of swallowing and speech in Unilateral Cerebral Palsy: shared and distinctive traits**

Rachel E Hahn Arkenberg, Samantha S Mitchell, Bruce A Craig, Barbara Brown, Wendy Burdo-Hartman, Jennifer P Lundine, Lisa Goffman, Anne Smith, Georgia A Malandraki

J Neurophysiol. 2023 Oct 25. doi: 10.1152/jn.00502.2022. Online ahead of print.

Our aims were to a) examine the neuromuscular control of swallowing and speech in children with unilateral Cerebral Palsy (UCP) compared to typically developing children (TDC), b) determine shared and separate neuromuscular underpinnings of the two functions, and c) explore the relationship between this control and behavioral outcomes in UCP. Surface electromyography (sEMG) was used to record muscle activity from the submental and superior and inferior orbicularis oris muscles during standardized swallowing and speech tasks. Variables examined were normalized mean amplitude, time to peak amplitude, and bilateral synchrony. Swallowing and speech were evaluated using standard clinical measures. Sixteen children with UCP and 16 TDC participated (7-12 yoa). Children with UCP demonstrated higher normalized amplitude and longer time to peak amplitude across tasks than TDC ($p < .01$); and $p < .02$) and decreased bilateral synchrony than TDC for swallows ($p < .01$). Both shared and distinctive neuromuscular patterns were observed between swallowing and speech. In UCP, higher upper lip amplitude during swallows was associated with shorter normalized mealtime durations, while higher submental bilateral synchrony was related to longer mealtime durations. Children with UCP demonstrate neuromuscular adaptations for swallowing and speech, which should be further evaluated for potential treatment targets. Further, both shared and distinctive neuromuscular underpinnings between the two functions are documented.

PMID: 37877193

**13. Signs of perceptual disorder during movement were reliably assessed in children with cerebral palsy in Sweden**

Cecilia Lidbeck, Åsa Bartonek, Adriano Ferrari, Silvia Alboresi, Maria Örtqvist

Acta Paediatr. 2023 Oct 24. doi: 10.1111/apa.17012. Online ahead of print.

Aim: The aim of this Swedish study was to evaluate the assessment of clinical signs of perceptual disorder in children with cerebral palsy (CP). Methods: Three experienced raters assessed 56 videos of 19 children from 1 to 18 years of age with bilateral spastic CP, which were recorded by colleagues at an Italian hospital. Six signs were evaluated for inter-rater reliability and criterion validity. Clinical applicability was evaluated by assessing inter-rater reliability between 47 Swedish clinicians, who examined 15 of the videos during face-to-face and online education seminars. There were 41 physiotherapists, two occupational therapists and four doctors, with 1-37 years of clinical experience and a median of 10 years. Results: The experienced raters demonstrated moderate to almost perfect inter-rater reliability (kappa 0.54-0.81) and criterion validity (0.54-0.87) for startle reaction, upper limbs in startle position, averted eye gaze and eye blinking. The clinicians recognised these signs with at least moderate reliability (0.56-0.88). Grimacing and posture freezing were less reliable (0.22-0.35) and valid (0.09-0.50). Conclusion: Four of the six signs of perceptual disorder were reliably recognised by experienced raters and by clinicians after education seminars. Extended education and larger study samples are needed to recognise all the signs.

PMID: 37874018

**14. Importance of antenatal identification of small for gestational age fetuses on perinatal and childhood outcomes: A register-based cohort study**

Emma Hertting, Lotta Herling, Pelle G Lindqvist, Eva Wiberg-Itzel

Acta Obstet Gynecol Scand. 2023 Oct 24. doi: 10.1111/aogs.14697. Online ahead of print.

Introduction: Fetal growth restriction (FGR) is associated with increased risk for stillbirth, perinatal morbidity, cerebral palsy, neurodevelopmental disorders and cardiovascular disease later in life. Identifying small-for-gestational-age (SGA) fetuses is crucial for the diagnosis of FGR. The aim of this study was to investigate the association between antenatal identification of SGA fetuses and severe adverse perinatal and childhood outcome. Material and methods: A register-based cohort study of all newborns delivered in Stockholm in 2014 and 2017. Inclusion criteria: singleton pregnancies without chromosomal aberrations or structural abnormalities, with a gestational age at delivery between 22+0 and 43+0 (n = 48 843). Data from childbirth

records were linked to data from nationwide Swedish registers. Pregnancy including offspring data were reviewed. Adverse outcomes for non-identified and identified SGA newborns were compared using logistic regression models. Primary outcome was a composite outcome called severe adverse outcome, defined as at least one of the following: stillbirth, severe newborn distress (Apgar score <4 at 5 min, pH <7 or resuscitation activities >10 min), severe neonatal outcome (hypoxic ischemic encephalopathy 2-3, necrotizing enterocolitis, neonatal seizures, intraventricular hemorrhage grade 3-4, bronchopulmonary disease or death at <1 year), severe childhood outcome (cognitive impairment or motor impairment or cerebral palsy or hearing impairment or visual impairment or death at 1-3 years old). Secondary outcomes were stillbirth, severe newborn distress, severe neonatal outcome, severe childhood outcome. Results: No association was found between antenatal identification of SGA fetuses and severe adverse outcome using the complete composite outcome (adjusted odds ratio [aOR] 1.19, 95% confidence interval [CI] 0.93-1.53). In subgroup analyses, non-identified SGA fetuses had an almost fivefold increased risk for stillbirth (aOR 4.79, 95% CI 2.63-8.72) and an increased risk for severe newborn distress (aOR 1.36, 95% CI 1.02-1.82), but a decreased risk for severe childhood outcome (aOR 0.63, 95% CI 0.40-0.99). No association was found between antenatal identification of SGA and severe neonatal outcome. Conclusions: Non-identified SGA fetuses have an increased risk for stillbirth and severe newborn distress. Conversely, identified SGA fetuses have an increased risk for severe childhood outcome.

PMID: 37875267

**15. Advances in Therapies to Treat Neonatal Hypoxic-Ischemic Encephalopathy**

Amaresh K Ranjan, Anil Gulati

Review J Clin Med. 2023 Oct 20;12(20):6653. doi: 10.3390/jcm12206653.

Neonatal hypoxic-ischemic encephalopathy (HIE) is a condition that results in brain damage in newborns due to insufficient blood and oxygen supply during or after birth. HIE is a major cause of neurological disability and mortality in newborns, with over one million neonatal deaths occurring annually worldwide. The severity of brain injury and the outcome of HIE depend on several factors, including the cause of oxygen deprivation, brain maturity, regional blood flow, and maternal health conditions. HIE is classified into mild, moderate, and severe categories based on the extent of brain damage and resulting neurological issues. The pathophysiology of HIE involves different phases, including the primary phase, latent phase, secondary phase, and tertiary phase. The primary and secondary phases are characterized by episodes of energy and cell metabolism failures, increased cytotoxicity and apoptosis, and activated microglia and inflammation in the brain. A tertiary phase occurs if the brain injury persists, characterized by reduced neural plasticity and neuronal loss. Understanding the cellular and molecular aspects of the different phases of HIE is crucial for developing new interventions and therapeutics. This review aims to discuss the pathophysiology of HIE, therapeutic hypothermia (TH), the only approved therapy for HIE, ongoing developments of adjuvants for TH, and potential future drugs for HIE.

PMID: 37892791

**16. Cochlear Implantation in Children with Additional Disabilities: A Systematic Review**

Valeria Caragli, Daniele Monzani, Elisabetta Genovese, Silvia Palma, Antonio M Persico

Review Children (Basel). 2023 Oct 5;10(10):1653. doi: 10.3390/children10101653.

This study examines the last 10 years of medical literature on the benefits of cochlear implantation in children who are deaf or hard of hearing (DHH) with additional disabilities. The most recent literature concerning cochlear implants (CIs) in DHH children with additional disabilities was systematically explored through PubMed, Embase, Scopus, PsycINFO, and Web of Science from January 2012 to July 2023. Our two-stage search strategy selected a total of 61 articles concerning CI implantation in children with several forms of additional disabilities: autism spectrum disorder, cerebral palsy, visual impairment, motor disorders, developmental delay, genetic syndromes, and intellectual disability. Overall, many children with additional disabilities benefit from CIs by acquiring greater environmental sound awareness. This, in turn, improves non-verbal communication and adaptive skills, with greater possibilities to relate to others and to be connected with the environment. Instead, despite some improvement, expressive language tends to develop more slowly and to a lesser extent compared to children affected by hearing loss only. Further studies are needed to better appreciate the specificities of each single disability and to personalize interventions, not restricting the analysis to auditory and language skills, but rather applying or developing cross-culturally validated instruments able to reliably assess the developmental trajectory and the quality of life of DHH children with additional disabilities before and after CI.

PMID: 37892316

**17. Assessing the Impact of Electrosuit Therapy on Cerebral Palsy: A Study on the Users' Satisfaction and Potential Efficacy**

David Perpetuini, Emanuele Francesco Russo, Daniela Cardone, Roberta Palmieri, Andrea De Giacomo, Domenico Intiso,

Federica Pellicano, Raffaello Pellegrino, Arcangelo Merla, Rocco Salvatore Calabrò, Serena Filoni

Brain Sci. 2023 Oct 22;13(10):1491. doi: 10.3390/brainsci13101491.

The aim of this study is to evaluate the effectiveness of electrosuit therapy in the clinical treatment of children with Cerebral Palsy, focusing on the effect of the therapy on spasticity and trunk control. Moreover, the compliance of caregivers with respect to the use of the tool was investigated. During the period ranging from 2019 to 2022, a total of 26 children (18 M and 8 F), clinically stable and affected by CP and attending the Neurorehabilitation Unit of the "Padre Pio Foundation and Rehabilitation Centers", were enrolled in this study. A subset of 12 patients bought or rented the device; thus, they received the administration of the EMS-based therapy for one month, whereas the others received only one-hour training to evaluate the feasibility (by the caregivers) and short-term effects. The Gross Motor Function Classification System was utilized to evaluate gross motor functions and to classify the study sample, while the MAS and the LSS were employed to assess the outcomes of the EMS-based therapy. Moreover, between 80% and 90% of the study sample were satisfied with the safety, ease of use, comfort, adjustment, and after-sales service. Following a single session of electrical stimulation with EMS, patients exhibited a statistically significant enhancement in trunk control. For those who continued this study, the subscale of the QUEST with the best score was adaptability (0.74 ± 0.85), followed by competence (0.67 ± 0.70) and self-esteem (0.59 ± 0.60). This study investigates the impact of the employment of the EMS on CP children's ability to maintain trunk control. Specifically, after undergoing a single EMS session, LSS showed a discernible improvement in children's trunk control. In addition, the QUEST and the PIADS questionnaires demonstrated a good acceptability and satisfaction of the garment by the patients and the caregivers.

PMID: 37891858

**18. The Challenge of Diffusion Magnetic Resonance Imaging in Cerebral Palsy: A Proposed Method to Identify White Matter Pathways**

Ophélie Martinie, Philippe Karan, Elodie Traverse, Catherine Mercier, Maxime Descoteaux, Maxime T Robert

Brain Sci. 2023 Sep 29;13(10):1386. doi: 10.3390/brainsci13101386.

Cerebral palsy (CP), a neuromotor disorder characterized by prenatal brain lesions, leads to white matter alterations and sensorimotor deficits. However, the CP-related diffusion neuroimaging literature lacks rigorous and consensual methodology for preprocessing and analyzing data due to methodological challenges caused by the lesion extent. Advanced methods are available to reconstruct diffusion signals and can update current advances in CP. Our study demonstrates the feasibility of analyzing diffusion CP data using a standardized and open-source pipeline. Eight children with CP (8-12 years old) underwent a single diffusion magnetic resonance imaging (MRI) session on a 3T scanner (Achieva 3.0T (TX), Philips Healthcare Medical Systems, Best, The Netherlands). Exclusion criteria were contraindication to MRI and claustrophobia. Anatomical and diffusion images were acquired. Data were corrected and analyzed using Tractoflow 2.3.0 version, an open-source and robust tool. The tracts were extracted with customized procedures based on existing atlases and freely accessed standardized libraries (ANTs, Scilpy). DTI, CSD, and NODDI metrics were computed for each tract. Despite lesion heterogeneity and size, we successfully reconstructed major pathways, except for a participant with a larger lesion. Our results highlight the feasibility of identifying and quantifying subtle white matter pathways. Ultimately, this will increase our understanding of the clinical symptoms to provide precision medicine and optimize rehabilitation.

PMID: 37891755

**19. Heart rate patterns predicting cerebral palsy in preterm infants**

Lisa Letzkus, Robin Picavia, Genevieve Lyons, Jackson Brandberg, Jiaxing Qiu, Sherry Kausch, Doug Lake, Karen Fairchild

Pediatr Res. 2023 Oct 27. doi: 10.1038/s41390-023-02853-2. Online ahead of print.

Background: Heart rate (HR) patterns can inform on central nervous system dysfunction. We previously used highly comparative time series analysis (HCTSA) to identify HR patterns predicting mortality among patients in the neonatal intensive care unit (NICU) and now use this methodology to discover patterns predicting cerebral palsy (CP) in preterm infants. Method: We studied NICU patients <37 weeks' gestation with archived every-2-s HR data throughout the NICU stay and with or without later diagnosis of CP (n = 57 CP and 1119 no CP). We performed HCTSA of >2000 HR metrics and identified 24 metrics analyzed on HR data from two 7-day periods: week 1 and 37 weeks' postmenstrual age (week 1, week 37). Multivariate modeling was used to optimize a parsimonious prediction model. Results: Week 1 HR metrics with maximum AUC for CP prediction reflected low variability, including "RobustSD" (AUC 0.826; 0.772-0.870). At week 37, high values of a novel HR metric, "LongSD3," the cubed value of the difference in HR values 100 s apart, were added to week 1 HR metrics for CP prediction. A combined birthweight + early and late HR model had AUC 0.853 (0.805-0.892). Conclusions: Using HCTSA, we discovered novel HR metrics and created a parsimonious model for CP prediction in preterm NICU patients. Impact: We discovered new heart rate characteristics predicting CP in preterm infants. Using every-2-s HR from two 7-day periods and highly comparative time series analysis, we found a measure of low variability HR week 1 after birth and a pattern of recurrent

acceleration in HR at term corrected age that predicted CP. Combined clinical and early and late HR features had AUC 0.853 for CP prediction.

PMID: 37891365

**20. Association between Cu/Zn/Iron/Ca/Mg levels and cerebral palsy: a pooled-analysis**

Haiquan Zhu, Song Mao, Wei Li

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It was well documented that macro/trace elements were associated with the neurodevelopment. We aimed to investigate the relationship between copper (Cu)/zinc (Zn)/iron/calcium (Ca)/magnesium (Mg) levels and cerebral palsy (CP) by performing a meta-analysis. We searched the PubMed, Embase, Cochrane and Chinese WanFang databases from January 1985 to June 2022 to yield studies that met our predefined criteria. Standard mean differences (SMDs) of Cu/Zn/Iron/Ca/Mg levels between CP cases and healthy controls were calculated using the fixed-effects model or the random-effects model, in the presence of heterogeneity. 95% confidence intervals (CI) were also computed. Sensitivity analysis was performed by omitting each study in turn. A total of 19 studies were involved in our investigation. CP cases showed markedly lower Cu, Zn, iron and Ca levels than those in controls among overall populations (SMD = - 2.156, 95% CI - 3.013 to - 1.299, P < 10-4; SMD = - 2.223, 95% CI - 2.966 to - 1.480, P < 10-4; SMD = - 1.092, 95% CI - 1.513 to - 0.672, P < 10-4; SMD = - 0.757, 95% CI - 1.475 to - 0.040, P = 0.038) and Asians (SMD = - 2.893, 95% CI - 3.977 to - 1.809, P < 10-4; SMD = - 2.559, 95% CI - 3.436 to - 1.683, P < 10-4; SMD = - 1.336, 95% CI - 1.807 to - 0.865, P < 10-4; SMD = - 1.000, 95% CI - 1.950 to - 0.051, P = 0.039). CP cases showed markedly lower Zn level than that in controls among Caucasians (SMD = - 0.462, 95% CI - 0.650 to - 0.274, P < 10-4). No significant differences of Cu, iron and Ca levels between CP cases and controls among Caucasians (SMD = - 0.188, 95% CI - 0.412 to 0.037, P = 0.101; SMD = - 0.004, 95% CI - 0.190 to 0.182, P = 0.968; SMD = 0.070, 95% CI - 0.116 to 0.257, P = 0.459) were observed. No marked difference of Mg level between CP cases and controls was noted among overall populations (SMD = - 0.139, 95% CI - 0.504 to 0.226, P = 0.455), Asians (SMD = - 0.131, 95% CI - 0.663 to 0.401, P = 0.629), and Caucasians (SMD = - 0.074, 95% CI - 0.361 to 0.213, P = 0.614). Sensitivity analysis did not change the overall results significantly for Cu, Zn, iron and Mg. CP cases demonstrated significantly lower levels of Cu/Zn/iron/Ca than those in healthy controls, particularly in Asians. Decreasing trend of Cu/Zn/iron/Ca levels merit attention, particularly in the population with high susceptibility to CP. Frequent monitoring and early intervention may be needed.

PMID: 37891210

**21. Perspectives of parents partnering with physical therapists to deliver intensive rehabilitation for their young children with perinatal stroke: A qualitative study**

Caitlin L Hurd, Lesley Pritchard, Jaynie F Yang

Child Care Health Dev. 2023 Oct 27. doi: 10.1111/cch.13190. Online ahead of print.

Background: Parental participation in their young children's rehabilitation has been promoted to increase intervention intensity, but parents' perspectives on increased involvement remain unclear. The objective of this study was to explore parents' experiences partnering with physical therapists (PTs) to administer early, intensive rehabilitation to their young children with cerebral palsy (CP). Methods: Twelve mothers and one father of children between 8 months and 3 years old with CP were interviewed. Semistructured interviews were conducted before and after parents partnered with a PT to deliver a 12 week activity-based intervention targeting their child's lower extremities. The intervention occurred in the child's home and in PT clinical sites. Interviews were audio recorded and transcribed verbatim. Interpretive description was used as the methodological framework. Results: The three themes were (1) focus on maximizing the child's potential, (2) participation in intensive rehabilitation is challenging, and (3) the importance of a positive experience with therapy. Families discussed a number of barriers and facilitators to participating in intensive rehabilitation. Conclusions: These results provide considerations for clinicians and researchers to facilitate meaningful engagement of parents in their young children's rehabilitation. This is especially important with increasing evidence for early, activity-based interventions for young children with CP.

PMID: 37888417

**22. Clinical practice**

I Bhorat, E Buchmann, K Frank, P Soma-Pillay, E Nicolaou, L Pistorius, I Smuts

S Afr Med J. 2023 Sep 4;113(9):22-24. doi: 10.7196/SAMJ.2023.v113i9.1063.

Basal ganglia and thalamus (BGT) hypoxic-ischaemic brain injury is currently the most contentious issue in cerebral palsy (CP) litigation in South Africa (SA), and merits a consensus response based on the current available international literature.

BGT pattern injury is strongly associated with a preceding perinatal sentinel event (PSE), which has a sudden onset and is typically unforeseen and unpreventable. Antepartum pathologies may result in fetal priming, leading to vulnerability to BGT injury by relatively mild hypoxic insults. BGT injury may uncommonly follow a gradual-onset fetal heart rate deterioration pattern, of duration ≥1 hour. To prevent BGT injury in a clinical setting, the interval from onset of PSE to delivery must be short, as little as 10 - 20 minutes. This is difficult to achieve in any circumstances in SA. Each case needs holistic, multidisciplinary, unbiased review of all available antepartum, intrapartum and postpartum and childhood information, aiming at fair resolution without waste of time and resources.

PMID: 37882127

**23. Cerebral palsy and its medicolegal implications in low- resource settings - the need to establish causality and revise criteria to implicate intrapartum hypoxia: A narrative review**

I Bhorat, E Buchmann, P S Soma-Pillay, E Nicolaou, L Pistorius, I Smuts, S Velaphi

Review S Afr Med J. 2023 Jun 21;113(7):29-34. doi: 10.7196/SAMJ.2023.v113i6.229.

The objective of this study was to establish scientific causality and to devise criteria to implicate intrapartum hypoxia in cerebral palsy (CP) in low-resource settings, where there is potential for an increase in damaging medicolegal claims against obstetric caregivers, as is currently the situation in South Africa. For the purposes of this narrative review, an extensive literature search was performed, including any research articles, randomised controlled trials, observational studies, case reports or expert or consensus statements pertaining to CP in low-resource settings, medicolegal implications, causality, and criteria implicating intrapartum hypoxia. In terms of causation, there are differences between high-income countries (HICs) and low-resource settings. While intrapartum hypoxia accounts for 10 - 14% of CP in HICs, the figure is higher in low-resource settings (20 - 46%), indicating a need for improved intrapartum care. Criteria implicating intrapartum hypoxia presented for HICs may not apply to low-resource settings, as cord blood pH testing, neonatal brain magnetic resonance imaging (MRI) and placental histology are frequently not available, compounded by incomplete clinical notes and missing cardiotocography tracings. Revised criteria in an algorithm for low-resource settings to implicate intrapartum hypoxia in neonatal encephalopathy (NE)/ CP are presented. The algorithm relies first on specialist neurological assessment of the child, determination of the occurrence of neonatal encephalopathy (by documented or verbal accounts) and findings on childhood MRI, and second on evidence of antepartum and intrapartum contributors to the apparent hypoxia-related CP. The review explores differences between low-resource settings and HICs in trying to establish causation in NE/CP and presents a revised scientific approach to causality in the context of low-resource settings for reaching appropriate legal judgments.

PMID: 37882043

**24. Clinical and radiographic follow-up after the Wilkie procedure at 28 years: A case report**

Piper Wenzel, Joan Maley, Antonio Zafred Marcelino, Henry Hoffman

Case Reports Radiol Case Rep. 2023 Oct 19;19(1):1-6. doi: 10.1016/j.radcr.2023.09.071. eCollection 2024 Jan.

Rerouting of the parotid ducts posteriorly to drain into the tonsillar fossae (Wilkie procedure) was initially designed to address drooling in patients with cerebral palsy. This procedure was subsequently modified to include bilateral submandibular gland excision and extended to apply to other etiologies of sialorrhea. Our literature review failed to identify report of long-term follow-up beyond 2 decades following this procedure. We describe a 33-year-old female with spastic cerebral palsy who underwent the Wilkie procedure to treat sialorrhea and, 25 years later, developed right-sided facial swelling and dental infections in association with xerostomia. CT imaging showed symmetric atrophy of the parotid glands with fat replacement interspersed with fibrosis. Ultrasound analysis with shear wave elastography offered the additional interpretation of a greater degree of gland stiffness involving the tail of the recently inflamed right parotid gland compared to the left. This case report identifies long-term complications associated with xerostomia following initial success employing the Wilkie procedure to address sialorrhea. The radiographic evaluation supports the contention that rerouting of Stensen's duct may be associated with chronic obstructive changes to the parotid gland. Ultrasound shear wave elastography supplemented CT imaging by identifying asymmetric stiffness of the parotid glands as was consistent with the more recent right parotid inflammation.

PMID: 37881474

**25. Use of the Motor Optimality Score-Revised (MOS-R) to predict neurodevelopmental outcomes in infants with congenital anomalies**

Cathryn Crowle, Michelle Jackman, Annabel Webb, Catherine Morgan

Early Hum Dev. 2023 Oct 20:187:105876. doi: 10.1016/j.earlhumdev.2023.105876. Online ahead of print.

Aims: To describe the Motor Optimality Score-Revised (MOS-R) in infants with congenital anomalies requiring major surgery in the neonatal period; and to determine the predictive validity of the MOS-R, including specific movement and postural patterns, for neurodevelopmental outcomes at 3 years of age. Method: A retrospective cohort study of 201 infants born with congenital anomalies requiring surgery in the neonatal period (mean gestational age 38.2 weeks, SD 2.2). MOS-R completed using the pre-recorded General Movements Assessment (GMA) videos taken at 12 to 14 weeks post-term age (mean 12.45, SD 1.54). Developmental outcomes were assessed at 3 years of age (38.13 months, SD 1.76) using the Bayley Scales of Infant and Toddler Development (3rd ed). Result: The mean score for the MOS-R was 21.85 (SD 5.16), with scores ranging from 6 to 28. Fifty-six infants (27.9 %) scored within the optimal range (25-28) with only 12 % demonstrating a normal movement character. A MOS-R total score of <21 was identified as the best performing cut-off to predict a mild, moderate or severe delay or CP diagnosis with sensitivity 0.39 (95 % CI: 0.25, 0.54) and specificity 0.86 (95 % CI: 0.80, 0.91), and an area under the ROC curve of 0.63. Outcome at 3 years was significantly associated with the MOS-R total ($p < 0.01$) and the subscales for observed movement patterns ($p < 0.01$) and age adequate repertoire ($p = 0.02$). Conclusion: The MOS-R may be an effective tool to use in addition to existing assessments to identify infants who are at risk of adverse developmental outcomes. Our study found that a MOS-R of <21 identified infants who would benefit from referral to early intervention.

PMID: 37879225

**26. Feeding dysfunction in NICU patients with cramped synchronized movements**

Anna Ermarth, Kristin Brinker, Betsy Ostrander

Early Hum Dev. 2023 Oct 19:187:105879. doi: 10.1016/j.earlhumdev.2023.105879. Online ahead of print.

Patients admitted to the neonatal intensive care unit (NICU) have higher association for neurodevelopment deficits, specifically cerebral palsy (CP). We identified patients with risk for CP using abnormal Pretchl's General Movement Assessment (GMA) and sub-category of cramped synchronized movements (CSM) and reported their feeding outcomes at discharge. Over 75 % of these patients required either nasogastric (NGT) or gastrostomy tube (GT) at discharge. Of these, 57 % weaned off their NGT or GT at home and 43 % of patients still needed a GT one year after discharge. Of those that could not wean off their NGT or GT, these patients had longer hospital stay, took lower percentage by mouth, and an older post-menstrual age at discharge. We did not find a difference in NGT or GT use between patients with IVH, ELBW, nor between their birthweight or gestation age at birth. This study provides further clinical characteristics in NICU patients who have higher risk of CP, and supports the need for skilled feeding therapy and resources both during and after NICU admission.

PMID: 37875030

**27. Exploring the transition experiences of young adults with cerebral palsy**

Isabelle Clough, Evelyn Culnane, Hayley Loftus

Child Care Health Dev. 2023 Oct 24. doi: 10.1111/cch.13186. Online ahead of print.

Background: It is important that young adults with a chronic health condition or developmental disability, such as cerebral palsy, receive adequate healthcare transition preparation and support to optimise the transition period and transfer from paediatric to adult health services. Understanding the healthcare experiences of young adults during and after the transition period will provide valuable insights into what enables a positive healthcare experience for young adults in the adult health setting. Methods: Eleven young adults with cerebral palsy who had their last appointment at the Royal Children's Hospital between 2016 and 2018 were purposively recruited for this study. Ten participants completed one-on-one telephone interviews, and one participant provided written responses to interview questions. Five participated via parent proxy. Interviews were recorded, transcribed verbatim, and analysed using the Braun and Clarke six-step thematic analysis to create an interpretive description of participants' transition experiences. Results: Three themes were generated: (1) "preparedness of the young adult and parent," which discussed the preparation for adult healthcare, with subthemes (a) expectations of adult care and (b) development of self-management skills during transition; (2) "coordination of transfer process and continuity of care," which illustrated the impact of transfer coordination on continuity of care; and (3) "adjusting to adult services," which highlighted experiences of care in the adult setting, with subthemes (a) differences between paediatric and adult services, (b) availability and accessibility of adult and community services to meet needs, and (c) autonomy and agency. Conclusion: Dedicated transition support for young adults and their parents during transition from paediatric to adult healthcare plays an important role in ensuring a supportive and well-coordinated transition and transfer of care. Experience of care in the adult setting is influenced by a combination of both transition experience and the capacity of adult services to cater for young adults' needs.

PMID: 37874030

**28. A systematic review of self and observer assessment of pain and related functioning in youth with brain-based developmental disabilities**

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Pain. 2023 Oct 23. doi: 10.1097/j.pain.0000000000003066. Online ahead of print.

Pain experiences of youth with brain-based developmental disabilities are often overlooked and/or misinterpreted, increasing the risk for poor or inadequate pain assessment and management. Ample measures exist to assess acute and chronic pain, yet their utility and frequency of use in youth with brain-based developmental disabilities is unclear and available measures do not have strong measurement properties for this diverse group. This systematic review identified the scope of self-reported and observer-reported pain assessment in studies of youth (aged 3-24 years) with brain-based developmental disabilities (phase 1) and summarized other measures of pain-related functioning for acute and chronic pain (ie, physical, emotional, social, sleep, and quality of life, within the subset of quantitative studies focused primarily on pain, phase 2). A comprehensive search for English-language studies was conducted in August 2022 in Web of Science, CINAHL, MEDLINE, Cochrane CENTRAL, EMBASE, and APA PsychINFO (PROSPERO registration: CRD42021237444). A total of 17,029 unique records were screened. Of the 707 articles included in phase 1, most assessed chronic pain (n = 314; 62.0%) and primarily used observer-report (n = 155; 31%) over self-report (n = 67; 13%). Of the 137 articles included in phase 2, other outcomes assessed alongside pain intensity included motor ability (16.8%), adaptive functioning (11%), quality of life (8%), pain interference (6.6%), mental health (5.8%), and communication ability (2.9%). Cerebral palsy was the most common population in both phase 1 (n = 343; 48.5%) and phase 2 (n = 83; 59.7%). This review provides a foundational understanding of pain assessment in brain-based developmental disabilities and highlights continued inequities in holistic pain assessment for this population.

PMID: 37870234

**29. Outcomes at 18-24 Months of Infants with Birth Weight under 500 g Born in Korea during 2013-2017: A Nationwide Cohort Study**

Soo Hyun Kim, Euiseok Jung, Ha Na Lee, Jeong Min Lee, Sung Hyeon Park, Jiyoon Jeong, Byong Sop Lee, Ellen Ai-Rhan Kim, Ki-Soo Kim

Neonatology. 2023 Oct 20:1-7. doi: 10.1159/000534194. Online ahead of print.

Introduction: This study aimed to investigate the outcomes of infants at 18-24 months born in the Korean Neonatal Network with a birth weight <500 g. Methods: The anthropometric and neurodevelopmental data of infants with a birth weight <500 g at a gestational age of ≥22 weeks who were registered in the Korean Neonatal Network 2013-2017 and followed up at a corrected age of 18-24 months were reviewed. Neurodevelopmental impairment was defined as the presence of any of the following: (1) cerebral palsy; (2) severe visual impairment; (3) hearing impairment; or (4) cognitive impairment. Cognitive impairment was defined as (1) a Bayley Scales of Infant Development-II Mental Development Index score <70; and (2) Bayley Scales of Infant and Toddler Development-III Cognitive and Language Composite scores <85. Cognitive testing was performed for infants with suspected problems upon clinician's referral to developmental specialists. Results: At a median corrected age of 20 months, 26/52 (50%) of included infants had neurodevelopmental impairment. Cerebral palsy, severe visual impairment, wearing of glasses, hearing impairment, and cognitive impairment occurred in 22%, 0%, 8%, 5%, and 57% of the included infants, respectively. The proportions of infants with <2 standard deviations of weight, length, and head circumference were 54%, 52%, and 56%, respectively. The majority (70%) of infants were rehospitalized, and the most common cause was respiratory problems. Conclusion: Half of infants with a birth weight <500 g in Korea may exhibit neurodevelopmental impairment and growth retardation at a corrected age of 18-24 months. Multidisciplinary follow-up along with continuous rehabilitation will be needed to improve neurological and physical development in this special population.

PMID: 37866355

**30. Long-Term Neurodevelopmental Impairment among Very Preterm Infants with Sepsis, Meningitis, and Intraventricular Hemorrhage**

Qi Zhou, Melissa Ong, Xiang Y Ye, Joseph Y Ting, Prakesh S Shah, Anne Synnes, Thuy Mai Luu, Shoo Lee; Canadian Neonatal Network & Canadian Neonatal Follow-Up Network Investigators

Neonatology. 2023 Oct 20:1-9. doi: 10.1159/000534178. Online ahead of print.

Introduction: Sepsis and intraventricular hemorrhage (IVH) are associated with poorer long-term neurodevelopmental outcomes in very preterm infants (VPIs), but less is known about the long-term effect of meningitis and the combined impact of both meningitis and IVH. Our objective was to examine the long-term neurodevelopmental outcomes of VPIs with late onset sepsis and meningitis, with and without IVH, in Canada. Methods: We conducted a retrospective cohort study of all infants <29 weeks GA who were admitted to 26 tertiary-level neonatal intensive care units in the Canadian Neonatal Network (CNN) and Canadian Neonatal Follow-Up Network (CNFUN) databases, from January 1, 2010, to December 31, 2016. Results: Of the 6,322 infants in the cohort, 4,575 had no infection, 1,590 had late onset culture-positive bloodstream infection

(CPBSI) only, and 157 had late onset meningitis. There was a significant (p < 0.05) trend of increasing rates of significant neurodevelopmental delay (sNDI) when comparing infants with no infection (sNDI rate 15.0%), late onset CPBSI (sNDI rate 22.9%), and late onset meningitis (sNDI rate 32.0%), even after adjustment for infant characteristics. Similar trends were observed for neurodevelopmental impairment, cerebral palsy, and individual Bayley-III scores <85 for cognitive, language, and motor development. There was an additive effect of IVH in all infant categories, but there was no multiplicative effect between IVH and late onset meningitis. Conclusion: There was an increasing trend of adverse neurodevelopmental outcomes when infants with no infection, late onset CPBSI and late onset meningitis are compared. IVH had an additive effect.

PMID: 37866353