

Monday 11 November 2013

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Interventions and Management

1. *Handb Clin Neurol.* 2013;118:243-63. doi: 10.1016/B978-0-444-53501-6.00021-4.

Ethics in neurodevelopmental disability.

Racine E, Bell E, Shevell M.

Neuroethics Research Unit, Institut de recherches cliniques de Montréal, Montreal, Canada; Department of Medicine and Department of Social and Preventive Medicine, University of Montreal, Montreal, Canada; Departments of Neurology and Neurosurgery, McGill University, Montreal, Canada. Electronic address: eric.racine@ircm.qc.ca.

Neurodevelopmental disabilities, like autism spectrum disorders and cerebral palsy are a common health problem in children. Given the impact of these conditions on children, families, and healthcare and social systems, the care of developmentally challenged children raises questions related to values and ethical principles. We review the common features of neurodevelopmental disorders that help understand the associated ethical questions. We focus on three major areas where ethical questions arise for clinicians and those involved in making decisions for or caring for these children: (1) the principles of decision-making and autonomy as they relate to developmental disability; (2) the issues related to quality of life that have long intersected with developmental disability; and (3) the use of unproven therapies and diagnostics that are particularly controversial given the extent that neurodevelopmental disabilities impact children and their families, yet active treatments options are limited.

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[PMID: 24182383](#) [PubMed - in process]

2. *IEEE Int Conf Rehabil Robot.* 2013 Jun;2013:1-6. doi: 10.1109/ICORR.2013.6650360.

Passive-type rehabilitation system for upper limbs which can display the exact resistance force in the orientation opposite to hand motion.

Haraguchi M, Furusho J.

In these days, there are many patients with ataxia, which is paralysis caused by a brain stroke or asynergia. Early detection of functional deterioration and sufficient rehabilitative training are necessary for these patients. Rehabilitation support systems for upper limbs using force display devices are expected to quantify the effects of

rehabilitative training and enhance the motivation of patients. The application of passive-type force display devices unactuated by motors is especially desirable for its high safety. There are, however, some orientations and positions for which it is difficult to display force in an unactuated force display systems using only passive elements. To solve this problem, a method for the improvement of controllability using larger number of brakes than the degree of freedom of system had been suggested. This method made it possible to display more various force power and orientations than could be done with previous systems. However, the system with the larger number of brakes often become huge system. In this study, we have developed a rehabilitation system for the upper limbs which use only the same number of brakes as the degree of freedom but can display the resistance force in the orientation opposite to operator's motion in any orientations and link posture: "Neo-PLEMO".

[PMID: 24187179](#) [PubMed - in process]

3. IEEE Int Conf Rehabil Robot. 2013 Jun;2013:1-7. doi: 10.1109/ICORR.2013.6650475.

Assist-as-needed path control for the PASCAL rehabilitation robot.

Keller U, Rauter G, Riener R.

Adults and children with neurological disorders often require rehabilitation therapy to improve their arm motor functions. Complementary to conventional therapy, robotic therapy can be applied. Such robots should support arm movements while assisting only as much as needed to ensure an active participation of the patient. Different control strategies are known to provide arm support to the patient. The path controller is a strategy that helps the patient's arm to stay close to a given path while allowing for temporal and spatial freedom. In this paper, an assist-as-needed path controller is presented that is implemented in the end-effector-based robot PASCAL, which was designed for children with cerebral palsy. The new control approach is a combination of an existing path controller with additional speed restrictions to support, when the arm speed is too slow, and to resist, when the speed is too fast. Furthermore, a target position gain scheduling is introduced in order to reach a target position with a predefined precision as well as an adaptable direction-dependent supportive flux that supports along the path. These path control features were preliminarily tested with a healthy adult volunteer in different conditions. The presented controller covers the range from a completely passive user, who needs full support to an actively performed movement that needs no assistance. In close future, the controller is planned to be used to enable reaching in children as well as in adults and help to increase the intensity of the rehabilitation therapy by assisting the hand movement and by provoking an active participation.

[PMID: 24187292](#) [PubMed - in process]

4. IEEE Int Conf Rehabil Robot. 2013 Jun;2013:1-6. doi: 10.1109/ICORR.2013.6650500.

A pediatric robotic thumb exoskeleton for at-home rehabilitation: The Isolated Orthosis for Thumb Actuation (IOTA).

Aubin PM, Sallum H, Walsh C, Stirling L, Correia A.

In this paper, we present the design of a thumb exoskeleton for pediatric at-home rehabilitation. Pediatric disorders, such as cerebral palsy (CP) and stroke, can result in thumb in palm deformity greatly limiting hand function. This not only limits children's ability to perform activities of daily living but also limits important motor skill development. Specifically, the device, dubbed IOTA (Isolated Orthosis for Thumb Actuation) is a 2-DOF thumb exoskeleton that can actuate the carpometacarpal (CMC) and metacarpalphalangeal (MCP) joints through ranges of motion required for activities of daily living. The device consists of a lightweight hand-mounted mechanism that can be custom secured and aligned to the wearer. The mechanism is actuated via flexible cables that connect to a portable control box. Embedded encoders and bend sensors monitor the two degrees of freedom of the thumb and flexion/extension of the wrist. Using this platform, a number of control modes can be implemented that will enable the device to be intuitively controlled by a patient to assist with opposition grasp, fine motor control, and ultimately facilitate motor recovery. We envision this at-home device augmenting the current in-clinic therapy and enabling tele-rehabilitation where a clinician can remotely monitor a patient's usage and performance.

[PMID: 24187315](#) [PubMed - in process]

5. IEEE Int Conf Rehabil Robot. 2013 Jun;2013:1-6. doi: 10.1109/ICORR.2013.6650463.**Restoring ADL function after wrist surgery in children with cerebral palsy: A novel Bilateral robot system design.**

Holley D, Theriault A, Kamara S, Anewenter V, Hughes D, Johnson MJ.

Cerebral palsy is a leading cause of disability in children and reducing its effects on arm function will improve quality of life. Our goal is to train children with CP after wrist tendon transfer surgery using a robotic therapy system consisting of two robot arms and wrist robots. The therapeutic goal is to determine if the robot training combined with surgery intervention improved functional outcomes significantly more than surgery alone. To accomplish this long-term goal we have developed a Bilateral ADL Exercise Robot, BiADLER aimed at training children with CP in reach to grasp coordination on ADLs. Specifically, the robot will provide active training using an assist-as-needed. This paper presents the design concepts.

[PMID: 24187280](#) [PubMed - in process]

6. Funct Neurol. 2013 Oct 30:1-6. [Epub ahead of print]**Use of botulinum toxin type A in the management of patients with neurological disorders: a national survey.**

Smania N, Colosimo C, Bentivoglio AR, Sandrini G, Picelli A.

The aim of this survey was to provide an overview of important issues relating to therapeutic strategies based on botulinum toxin type A injection for the treatment of patients with neurological disorders. Two hundred and ten physicians from neurology and neurorehabilitation units in Italian hospitals answered a questionnaire exploring some clinical aspects of the use of botulinum toxin type A in patients with spasticity/dystonia. 66% of the physicians treated patients with dystonia, 80% treated adults with spasticity, and 35% treated children with cerebral palsy. Palpation with no instrumental guidance was the injection technique most commonly used for treating patients with dystonia, spasticity and cerebral palsy; 57% of the physicians evaluated patients instrumentally before toxin injection, while 45% assessed postinjection improvements by instrumental means; 78% of the physicians prescribed (when appropriate) rehabilitation procedures after toxin injection. Our results seem to show that the routine use of botulinum toxin in clinics is far from standardized.

[PMID: 24188567](#) [PubMed - as supplied by publisher]

7. J Zhejiang Univ Sci B. 2013 Nov;14(11):983-92. doi: 10.1631/jzus.B1300021.**Influence of injection of Chinese botulinum toxin type A on the histomorphology and myosin heavy chain composition of rat gastrocnemius muscles.**

Hong B, Chen M, Hu XY.

Department of Neurology, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University, Hangzhou 310016, China; Department of Endocrinology, the First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou 310003, China.

Background and objective: Botulinum toxin type A (BoNT/A) is a metalloprotease that blocks synaptic transmission via the cleavage of a synaptosomal-associated protein of 25 kDa (SNAP-25). It has gained widespread use as a treatment for cerebral palsy and skeletal muscle hypertrophy. In China, Chinese botulinum toxin type A (CBTX-A), a type of BoNT/A, is in widespread clinical use. However, the changes in the morphological and biochemical properties of treated muscles and in remote muscles from the CBTX-A injection site are relatively unknown. Therefore, we investigated the changes in histomorphology and myosin heavy chain (MyHC) isoform composition and distribution in rat gastrocnemius muscles after intramuscular injection of CBTX-A. Methods: The weakness of the injected muscles was assessed periodically to identify their functional deficiency. Muscle slices were stained with hematoxylin-eosin (HE) and adenosine triphosphatase (ATPase). MyHC isoform composition was analyzed by sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) to uncover changes in morphological and

biochemical properties. Results: Our findings demonstrate that following injection of CBTX-A 5 U into rat gastrocnemius muscles, shifts in MyHC isoform composition emerged on the third day after injection and peaked in the fourth week. The composition remained distinctly different from that of the control group after the twelfth week. More specifically, there was a decrease in the proportion of the type IIb isoform and an increase in the proportions of type IIx, type IIa, and type I isoforms. Conclusions: Data revealed that CBTX-A led to a shift in MyHC composition towards slower isoforms and that the MyHC composition remained far from normal six months after a single injection. However, no noticeable remote muscle weakness was induced.

[PMID: 24190444](#) [PubMed - in process]

8. PLoS One. 2013 Oct 23;8(10):e77609. doi: 10.1371/journal.pone.0077609.

Active prospective control is required for effective sensorimotor learning.

Snapp-Childs W, Casserly E, Mon-Williams M, Bingham GP.

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Passive modeling of movements is often used in movement therapy to overcome disabilities caused by stroke or other disorders (e.g. Developmental Coordination Disorder or Cerebral Palsy). Either a therapist or, recently, a specially designed robot moves or guides the limb passively through the movement to be trained. In contrast, action theory has long suggested that effective skill acquisition requires movements to be actively generated. Is this true? In view of the former, we explicitly tested the latter. Previously, a method was developed that allows children with Developmental Coordination Disorder to produce effective movements actively, so as to improve manual performance to match that of typically developing children. In the current study, we tested practice using such active movements as compared to practice using passive movement. The passive movement employed, namely haptic tracking, provided a strong test of the comparison, one that showed that the mere inaction of the muscles is not the problem. Instead, lack of prospective control was. The result was no effective learning with passive movement while active practice with prospective control yielded significant improvements in performance.

[PMID: 24194891](#) [PubMed - in process] [Free full text](#)

9. Neurosciences (Riyadh). 2001 Jul;6(3):162-5.

Therapeutic functional electrical stimulation in hemiplegic cerebral palsy.

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OBJECTIVE: Cerebral palsy is a chronic non-progressive disorder of early onset primary effects of cerebral palsy include muscle spasm or tightness, involuntary movements, abnormal gait patterns, abnormal sensation and perception. Neuromuscular electrical stimulation can be effective means of managing increased muscle tone, of facilitating voluntary motor control, and of improving gait pattern. The purpose of this study was to evaluate the effect of therapeutic electrical stimulation on gait patterns in children with hemiplegic cerebral palsy and to investigate to which extent the increased muscle tone will be decreased after electrical stimulation. **METHODS:** Twenty two children with hemiplegic cerebral palsy, their ages ranging from 5 to 9 years were involved in the study. They were divided into 2 equal groups; experimental and control group. The experimental group continued with their current physiotherapy regime plus surface electrical stimulation of the anterior tibial muscle of the hemiplegic leg for one hour per day for 12 weeks. While the control group continued with their current physiotherapy regime with no change. All children of the study were evaluated before and after 12 weeks of treatment. Items of evaluation were gait patterns by method of foot print and the degree of spasticity through the ratio Hofman/Myogenic ratio. **RESULTS:** The results showed a significant improvement in gait patterns of children who received electrical stimulation as well a significant reduction of spastic muscle tone through the reduction of Hofman/Myogenic ratio. While the control group did not show any significant change. **CONCLUSION:** The results of this study indicated that, with careful supervision, electrical stimulation can be used as an adjunct therapy for the improvement of gait patterns in children with cerebral palsy with the associated benefit of improved active movement and muscle power.

[PMID: 24185362](#) [PubMed]

10. Vopr Kurortol Fizioter Lech Fiz Kult. 2013 Jul-Aug;(4):18-22.

Diagnostics and early rehabilitation of biomechanical gait abnormalities in the patients with cerebral hemiparesis [Article in Russian]

Dobrushina OR, Snopkov PS, Sidiakina IV.

The objective of the present study was to evaluate the effectiveness of various systems for the analysis of gait biomechanics during the early period of rehabilitation in the patients presenting with central hemiparesis. 30 patients with central hemiparesis were examined with the use of the "Raptor-12", motion capture system, "TRUST-M" gyroscopic system, "Balance Master platform, and "Diasled" tension registration system. The severity of paresis estimated based on the 6-score scale varied from 2 to 4.5 (mean 3.7 +/- 0.9), the Ashworth spasticity index was 1.1 +/- 1.2. The clinically significant phenomena (low goniogram amplitude, gate asymmetry etc.) responsible for the poor mobility (the Rivermead index below 13) were revealed during the analysis using "Raptor-12" and "TRUST-M". These abnormalities served as the targets for the rehabilitative treatment. The analysis of walking parameters on the "Balance Master" platform provided no clinically significant results. The "Diasled" data made it possible to evaluate the treatment-induced improvement in the patients' conditions but had no influence on decision-making as regards the choice of the rehabilitation strategy. The analysis of gait biomechanics with goniometry provides a basis for differential early rehabilitation of walking disorders in the patients suffering central hemoparesis.

[PMID: 24137930](#) [PubMed - indexed for MEDLINE]

11. Eur J Phys Rehabil Med. 2013 Nov 4. [Epub ahead of print]

Medical tourism: evidence from an Italian descriptive survey on pediatric neurorehabilitation treatment abroad.

Trabacca A, Ricci S, Russo L, Gennaro L, Losito L, De Rinaldis M, Paloscia C.

Unit of Neurorehabilitation I Developmental Neurology and Functional Rehabilitation Regional Reference Centre for Diagnosis and Treatment of Cerebral Palsy and Severe Acquired Brain Injury in Childhood and Adolescence Scientific Institute I.R.C.C.S. "Eugenio Medea" - "La Nostra Famiglia", Brindisi, Italy.

Background: In recent years we have witnessed a rapidly-growing tendency to seek neurorehabilitation abroad. Aim: This study aimed at better understanding this practice through a analysis of the authorizations for pediatric neurorehabilitation services issued by Italian Regions. Design: Descriptive retrospective survey study. Setting: Outpatient. Population: Italian children travelling abroad for neurorehabilitation. Methods: We analyzed the number of authorizations granted in the 2008-2011 period by local health agencies of Italian regions to children aged 0-18 years applying for neurorehabilitation services abroad. Information was obtained from the Ministry of Health database management systems. Results: Our analysis showed an extreme variability across Italian regions. This is probably suggestive of an unbalanced offer of pediatric neurorehabilitation services across regions, different mechanisms used to control the phenomenon. Conclusion: Our study looked specifically at the practice of neurorehabilitation abroad in order to encourage further and larger studies, even at international level. A greater integration of health systems with common policies is to be achieved in order to control this phenomenon in a field as sensitive as pediatric neurorehabilitation. Clinical rehabilitation impact: Our study, which is the only study so far focusing on pediatric neurorehabilitation, looked specifically at the practice of health tourism in order to encourage further and larger studies, even at international level. Health tourism is a critical issue for all Western welfare systems which are under a pressure to cut health-related expenses.

[PMID: 24185691](#) [PubMed - as supplied by publisher] [Free full text](#)

12. Neurosciences (Riyadh). 2001 Jan;6(1):30-2.**Epilepsy in Saudi children with cerebral palsy.**

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OBJECTIVE: To study the clinical characteristics, electroencephalographic and computerized axial tomography profile in Saudi children with cerebral palsy who suffer epilepsy in a university referral center.
METHODS: A total of 113 patients with cerebral palsy and epilepsy was seen (67 boys, 46 girls) with an over all mean age 5.3 years (range .2-12 years) during the study period (January 1998 - December 1999). They all had clinical evaluation and standardized electroencephalographic studies interpreted by the same examiner. **RESULTS:** The main clinical features were language delay (61%), hypotonia (45%), hypertonia (38%), and behavioral abnormalities (41%). Seizure types included generalized in 96 (85%), and partial and complex partial with or without secondary generalization in 17 (15%). None of the patients had simple partial seizures. The generalized seizures were non-convulsive in 4 patients (3.5%), tonic/clonic 73 (65%), atonic 3 (3%), myoclonic 16 (14%), and mixed 2 (2%). Inter-ictal electroencephalographic abnormalities were epileptiform activity, generalized in 65 (57.5%) and focal 18 (16%), slow-wave activity in 58 (51%) and hypsarrythmia pattern in 6 (5%). Only 9 patients had normal electroencephalogram. The cranial computerized tomography findings were normal in 11.5%. The main abnormalities were cerebral atrophy (65%), hydrocephalus (8%) and agenesis of the corpus callosum (8%).
CONCLUSION: The pattern of seizure type in patients with cerebral palsy and types of electroencephalogram abnormalities electroencephalogram and cranial computerized tomography are comparable to the results from studies in other clinical settings and environments.

[PMID: 24185221](#) [PubMed]

13. JAMA Surg. 2013 Nov 6. doi: 10.1001/jamasurg.2013.2685. [Epub ahead of print]**Antireflux Procedures for Gastroesophageal Reflux Disease in Children: Influence of Patient Age on Surgical Management.**

McAteer J, Larison C, Lariviere C, Garrison MM, Goldin AB.

Division of Pediatric General and Thoracic Surgery, Seattle Children's Hospital, Seattle, Washington²Department of Surgery, University of Washington School of Medicine, Seattle.

IMPORTANCE Gastroesophageal reflux disease (GERD) is a common diagnosis in infants and children, but no objective criteria exist to guide the diagnosis and treatment of this disease in this population. The extent to which age influences decisions about surgical treatment in childhood GERD is unknown. **OBJECTIVE** To identify factors associated with progression to antireflux procedures (ARPs) in children hospitalized with GERD. **DESIGN, SETTING, AND PARTICIPANTS** Retrospective cohort study using inpatient data from 41 US children's hospitals in the Pediatric Health Information System database. We included patients younger than 18 years discharged from January 1, 2002, through December 31, 2010, with primary diagnostic codes for GERD (n = 141 190). We evaluated demographics, comorbidities, and diagnostic procedures descriptively and with a multivariate Cox proportional hazards regression model. **EXPOSURE** Patient age. **MAIN OUTCOMES AND MEASURES** Proportional hazard of progression to ARP during admission. **RESULTS** Of the 141 190 patients meeting study criteria, 11 621 (8.2%) underwent ARPs during the study period. More than half of patients undergoing ARPs (52.7%) were 6 months or younger. Although most patients in the ARP group had preoperative upper gastrointestinal tract fluoroscopy (65.0%), these patients did not undergo a uniform workup. The hazard of progression to an ARP was significantly decreased in children aged 7 months to 4 years (hazard ratio, 0.63 [P < .001]) and 5 to 17 years (0.43 [P < .001]) relative to children younger than 2 months. Hazard ratios were independently increased for comorbid diagnoses of failure to thrive, neurodevelopmental delay, cardiopulmonary anomalies, cerebral palsy, and aspiration pneumonia and among patients with tracheoesophageal fistula and diaphragmatic hernia. Each additional GERD-related hospitalization was associated with a 10% increased risk of an ARP. **CONCLUSIONS AND RELEVANCE** Antireflux procedures are most commonly performed in children during a period of life when regurgitation is normal and physiologic and objective measures of GERD are difficult to interpret. To identify meaningful outcomes after ARP, indications must be clear and standardized. We must clarify the

appropriate workup for infants and young children with GERD and better define "failure of medical management" in this population.

[PMID: 24197138](#) [PubMed - as supplied by publisher]

14. IEEE Int Conf Rehabil Robot. 2013 Jun;2013:1-5. doi: 10.1109/ICORR.2013.6650501.

Usability test of KNRC self-feeding robot.

Song WK, Song WJ, Kim Y, Kim J.

Various assistive robots for supporting the activities of daily living have been developed. However, not many of these have been introduced into the market because they were found to be impractical in actual scenarios. In this paper, we report on the usability test results of an assistive robot designed for self-feeding for people having disabilities, which includes those having spinal cord injury, cerebral palsy, and traumatic brain injury. First, we present three versions of a novel self-feeding robot (KNRC self-feeding robot), which is suitable for use with Korean food, including sticky rice. These robots have been improved based on participatory action design over a period of three years. Next, we discuss the usability tests of the KNRC self-feeding robots. People with disabilities participated in comparative tests between the KNRC self-feeding robot and the commercialized product named My Spoon. The KNRC self-feeding robot showed positive results in relation to satisfaction and performance compared to the commercialized robot when users ate Korean food, including sticky rice.

[PMID: 24187316](#) [PubMed - in process]

Prevention and Cure

15. Dev Neurosci. 2013 Nov 1. [Epub ahead of print]

Concurrent Erythropoietin and Hypothermia Treatment Improve Outcomes in a Term Nonhuman Primate Model of Perinatal Asphyxia.

Traudt CM, McPherson RJ, Bauer LA, Richards TL, Burbacher TM, McAdams RM, Juul SE.

Department of Pediatrics, University of Washington, Seattle, Wash., USA.

Background: Up to 65% of untreated infants suffering from moderate to severe hypoxic-ischemic encephalopathy (HIE) are at risk of death or major disability. Therapeutic hypothermia (HT) reduces this risk to approximately 50% (number needed to treat: 7-9). Erythropoietin (Epo) is a neuroprotective treatment that is promising as an adjunctive therapy to decrease HIE-induced injury because Epo decreases apoptosis, inflammation, and oxidative injury and promotes glial cell survival and angiogenesis. We hypothesized that HT and concurrent Epo will be safe and effective, improve survival, and reduce moderate-severe cerebral palsy (CP) in a term nonhuman primate model of perinatal asphyxia. **Methodology:** Thirty-five Macaca nemestrina were delivered after 15-18 min of umbilical cord occlusion (UCO) and randomized to saline (n = 14), HT only (n = 9), or HT+Epo (n = 12). There were 12 unasphyxiated controls. Epo (3,500 U/kg × 1 dose followed by 3 doses of 2,500 U/kg, or Epo 1,000 U/kg/day × 4 doses) was given on days 1, 2, 3, and 7. Timed blood samples were collected to measure plasma Epo concentrations. Animals underwent MRI/MRS and diffusion tensor imaging (DTI) at <72 h of age and again at 9 months. A battery of weekly developmental assessments was performed. **Results:** UCO resulted in death or moderate-severe CP in 43% of saline-, 44% of HT-, and 0% of HT+Epo-treated animals. Compared to non-UCO control animals, UCO animals exhibit poor weight gain, behavioral impairment, poor cerebellar growth, and abnormal brain DTI. Compared to UCO saline, UCO HT+Epo improved motor and cognitive responses, cerebellar growth, and DTI measures and produced a death/disability relative risk reduction of 0.911 (95% CI -0.429 to 0.994), an absolute risk reduction of 0.395 (95% CI 0.072-0.635), and a number needed to treat of 2 (95% CI 2-14). The effects of HT+Epo on DTI included an improved mode of anisotropy, fractional anisotropy, relative anisotropy, and volume ratio as compared to UCO saline-treated infants. No adverse drug reactions were noted in animals receiving Epo, and there were no hematology, liver, or kidney laboratory effects. **Conclusions/Significance:** HT+Epo treatment improved outcomes in nonhuman primates exposed to UCO. Adjunctive use of Epo combined with HT

may improve the outcomes of term human infants with HIE, and clinical trials are warranted. © 2013 S. Karger AG, Basel.

[PMID: 24192275](#) [PubMed - as supplied by publisher]

16. Ideggyogy Sz. 2013 Jul 30;66(7-8):228-34.

Prenatal diagnosis of central nervous system malformations [Article in Hungarian]

Langmár Z, Németh M, Csaba Á, Szigeti Z, Joó JG.

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The prenatal diagnosis of fetal malformations have been the subject of numerous publications in the literature. This has dramatically increased in the last 15 years, mainly due to the advent of high-resolution ultrasound. In addition adequate guidelines issued by professional organizations have encouraged the universal approach to the imaging of fetal anatomy as well as malformations. One of the most significant groups of the fetal anomalies is the central nervous system malformation. Due to its prevalence and severity the praenatal diagnostics of central nervous system malformations got basic significance. In this review we attempted to summarize the recent informations concerning the prenatal diagnostics of the central nervous system anomalies.

[PMID: 23971353](#) [PubMed - indexed for MEDLINE]

17. Lancet Infect Dis. 2013 Sep;13(9):743. doi: 10.1016/S1473-3099(13)70236-6.

Cheryl Jones: cracking mysteries in paediatric infection.

Kirby T.

[PMID: 23969215](#) [PubMed - indexed for MEDLINE]

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