Evaluation of the central nervous system of fetuses and neonates

Avaliação do sistema nervoso central do feto e neonato

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Central nervous system (CNS) malformations play a relevant role in the set of all fetal malformations, standing out for the following factors:

- incidence: this is the second highest after cardiac malformations;
- feasibility of prenatal diagnosis: currently, they are the most frequently diagnosed malformations, together with urinary tract malformations;
- difficulty in evaluating the patient's prognosis: many times, a multidisciplinary discussion is required to define the prognosis.

Ultrasonography (US) is the best screening method to identify fetal CNS malformations[1]. The echographic study of the cephalic pole at the 12th gestational week already constitutes a relevant biometric method for evaluating the gestational age. It also provides an early morphological appreciation of the development of the brain and of the fetus as a whole, together with other parameters, such as fetal dynamics (tonus, respiratory motion, heartbeats) and structural elements of the fetus (spine, skeleton, face, thorax and abdomen)[1].

A good echographic study depends on several factors, such as positioning, fetal mobility and growth, volume of amniotic fluid, position of the placenta, maternal wall, quality of the apparatus, and the sonographer's experience.

Three-dimensional US (3DUS) has become an integral part in the assessment of a great number of fetal abnormalities. As conventional US and 3DUS are compared in the evaluation of medullary canal malformations, multiplanar 3DUS imaging provides more complete information on such alterations. Among others, the following benefits from this imaging modality are highlighted:

- multiplanar imaging: the three orthogonal planes are displayed, allowing the reproduction of all possible imaging planes;
- surface mode: based on the set of acquired data, it is possible to recover all the required information to reconstruct the morphologic features of a determined structure surface;
- tomographic ultrasound image (TUI): similarly to computed tomography, 2D sections are displayed from any given volume, at any orthogonal plane.

By means of color Doppler and power Doppler, the fetal circulation is studied in order to evaluate its hemodynamics.

Color Doppler analyzes changes in the blood flow and has been utilized as a diagnostic tool in the evaluation of both uterine and fetal circulations. Such method allows the measurement of the velocity of blood flow waves and the evaluation of the cerebral oxygenation status. It is utilized as a reference in the study of the middle cerebral artery flow and is considered to be easily identifiable, with good reproducibility.

Power Doppler is more sensitive for evaluating small low-resistance vessels, what facilitates the identification of small changes in the blood flow[2,3].

Although US still remains a modality of choice in the routine prenatal follow-up because of its low cost, wider availability, safety, good sensitivity and real-time capability, magnetic resonance imaging (MRI) has a good potential in the morphological evaluation of fetuses that otherwise would not be appropriately evaluated by ultrasonography. Such imaging modality started being utilized for fetal evaluation in the eighties and, in Brazil, in the nineties[4–6].

Fetal MRI is performed in a high-field apparatus (1.5 tesla / 3.0 tesla) and follows specific protocols, particularly in the third gestational trimester. The T2-weighted sequences provide good tissue characterization, facilitating the anatomic study, the evaluation of hem-

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orrhages and of sulcal patterns of the fetal brain. The T1-weighted sequences may be useful in the evaluation of bleedings, calcifications, lipomas and areas of necrosis.

Fetal movements, if exaggerated, may impair the study, limiting other protocols of fetal brain evaluation, such as diffusion-weighted imaging, diffusion-tensor imaging and spectroscopy, which can provide other information regarding fetal development, myelination, maturation and metabolism[7–10].

In fetuses and preterm infants, the brain is extremely vulnerable to lesions resulting from ischemic, inflammatory, infectious and neurotoxic factors[11–13].

Brain hemorrhages and white matter lesions represent the most common brain conditions in newborns, preterm neonates being most frequently affected. There is a correlation between the presence of alterations in the cerebral hemodynamics and the subsequent development of hemorrhages and hypoxic-ischemic lesions[14].

US and MRI are the imaging methods of choice in the evaluation of the brain in preterm newborns[15].

US is effective in the evaluation of hemorrhagic lesions, hydrocephalus and cystic changes. However, such imaging technique is performed through the anterior fontanelle, which results in a narrow field of view. Additionally, US is not sufficiently accurate to evaluate diffuse or subtle lesions, particularly those located in the white matter[16,17].

The early utilization of color Doppler in preterm neonates is important to detect brain lesions and to define the prognosis. A change in the resistance index may be related to a greater severity of the clinical condition[18].

Brain MRI is more sensitive and specific than US in the detection of hemorrhages, ischemia and white matter lesions. However, in severe cases, technical difficulties of the method should be taken into consideration as compared with US that, besides its bedside capability, is easy to perform[15–18].

The diagnosis of the anomalies of the fetal brain represents a factor of extreme distress for parents and a huge challenge for the clinical team in the pre- and postnatal counselling. Development of the diagnosis in the prenatal period facilitates the postnatal follow-up. MRI does not replace US, but is a supplementary method that provides additional information for the diagnosis and evaluation of the prognosis of CNS malformations.

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