Partial agenesis of corpus callosum - case study

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Summary

Agenesis of the corpus callosum is an uncommon cerebral malformation usually of unknown etiology. It can be associated with other brain abnormalities, such as ventriculomegaly, or in combination with problems with other organs, such as congenital heart defect, as well as with chromosome anomalies. Diagnosis of this rare anomaly is important not only because of possible association with other developmental anomalies but also because of postnatal treatment and evaluation of children with this disorder. This paper presents prenatal diagnosis of partial agenesis of the posterior part of corpus callosum of a fetus detected in gestational week 33 by ultrasonography as an isolated developmental disorder, i.e., not accompanied by other morphological anomalies of the fetus or chromosome aberrations or other genetic defects.

Key words: Fetal corpus callosum; Corpus callosum agenesis.

Introduction

The corpus callosum is a collection of many millions of nerve fibers in the middle of the brain. One of its functions is to connect the right and left side of the brain to allow for communication between the two sides, or hemispheres. The corpus callosum coordinates signals from different parts of the brain and helps the thinking process.

Agenesis of the corpus callosum is a birth defect in which this structure in the brain is either partially or completely missing. It may occur as an isolated brain problem (49% of cases), in combination with other brain abnormalities, such as ventriculomegaly, or in combination with problems with other organs, such as congenital heart defect. In addition to agenesis of the corpus callosum, other callosal disorders include hypogenesis (partial formation), dysgenesis (malformation) of the corpus callosum, and hypoplasia (underdevelopment) of the corpus callosum. Agenesis of the corpus callosum is caused by disruption during development of the fetal brain between the third and 12th week of pregnancy but it is diagnosed considerably later, usually after 30th week of gestation. In most cases, it is not possible to know what caused this anomaly. However, research suggests that some possible causes may include chromosome errors (most frequently trisomy 13 and 18), inherited genetic factors, prenatal infections or injuries, prenatal toxic exposures, structural blockage by cysts or other brain abnormalities, and metabolic disorders [1].

Callosal disorders can be diagnosed only through a brain scan. They may be diagnosed through magnetic resonance imaging (MRI), computed tomography (CT) scan, prenatal ultrasound or prenatal MRI. Prenatal diagnosis of this malformation is now routinely performed by ultrasonography (after 20th week) and MRI (after 30th week).

Agenesis of the corpus callosum is an uncommon cerebral malformation that has been reported in one in 19,000 unselected autopsies and 2.3% of children with mental retardation [2].

Partial agenesis of the corpus callosum is a very rare birth defect.

Case Report

Case of partial agenesis of corpus callosum in a fetus from a pregnancy detected through in vitro fertilization (IVF) program is presented. Anomaly was detected by ultrasonographic exam in gestational week 33 and subsequently confirmed by fetal MRI two weeks later.

IVF was performed due to male sterility i.e. very poor spermogram results. Pregnancy was achieved at 34 years of age of both partners, whose findings were all (except the spermogram in male partner) normal. In gestational week 12,6 a biochemical screening was performed for chromosomal anomalies. Finding was normal. Prenatal invasive diagnostics (chorionic villus sampling, amniocentesis) was not performed. Fetal growth and development were subjected to regular ultrasonographic checkups, fetal morphology was normal, biometric parameters corresponded to gestational age until week 32. In 33rd week of gestation the ultrasonographic exam of fetal head showed a deviation-biparietal diameter (BPD) corresponded to 36 weeks instead of 32,3 gestational weeks (Figure 1), together with discrete widening posterior cornu of the lateral ventricles up to 12 mm.

A 3D/4D multislice ultrasonographic examination of the fetal brain was performed. Cavum septi pellucidi was slightly narrowed and irregular in shape, lateral ventricles borderline expanded, while the posterior part of corpus callosum failed to be visualized. Doubt was raised concerning partial agenesis of the corpus callosum (Figure 2). Patient was referred to fetal endocranial MRI exam which confirmed the absence of the posterior part of the corpus callosum, i.e. partial agenesis of fetal corpus callosum.

Considering that the defect was very small, located in the posterior third of corpus callosum, and that there were no other visible anomalies, pregnancy was carried to term. Elective cesarean section was performed at term and a healthy male child weigh-

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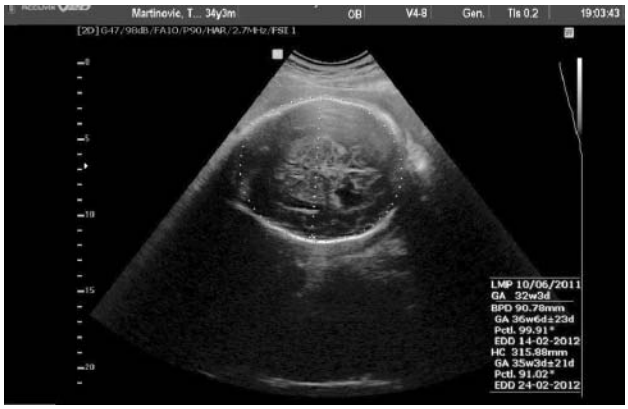

Figure 1. — Biparietal diametar of the fetal head.

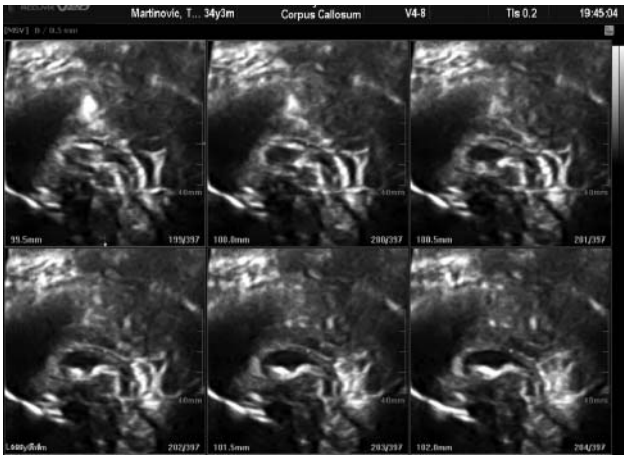

Figure 2. — 3D/4D multislice ultrasound of fetal brain.

ing 3,600 grams was born. Several ultrasonographic exams of the fetal brain were performed in the early neonatal period (Figure 3). Existence of a minute defect in the posterior part of corpus callosum was confirmed, calling for nuclear MRI which was in compliance with ultrafonographic exams. Regular monthly checkups were performed during the first six months, followed by increase of interval to two months over the second six months. Fetal brain development was normal while previously visualized defect did not show any increase. Growth and development of the fetus were normal and no disorders in mental functions were noted during the first years of life.

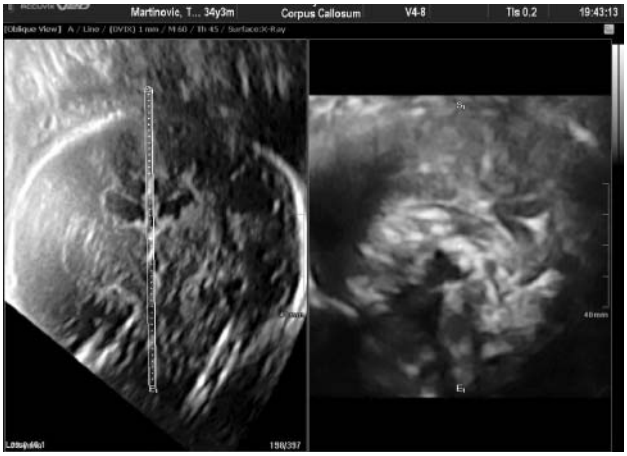

Figure 3. — Ultrasound scan of fetal brain.

Discussion

Several studies from literature analyze the disorders in development of corpus callosum, complete absence of this brain structure i.e., complete agenesis; these studies date from 1990s until today. Majority of described cases were detected between 19 and 37 weeks of gestation. The research of Pilu *et al.*, dating from 1993, for example, showed 35 fetuses in which ultrasonographic imaging detected absence of the corpus callosum and cavum septum pelucidum with typical "teardrop" configuration of the lateral ventricles, distension of the interhemispheric fissure, upward displacement of the third ventricle, radiate arrangement of the medial cerebral gyri, and abnormal branching of the anterior cerebral artery [3]. Narrowing of the corpus callosum and the so-called "teardrop" configuration of the lateral ventricles was also verified in the presented case.

Establishing the reference range during human pregnancy for normal fetal corpus callosum is especially important for the detection of this rare anomaly. The research of Professor Achiron, dating back to 2001, for example, defines criteria for fetal corpus callosum measurement in the period from 16th to 37th week of gestation, follows growth and development of corpus callosum (by weekly ultrasonographic measurements), with the aim of defining criteria for size of corpus callosum measured in all three sections in each week of gestation. This study offers normative measurements of the fetal corpus callosum and may facilitate a more objective diagnosis of its congenital abnormalities [4].

Research performed by d'Ercole *et al.* in 1998 compares the accuracy of ultrasonographic diagnostic of defects in development of corpus callosum with that of MRI diagnostics performed after this development defect was suspected during ultrasonographic exam [5]. This research showed that ultrasonography was able to suspect agenesis of the corpus callosum by indirect signs but definitive diagnosis of corpus callosum agenesis was achieved in only four of 14 cases.

Application of 3D/4D multislice ultrasonographic exams significantly increased diagnostic accuracy in detecting this rare anomaly in brain development; this is confirmed in the case described in the present study. The corpus callosum can be assessed on ultrasound by direct visualization, but indirect features, such as ventriculomegaly, absence of the cavum septi pellucidi or widening of interhemispheric fissure, are often reasons for

detection in a screening population. Careful imaging in center with a high level of expertise is required to make a full assessment and to exclude coexisting abnormalities, which occur in about 46% of fetuses [6].

Even though partial agenesis of the corpus callosum is fortunately not a frequent anomaly, it is necessary to consider the possibility of occurrence of this disorder in development of brain structures, not only because it may be associated with other developmental anomalies, but also because of the postnatal treatment and follow-up of children diagnosed with it.

There are currently no specific medical treatments for callosal disorders, but individuals with agenesis of the corpus callosum and other callosal disorders may benefit from a range of development therapies, additional support, and services. It is important to consult with a variety of medical, health, educational, and social work professionals. Such professionals include neurologists, neuropsychologists, occupational therapists, physical therapists, speech and language pathologists, pediatricians, music therapists, geneticists, special educators, early childhood intervention specialists, and caregivers for adults.

Research performed by Moutard *et al.* in 2012 analyzes development of children prenatally diagnosed with corpus callosum agenesis over a ten-year period and concludes that although prenatal diagnosis of isolated corpus callosum agenesis is reliable, false postnatal diagnoses remain possible (10-20%) even with complete prenatal screening. Outcome is mostly favorable because intelligence is within the normal range for nearly 3/4 of children. However, they frequently have mild learning difficulties [7].

The prognosis in cases of isolated agenesis of the corpus callosum remains uncertain, although it is expected that a normal or borderline intellectual development will occur in many cases.

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