

# Early sonographic signs in agenesis of the fetal corpus callosum

Elisa Nica<sup>1</sup>,  
Mihai Mitran<sup>2</sup>,  
Bogdan  
Marinescu<sup>2</sup>

1. "Carol Davila" University  
of Medicine and Pharmacy;  
CF 1 Witting Hospital,  
Bucharest, Romania

2. "Carol Davila" University  
of Medicine and Pharmacy,  
Bucharest;  
"Prof. Dr. Panait Sîrbu"  
Clinical Hospital of Obstetrics  
and Gynecology,  
Bucharest, Romania

Corresponding author:  
Elisa Nica  
E-mail: elisa.bondoc@gmail.com

## Abstract

**Objectives.** Although the agenesis of corpus callosum is currently a second-trimester diagnosis, it is a worthwhile pursuit to lower the gestational age at which this pathology should be at least suggested, if not diagnosed. **Materials and method.** We performed an ultrasound examination (2D and 3D) on women with a singleton or twin pregnancy at 12 to 14 weeks of gestation. Images with measurements of midbrain and falx cerebri were acquired and their ratio computed, along with 3D volume with power Doppler images of the pericallosal arteries. We also performed a follow-up scan at 20-22 weeks of gestation in order to confirm the absence of the corpus callosum. **Results.** Nineteen fetuses with high suspicion on the first trimester were found with agenesis of corpus callosum at the second-trimester scan. **Conclusions.** Ultrasound measurements of midbrain/falx cerebri with calculated ratio and pericallosal artery in the first trimester could be a matter of concern for agenesis of corpus callosum. **Keywords:** first-trimester scan, agenesis of corpus callosum, midbrain, falx cerebri, ratio, pericallosal artery

## Rezumat

**Obiective.** Deși agenizia de corp calos este un diagnostic stabilit în trimestrul al doilea, este un deziderat să scădem vârsta gestațională pentru depistarea acestei patologii. **Materiale și metodă.** S-au efectuat examinări ecografice 2D și 3D la paciente gravide cu sarcină unică sau multiplă între săptămânile 12 și 14. S-au obținut măsurători ale mezencefalului și falx cerebri și s-a calculat raportul celor două, alături de examinarea power Doppler a arterei pericalosale. De asemenea, s-a confirmat, prin follow-up la 20-22 de săptămâni gestaționale, absența corpului calos. **Rezultate.** Nouăsprezece feți au fost descoperiți cu diagnostic cert de agenizie de corp calos la morfologia de trimestrul al doilea. **Concluzii.** Măsurarea ecografică a mezencefalului/falx cerebri, calculul raportului celor două și evidențierea arterei pericalosale în trimestrul întâi pot prezice agenizia de corp calos, confirmată în trimestrul al doilea. **Cuvinte-cheie:** morfologie de trimestru întâi, agenizie de corp calos, diencefal, falx cerebri, raport, arteră pericalosală

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## Introduction

*Corpus callosum* is one of the most interesting and important yet unknown structures of the human brain. It is the one that interchanges sensory information between the left and the right hemispheres and connects them.

In the unlikely event of its absence (agenesis of *corpus callosum*), there are still some non-callosal commissures that apparently fulfill its function and therefore many individuals can be asymptomatic.

Because the *corpus callosum* is not fully formed until 19 to 21 weeks of gestation, the diagnosis of agenesis of *corpus callosum* by ultrasound before this period is very challenging.

The condition is suggested by the absence of *cavum septum pellucidum* (CSP) and the teardrop configuration of lateral ventricles with enlargement of the posterior horns between 18 and 37 weeks<sup>(1,2)</sup> (Figure 1).

The development of the *corpus callosum* begins between 12 and 18 weeks of gestation. It represents a thin band of white matter and it can be visualized in midsagittal or midcoronal views of the fetal brain<sup>(3)</sup>.

Because most of the pregnant women with this pathology of the fetus choose the termination of pregnancy, we try to diagnose the agenesis of *corpus callosum* (ACC) as soon as possible, by measuring midbrain and *falx cerebri* diameters, computing their ratio, along with the discovery of the pericallosal artery at the end of the first trimester.

## Materials and method

The study started in 2014 and included 12-14-week pregnant women who undertook first-trimester scan and also pregnancies with confirmed ACC during the second-trimester scan, where a midsagittal scan of the fetal brain<sup>(4)</sup> from the first trimester was available.

In the light of the results observed by Lachmann<sup>(5)</sup>, where the midbrain diameter of ACC-confirmed cases was above the 95<sup>th</sup> percentile and the falx diameter was below the 5<sup>th</sup> percentile, we performed measurements of midbrain and *falx cerebri* diameter in mid sagittal view of the fetal brain, and we computed midbrain to *falx cerebri* ratio. Afterwards we performed descriptive statistics and stratified comparative analysis using the SPSS software package.



**Figure 1.** Teardrop configuration of lateral ventricle, the absence of cavum CSP (TUI)



**Figure 2.** Measurements of midbrain and falx cerebri (normal/abnormal)

The examinations were performed by FMF certified sonographers in the 11-13 weeks scan on E8 Voluson GE machine. The measurements were represented by the diameter taken from the sphenoid bone to the echogenic falx for the midbrain, and the distance between the upper border of the midbrain and the skin of the fetal head for the falx (Figure 2). The ratio between the two structures was calculated.

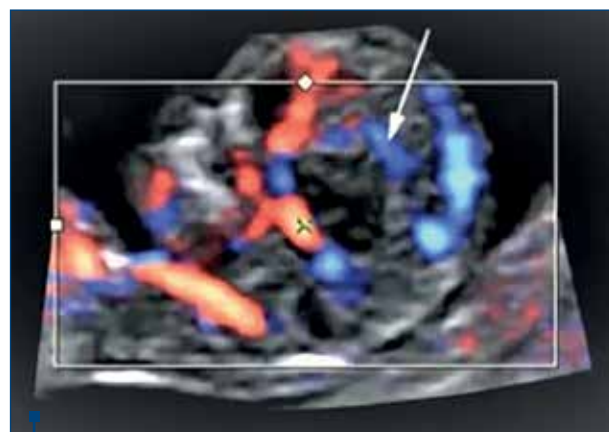
After this, the high-definition power Doppler was activated (set with a PRF of 0.3 kHz) and a 3D scan was performed to visualize the pericallosal arteries<sup>(6,7)</sup>. Both mechanical and thermal indices were kept under 1 due to health and safety concerns (Figure 3).

## Results

Overall, 1040 patients were included in the study, of which 23 were cases of confirmed agenesis of *corpus callosum*, with only 19 first-trimester scans available.

The crown-rump length (CRL) of the 19 fetuses was between 54 and 81 mm, with midbrain diameter from 6 to 10.5 mm and falx between 4.9 and 9.24 mm, with

a higher than 1 ratio exceeding the normal limit, with one exception (0.93), in a case of a partial agenesis of the *corpus callosum*.



**Figure 3.** Pericallosal artery of a normal first-trimester fetus<sup>(6)</sup>

**Table 1** Measurements of midbrain and *falx cerebri* in fetusus with ACC, according to ACC type

Associated/isolated		CRL (mm) (NL: 45-84)	Midbrain diameter (mm) (NL: 3.7-6.5)	Falx diameter (mm) (NL: 6.5-12.1)	Ratio* (NL: 0.5-0.8)
Associated	Mean	70.72	8.42	6.61	1.2840
	Std. Dev.	7.50	1.38	1.18	0.16
	Minimum	60	6	4.90	1.0923
	Maximum	81	10.20	9.24	1.4778
	Median	72.50	8.85	6.55	1.2510
	N	12	12	12	12
Isolated	Mean	69.64	7.55	6.88	1.0963
	Std. Dev.	9.37	1.65	1.164	0.15
	Minimum	54	5.50	5.80	0.9354
	Maximum	79.9	10.50	9	1.3759
	Median	69	7.98	6.80	1.0415
	N	7	7	7	7

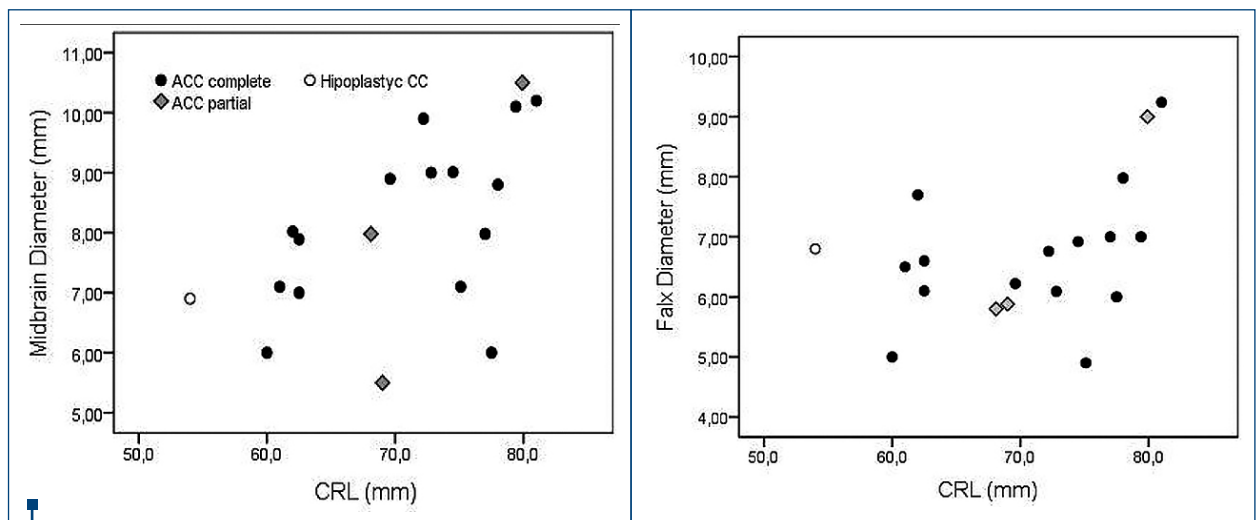
(NL= range of normal fetuses; \*p Student independent t Test = 0.021)

The whole length of the pericallosal artery was obtained (3.5 to 4.5 mm) in fetuses above 12 weeks of gestation who showed no evidence of abnormal brain findings<sup>(2)</sup>.

The diagnosis of agenesis in all cases was made in the second trimester, between 21 and 24.5 weeks of gestation, as following: 15 complete ACC, 3 partial ACC, one

hypoplastic CC, with 12 cases of associated pathology (CNS or extra CNS) and only 7 isolated ACC. We had a total of 15 births and 4 terminations of pregnancy (all of which had associated pathology).

The midbrain/*falx cerebri* ratio of associated pathology cases of ACC was significantly (p=0.021) higher than those of isolated cases of ACC (1.28±0.16 versus



**Figure 4.** Individual measurements of midbrain and falx cerebri diameter in fetusus with ACC, according to CRL value

1.09±0.14), therefore the calculated ratio can be considered to predict the cases of associated pathology in agenesis of *corpus callosum* (Table 1).

A medium significant positive correlation ( $r=0.566$ ;  $p=0.011$ ) was identified between CRL and midbrain diameter for all ACC cases. A significant correlation ( $r=0.523$ ;  $p=0.045$ ) was identified between CRL and midbrain diameter only for cases of complete ACC, and also a strong significant correlation ( $r=0.99$ ;  $p=0.030$ ) was found between CRL and falx diameter only for cases of partial ACC (Figure 4).

## Discussion

Compared to normal fetuses, in fetuses with ACC the midbrain diameter is higher, the falx diameter is lower and midbrain to *falx ratio* is higher than 1.

The findings are compatible with the work of Lachmann et al., and we can say that in the midsagittal view of the brain in the first trimester there are measurable abnormalities that could suggest no forming of the *corpus callosum*.

On the other hand, we failed to observe the pericallosal artery in the first trimester, with good results in the second trimester, as we found a normally developed *corpus callosum*<sup>(8)</sup>.

Although the presence of the feeding vessel should anticipate the development of the target organ, so the pericallosal artery should predict the appearance of *corpus callosum*. In our experience, this can be ambiguous and tricky.

## Conclusions

Our study has shown that there are some structures and measurements that can suggest the abnormal development of the *corpus callosum* in the first trimester. We will continue our research in order to determine if these findings can be confidently accepted in this diagnosis. ■

**Conflict of interests:** The authors declare no conflict of interests.

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