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THE IMPORTANCE OF MONITORING FETAL BIOMETRY PARAMETERS AND DOPPLER VELOCIMETRY IN THE THIRD TRIMESTER OF PREGNANCY

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ABSTRACT

The aim of this study was to evaluate fetal biometry parameters, fetal morphology, Doppler velocimetry indices in the umbilical and middle cerebral arteries, fetal heart rate, placental appearance, and amniotic fluid index in a third-trimester fetus. Estimate fetal weight according to the biometric parameters was corresponding to 30w4d, although gestational age was 34w0d and previous ultrasound examinations showed fetal biometry parameters within normal limits. Growth percentage was under 10 %, being in the growth restriction zone. The ratio between the resistance indices in middle cerebral and umbilical arteries was 0.96, the normal value should be below 1.1. There was a risk of fetal distress and fetal death, so the delivery by emergency cesarean section was decided.

INTRODUCTION

According to the guidelines of the Romanian Society of Obstetrics and Gynecology (SOGR) and International Society of Ultrasound in Obstetrics and Gynecology (ISUOG), ultrasound examinations to detect fetal abnormalities should be performed in the first trimester of pregnancy between 11 weeks and 13w6d and in the second trimester between 19 weeks and 23w6d of gestation (www.sogr.ro).

In the third trimester of pregnancy, ultrasound should be performed between 30 weeks and 35w6d of gestation and should monitor all fetal biometry parameters, estimate fetal weight, and evaluate Doppler velocimetry through the umbilical artery (UmA) and middle cerebral artery (MCA), with calculation of the ratios between resistance and pulsatility indices in these vessels (Ellestad et al. 2017, Mlynarczyk et al. 2017).

The umbilical artery was the first fetal vessel to be evaluated by Doppler velocimetry in the fetus and become the most widely investigated component of the fetal circulation (Maulik et al. 2023).

The hypoxic status is triggered by the reduced umbilical artery blood flow, secondary to placental insufficiency. The cerebral arteries Doppler flow was noted to have a large diastolic component, approximately 40 % of the systolic peak. Hypoxia would induce fetal cerebral dilatation to increase cerebral flow and to compensate for the lack of oxygeneted blood from the placenta (Maulik 2006).

The cerebroplacental ratio (CPR) was defined as the ratio between the cerebral artery resistance index (CRI) and the umbilical artery resistance index (URI). The CPR was proposed as a parameter to quantify fetal blood flow redistribution to the brain response to hypoxia (Arbeill et al. 2023).

In pregnancies with normal estimated fetal weight, the CPR is consistently noted to be above 1, while in pregnancies complicated by fetal growth restriction, the CPR is less than 1 (Reeves & Galan 2019).

MATERIAL AND METHODS

The objective of this study was to evaluate by ultrasonography a fetus of a 28-year-old pregnant woman, in the third trimester of pregnancy.

Through the anamnesis, information was obtained regarding the following aspects:

- demographic information: name, age, address;
- menstrual history;
- sexual history;
- history of births and spontaneous or on-demand abortion;
- the date of the last menstrual period;
- the anterior medical examinations;
- the general state of health and current complaints.

The ultrasound examination was performed using a General Electrics Voluson E8 Ultrasound Scanner and a transabdominally transducer of 3.5 MHz.

The following aspects were evaluated by ultrasonography.

1. The position of the fetus
2. Active fetal movements
3. Fetal biometric parameters:

-the biparietal diameter (BPD) and cranial circumference (HC);
-the abdominal circumference (AC);
-the length of the humerus (HL) and forearm bones, ulna and radius;
-the length of the femur (FL) and the shin bones, tibia and fibula.

4. Fetal morphology:

-the brain structures and fetal face;
-the spine;
-the stomach and the diaphragm;
-the urinary bladder and kidneys;
-4-chambers view of the heart, emergence of the aorta and the pulmonary artery, aortic arch, interventricular septum;
-abdominal insertion of the umbilical cord;
-integrity of the anterior abdominal wall;
-presence of two arteries in the umblical cord;
-external genitalia.

5. Recording and monitoring fetal heartbeats (FHR)
6. Doppler velocimetry assessment through the umbilical artery and middle cerebral artery
7. The location and appearance of the placenta
8. Measurement of the amniotic fluid index (AFI)

Doppler interrogation of the fetal circulation are performed with the patient in the semirecumbent position, with the lateral tilt, so that the risk of hypotension is minimized (Maulik 2023).

RESULTS AND DISCUSSIONS

A. The following information were obtained through the anamnesis:

- the patient's age: 28 years old;
- the reproductive medical history: one natural birth, one abortion on-demand;
- the history of previous menstrual periods: regular menstrual periods;
- date of the last normal menstruation: 34 weeks ago;
- previous ultrasound examinations: at 12w6d and at 19w6d of pregnancy;
- no current complaints.

B. The ultrasound examination

1. Fetal biometric parameters:

- BPD = 8.19 cm, corresponding to 32w6d, GP (growth percentage 18.2 %);
- HC = 29.08 cm, corresponding to 32w0d, GP < 2.3 % (Figure 1);
- OFD = 9.45 cm;
- AC = 26.36 cm, corresponding to 30w3d, GP < 2.3 % (Figure 2);
- FL= 5.89 cm, corresponding to 30wd, GP < 2.3 % (Figure 3);
- TIB = 5.22 cm, corresponding to 31w0d, GP < 5.0 % (Figure 4);
- FIB = 5.34 cm, corresponding to 32w5d, GP = 38.5 %;
- HL = 5.20 cm, corresponding to 30w2d, GP < 5.0 % (Figure 5);
- RAD = 4.61 cm, corresponding to 33w1d, GP = 41.9 %;
- Ulna = 4.97 cm, corresponding to 31w3d, GP < 5 %;
- Cereb = 4.66 cm, corresponding to 35w2d, GP = 55.3 %.

The ratios between fetal biometric parameters showed proporțional and symmetrical development of the fetus.

CI (BPD/ HC) = 87 %, range 70 – 86 %

FL/AC = 22 %, range 20 – 24 %

FL/BPD = 72 %, range 71 – 87 %

FL/ HC = 20 %, range 19 – 22 %

HC/AC = 1.10, range 0.96 – 1.11

Estimate fetal weight (EFW) according to AC/ BPD/ FL/ HC measurements was 1662 grams, with a range of +/- 243 grams, which corresponds to 30w4d of pregnancy, GP < 10.0 %, being in the growth restriction zone. Based on the data of the last menstruation period (LMP), the gestational age should have been 34w0d.

Previous ultrasound examinations, performed at 12w6d and 19w6d of gestation showed fetal biometry parameters within normal limits. Since the 19-weeks assessment, the patient has not presented for the necessary clinical and ultrasound examinations.

2. Evaluation of the fetal morphology showed normal aspects of the structures: brain, face, spine, limbs, hearth and viscera.

3. Heart rate monitoring recorded values between 135 and 141 beats per minute (Figure 6).

4. Evaluation of the Doppler velocimetry

Umbilical artery: RI = 0.58, PI = 0.90, S/D = 2.38, PS = 35.96 cm/s, ED = 15.14 cm/s, MD = 13.25 cm/s, TA max = 23.13 cm/ s (Figure 7).

Middle cerebral artery: RI = 0.56, PI = 0.87, S/D = 2.28, PS = 21.36 cm/s, ED = 9.35 cm/s, MD = 9.20 cm/s, TAmax = 13.81 cm/s (Figure 8).

The ratio between the resistance indices (RI) in MCA and UmA was 0.96(5). The ratio between the pulsatility indices (PI) was 0.96(6).

The normal values of these parameters should be below the value 1.1. In this case, the fetal circulation is not normal, there is a risk of fetal distress and fetal death, so the pregnant woman was urgently sent for hospitalization, fetal surveillance and delivery. A few hours after admission, an emergency cesarean section was decided, before fetal distress worsened.

5. The placenta showed microcalcifications, its thickness at the umbilical cord insertion site was 4 cm (Figures 9 and 10).

6. The amniotic fluid index (AFI) was 15.50, the largest amniotic fluid sac being 4.57 cm, normal values being between 5 and 8 cm (Ellestad et al. 2017).

Figure 11 shows the graph of estimated fetal weight before birth, located below the 10th percentile of the fetal growth curve. The fetus weighed 1800 grams at birth and remains in the hospital until it reached a weight of 2500 grams.

In the third trimester of pregnancy, monthly monitoring is necessary, and even every two weeks in high-risk pregnacies. Recording of Doppler flows is mandatory at every ultrasound examination after 28 weeks of gestation (Ellestad et al. 2017, Mlynarczyk et al. 2017)

The abnormal CPR is associated with higher risk of cesarean section delivery do to fetal distress, low Apgar scores, neonatal intensive care unit admission. CPR with middle cerebral artery Doppler could add value to umbilical artery Doppler assessment in the prediction of adverse perinatal outcomes and neurodevelopmental outcomes (Arbeille et al. 2023).

CPR should be evaluated systematically in all pregnancies. In high-risk pregnancies, the umbilical artery, cerebral artery, and CPR index are monitored weekly. The frequency of monitoring is increased if the CPR becomes abnormal (Mlynarczyk et al. 2017).

Fetal growth restriction can have various etiologies, restricted flow through the placental vasculature being the most common cause of this relatively frequent complication of pregnancy (Reeves & Galan 2019, Unterschneider et al. 2013).

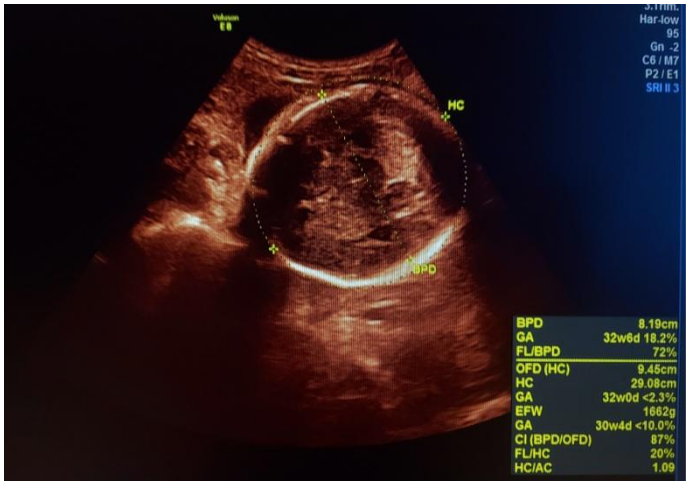


Figure 1. Measurement of the biparietal diameter and head circumference



Figure 2. Measurement of the abdominal circumference

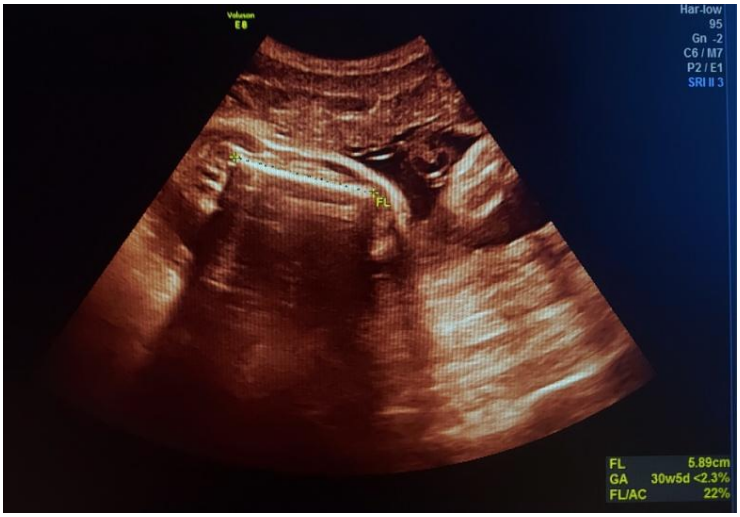


Figure 3. Measurement of the femur length



Figure 4. Measurement of the tibial length

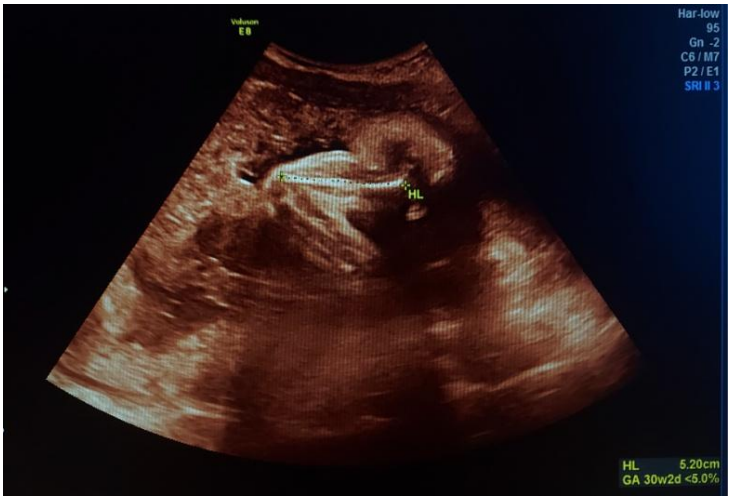


Figure 5. Measurement of the humerus length

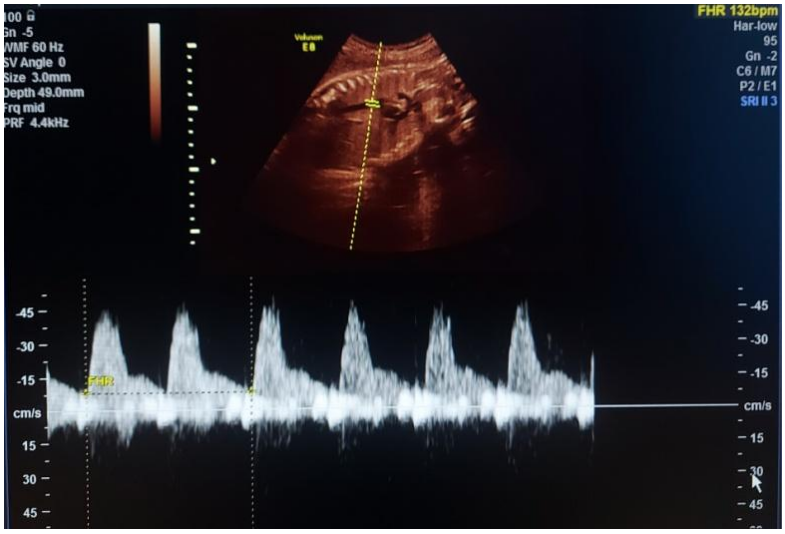


Figure 6. Recording of fetal heartbeats

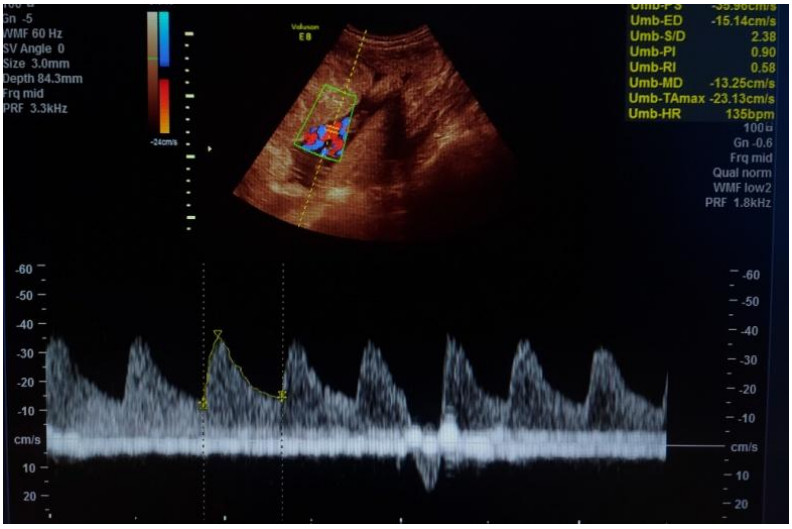


Figure 7. Doppler flow pattern in the umbilical artery

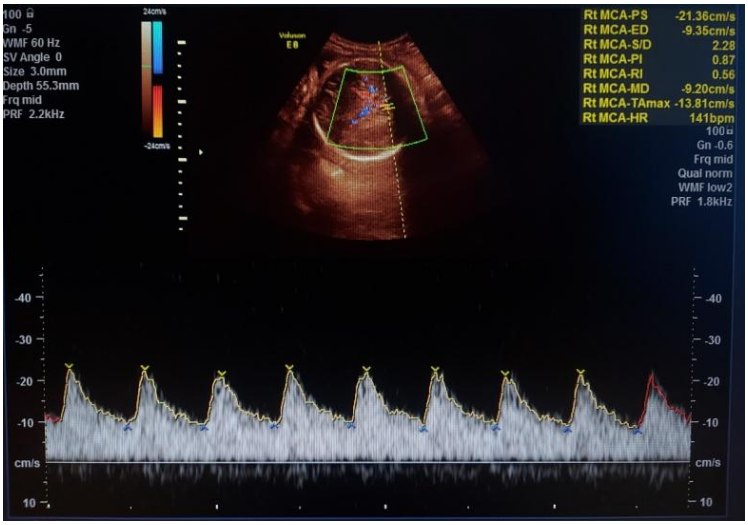


Figure 8. Doppler flow in middle cerebral artery

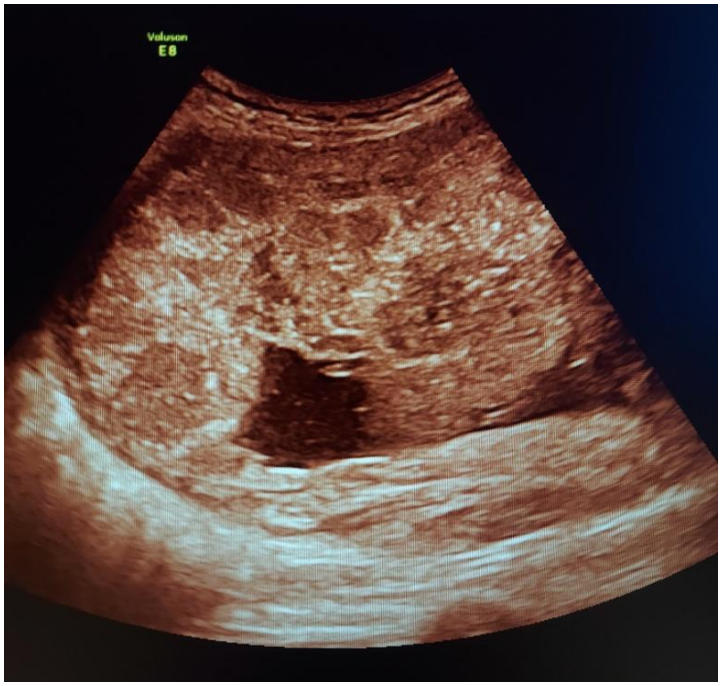


Figure 9. Appearance of the placenta showing microcalcifications

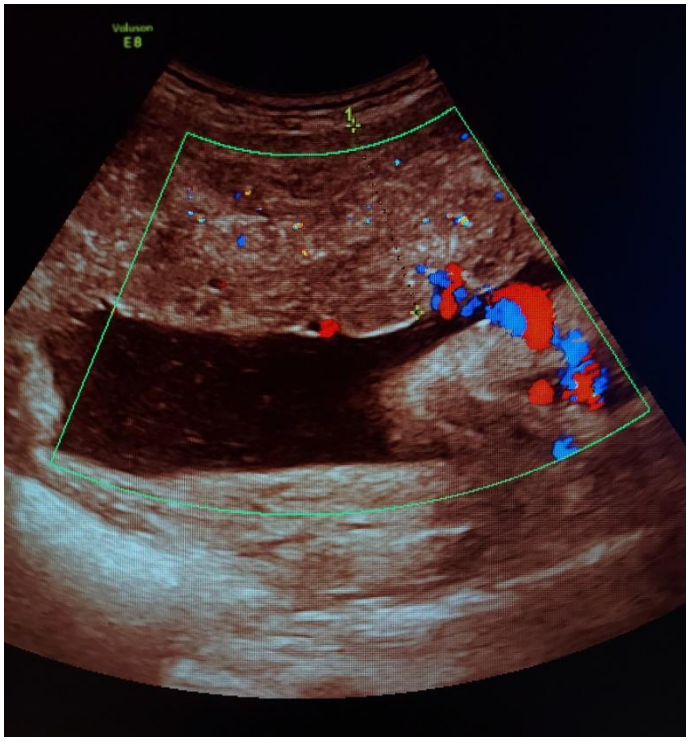


Figure 10. Measurement of placental thickness
at the umbilical cord insertion site

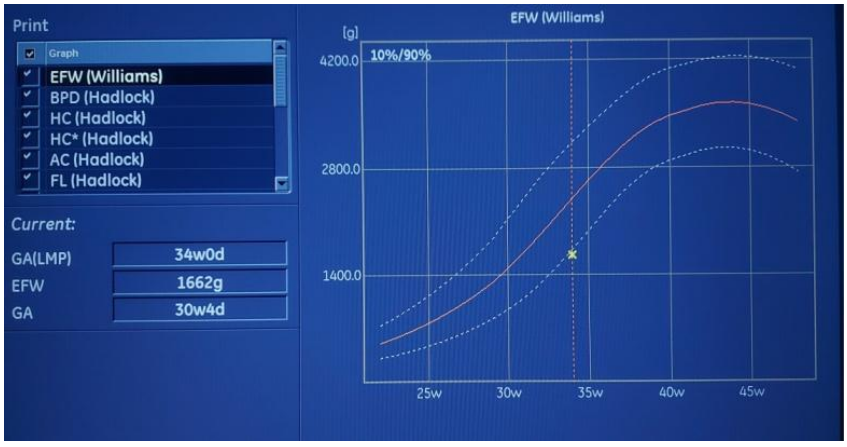


Figure 11. Graph of the estimated fetal weight

CONCLUSIONS

Measuring all fetal biometry parameters allows for the determination of the fetal weight and the diagnosis of intrauterine growth restriction.

Umbilical artery Doppler velocimetry is essential in monitoring intrauterine growth restriction. Doppler velocimetry assessment can detect changes in resistance indices that indicate fetal distress, even if the heart rate is currently within normal limits. For these reasons, frequent monitoring is important in the third trimester in order to detect placental insufficiency, responsible for growth restriction.

The time of birth of a fetus with growth restriction is determined in each case based on gestational age, Doppler velocimetry, estimated fetal weight, and biophysical profile.

The occurrence of fetal distress can lead to fetal death if the fetus is not extracted from the uterus in time, by performing a cesarean section.

Pregnant women must be educated to understand the importance of clinical and ultrasound monitoring, because it is not enough to feel good for everything to be fine. An important role should be played by family doctors, who provide primary care and who must refer pregnant women to obstetricians.

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