

FETAL HEART ARRHYTHMIAS AND DOPPLER ULTRASOUND

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ABSTRACT:

The objective of this study is to emphasize the role of fetal Doppler ultrasound not only in diagnosing heart anomalies but also in establishing the fetal well-being. The authors report a particular case of fetal bradyarrhythmia caused by an atrioventricular block. While the standard cardiotocography did not offer any substantial information about the fetus, ultrasound, and especially Doppler velocimetry proved to be of real help.

We recorded Doppler flow velocimetry at atrial, venous and cardiac level and noticed important changes consisting in alteration in E-A waves relation, reverse flow in ductus venosus, bradycardia-induced absent diastolic flow in umbilical artery.

Only Doppler velocimetry allowed a proper estimation of the fetal status and was the only useful assay to monitor the fetus until delivery.

Key Words: arrhythmias, Doppler ultrasound, fetal heart

INTRODUCTION

When dealing with a case of fetal heart arrhythmias, the obstetrician has to answer some questions concerning its etiology or the best way to investigate the fetal well-being.

Modern obstetrics does not offer many alternatives. Besides the classical direct auscultation, the remaining non-invasive tools left for use are cardiotocography (CTG), and ultrasound.

Heart arrhythmias are seldom diagnosed properly by using external CTG, which investigates more the influence of sympathetic and parasympathetic nervous system over the heart (beat-to-beat variation, basal heart rate) in hypoxic conditions. Fetal ECG is much more useful in such case, but ruptured membranes and a dilated cervix are prerequisites for access to the presentation.

M-mode ultrasound is also of some help, illustrating more obviously the heart rate, the interrelation between

atrial and ventricular contraction and allowing some physiological measurements such as the ejection fraction.^{1,2}

The objective of this study is to emphasize the role of fetal Doppler ultrasound not only in diagnosing the heart abnormality but also in establishing the fetal well-being.

CASE REPORT

The obstetrical exam of the patient A.E., 24 years old, revealed a pregnancy at 26 weeks of amenorrhoea, with a normally developed fetus, but with a severe fetal arrhythmia of 60 beats per minute. Difficulties in recording a proper CTG were encountered, not because of the bradycardia, but because of a severe bradyarrhythmia (Fig. 1). Unfortunately, the quality of the recordings did not improve until delivery, thus making the CTG recording a less useful assay for the obstetrician.

After the administration to the mother of 1 mg of Atropine, the response of fetal heart was unclear.

Real time ultrasound did not show any fetal malformations. Fetal echocardiography revealed:

- severe bradyarrhythmia suggesting a low grade atrioventricular block (fetal heart rate of 60 bpm and less)

- simetric atrial chambers, with atrial contractions occurring more often then ventricular ones (Fig. 2)

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- left ventricle slightly more dilated than the right ventricle.

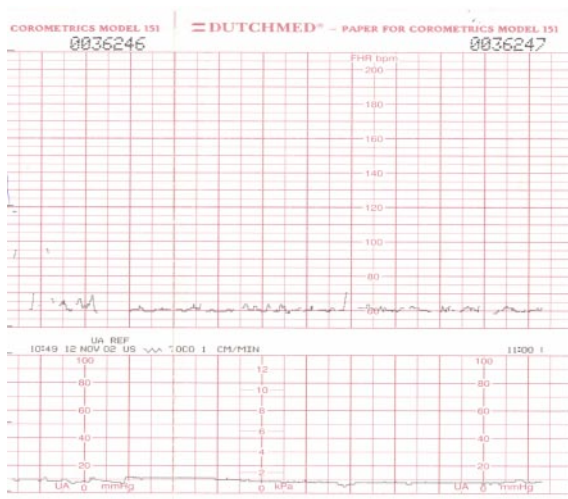


Figure 1. CTG demonstrating low fetal heart rate (FHR)

Ultima menstruație: 24.04.2002	Data probabila a nasterii: 31.01.2003			
Data consultatiei	22.07.2002	28.10.2002	11.11.2002	02.12.2002
Saptamana gestatie	13 S.A.	26 S.A.	28 S.A.	31 S.A.
Greutatea gravidei	53,5 kg	60 kg	62 kg	63,5 kg
Tensiune arteriala	115/65 mmHg	95/60 mmHg	100/60 mmHg	110/60 mmHg
B.C.F.		60-64 bpm	60-64 bpm	60-64 bpm
Aspecte ecografice				
Prezentatia fatului	Asez. Indiferentă	Culbutat	Cefalică	Cefalică
DBP (cm)	2,4/12 S.A.	6,7/26 S.A.	7,3/28 S.A.	7,9/30 S.A.
LF (cm)		5,1/27 S.A.	5,2/28 S.A.	6,4/32 S.A.
MCF	Prezente, ritmice	Bradi-aritmice	Bradi-aritmice	Bradi-aritmice
Placentatie	FU și posterior	FU, posterior, (I)	FU, posterior, (I)	FU, posterior, (I)
Lichid amniotic	Normal	Discret oligo	Oligoamnios	Oligoamnios

Data consultatiei	22.12.2002		20.01.2002	
Saptamana gestatie	34 S.A.		38 S.A.	
Greutatea gravidei	64 kg			
Tensiune arteriala	105/60 mmHg			
B.C.F.	68-74 bpm			
Aspecte ecografice				
Prezentatia fatului	Cefalică			
DBP (cm)	8,6/33 S.A.		NASTERE PRIN	FEM=3.000 g
LF (cm)	6,6/34 S.A.		OPERATIE	IA=9
MCF	Prezente, ritmice			L=49 cm
Placentatie	FU, posterior, (II)		CEZARIANĂ	PT=33,5 cm
Lichid amniotic	Oligoamnios			PC=33,5 cm

Figure 2. Prenatal surveillance of the pregnancy

Fetal Doppler ultrasound revealed:

- at the atrioventricular level, the E wave was higher than normal for the gestational age. In some recordings, the E wave was equal to A wave, showing an adult pattern (Fig. 3);

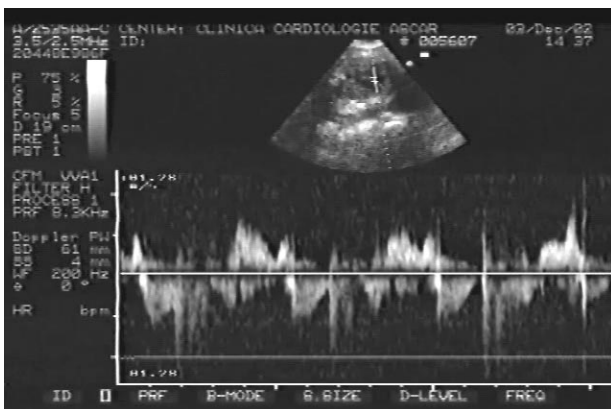


Figure 3. Doppler flow at the mitral atrioventricular valve

- a bloodflow speed much higher than normal in the ascending aorta;

- inferior vena cava Doppler showed a normal pattern, while in ductus venosus a D wave smaller than those observed in a normal fetus was recorded (Fig. 4, 5).

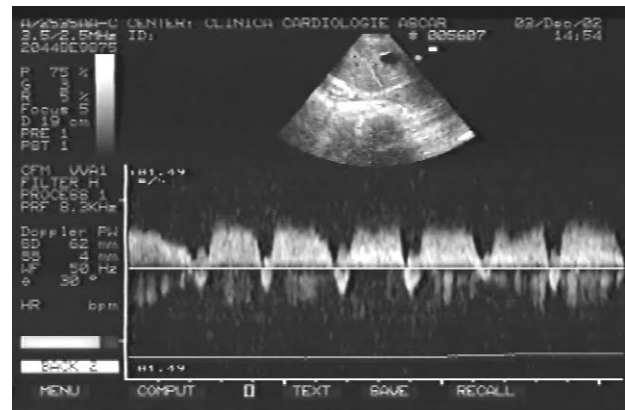


Figure 4. Abnormal Doppler flow in ductus venosus (reverse flow)

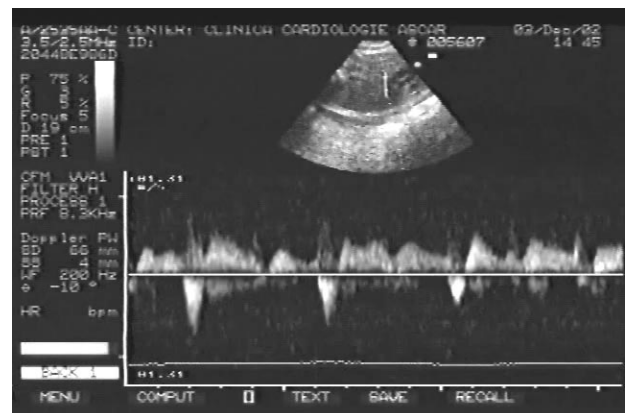


Figure 5. Doppler flow pattern at the level of inferior vena cava

The existence of an atrioventricular block was also suggested by the fact that the *a* wave was inconstantly recorded when exploring IVC. In the same time, the *A* wave recorded at ductus venosus (DV), was constantly present following *S* and *D* waves, showing its different etiology as previously demonstrated.

Considering the small gestational age and the relatively normal venous Doppler recordings, we decided to continue the pregnancy, with a close surveillance of the fetus.

In the following weeks, the fetus developed normally, but recorded a constant decrease of amniotic fluid was recorded. Fetal heart rate remained between 60 -70 bpm, having the same bradyarrhythmic aspect (Fig. 6).

Medial cerebral artery velocimetry was normal, with a very small rise of the *D* wave before delivery (Fig. 7). Umbilical artery velocimetry (Fig. 8) was difficult to be analyzed due to the severe bradyarrhythmia which led to the almost complete

disappearance of the diastolic wave, but no reverse flow was noticed.



Figure 6. Four chamber view of fetal heart



Figure 7. Normal Doppler flow of medium cerebral artery



Figure 8. Umbilical artery velocimetry showing a low fetal heart rate

Only venous flow velocimetry showed significant changes a few days before delivery at 38 weeks of amenorrhoea, consisting in negative *A* wave (reverse flow) on DV, a high *a* wave on IVC. As previously mentioned, the *E* wave was higher than *A* wave at the atrioventricular level.

Fetal heart rate remained between 60-70 bpm, being severely arrhythmic and making CTG recordings useless.

Considering our experience on fetal venous flow abnormalities, we decided to deliver the baby by cesarean section at 38 weeks of amenorrhoea. A female

infant of 3,000 g was born, having an Apgar score of 8.

After the delivery, the mother had an uneventful recovery, while the newborn was followed up in our hospital for another month during which the heart rate remained between 60 and 70 bpm (Fig. 9), and she developed cyanosis. She was under continuous observation and eventually transferred to a specialized cardiology clinic for further evaluation and possible placement of a pacemaker.



Figure 9. ECG of the newborn showing atrioventricular block

DISCUSSIONS

The main goal in this case was not only to properly diagnose the fetal heart rate abnormality, but also to assess the fetal well-being and to offer the obstetrician a useful investigation for deciding the optimal moment for delivering the baby.

From this point of view, Doppler ultrasound was much more useful than cardiotocography, first in deciding to allow the pregnancy to continue in the absence of any signs of fetal heart failure, and later on when we decided to deliver the baby.

Ultrasound exam allowed a correct diagnosis of the heart beat anomaly: atrioventricular block, with low fetal heart rate. Although low fetal heart rate persisted during the pregnancy, no intrauterine growth retardation occurred, in spite of a probable existence of hypoxia and hypercapnia.

The constant decrease of amniotic fluid after 29 weeks must be explained by the impaired renal perfusion due to the low fetal heart rate, leading to oliguria.

A very interesting finding was the recording of a *E* wave higher than normal³. In fact, the *E* wave had values close to *A* wave and even higher, same as we can see in the normal adult heart (which has a 60 – 80 bpm). A higher *E* wave suggests that passive atrial filling was longer due to bradycardia.

Another interesting finding was a longer distance than normal between *E* and *A* waves and the aortic pulsation (Fig 10).

We could not demonstrate any presence of brain sparing effect. The blood flow of medial cerebral artery

was normal, while there was no reverse-flow noticed at the umbilical vessels.

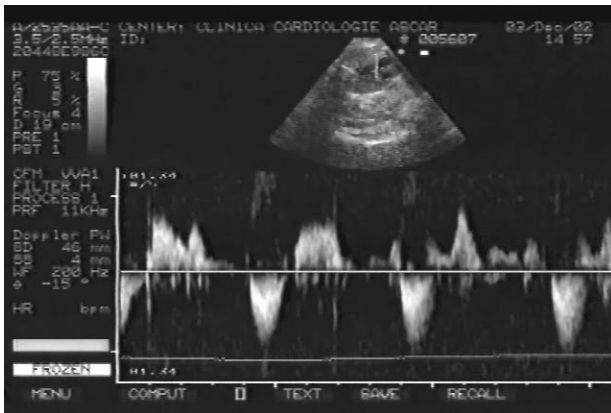


Figure 10. Longer distance than normal between *E* and *A* waves and the aortic pulsation.

Flow velocimetry of the great vessels that leave the heart showed a very high speed, but the major abnormal changes of flow velocimetry were recorded only at the venous site.

Ductus venosus *A* wave was smaller than normal^{4,5} and it became negative (reverse flow) at a fetal heart beat of 60 bpm, while IVC's *a* wave was normal until several days before the delivery, when it became higher, both signs deciding the delivery.

CONCLUSIONS

We have presented a case of fetal atrioventricular block, with a severe but otherwise well tolerated bradycardia, which allowed a normal development of the fetus.

When investigating fetal heart arrhythmias, cardiocography is of very little help, while ultrasound and especially Doppler ultrasound, is more useful.

From this point of view, venous velocimetry (DV, IVC) reflects more accurately the fetal well-being than arterial velocimetry, and helps the obstetrician to decide when to deliver the fetus.

REFERENCES

1. Dale RC, Guntheroth WG. Fetal echocardiography. In Berman CM, Kohen LH, editors. *Obstetrics & Gynecology*, 2nd ed., New York: Lippincott-Raven, 1997, p. 321-344.
2. Kubilay EA, Tanriverdi HA, Schmidt W. Doppler Sonography in Obstetrics. In Kurjak A, Chervenak FA, editors. *Textbook of Ultrasound*, Ed. Jaypee Brothers Med. Publ., 2003, p. 395-421.
3. Hecher K, Campbell S, Doyle P, et al. Assessment of fetal compromise by Doppler ultrasound investigation of the fetal circulation. Arterial, intracardiac and venous blood flow velocity studies. *Circulation* 1995; 91:129-38.
4. DeVore GR, Horenstein J. Ductus venosus index: a method for evaluating right ventricular preload in the second-trimester fetus. *Ultrasound Obstet Gynecol* 1993; 3:338-42.
5. Huisman TWA, Stewart PA, Wladimiroff JW. Ductus venosus blood flow velocity waveforms in the human fetus; a Doppler study. *Ultrasound Med Biol* 1992; 18:33-7.