

Can fetal heart rate in twin pregnancy in the first trimester be useful as a marker of pregnancy prognosis?

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SUMMARY

Introduction. Assessment of the fetal heart rate become a routine manner and was found to be helpful in making important clinical decisions. In the available literature there are no any information about fetal heart rate in twin pregnancy and it usefulness in predicting pregnancy outcome.

Objective. The aim of our study was to evaluate a range of heart rates in the first trimester in twin pregnancy and the influence of the rate of fetal heart on the outcome of the pregnancy.

Material and methods. The study included 89 twin pregnancies between 6 and 11 weeks of pregnancy (78 pregnancies finished with good outcome and 11 with unfavorable outcome).

Results. The date shows that the heart rate of embryos / fetuses in the first trimester of an uncomplicated twin pregnancy progressively increases between 6 and 8 weeks of pregnancy and then slows down in week 11. Our data shows that the rate of fetal death in the first trimester of twin pregnancy increases progressively with decreasing of the heart rate. In our study none of the twins survived when the observed rate of the fetal heart was less than 110 beats per minute and half of them died when heart rate was between 110 and 120 beats per min. Furthermore, the significant difference in the heart rates of a set of twins was connected with a poor prognosis. In mono-chorionic pregnancies with a significant difference in heart rate (20 beats/min or more) despite a normal fetal heart rate (120 beats/min or more) TTTS syndrome was confirmed later in pregnancy.

Conclusions. The heart rate in twin pregnancy more than 120 beats per minute is connected with a good prognosis, whereas below 110 beats per minute with a poor prognosis. Furthermore, the significant difference in fetal heart rate (20 beats/min or more) can be a marker of developing TTTS syndrome later in pregnancy.

Key words: fetal heart rate; twin pregnancy; first trimester; TTTS

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INTRODUCTION

In the past and nowadays the fetal heart rate is being used as a confirmation of the embryo/fetal life. Large group studies have reported changes in the heart rate in early stage of pregnancy [1-10]. Furthermore, miscarriages were observed in pregnancies with abnormal fetal heart rate [1-7,11]. Therefore assessment of the fetal heart rate become a routine manner and was found to be helpful in making important clinical decisions. However in the available literature there are no any information about fetal heart rate in twin pregnancy.

AIM

The aim of our study was to evaluate range of heart rate in first trimester in twin pregnancy and influence of rate of fetal heart on pregnancy outcome.

MATERIALS AND METHODS

The study was conducted in the Ultrasound Unit in Healthcare Center in Kutno from 2010 to 2016. In the study were included 89 twin pregnancies between 6 and 11 weeks of pregnancy (78 pregnancies finished with good outcome and 11 with unfavorable outcome). All pregnancies with risk factors (smoking, alcohol, drug addiction) and complications (diabetes mellitus, hypertension, anemia) were excluded from the study

Measurements were obtained using ultrasound machine (B&K Medical 3535 and Voluson 730 PRO) with vaginal probe of 6.5 MHz frequency. All pregnancies were calculated according CRL measurement. The gestational age was given in weeks according formula: 7 weeks = 7 weeks + 0/6 days. The heart rate was performed using M-mode technique for each twin separately.

RESULTS

The mean fetal heart rate in the first trimester of twin pregnancy with good outcome is presented in Table 1. The above data show that the heart rate of embryos / fetuses in the first trimester of uncomplicated twin pregnancy progressively increases between 6 and 8 weeks of pregnancy, reaches the nadir of 170 beats per minute in week 8 and then slows down to 150 beats per minute in week 11. The biggest difference in heart rate between a pair of twins was found between 6 and 7 weeks of pregnancy. Later in pregnancy, up to 11+6 weeks the difference was similar and remained low.

Fetal heart rate in the first trimester of twin pregnancies with unfavorable outcome is presented in Table 2.

In the case of intrauterine fetal demise of both twins the heart rate was below 120 beats per minute in at least one of the twins. Furthermore, we found that the difference in the heart rate is as important as the heart rate itself. In pregnancies with high difference in heart rate (20 or more beats/min) the outcome of the pregnancy was unfavorable (death or TTTS syndrome). In two cases with the fetal heart rate more than 120 beats/min and high difference in the heart rate, TTTS syndrome was observed later in pregnancy.

Tab. 1. The mean fetal heart rate and the difference in heart rate between the pair of twins between 6 and 11 weeks of uncomplicated twin pregnancy

| Group | Gestational age (weeks) | The mean heart rate (beats/min.) | Range (beats/min) | The difference in heart rate between twins (beats/min.) |
|----------|-------------------------|----------------------------------|-------------------|---|
| 1 (n=12) | 6+0 – 6+6 | 141 | 125 - 158 | 11 |
| 2 (n=10) | 7+0 – 7+6 | 140 | 115 - 169 | 11 |
| 3 (n=10) | 8+0 – 8+6 | 170 | 164 - 176 | 6 |
| 4 (n=18) | 9+0 – 9+6 | 165 | 136 - 179 | 6 |
| 5 (n=16) | 10+0 – 10+6 | 160 | 146 - 176 | 5 |
| 6 (n=12) | 11+0 – 11+6 | 150 | 136 - 164 | 6 |

Tab. 2. Fetal heart rate in the first trimester of twin pregnancies with unfavorable outcome

| No. | Gestational age (in weeks) | Heart rate twin A / twin B (beats/min) | The difference in heart rate between twins (beats/min.) | Type of complications |
|-----|----------------------------|--|---|------------------------------|
| 1. | 6+0 – 6+6 | 118/158 | 30 | death of both fetuses MCDA |
| 2. | 7+0 – 7+6 | 115/119 | 4 | death of both fetuses DCDA |
| 3. | 7+0 – 7+6 | 138/168 | 30 | TTTS at 28 weeks MCDA |
| 4. | 8+0 – 8+6 | 105/129 | 14 | death of both fetuses MCDA |
| 5. | 9+0 – 9+6 | 104/118 | 14 | miscarriage DCDA |
| 6. | 10+0 – 10+6 | 95/109 | 13 | death of both fetuses MCMA |
| 7. | 10+0 – 10+6 | 0/24 | 24 | death of both fetuses MCMA |
| 8. | 9+0 – 9+6 | 124/146 | 22 | TTTS at 28 weeks MCDA |
| 9. | 7+0 – 7+6 | 98/106 | 8 | death of both fetuses MCDA |
| 10. | 7+0 – 7+6 | 115/124 | 9 | miscarriage at 8 weeks MCD |
| 11. | 7+0 – 7+6 | 110/122 | 12 | miscarriage at 10 weeks DCDA |

TTTS – Twin-to-twin transfusion syndrome

In case number 7 very slow heart rate as 24 beats per minute was observed after fetal demise of one twin. Furthermore, on the scan next day death of both fetuses was confirmed. The data show that the rate of fetal death in the first trimester of twin pregnancy increases progressively with a decreasing heart rate. In our work, an unfavorable outcome of a pregnancy was observed in 5.8% (in 4 cases out of 69) when the fetal heart rate was above 120 beats/min and in 50% (in 6 cases out of 12) when the fetal heart rate was between 120-110 beats/min. In our study, none of the twins survived when the observed rate of the fetal heart was less than 110 beats per minute (8 cases).

DISCUSSION

The incidence of miscarriage in the first trimester of a singleton pregnancy is assumed to be around 10 to 20% [12,13]. However the real percentage is unknown due to early losses of pregnancy which usually occurs before ultrasound conformation. For the same reasons the true frequency of miscarriage of twins also remains difficult to assess. Stoeckel (1945) was the first who suggested that the proportion of twin pregnancies conceived can be much larger than those observed at the actual birth: *„... it seems that the twins are more often conceived than born, which idea is supported by the presence of fetus papyraceus. It may also happen that in the event of death in early twin pregnancy, the tissues will be completely absorbed without leaving any trace”* [14]. Many years later Boklage (1995) stated that *„... the loss of one member of a pair of twins can simply be understood as an expression of a highly imperfect human reproductive biology. Most human conception in fact die before birth. It is not different and not more mysterious in case of twins”* [15].

In 1998, Landy and Keith had reviewed published studies on this topic since 1990. Most of them was focused on pregnancies resulting from ART. They found that approximately 30% of twin pregnancies were finished as a singleton pregnancy and 10% were miscarried [16]. Furthermore, in comparison with dichorionic twins, monochorionic twin pregnancies have higher percentage of fetal loss [17].

In our study 11 cases (12%) out of 89 ended with one or both fetuses death. In the first stage of heart development inherent myogenic activity is likely to dominate, with very high continuous vascular resistance and a rapid he-

art rate [18]. However, from the moment of developing neurogenic regulation a decrease in heart rate occurs. This is not only due to the functional maturation of the parasympathetic system, but also because of an extension of the vascular bed and the development of secondary connections in the chorion, yolk-sac, the vessels of umbilical cord and within the embryo [19].

Tests using M-mode techniques have shown that in 6 weeks of properly developing singleton pregnancy embryonic heart rate is around 100-120 beats/min. In the next 2-3 weeks it increases gradually, reaching its maximum at 8 weeks, and then gradually slows down [11,20-22].

We found in our material that the heart rate of embryos/fetuses in the first trimester of uncomplicated twin pregnancy progressively increases between 6 and 8 weeks of pregnancy reaches the nadir of 170 beats per minute in week 8, and then slows down to 150 beats per minute in week 11. The biggest difference in heart rate between pair of twins was found between 6 and 7 weeks of pregnancy. Later in pregnancy up to 11+6 weeks the difference was similar and remained low.

Numerous studies have shown a strong correlation between slow heart rate of the embryo / fetus and its intrauterine death [2,10, 23-25]. Was proven that bradycardia is an independent risk factor for fetal death as a reflection of failure of the cardiovascular system. Another likely cause of the high rate of miscarriages in case of abnormal FHR (fetal heart rate) may be presence of chromosomal abnormalities such as trisomy 18 or triploidy, which are often accompanied with bradycardia in the fetus [26,27].

According to Doubilet and Benson heart rate below 100 beats per minute before 6+3 weeks or less than 120 in 6+3-7+0 weeks meant an increased risk of death within the first trimester. The prognosis was particularly bad in case of FHR less than 80 beats per minute prior to 6+3 weeks or less than 100 beats per minute in 6+3-7+0 weeks [9]. On the other hand, if an embryo with a slow heart rate remained alive until the end of the first trimester it was very likely to be born healthy [13].

Different results were obtained by Arleo and Troiano. According to them, diagnosing in the embryo between 5+0 and 6+1 weeks of gestation FHR below 100 beats per minute does not necessarily have to result in poor prognosis. In their material, more than half (55.6%) of the

fetuses with a slow heart rate survived the first trimester [22].

In our group in twin pregnancies complicated by intrauterine death of one or both twins heart rate was below 120 beats/min. The slowest heart rate which was noted was 24 beats/min and was found in MCDA twins after death of the one twin. This fetus has died next day.

Our data shows that the percentage of fetal death in the first trimester of twin pregnancy increases with decreasing of the fetal heart rate. In our group none of twins have survived if heart rate was below than 110 beats/min and half of fetuses have died when rate was between 110 and 120 beats/min. We found out that the difference in the heart rate is as important as the heart rate itself. In pregnancies with a significant difference in heart rate (20 or more beats/min), the outcome of the pregnancy was unfavorable (death or TTTS syndrome). In two cases with the fetal heart rate more than 120 beats/min and high difference in the heart rate TTTS syndrome was observed later in pregnan-

cy. Perhaps it can be an early sign of TTTS, unfortunately, we cannot confirm this fact as only two cases were noted. As Rauch et al [28], we believe that the measurement of the fetal heart rate in the first trimester of pregnancy is a useful method of assessing the prognosis of further development of pregnancy. Pregnant women with a low heart rate [$<110/\text{min}$] between 5 and 8 weeks of a twin pregnancy should be informed that they are at high risk of pregnancy loss by the end of the first trimester. Furthermore, the difference in heart rate between twins is also important and should be noted.

CONCLUSIONS

The heart rate in twin pregnancy more than 120 beats per minute is connected with a good prognosis, whereas below 110 beats per minute with a poor prognosis. Furthermore, the significant difference in fetal heart rate (20 beats/min or more) can be a marker of developing TTTS syndrome later in pregnancy.

REFERENCES

1. Laboda LA, Estroff JA, Benacerraf BR. First trimester bradycardia: a sign of impending fetal loss. *J Ultrasound Med.* 1989;8:561-563.
2. Howe RS, Isaacson KJ, Albert JL, Coutifaris CB. Embryonic heart rate in human pregnancy. *J Ultrasound Med.* 1991;10:367-71.
3. May DA, Sturtevant NV. Embryonic heart rate as a predictor of pregnancy outcome: a prospective analysis. *J Ultrasound Med.* 1991;10:591-3.
4. Merchiers EH, Dhont M, DeSutter PA, et al. Predictive value of early embryonic cardiac activity for pregnancy outcome. *Am J Obstet Gynecol.* 1991;165:11-14.
5. Montenegro N. Anatomico-physiopathology of fetoplacental circulations. Clinical implications of Doppler flowmetry. PhD Thesis, Porto, 1993.
6. Wisser J, Dirschedl P. Embryonic heart rate in dated human embryos. *Early Hum Dev.* 1994;37:107-115.
7. Rempen A. Diagnosis of viability in early pregnancy with vaginal sonography. *J Ultrasound Med.* 1990;9:711-716.
8. Achiron R, Tadmor O, Mashiach S. Heart rate as a predictor of first-trimester spontaneous abortion after ultrasound proven viability. *Obstet Gynecol.* 1991;78:330-333.
9. Doubilet PM, Benson CB. Embryonic heart rate in the early first trimester: what rate is normal? *J Ultrasound Med.* 1995;14:431-434.
10. Stefos TI, Lolis DE, Sotiriadis AJ, Ziakis GV. Embryonic heart rate in early pregnancy. *J Clin Ultrasound.* 1998;26:33-36.
11. Hamela-Olkowska A, Więch K, Jalinik K, et al. Evaluation of the embryonic and foetal heart rate at 6+0 to 11+6 weeks of gestation. *Ginekol Pol.* 2009;80:188-192.
12. Rauch ER, Schattman GL, Christos PJ, et al. Embryonic heart rate as a predictor of first-trimester pregnancy loss in infertility patients after in vitro fertilization. *Fertil Steril.* 2009;91:2451-2454.
13. Tummers P, De Sutter P, Dhont M. Risk of spontaneous abortion in singleton and twin pregnancies after IVF/ICSI. *Hum Reprod.* 2003;18(8):1720-1723.
14. Stoeckel W. *Lehbuch der Geburtshilfe.* Gustav Fisher, Jena, 1945:258.
15. Boklage CE. The frequency and survival probability of natural twin conceptions. In Keith, L.G., Papiernik, E., Keith, D.M. (eds) *Multiple pregnancy: epidemiology, gestation, and perinatal outcome.* Parthenon, New York, 1995:4150.
16. Landy HJ, Keith LG. The vanishing twin: a review. *Hum Reprod.* 1998;4:177-183.
17. Sebire NJ, Snijders RJ, Hughes K, et al. The hidden mortality of monochorionic twin pregnancies. *Br J Obstet Gynecol.* 1997;104:1203-1207.
18. Clark EB, Hu N. Hemodynamics of the developing cardiovascular system. In Bockman DE, Kirby ML, eds. *Embryonic Origins of Defective Heart Development.* New York: The New York Academy of Sciences, 1990:41-47.
19. Baschat A, Gembruch U. Development of fetal cardiac and extracardiac Doppler flows in early gestation. In: *Fetal cardiology.* Ed. Yagel S, Silverman N, Gembruch U. London: Martin Dunitz, 2003:121-139.
20. Hanprasertpong T, Phopong V. First trimester embryonic/fetal heart rate in normal pregnant women. *Arch Gynecol Obstet.* 2006;274:257-260.
21. Laboda LA, Estroff JA, Benacerraf BR. First trimester bradycardia: a sign of impending fetal loss. *J Ultrasound Med.* 1989;8:561-563.
22. Arleo EK, Troiano RN. Outcome of Early First-Trimester Pregnancies (< 6.1 Weeks) With Slow Embryonic Heart Rate. *AJR* 2011;197:252-255.
23. Benson CB, Doubilet PM. Slow embryonic heart rate in early first trimester: indicator of poor pregnancy outcome. *Radiology* 1994;192:343-344.

24. **Falco P, Milano V, Pilu G, et al.** Sonography of pregnancies with first-trimester bleeding and a viable embryo: a study of prognostic indicators by logistic regression analysis. *Ultrasound Obstet Gynecol.* 1996;7:165-169.
 25. **Doubilet PM, Benson CB, Chow JS.** Long-term prognosis of pregnancies complicated by slow embryonic heart rates in the early first trimester. *J Ultrasound Med.* 1999;18:537-541.
 26. **Liao AW, Snijders R, Geerts L, et al.** Fetal heart rate in chromosomally abnormal fetuses. *Ultrasound Obstet Gynecol.* 2000;16:610-613.
 27. **Hyett JA, Noble PL, Snijders RJM, et al.** Fetal heart rate in trisomy 21 and other chromosomal abnormalities at 10-14 weeks of gestation. *Ultrasound Obstet Gynecol.* 1996;7:239-240.
 28. **Rauch ER, Schattman GL, Christos PJ, et al.** Embryonic heart rate as a predictor of first-trimester pregnancy loss in infertility patients after in vitro fertilization. *Fertil Steril.* 2009;91:2451.
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