Study of foetal heart rate patterns in pregnancy with intra-uterine growth restriction during antepartum period

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Abstract

Objectives: To evaluate foetal heart rate pattern during antepartum period in pregnancies suffering from intra-uterine growth restriction.

Methods: The case control study was conducted at the Alzahra Hospital, Tabriz, Iran from April 2008 to April 2011. It comprised 100 pregnancies with intra-uterine growth restriction and 92 normal pregnancies. The foetal heart rate pattern including basal heart rate, beat-to-beat variation, non-stress test (NST) result and acceleration and deceleration patterns of the heart rate were determined in both groups during the antepartum period. Findings were compared between the two groups and their relation with pregnancy-foetal outcomes was specified in the case group. SPSS 15 was used for statistical analysis.

Results: There was no statistically significant difference between the foetus mean basal heart rate in the two groups (p <0.960). Frequency of cases with non-reactive non-stress test in the Cases was significantly higher than Controls (p <0.005). The difference in heart rate acceleration was also not statistically significant (p <0.618). Frequency of cases with low birth weight and caesarian was non-significantly but borderline higher among the Cases (p <0.081 and 0.060, respectively).

Conclusion: Abnormal foetal heart rate pattern is more common in pregnancies marked by intra-uterine growth restriction and is directly associated with worse pregnancy/foetal outcomes.

Keywords: Intra-uterine growth restriction, Foetus heart rate, Pregnancy outcome. (JPMA 63: 865; 2013)

Introduction

Intra-uterine growth restriction (IUGR) is the defined as decrease of body mass to less than 3-10%. It is regarded as a sign of dangerous pregnancy due to complications resulting from delivery interventions.[1,2] The prevalence of this condition is observed in 3-10% of the born foetuses, but it varies in different populations; 4-8% in developed countries to 6-30% in the developing countries.[3,4] Several maternal, foetal and placental factors have been identified in IUGR, including chromosome and foetal structural abnormalities and infections (foetal factors); placenta separation, foundling placenta and placenta thrombosis (placental factors); thrombophlebitis and connective tissue diseases, hypertension and maternal chronic diseases (maternal factors).[5,6] IUGR is associated with foetal and maternal mortality. Evaluating the foetus heart condition to take the decision about the continuation or termination of pregnancy is the most important issue in the management of such pregnancies.[7] After an IUGR diagnosis, it is necessary to evaluate foetus regarding oxygenation and probability of hypoxia.[8] There are different methods to monitor or evaluate foetus condition, including sonography, to determine foetus biophysical profile, colour Doppler to evaluate blood provision of placental-uterine, foetal heart rate (FHR) pattern assessment using cardiotocography, and foetus serial sonography to evaluate foetus growth rate.[9,10] In this regard, cardiotocography is the easiest, cheapest and most available method for foetus evaluation. It is used widely in obstetrics as a method by which to monitor both the foetal heart and uterine contractions. It is used in conjunction with partograms to monitor labour, but is done at some third trimester appointment. It is, however, quite cumbersome and does restrict the movements of the woman to a couple of metres from the machine, which some women find annoying.[9,11,12] The current study was planned to demonstrate FHR patterns with restricted growth and those exposed to hypoxia through evaluating foetus cardiotocogram and its comparison with colour Doppler of foetal vessels as well as post-delivery results of IUGR foetuses.

Subjects and Methods

The case control study was conducted at Alzahra Hospital, Tabriz, Iran, from April 2008 to April 2011. Considering $\alpha=0.05$ and $\beta=0.1$, the sample volume was

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calculated as 100 cases in with IUGR and 100 normal pregnancies. The FHR pattern was determined and compared during the antepartum period. The cases of IUGR pregnancy, hospitalised due to termination of pregnancy or automatic starting of delivery and foetuses' cardiotocogram, were studied within 20-40 minutes and compared with the healthy Controls. The study was approved by the Ethical Committee of Tabriz University of Medical Sciences. Parameters studied included family financial status, gravid, parity, pregnancy age, rate of the reported growth restriction, amount of amniotic liquid, mother's body mass index (BMI), records of IUGR, records of stillbirth, records of previous abortion, records of abnormal foetus, records of pregnancy blood pressure, results of colour Doppler (uterine, umbilical and middle cerebral arteries), biophysical test score, results of cardiotocography (including basal heart rate, beat-to-beat variation, rate pattern and type), pregnancy termination age in the IUGR group, causes of pregnancy termination, type of delivery, neonate gender and its condition. The data was statistically analysed using SPSS 15. Depending on the conditions, categorical variables were compared using contingency tables, Chi-Square test or Fisher's exact test. Qualitative variables were compared using independent samples t-test or Mann-Whitney U-test. In all cases, $p \leq 0.05$ was regarded as significant.

Results

Eight (8%) women in the Control group left the study, and, as such, the group strength came down to 92. According to sonography, diagnosis time, median of pregnancy age, and amount of amniotic liquid were significantly more among the Controls (p <0.05). Also, records of IUGR and abnormal foetus in this group and records of previous abortion were significantly high (p <0.05). There was no statistically significant difference in other areas (Table-1). Colour Doppler results demonstrated resistance increase of uterine arteries in the Cases to be significantly high (p <0.001). Resistance increase in umbilical artery was also significantly high (p <0.001). Resistance increase in middle cerebral artery of the Cases was observed in 28 (28%) cases. Such a case was not reported in the other group. Frequency of cases with increased resistance in middle cerebral artery in IUGR group was significantly high (p <0.001). Mean biophysical test score in Cases and Controls was, respectively, 7.5±2.34 and 7.9±2.42. Mean biophysical test score in the Cases was significantly less than the Controls (p <0.007). Mean basal heart rate of foetus in Cases and Controls was, 138.5±34.22 per minute and 138.5±36.62 respectively. Statistically significant difference was not observed

Table-1: Pregnancy Baseline Data.

	Cases (n=100) N (%)	Control (n=92) N (%)	P-value
Economical Status			<0.915
Well	16 (16)	13 (14.1)	
Fair	68 (68)	65 (70.7)	
Weak	16 (16)	14 (15.2)	
Gravid	1.7±0.68	1.9±0.72	<0.399
Parity	0.5±0.12	0.6±0.24	<0.546
Pregnancy Age (week)	33.6±8.82	38.5±9.24	<0.001
Reported growth restriction (day)	27.6±9.4	-	-
Amount of amniotic liquid (cm)	8.2±3.12	13.3±4.36	<0.001
Mother's BMI	29.3±8.24	28.4±7.82	<0.275
Records of IUGR	5 (5)	0 (0)	<0.036
Records of stillbirth	3 (3)	1 (1.1)	<0.343
Records of abortion	3 (3)	15 (16.3)	<0.002
Abnormal foetus	7 (7)	0 (0)	<0.009
Records of pregnancy blood pressure	11 (11)	4 (4.3)	<0.086

IUGR: Intrauterine growth restriction. BMI: Body mass index.

Table-2: Reasons of pregnancy termination.

	IUGR (n=100) N (%)	Control (n=92) N (%)
IUGR	71 (71)	0 (0)
Foetus bradycardia	10 (10)	0 (0)
Preeclampsia	8 (8)	0 (0)
Mother's pain	7 (7)	36 (39.1)
Flowing of liquid	4 (4)	21 (22.8)
Term foetus	0 (0)	35 (38)

IUGR: Intrauterine growth restriction.

between the two groups considering the mean basal heart rate of the foetus (p <0.960). Non-reactive NST was seen in 11 (11%) and 1 (1.1%) foetus in the Cases and Controls, respectively. Non-reactive NST was significantly high in the Cases (p <0.005). Unnatural beat-to-beat variations of the foetus heart were observed in none of the groups. Acceleration of the foetus heart rate was reported in three foetuses in the two groups. The difference was not statistically significant (p<0.618). The mean acceleration rate was 176.7±45.82 and 176.7±44.68 in the Case and Control groups, respectively. Foetus heart rate deceleration was seen in 31 (31%) foetuses in the Case group and 10 (10.8%) foetuses of the Control group (p <0.001). Mean deceleration was 84.1±22.32 and 88.0±35.42 in the Case and Control groups, respectively (p <0.458). Late or variable heart rate deceleration was significantly high in the Cases (p <0.040). As for the causes of pregnancy termination, caesarian was reported in 83

(83%) of the cases and natural delivery in 17 (17%). In the Control group, 41 (44.6%) caesarian and 51 (55.4%) natural deliveries were reported. The frequency of caesarian was significantly high in the IUGR group (p<0.001) (Table-2). IUGR group had 49 (49%) baby girls and 51 (51%) baby boys, while there were 37 (40.2%) baby girls and 55 (59.8%) baby boys in the Control group (p <0.222). In the IUGR group, there were 94 alive and 6 dead neonates, while there were 100% live births in the Control group (p <0.019). Frequency of cases with low birth weight and caesarian was non-significantly, but borderline higher in the IUGR group suffering from heart rate deceleration. Frequency of cases with low birth weight and increased resistance of umbilical and middle cerebral arteries was significantly higher in the IUGR group with non-reactive NST.

Discussion

The frequency of women suffering from deceleration of heart rate in our study was significantly higher in the IUGR group (p<0.05). A study conducted on 953 foetuses, demonstrated that the frequency of women suffering from heart rate deceleration was significantly high in the IUGR group.[13] Contrary to the results of our study, indicating high frequency of cases suffering from late or variable heart rate deceleration in the IUGR group, all three types of heart rate deceleration in the IUGR group were reported more than that of the control group in this study. Additionally, the study revealed that frequency of cases with unnatural beat-to-beat variation was not statistically significant in the two groups.[13] Another study on 28 pregnancies with IUGR demonstrated that frequency of heart rate acceleration, unnatural beat-to-beat variation and frequency of heart rate deceleration in the IUGR group was meaningfully higher than the control group.[14] Another study on 57 foetuses with IUGR demonstrated that non-reactive NST was seen in 53 (93%) cases.[15] Frequency of cases with non-reactive NST in the above-mentioned study is very much higher than what has been observed in our study (11%). It should be noted that the above study is a relatively traditional one and more exact studies of foetus have been conducted with recent progresses. This leads to increase of diagnostic sensitivity of our study compared to the above-mentioned study. On the other hand, difference in the studied sample may play a role in this regard considering prevalence of other effective factors. The current study considered comparison of foetus heart rate in natural and IUGR pregnancies. One study in this regard demonstrated that non-reactive NST in cases with IUGR is accompanied by increase of caesarian due to foetal distress, foetal anomalies, low Apgar and prenatal mortality.[16] Another study showed that NST condition in these pregnancies had no relationship with foetus condition at birth time. At the same time, it reported a significant relationship between rate deceleration and increase of complications and prenatal mortality.[17] In one study, delayed heart rate deceleration was predictive of acidosis of foetus suffering from IUGR at birth time.[18] Another study evaluated the relationship of foetus heart rate pattern in IUGR pregnancies and findings of colour Doppler sonography of the umbilical artery and demonstrated that delayed heart rate deceleration had a direct relationship with blood circulation disorders of the umbilical artery.[19] Another study demonstrated that unnatural pattern of foetus heart rate in IUGR pregnancies, especially rate deceleration of late and variable type, predicts foetal acidosis and related complications.[20] A study on 257 foetuses with IUGR made clear that heart rate disorders are accompanied by premature delivery, low birth weight, foetus acidosis and, finally, worse general prognosis.[21]

Conclusion

Abnormal FHR pattern is more common in IUGR pregnancies and is directly associated with worse pregnancy/foetal outcomes.

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