Original Research Article

Heart Rate Variability in Pregnant Women with Anaemia

Lalitha V[1*], Parghavi V[2]

[1]Department of Physiology, Indira Gandhi Medical College & Research Institute (IGMC&RI), Pondicherry, Tamil Nadu, India

[2]Ex-MBBS Student, Indira Gandhi Medical College and Research Institute (IGMC&RI), Pondicherry, Tamil Nadu, India

Received: 19-10-2021 / Revised: 11-11-2021 / Accepted: 23-12-2021

Abstract

Background: Anaemia is one of the commonest hematological disorders during pregnancy. In developing country like India, anaemia contributes to a major percentage of maternal deaths. In the present study, we have assessed the cardiovascular autonomic functions using the short term heart rate variability analysis in South Indian pregnant woman with anemia. **Materials and methods:** Forty newly diagnosed pregnant women with anaemia were matched with forty normal pregnant women as controls. Anthropometric measurements were done. Lead II ECG was recorded with subject in left lateral position and short term heart rate variability (HRV) analysis was done. **Results**: Basal heart rate was significantly high in study group subjects. Among the frequency domain indices, total power and HFnu was significantly less in pregnant woman with anaemia (P<0.001). LFnu and LF-HF ratio was significantly high in pregnant woman with anaemia (P<0.001).The time domain indices namely SDNN, RMSSD, and PNN50 was significantly less in pregnant woman with anemia. **Conclusion**: Anaemia in pregnancy is associated with an altered autonomic tone. Hence, pregnant woman with anemia are prone for increased cardiovascular risks and autonomic dysfunctions.

Keywords: Anaemia, heart rate variability, pregnancy

Introduction

Anaemia is one of the commonest hematological disorders during pregnanc[1]. In developing country like India, anaemia contributes to a major percentage of maternal deaths[2]. It accounts for 10-15% of direct maternal deaths in India[2, 3]. Anaemia in pregnancy affects the health of both mother and the fetus[3, 4]. Pregnancy is associated with various adaptive cardiovascular changes and autonomic dysfunction[5, 6]. Pregnant women with anaemia are prone to increased cardiovascular risks[4, 5]. Hence, early assessment of cardiovascular health in pregnant woman with anaemia becomes mandatory. Autonomic nervous system plays an important role in the homeostasis of cardiovascular system. Heart rate variability is a simple non invasive technique to evaluate the cardiovascular risks and to assess the autonomic functions[7].

Previous studies have reported autonomic dysfunction in the form of increased sympathetic activity and reduced parasympathetic activity in pregnant women with anaemia in western population[5]. However, till date no such studies have been conducted in South Indian pregnant women with anaemia to know whether their autonomic functions are altered or not. If there is an autonomic dysfunction, the exact nature of change in autonomic function is not yet studied. Therefore, in the present study we have planned to assess the cardiovascular autonomic functions using the short term heart rate variability analysis in South Indian pregnant woman with anemia.

Materials & methods

Study design

The present analytical cross-sectional study was carried out in the Department of Physiology, IGMC and RI, Pondicherry.

*Correspondence
Dr. Lalitha V
Department of Physiology, Indira Gandhi Medical College & Research Institute (IGMC&RI), Pondicherry, Tamil Nadu, India
E-mail: lalitha.jipmer2010@gmail.com

After obtaining the approval from the Institute Research committee and Ethics Committee, a total of 80 pregnant women belonging to the second trimester of pregnancy (13-28 weeks of gestation) who visited the out-patient department of Obstetrics and Gynaecology of IGMC and RI were recruited for the study. They were divided into two groups: Control group and Study group. Control group consists of 40 normal pregnant woman (n= 40) and Study group consists of 40 newly diagnosed pregnant woman with anaemia (Classification of anaemia was based on WHO criteria for anaemia in pregnant women). Pregnant women with hypertension, gestational diabetes mellitus, any other chronic medical illness, multiple pregnancies and pregnant women already on iron therapy were excluded from the study.

The Subjects were asked to report to the research laboratory of Physiology department of IGMC&RI about two hours after a light breakfast. The entire procedure was explained to the subjects and a written informed consent was obtained from them. Age, height and weight of the subjects were recorded and their body mass index (BMI) was calculated. Basal heart rate, systolic blood pressure (SBP) and diastolic blood pressure (DBP) was recorded using Omron (SEM 1 Model) automatic BP monitor (Omron Healthcare Co. Ltd, Kyoto, Japan).

HRV recording

Short-term HRV recording was performed using lead II electrocardiogram (ECG), following the standard procedure as per the recommendation of Task Force[8]. ECG electrodes were connected and Lead II ECG of the subjects in left lateral position was recorded for a period of five minutes. The data acquisition was performed using BIOPAC MP100 (BIOPAC, Goleta, CA, USA) with AcqKnowledge software version 3.8.2. Lead II ECG was obtained at the rate of 1000 samples/s per channel. RR tachogram was performed for frequency domain (by power spectral analysis using fast Fourier transformation) and time domain measures using the software from the Biomedical Signal Analysis Group ver. 1.1 (Kuopio, Finland). The frequency domain indices of HRV such as total power (TP), LF in normalized units (LFnu), HF in normalized units (HFnu) and the ratio of LF to HF (LF-HF ratio) were recorded. The time domain

measures such as mean RR (mean of RR interval), the square root of the mean of the sum of the squares of the differences between adjacent NN intervals (RMSSD), standard deviation of RR interval (SDNN), the number of pairs of adjacent NN intervals differing by more than 50 msec in the entire recording (NN50) and the percentage of NN50 counts, given by NN50 count divided by total number of all NN intervals (pNN50) were recorded[9, 10].

Statistical analysis of data

Data were expressed as mean ± Standard deviation (SD). Analysis of data was done by two-tailed unpaired Student't' test using Graph pad InStat (Version 3, USA) software. The probability of chance (p value) less than 0.05 was considered statistically significant.

Results

Table 1 shows the age, BMI, cardiovascular parameters and hemoglobin status between the control group and study group. There was no significant difference in age, body weight, BMI, SBP & DBP between the subjects of control group and study group. However, BHR was significantly more in the study group.

Table 1: Age, BMI, cardiovascular parameters and hemoglobin status in control group (normal pregnant woman) and study group (pregnant woman with anaemia)

Parameters	Control group (n=40)	Study group (n=40)	P value
Age (Yrs)	25.12 ± 2.20	25.68 ± 3.92	0.4331
Height (Cm)	156.24 ± 3.58	157.18 ± 4.61	0.3116
Weight (Kg)	60.22 ± 8.11	61.84 ± 7.28	0.3501
BMI (Kg/m^2)	24.16 ± 5.36	25.08 ± 6.31	0.4843
BHR (per min)	72.16 ± 2.24	86.24 ± 1.82	<0.0001
SBP (mmHg)	108.26 ± 10.84	112.48 ± 9.72	0.0706
DBP (mmHg)	78.14 ± 3.44	76.98 ± 2.96	0.1100
Hemoglobin (gm/dL)	12.08 ± 2.66	9.84 ± 1.76	<0.0001

Data are expressed as mean±SD. Analysis of data was done by unpaired Student's 't' test. $P < 0.05$ was considered significant. BHR: Basal heart rate, BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure.

Table 2 shows the HRV indices in control group and study group. Among the frequency domain indices, total power (TP) was significantly less in the study group subjects. LFnu was significantly more and HFnu was significantly less in study group when compared to control group. LF-HF ratio was significantly high in the study group. Time domain indices namely RMSSD, SDNN, NN50 and pNN50 was significantly less in the study group when compared with the control group.

Table 2: HRV indices in control group (normal pregnant woman) and study group (pregnant woman with anaemia)

Parameters	Control group (n=40)	Study group (n=40)	P value
Frequency domain indices			
TP (ms^2)	246.24 ± 12.56	232.76 ± 8.31	<0.0001
LFnu	45.18 ± 2.36	52.76 ± 5.12	<0.0001
HFnu	51.62 ± 8.70	44.28 ± 6.18	<0.0001
LF-HF ratio	1.32 ± 0.78	1.94 ± 0.34	<0.0001
Time domain indices			
RMSSD	29.68 ± 5.72	20.26 ± 4.48	<0.0001
SDNN	26.12 ± 2.14	20.48 ± 1.78	<0.0001
NN50	28.62 ± 4.28	18.24 ± 3.86	<0.0001
pNN50	12.48 ± 2.82	8.46 ± 1.92	<0.0001

Data are expressed as mean±SD. Analysis of data was done by unpaired Student's 't' test. $P < 0.05$ was considered significant.TP: Total power of HRV, LFnu: Normalized low-frequency (LF) power, HFnu: Normalized high-frequency (HF) power, RMSSD: The square root of the mean of the sum of the squares of the differences between adjacent NN intervals, SDNN: Standard deviation of normal to normal interval, NN50: The number of interval differences of successive NN intervals greater than 50, pNN50: The proportion of derived by dividing NN50 by the total number of NN intervals.

Discussion

In the present study, we have assessed the heart rate variability (HRV) in pregnant woman with anaemia using the short term HRV analysis. In table 1, basal heart rate was significantly more in pregnant woman with anaemia. Basal heart rate is a measure of vagal function[11, 12]. Increase in basal heart rate in the study group indicates decreased parasympathetic activity in them. Recently, increase in basal heart rate is considered as a cardiovascular risk factor for all cause mortality[11,13].In Table 2, among the frequency domain indices, TP represents the magnitude of heart rate variability and vagal tone[11, 14, 15]. Hence, decrease in TP in pregnant woman with anaemia indicates a decrease in overall HRV and reduced parasympathetic activity in them[11, 16]. Decrease in TP is recently associated with cardiac morbidity and sudden cardiac death[11,16]. Decrease in HFnu and increase in LFnu in study group subject shows that there is both sympathetic activation and vagal withdrawal in pregnant woman with anaemia as LFnu represents sympathetic component and HFnu represents parasympathetic component to the heart[11,14,15]. LF-HF ratio is the index of SVI and increase in this ratio indicates sympathetic overactivity in pregnant woman with anaemia[11, 14, 15]. This is further supported by significantly less value in time domain indices namely RMSSD, SDNN, NN50 and pNN50 in pregnant woman with anaemia. Decrease in RMSSD, SDNN, NN50 and pNN50 shows that there is a decreased parasympathetic drive in pregnant woman with anaemia as time domain indices represent the vagal modulation of the heart[11, 14, 15]. Hence, all these findings strongly suggest that there is sympathovagal imbalance in pregnant woman with anaemia in the form of sympathetic overactivity and decreased vagal tone.

Conclusion

To conclude, anaemia in pregnancy is associated with an altered autonomic tone. Hence, pregnant woman with anemia are more prone for autonomic dysfunctions and increased cardiovascular risks than normal pregnant woman. Early identification of anaemia during pregnancy and prompt treatment with iron can reduce the incidence of autonomic dysfunctions in pregnant woman with anaemia and thereby, reduce the risk of CV diseases in them. HRV can be used as a cardiovascular marker to assess the cardiovascular risks in pregnant

woman with anaemia and it can also be included as one of the routine investigations done for pregnant woman.

Limitations of the study

The major limitation of the study is that we have assessed the HRV in pregnant woman with anaemia belonging to second trimester of pregnancy. We have not included pregnant woman belonging to first and third trimester of pregnancy. We have included only pregnant woman with mild degrees of anaemia. We have not studied the HRV of pregnant woman with moderate and severe anaemia.

Future perspectives

In future studies, we would like to compare the HRV of pregnant woman with mild, moderate and severe anaemia and compare the changes across the three trimesters of pregnancy.

References

1. Dutta DC. Medical and surgical illness complicating pregnancy. In: Textbook of Obstetrics. New Central Book Agency. Calcutta. 6th edition. 2004; 262 – 273.
2. Mudaliar and Menon's. Anemia in pregnancy. In: Clinical obstetrics. Orient Longman private limited. Hyderabad. 2005; 147-150.
3. Talaulikar VS, Arulkumaran S. Folic acid in obstetric practice: a review. Obstetric Gynecol Survey. 2011 Apr 1; 66(4):240-7.
4. Lalitha V, Priyadharsini R, Parghavi V. A study on rate pressure product in south Indian pregnant women with anaemia. Int J Adv Med 2018; 5: 1922-27.
5. Jigna K, Hetal Desai. Spectral heart rate variability during late gestation in moderately anemic pregnancy. NJIRM. 2015; 6(2): 10-14.
6. Solanki JD, Desai FH, Desai KH. Heart rate variability is reduced in normal pregnancy irrespective of trimester: A cross-sectional study from Gujarat, India. J Family Med Prim Care 2020;9: 626-31.
7. Pal GK: Heart rate variability. In: Comprehensive Textbook of Medical Physiology, 1st ed, New Delhi, Jaypee Publication, 2017, vol 1: pp –317-324.
8. Heart rate variability: Standards of measurement, physiological interpretation and clinical use. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Circulation 1996; 93: 1043–1065.
9. Saranya K, Pal GK, Habeebullah S, Pal S. Assessment of cardiovascular autonomic function in patients with polycystic ovary syndrome. J. Obstet. Gynaecol. Res. Vol. 40, No. 1: 192–199.
10. Yildirir A, Kabakci G, Akgul E, Tokgozoglu L, Oto A. Effects of menstrual cycle on cardiac autonomic innervation as assessed by heart rate variability. Ann Noninvasive Electrocardiol 2002; 7: 60–63.
11. Pal GK, Habeebullah S, Pal S, Subha M, Saranya K, Nanda N. Practice of alternate-nostril breathing (Anuloma-viloma Pranayama) attenuates the development of hypertension and cardiometabolic dysfunctions during pregnancy in women having risk factors for pregnancy-induced hypertension. Int J Clin Exp Physiol. 2018; 5(4): 189-95.
12. Jensen MT, Suadicani P, Hein HO, Gyntelberg F. Elevated resting heart rate, physical fitnessand all-cause mortality: a 16-year follow-up in the Copenhagen male study. Heart. 2013;99(12):882-7.
13. Ganong WF. Cardiovascular regulatory mechanisms. In: Review of Medical physiology .22nd ed. San Francisco: McGraw Hill.2005; 597-602.
14. Mallaini A. Heart rate variability: from bench to bedside. Europ J Int Med 2005;16(1):12-20.
15. Kiviniemi AM, Tulppo MP, Witchterle D, Hautala AJ, Tiananen S, Seppanen T, et al. Novel spectral indices of heart rate variability as predictors of sudden and non-sudden cardiac death after an acute myocardial infarction. AnnMed. 2007; 39(1): 54-62.
16. Lambert E, Sari CI, Dawood T, Nguyen J, McGrane M, Eikelis N, et al. Sympathetic nervous system activity is associated with obesity-induced subclinical organ damage in young adults. Hypertension. 2010; 56(3): 351-8

Conflict of Interest: Nil Source of support: Nil