Original Research Article

Cardiopulmonary and hematological parameters in pregnancy

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Abstract

Introduction: We have studied cardiopulmonary and hematological parameters in pregnancy, such as electrocardiographic parameters, peak expiratory flow rates and packed cell volumes in 1st, 2nd and 3rd trimesters of pregnancy.

Material and methods: 50 consecutive normal healthy pregnant women in 1st, 2nd and 3rd trimester each, between 20- 30 years and 50 normal non-pregnant women of the same age group were enrolled. All subjects underwent onetime ECG, pulmonary function tests and complete hemogram.

Results: Heart rate statistically significant increased in pregnant women in 1st, 2nd and 3rd trimester when compared to controls ($p < 0.01$). PR interval showed statistically significant decrease in pregnant women in 2nd trimester and 3rd trimester when compared to controls ($p < 0.01$). QTc showed statistically significant increase in pregnant women all the trimesters when compared to controls with ($p < 0.01$). QRS frontal axis showed statistically significant decrease in pregnant women of 1st trimester, 2nd trimester ($p < 0.01$) and 3rd trimester ($p < 0.01$) when compared to controls. PEFR values showed statistically highly significant decrease in pregnant women of 1st trimester, 2nd trimester and 3rd trimester when compared to controls with ($p < 0.001$). PCV values showed statistically significant decrease in pregnant women 0f 1st Trimester, 2nd trimester and 3rd trimester when compared to controls with ($p < 0.01$).

Conclusion: We found a statistically significantly increase in the HR QTc, PEFR, PCV and a decrease in PR interval in 1st, 2nd and 3rd trimesters of pregnancy as compared to controls. Additionally, QRS frontal axis was also deviated to left side with advancing pregnancy.

Key words

Electrocardiography, Pulmonary function, Hematology, Trimesters, Pregnancy.

Introduction

Normal pregnancy is characterized by profound changes in almost every organ system to ensure the fetus grows properly and receives adequate nutrition. Altered physiological findings and such findings can be misinterpreted as pathological changes in reference to pre-pregnancy standards [1, 2]. Additionally, assessment of these adaptations in normal women during pregnancy is also necessary for better antenatal care, in the assessment of fitness for surgery and to know the progress of pre-existing disease [3-7]. To this purpose we studied cardiopulmonary and hematological parameters in pregnancy, such as electrocardiographic parameters, peak expiratory flow rates and packed cell volumes in 1st, 2nd and 3rd trimesters of pregnancy.

Materials and methods

The study was conducted in the Physiology department, Kakatiya Medical College, Warangal. Ethical committee has approved the study protocol. 50 consecutive normal healthy pregnant women in 1st, 2nd and 3rd trimester each, between 20- 30 years and 50 normal non-pregnant women of the same age group were enrolled. Following an explanation about the nature and purpose of the study, those subjects who gave written informed were enrolled. Normal healthy pregnant women in 1st, 2nd and 3rd trimester between 20-30 years of age were included. Subjects were excluded if they were less than 20 and more than 30 years and / or with any organic cardiac disease, renal disease, severe anemia, thyroid disease, diabetes and hypertension. Relevant information which includes demographic and clinical data from each individual was recorded in a pretested structured proforma. Then these subjects underwent a detailed physical and systemic examination. Physical examination includes measuring height in centimeters, weight in kilograms, and recording of resting pulse rate by palpating the radial artery and blood pressure recording with a mercury sphygmomanometer using the appropriate sized cuff. Clinical examination of the cardiovascular system and respiratory system was done in detail. Data acquisition was performed in the morning. ECG was recorded using "Digital Physiograph the Lab Tutor". It is an HTML-based software package, designed specifically for laboratory teaching and used in conjunction with ADInstruments' Power Lab. The recorded ECG was evaluated for different parameters such as heart rate, PR interval, QT, QTc interval and QRS axis deviation. Peak expiratory flow was monitored using small hand held apparatus with a mouthpiece at one end and a scale with a moveable indicator. This test was performed three times with Wright peak flow meter (Clement Clarke) and the highest value of PEFR from three accurately performed blows was measured. The PCV can be measured by centrifuging heparinized blood in a capillary tube at 10,000 rpm for five minutes. This separates the blood into layers. The volume of packed red blood cells divided by the total volume of the blood sample gives the PCV. Since a tube is used, this can be calculated by the lengths of the layers.

Statistical analysis

Results are analyzed with the help of Graph pad calculator and expressed as Mean ± SD for continuous data and number and percentages for categorical data. One way ANOVA was used for multiple group comparisons followed by 'Post – hoc – Tukey' test for group – wise comparisons.

Categorical data was analyzed by Chi – square test. A two tailed p value less than 0.05 was considered statistically significant.

Results

The results were as per **Table - 1**. Heart rate showed statistically significant increase in pregnant women in 1st, 2nd and 3rd trimester when compared to controls ($p < 0.01$). There was also statistically significant increase in heart rate in pregnant women in third trimester when compared to pregnant women in second trimester and first trimester ($p<0.01$). PR interval showed statistically significant decrease in pregnant women in 2nd trimester and 3rd trimester when compared to controls ($p < 0.01$).There was also statistically significant decrease in PR interval in pregnant women in 3rd trimester when compared to pregnant women in 2nd trimester and 3rd Trimester ($p < 0.01$). There was slight increase in QT interval in pregnant women in third trimester, there was no statistical significance when values of controls, pregnant women in 1st trimester, 2nd trimester and pregnant women in 3rd trimester were compared ($p > 0.05$). QTc showed statistically significant increase in pregnant women 0f 1st trimester, 2nd trimester and 3rd trimester when compared to controls with ($p < 0.01$). There was also statistically significant increase in QTc interval in pregnant women in 3rd trimester when compared to pregnant women in 2nd trimester and 1st trimester. ($p < 0.05$). QRS frontal axis showed statistically significant decrease in pregnant women of 1st trimester, 2nd trimester ($p < 0.01$) and 3rd trimester ($p < 0.01$) when compared to controls. There was no statistically significant difference between pregnant women in 1st trimester, 2nd trimester and pregnant women in 3rd trimester ($p > 0.05$). PEFR values showed statistically highly significant decrease in pregnant women of 1st Trimester, 2nd trimester and 3rd trimester when compared to controls with ($p < 0.001$). There was also statistically significant decrease in PEFR values of pregnant women in 3rd trimester when compared to pregnant women in 2nd trimester and 1st trimester. ($p < 0.01$). PCV values showed statistically significant decrease in pregnant women 0f 1st Trimester, 2nd trimester and 3rd trimester when compared to controls with ($p < 0.01$). There was also statistically significant decrease in PCV values of pregnant women in 3rd trimester when compared to pregnant women in 2nd trimester and 1st trimester. ($p < 0.01$).

Table – 1: Comparison of parameters between non-pregnant and pregnant groups

	Controls [A]	**1st TM [B]**	**2nd TM [C]**	**3rd TM [D]**	**Differences between groups**				
					A-B	A-C	A-D	B-C	B-D
Age (years)	24.7 ± 2.2	24.1 ± 2.4	24.3 ± 2.6	25.5 ± 2.8	n	n	n	n	n
HR (b/m)	79.0 ± 6.60	84.2 ± 6.40	87.2± 6.16	94.2 ± 8.5	**	**	**	**	**
PR (sec)	0.15 ± 0.01	0.14 ± 0.02	0.13± 0.02	0.12 ± 0.02	**	**	**	**	**
QT (sec)	0.35 ± 0.02	0.35 ± 0.01	0.35 ± 0.01	0.36 ± 0.01	n	n	n	n	n
QT_C	0.38 ± 0.01	0.39 ± 0.01	0.40± 0.01	0.41 ± 0.01	**	**	**	**	**
QRS (degrees)	64.10 ± 6.8	57.0 ± 12.5	53.0 ± 16.7	45.9 ± 22.1	**	**	**	N	N
PEFR (Lit/min)	331.46 ±40.84	297.52±32.81	234.77±34.44	183.81±33.90	**	**	**	**	**
PCV %	38±2	33 ± 2	31 ± 2	29 ± 3	*	*	*	*	*

*=p<0.05, **= p<0.01, n=P>0.05

Discussion

Pregnancy is associated with remarkable changes in the cardiovascular system. The ECG during normal pregnancy may show wide variation from the normal limits even in the absence of demonstrable heart disease. This can be due to the altered spatial arrangement of the chest organs, and electrical properties of the myocardium are due to change in sympathetic and hormonal modulation of the electrical activity of the heart during pregnancy. It is also interesting to note that pregnancy may be associated with a concentric enlargement of the left ventricle in response to the hemodynamic requirements, which can explain these ECG changes [8-10].

In this study, we found linear increase in HR across 1st, 2nd and 3rd trimester pregnant women who were statistically significant as compared to controls as well as between trimesters. Pregnancy is associated with dramatic cardiovascular adaptations like increase in HR .This increase in HR is linked to autonomic nervous system changes that produce alterations in cardiac autonomic modulation such an association was seen in early pregnancy where the initial change in HR may be linked to the production of chorionic gonadotropin, with the later gradual increase being related to the vascular changes which accompany placental and fetal growth [11].This increased in heart rate during third trimester compensates for the fall in stroke volume resulting from caval compression [12]. Additionally, the cardiac output increases as early as 5 weeks and rises to 45% above the baseline at 24 weeks of gestation.

We also observed that PR interval significantly decreased in pregnant women of 1st, 2nd and 3rd trimesters when compared to controls. Furthermore, significant decrease in PR interval was also observed in pregnant women in 3rd trimester when compared to pregnant women in 2nd trimester and 1st trimesters. The decrease in PR interval during pregnancy could be due to shortening of AV conductance with respect to increase in heart rate that accompany during pregnancy [13-14]. QT Interval a marker for ventricular depolarization and repolarization was in pregnant women during 1st, 2nd and 3rd trimesters when compared to controls. However when corrected to heart rate QTc showed a significant increase in the pregnant women of 1st, 2ndand 3rd trimesters when compared to controls. It is possible that the increase in QTC may be due to increase in HR. This could be linked to changes in ventricular depolarization and repolarization patterns during pregnancy and they must be considered as a complex consequence with changes in regulatory mechanisms during normal pregnancy [15-17]. It can be concluded that prolonged QTc is simply just as a non specific sign of changed course of repolarization [8, 18]. In pregnancy, the change in the electrical axis can be raising diaphragm as pregnancy advances, left shift of apical impulse of axis due to changes in the left ventricular size and mass with associated increased volume, elevation and rotation of the heart, resulting from the enlarging uterus [8-10, 13-14], Similarly we also observed, a significant decrease in QRS frontal axis in pregnant women of 1st, 2ndand 3rd trimesters when compared to controls.

There was a decline in mean PEFR as the pregnancy advances from 1st to 3rd trimester and this decline was significant when compared to controls as well as between trimesters. Similar was observation was noted in the earlier studies on PEFR in pregnancy [19, 20, 21-31]. The decrease in PEFR may be attributed to upward displacement of the diaphragm, increased metabolic rate, changes in the mechanics of breathing, and increases in progesterone level [32, 33].

This study has shown that in pregnancy hemorrheologic activity differs significantly due to increased values of PCV as compared to non-pregnant subjects. Likewise, there was also statistically significant increase in PCV in pregnant women in 3rd trimester when compared to pregnant women in 2nd trimester and 1sttrimester. This increase in PCV could be due to marked increase in plasma volume associated

with normal pregnancy causing dilution of many circulating factors and cells resulting in physiological anemia [34-37].

Conclusion

We found a statistically significantly increase in the HR QTc, PEFR, PCV and a decrease in PR interval in 1st, 2ndand 3rd trimesters of pregnancy as compared to controls. Additionally, QRS frontal axis was also deviated to left side with advancing pregnancy. Our study provides a quick look into the variety of adaptations in cardiopulmonary and hematological systems during normal pregnancy which brings about changes in even in the absence of any disease.

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