

**Research Article**

## **COMPARATIVE STUDY OF SYSTOLIC TIME INTERVAL IN NON PREGNANT AND PREGNANT WOMEN OF FIRST, SECOND AND THIRD TRIMESTER**

**\*Prem Lata Puri and Ram Sarup Sharma**

<sup>1</sup>Department of Physiology, MAMC, Agroha (Hissar),

<sup>2</sup>Department of Physiology, GMC, Amritsar

*\*Author for Correspondence*

### **ABSTRACT**

The changing pattern of life style in the modern age aggravates physical and mental stress and strain which leads to increase the incidence of heart diseases as well as morbidity and mortality. Complications during pregnancy and delivery are major public health problems these days both in developing and developed countries. Many studies indentify that the blood pressure and malnutrition are important risk factors for the cardiovascular diseases and mortality which are due to the deranged left ventricular performance. In present study systolic time interval in first, second and third trimester were studied in pregnant and non pregnant women to find out the time during which cardiac functions starts deteriorating.

**Keywords:** *QS<sub>2</sub>-I -Electromechanical Systole Index, LVET-I- Left Ventricular Ejection Time Index PEP-I - Pre-ejection Period Index, PEP/LVET ratio - Pre-ejection period/left Ventricular Ejection Time Ratio*

### **INTRODUCTION**

Pregnancy is a physiological process which imposes a good deal of functional strain on the cardiovascular system. Many important and reversible changes take place in the cardiovascular dynamics of the body during normal pregnancy. There occurs progressive increase in cardiac output throughout the pregnancy and it comes to pre-pregnancy level in about two weeks after post-partum. This increased cardiac output is achieved partially by increased heart rate and to a greater extent by increase in stroke output (Hamilton, 1951; Adam, 1954).

The maximum increase in the blood volume is about 30%, plasma contributes 40% and erythrocytes about 20%, the latter may continue to increase till term (Caton *et al.*, 1951). Blood pressure shows no change during pregnancy although at times both systolic and diastolic levels tend to decline slightly in mid trimester of pregnancy. Diastolic level shows more fall than systolic pressure. Recently, the ratio of PEP to LVET has become popular as a single expression of ventricular performance from STI's in the heart rate range below 110 beat/minute. This ratio is unrelated to heart rate since the PEP and LVET shorten proportionately as the heart rate increases. The PEP/LVET may identify left ventricular dysfunction when either or both PEP-I and LVET-I are still within the normal range. Consequently, the PEP/LVET has become the single most useful measurement of left ventricular performance from the STI's (Richard *et al.*, 1977). The increased PEP/LVET ratio can reveal a pre-clinical phase of cardiac dysfunction which may ultimately lead to clinical phase of cardiac decompensation.

### **MATERIALS AND METHODS**

The present study consists of 100 normal women with age raging from 20 to 40 years. Out of these, 75 were healthy pregnant women and 25 were non-pregnant women (GROUP C). The pregnant women were divided in the following three groups each consisting of 25 patients. GROUP I -Twenty five women during the first trimester. GROUP II -Twenty five women during second trimester. GROUP III -Twenty five women during third trimester. History of each woman was taken in detail to exclude any cardiovascular or associated disease. Particular attention was laid on the history of breathlessness, palpitation, pain chest especially retrosternal pain with or without radiation, history of oedema feet, rheumatic fever and history of treatment for hypertension. A thorough general physical examination was done. The women showing abnormal electrocardiogram or hypertension were not included in this study.

## Research Article

The systolic time intervals are measured as described by Weissler and associates from simultaneous electrocardiogram, phonogram and external carotid pulse tracings. These were recorded on a four channel polygraph at a paper speed of 50 mm/sec and time markers of 0.1 second. The Polyrite – machine manufactured by recorders and medicore system, Chandigarh was used for this purpose.



**Polyrite Machine**

QS<sub>2</sub> – I -Electromechanical systole index

LVET–I- Left ventricular ejection time index

PEP – I - Pre-ejection period index

PEP/LVET ratio - Pre-ejection period/left ventricular ejection time ratio

## RESULTS AND DISCUSSION

### Results

**Table I: Changes in the systolic and diastolic blood pressure in control group, in pregnant women of group-I, group II and group-III (Mean±SD)**

Group	No. of subject	Systolic B.P in mm of Hg	Diastolic B.P in mm of Hg
Group C	25	113.68 ± 9.32	76.38 ± 6.78
Group I	25	109.60 ± 8.2365	75.60 ± 5.7131
Group II	25	112.80 ± 7.2222	77.60 ± 7.6315
Group III	25	110.00 ± 8.4853	77.20 ± 7.7565

On comparison there was no significant change observed in systolic and diastolic blood pressure.

**Table II: Showing the heart rate in group C, group I, group II and group III (Mean±SD)**

Group	No. of subject	Heart rate per minute	
Group C	25	82.60	6.876
Group I	25	82.20	7.7974
Group II	25	84.68	9.2508
Group III	25	85.00	12.684

On comparison no significant change was observed in heart rate of all the groups in Table II.

## Research Article

**Table III: Showing comparison of the STI's indices of control group group I, group II and group III of pregnant women. After applying regression equation (All the interval are expressed in millisecond) (Mean±SD)**

Group	No. of subject	QS <sub>2</sub> -I	LVET-I	PEP-I	PEP/LEV T
Group C	25	525.64±23.205	412.96±19.144	118.6±6.1115	0.2874±0.31942
Group I	25	553.08± 19.693	424.76±16.442	128.64±5.9321	0.30285±0.36079
Group II	25	555.6±18.564	425.2±26.035	124.44±11.943	0.29266±0.45873
Group III	25	541.12±29.146	410.6±23.21	130.24±15.005	0.31719±0.6464

**QS<sub>2</sub>-I** Value are increased in all group as compared to group C. But increase in QS<sub>2</sub> in group I & group II is significant and increase in group III is not significant.

### LVET-I

The mean values in group I & group II are significantly increased as compared to LVET-I value in group C. In group III LVET –I value is decreased as compared to the LVET-I value in group C but not significantly.

### PEP-I

PEP value in group I is increased significantly as compared to PEP-I value in group C. PEP-I value in group II is significantly increased as compared to group C but decreased as compared to PEP-I in group I. The PEP-I value is significantly increased in group III as compared to group II and group C and is less significantly increased as compared to group I.

### PEP/LVET

In group III PEP/LVET ratio is increased as compared to group C, group I and group II

PEP/LVET ratio is slightly increased in group I as compared to group C, in group II PEP/LVET ratio is decreased as compared to group I and group III and PEP/LVET value is increased as compared to control group C.

## Discussion

Good health is one of the most precious gift of the nature to mankind. But there are many diseases which are continuously spoiling the charm of this gift. It has been observed that the myocardial functions are abnormal even though there are no clinical signs and symptoms of heart disease, clinically signs and symptoms of disease appear only when there is gross impairment of myocardium. So, the heart and its functions have always intrigued the human mind. Thus the evaluation of the left ventricular functions in healthy persons, in patients with suspected heart disease or with known heart disease is of paramount importance. Pregnancy is a physiological process which imposes a good deal of functional strain on the cardiovascular dynamics of the body, during normal pregnancy these changes have little effect on normal heart which calls upon its substantial reserve to meet the requirements of foetus. But the response of the diseased heart which otherwise appear normal clinically is not always adequate and can lead to decompensatory state of heart. The present study has been undertaken to determine the normal values of STI's during normal pregnancy to provide baseline data necessary for further clinical application of method in the pregnant women of this part of country. This study was conducted on 100 subjects who were divided in the following four groups with 25 subjects in each group. **Control group (Group C), Group I, Group II & Group III.**

**Control group:** Twenty five healthy women of fertile age group (age ranging from 20 to 40 year). The mean systolic blood pressure was  $113.68 \pm 9.32$  (ranging from 100 to 120 mmHg) and the mean diastolic blood pressure was  $76.36 \pm 6.78$  (ranging from 70 to 80 mmHg).

**Heart Rate :** The mean heart rate of the control group (group C) was  $82.6 \pm 6.876$  (The range is from 70 to 95 per minute). The STI's indices values in control group were as follows : **QS<sub>2</sub> – I** – 525.64± 23.205, **LVET-I** - 412.96 ± 19.144, **PEP – I**- 118.6 ± 6.1115, **PEP/LVET**- 0.3076 ± 0.0251.

The mean value of QS<sub>2</sub> – I, 525.64 ± 23.205 milliseconds in the present study is lower than the value observed by Weissler *et al.*, (1968); The results of the present study are comparable with that of Srivastva

## Research Article

*et al.*, (1979) and Bribek *et al.*, (1976). The mean value of  $QS_2 - I$  in the present study is higher than the values observed and Sharma *et al.*, (1991).

The mean value of LVET -I, is  $412.96 \pm 19.144$  milliseconds in the present study is lower than the values observed. The only comparable with that of Weissler *et al.*, (1968); Abdullah *et al.*, (1977) and higher than the values observed (Manchanda *et al.*, 1974; Srivastva *et al.*, 1979).

The mean value of PEP-I is  $118.6 \pm 6.1115$  milliseconds in the present study is lower than the value observed by Weissler *et al.*, (1968); Abdullah *et al.*, (1977); Srivastva *et al.*, (1979). This could be due to physical status and nutritional variations of subjects under study. The only comparable study with the values of Bhatia *et al.*, (1975).

The mean value of PEP/LVET ratio  $0.2874 \pm 0.31942$  in the present study is lower than the values observed by Weissler *et al.*, (1968); PEP/LVET ratio values are higher than values observed by Salzman *et al.*, (1971). Only comparable with that the values observed by Abdullah *et al.*, (1977) and Srivastva *et al.*, (1979).

**Normal pregnant women group:** It was observed that there is fall in systolic blood pressure, during the successive first, second and third trimester of pregnancy but the fall in the systolic and diastolic pressures are not significantly changed during normal pregnancy. It was observed that there is slight fall in the mean heart rate during the first trimester of pregnancy. It was observed that the heart rate is increased during second and third trimester of pregnancy but the increase in heart rate per minute is not significant. The fall in systolic blood pressure and increase in heart rate is due to obstruction of venous return by enlarged uterus and also the placenta acting as arteriovenous shunt so the placenta is responsible for elevation of heart rate and slight decreased arterial blood pressure (William, 1971).

In group I, it was observed that the mean value of  $QS_2 - I$  was same as in control group of patients. But in the group II there was significant change in value  $QS_2 - I$  and in the group III it was observed that there was no significant decrease in the value of  $QS_2 - I$ . Our finding are in accordance with the observation made by other workers Rubber *et al.*, (1973); Sharma *et al.*, (1989).

The LVET- I values observed in different groups as in group C, group I, group II and group III are  $412.96 \pm 19.144$ ,  $424.76 \pm 16.442$ ,  $425.2 \pm 20.035$ ,  $410.6 \pm 23.21$  respectively. It was observed that the value of LVET -I in group I is almost same as that of group C. In the group II this value is slightly increased which is not significant as compared to group I. There is significant decrease in the LVET-I value in the group III as compared to group II, group I and group C. Our findings are in accordance with the observations made by other workers as by Shirley *et al.*, (1973), Sharma *et al.*, (1991), Srivastva also found a significantly decreased value of left ventricular ejection time in 1989.

It was observed that the PEP-I value in group I is increased as compared to the control group (Group C). It was observed that the PEP-I value in group II is decreased significantly as compared to group C and group I. The PEP-I value in group III is significantly increased as compared to group I, group II and group C. Commonly prolongation of PEP is believed to represent a decreased velocity of contraction (Weissler *et al.*, 1968, 1971).

The PEP/LVET ratio has become single most useful measurement of left ventricular performance from the STI's (Lewis *et al.*, 1977) as in the heart rate range below 110 beats/minute. This ratio is unrelated to heart rate since the PEP and LVET ratio shortens proportionally as the heart rate increases. The PEP/LVET ratio may identify left ventricular dysfunction with either PEP-I and LVET-I are still within normal range (Lewis *et al.*, 1977). On observation the PEP/LVET ratio calculated in group I and group II were less as compared to group III. The PEP/LVET ratio in group III is more as compared to group I and group II. Our observations also correlate with the observations calculated by Sharma *et al.*, (1991) Srivastva and Jain (1989).

## Conclusion

In present study  $QS_2 - I$  is increased in all trimesters of pregnancy. LVET-I is significantly increased in 1<sup>st</sup> and 2<sup>nd</sup> trimester of pregnancy. PEP-I is significantly increased in all trimesters of pregnancy but increase is more in 1<sup>st</sup> and 3<sup>rd</sup> trimester. PEP/LVET ratio is increased in all trimesters of pregnancy and increase is maximum in 3<sup>rd</sup> and least in 2<sup>nd</sup> trimester of pregnancy. Further studies are required to measure STI's

### **Research Article**

parameters weekly between 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> trimester to find out the time at which cardiac function starts deteriorating and during which period of pregnancy the cardiac functions are affected with complication.

### **REFERENCES**

- Abdullah AK, Siddique MA and Jejudin M (1977).** Systolic time intervals in chronic anemia. *American Heart Journal* **94** 287.
- Admas JG (1954).** Cardio-vascular physiology in normal pregnancy. *American Journal of Obstetrics & Gynecology* **67** 741.
- Bhatia ML and Manjuran RJ (1975).** Systole time intervals in constructive pericarditis. A study before and after digitalis. *British Heart Journal* **37** 1176.
- Burwell CS, Strayhorn WD, Flickinger D, Corlette MB, Bowerman EP and Kennedy JA(1938).** Circulation during pregnancy. *Archives of Internal Medicine* **62** 977.
- Hamilton HF (1951).** Cardiac output in hypertensive toxemia of pregnancy. *Journal of Obstetrics and Gynaecology British Emporium* **58** 977.
- Lewis RP, Leighton RF, Forester EF and Weissler AM (1974).** Systolic time intervals. In: *Non-invasive Cardiology*, edited by Weissler AM (Grune and straton) New York 301- 368.
- Richard PL, Stanley E, Rittgers, Wilbur FF and Harios Boudoulas (1977).** A critical review of the systolic time intervals. *CIRC* **56** 147.
- Rubber S, Schneebaum R and Hammer N (1973).** STI's in pregnancy and the post-partum period. *American Heart Journal* **86** 182.
- Salzman SH, Wolfron S, Jackson B and Schechter E (1971).** Epinephrine infusion in man. Standardisation, normal response and abnormal response in idiopathic hypertrophic sub-aortic stenosis. *Circulation* **43** 137
- Sharma RS, Khetarpal P and Ghai CL (1991).** Systolic time intervals normal standards for clinical use in healthy Punjabi population. *IJPP* **35** 79.
- Srivastva SC, Popli HC, Mahajan SK and Khosla SN (1978).** Normal values of systolic time intervals in Indian subjects. *National Academy of Medical Sciences (India)* **14** 262.
- Srivastva SC, Gupta RR and Popli HC (1979).** Normal values and regression equations of systolic time intervals. *Indian Heart Journal* **31** 233.
- Weissler AM, Harris WS and Schoenfeld CD (1968).** Systolic time intervals in heart failure in man. *CIRC* **37** 149.
- Weissler AM and Garrard CL (1971).** Systolic time intervals in cardiac disease (1) Mod. Conc. Cardiovascular disease **4**(1).
- William JN (1970).** Maternal physiology in pregnancy. In: *Obstetrics*, chapter 8, edited by Hellman IM and Pritchardts JA (Appleton century crafts, Inc) New York.