

EFFECT OF TREATMENT ON MYOCARDIAL PERFORMANCE INDEX (MPI) IN CHRONIC SEVERE ANAEMIA

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Abstract : Anaemia is a common ailment in developing countries which imposes mechanical load on heart. Myocardial Performance index (MPI) was evaluated by apex cardiogram (ACG) in 30 patients suffering from chronic severe anaemia (CSA) (with hemoglobin level less than 6 gm% and at least more than 3 months duration) before and after treatment in the age group of 20-40 years and compared with age and sex matched healthy controls. MPI was measured by simultaneous recordings of apex cardiogram, carotid arterial pulse, electrocardiogram and phonocardiogram on four channel polyrite (INCO). There was considerable increase ($P<0.001$) in heart rate (HR), left ventricular ejection time (ET) ($P<0.02$), shortening of isovolumic contraction time (ICT) ($P<0.001$), with no significant change in isovolumic relaxation time (IVRT) in anaemia versus controls. On treatment of anaemia HR and ET decreases ($P<0.001$), ICT increases ($P<0.01$) without any change in IVRT. Our findings indicate that performance of myocardium is improved after treatment. So treatment should be instituted as early as possible.

Key words : Myocardium anaemia apex cardiogram

INTRODUCTION

Myocardial Performance Index in chronic severe anaemia :

A myocardial performance index (MPI) has been described as a noninvasive Doppler measurement of global (systolic and diastolic) ventricular function (1). MPI has been shown to correlate well with other invasive and noninvasive measurement of left ventricular (LV) function in adults (2) and has significant clinical utility. It is the powerful predictor of outcome in adult

patients with dilated cardiomyopathy and primary pulmonary hypertension (3, 4) and in pediatric cancer patients receiving anthracycline antibiotics (5). Systolic and diastolic functions of LV can be measured by recording of carotid arterial pulse (CAP) (6) and apexcardiogram (ACG) noninvasively (7). Moreover, systolic wave of ACG bears a close relation to left ventricular wall motion (8).

Anaemia is a common ailment in developing countries. Harmonal and metabolic effects induced by anaemia can

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decrease myocardial function (9) or result in direct myocardial toxicity, myocardial hypertrophy and salt and water retention (10). However, effect of treatment of anaemia on myocardium is not well documented. So in present study MPI was calculated before and after treatment in chronic severe anaemia (CSA).

MATERIALS AND METHODS

The study was carried out in 38 patients of CSA (haemoglobin level was less than 6 gm%, range 2-6 gm%, with at least 3 months duration in nutritional anaemia diagnosed by complete hemogram, using world health organization definition of anaemia-haemoglobin <13g/dl for men and <12 g/dl in women (12) in the age group of 20-40 years without clinical evidence of cardiac decompensation and 30 age and sex matched healthy subjects (haemoglobin level 12-14.02 gm%). Subjects received a thorough physical examination, and an ECG was recorded to exclude presence of any cardiovascular disease. Isovolumic contraction time (ICT), ejection time (ET) and isovolumic relaxation time (IVRT) were measured by simultaneous recording of electrocardiogram (ECG) Lead-II, carotid arterial pulse (CAP), apexcardiogram (ACG) and phonocardiogram (PCG) on four channel polyrite (INCO) at paper speed of 50 mm/sec. Mean of 10 cycles were calculated and results were expressed in msec. ET was measured from point of onset of sudden upstroke of CAP to trough of incisura. ICT was obtained by subtracting ET from the measurement taken from onset of QRS deflection of ECG to first high frequency vibration of aortic component of second heart sound (6). IVRT was measured from beginning of first high frequency

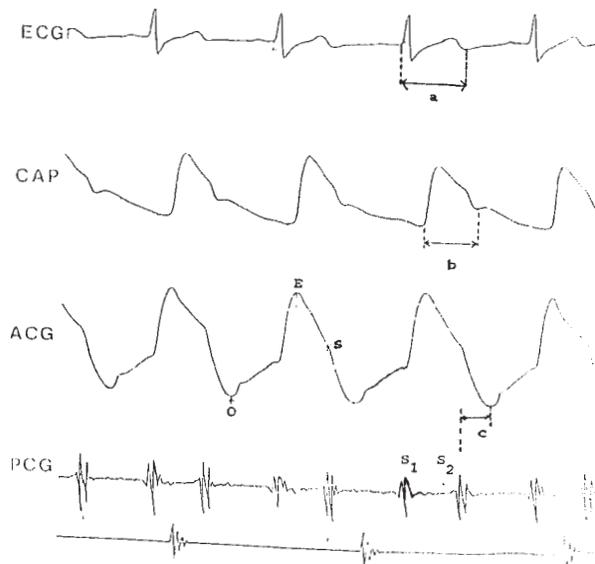


Fig. 1 : Myocardial performance index (MPI)
 ECG-Electrocardiogram, CAP-Carotid arterial pulse,
 ACG-Apexcardiogram,
 E-Onset of ejection, S-Systolic wave shoulder at aortic valve closure, O-coincides with opening of mitral valve.
 PCG-Phonocardiogram, S₁, S₂ - First and Second heart sound.
 a- Measured from onset of QRS deflection of ECG to high frequency vibration of aortic component of second heart sound.
 b- Ejection time (ET), c-Isovolumic relaxation time (IVRT) Isovolumic contraction time (ICT) = a-b

$$MPI = \frac{(a-b) + c}{b}$$

vibration of second heart sound to nadir of 'o' point on ACG (Fig. 1). From these MPI was computed. The MPI is defined as sum of isovolumic activity (ICT+IVRT) divided by ventricular ET (5).

$$MPI = \frac{ICT + IVRT}{ET}$$

Measurement were taken before and after treatment of anaemia. Anaemia group received iron therapy in the form of ferrus iron 300 mg/day on empty stomach for 90 days.

Statistical comparison was performed by unpaired and paired 't' test. A value of <0.05 indicated difference between groups that was not attributed purely to chance. Results were expressed as mean \pm SD.

RESULTS

Patients demographic data were listed in Table I. There was an increase in heart rate (HR) from 75.40 ± 12.50 beats/min to 92.08 ± 18.19 beats/min respectively in controls versus anaemia ($P < 0.001$) which was decreased to 71.48 ± 6.62 beats/min after treatment. This was not statistically significant from control level (Table II).

TABLE I: Demographic data in controls and anaemic subjects (Mean \pm SD).

Parameters	Control	Anaemia	After treatment of anaemia
Number	30	30	
Age (years)	31.49 \pm 3.34	32.65 \pm 1.62	
Sex			
Male	15	15	
Female	15	15	
BMI	22.2 \pm 0.36	22.9 \pm 0.33	
Haemoglobin Level (gm%)	12.87 \pm 0.79	4.13 \pm 1.57	10.64 \pm 1.31 (10-11.6)

BMI = Body Mass Index

In anaemia LV ICT was shortened ($P < 0.001$) and ET was lengthened ($P < 0.02$) with non-significant change in IVRT producing significant change ($P < 0.001$) in MPI of LV compare to controls (Table II). After treatment ICT lengthened ($P < 0.01$) and LV ET shortened ($P < 0.001$) without any effect on relaxation period.

TABLE II: Parameters recorded in controls and anaemia (before and after treatment) (Mean \pm SD).

Parameters	Control	Anaemia	After treatment of anaemia
Heart rate (beats/min)	75.4 \pm 12.5	92.06 \pm 18.19***	71.48 \pm 6.62***
Blood pressure (mmHg)			
– Systolic	120.30 \pm 8.90	111.04 \pm 10.21***	114.35 \pm 7.60
– Diastolic	71.10 \pm 9.20	70.80 \pm 9.27	70.02 \pm 8.06
Insovolumic contraction time (msec)	131.85 \pm 14.20	119.17 \pm 24.41***	125.00 \pm 39.48*
Ejection time (msec)	344.26 \pm 15.24	352.48 \pm 23.73*	315 \pm 19.39***
Isovolumic relaxation time (msec)	111.06 \pm 36.01	109.61 \pm 46.36	113.33 \pm 27.48
Myocardial performance index	0.70 \pm 0.17	0.64 \pm 0.22	0.75 \pm 0.15***

***, ***-very significant, *, *-significant.

DISCUSSION

The present study is carried out in young adults because iron deficiency either because of low iron intake or low bioavailability of dietary iron is main cause of anaemia in younger population (13). In patients of CSA there is increase in ET and decrease in ICT in this study. These findings are in agreement with Abdullah (14) and Floranzo (15). These observations reflect enhanced myocardial contractility (16). The decreased oxygen carrying capacity of blood in anaemia is expected to be compensated by hyperdynamic circulation (17), increase LV filling and myocardial contractility. Prolongation of IVRT indicates impaired myocardial contractility as observed in ischaemic heart disease (7), hypertension (18) and in aging (19). But no significant change is found in IVRT in present study. It is to be observed that these changes occurred inspite of presence of tachycardia which has been shown to produce incomplete relaxation (20).

These observations explain different LV MPI in patients of CSA compare to normal healthy subjects. Treatment of anaemia with erythropoitin or iron improve LV ejection fraction and functional status (10). It is found that ICT is raised and ET is reduced although they are not reached to control value on treatment in present study. It is shown that LV MPI is significantly elevated before changes in LV ejection fraction (<45%) takeplace (5). Serial surveillance for cardiotoxicity in patients receiving anthracycline shows that MPI improves with discontinuation of drug or institution of pharmacotherapy to augment LV function (5).

Thus anaemia has prognostic importance. MPI is improved after treatment of anaemia, relaxation time is not affected in decompensated anaemia. Treatment of anaemia should be started as early as possible otherwise it may lead compensated heart failure (12).

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