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A STUDY ON MYOCARDIAL FUNCTION IN CHILDREN WITH SEVERE ACUTE MALNUTRITION

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ABSTRACT

Objective: To compare the myocardial function in severely acute malnourished and apparently healthy children of 6- 59 months of age group. Design: Observational cross sectional study. Setting: Sir padampat mother and child health institute, attached to SMS medical college, Jaipur. Patients: from September 2011 to December 2012, 32 children with severe acute malnutrition and 32 apparently healthy children. **Methods:** 32 children with severe acute malnutrition (SAM) as cases were compared with 32 apparently healthy children as controls, all of them were undergone thorough history and clinical examination and investigations including CPK-MB and Echocardiography to assess cardiac function.Main outcome measures: cardiac enzyme (CPK-MB) and cardiac dimensions, muscle mass and functions to assess myocardial function. **Results:** Cardiac dimensions of malnourished group LVEDD(23.06±3.21vs. 28.36±4.23mm) ,LVESD (23.06±3.21vs.18.54±3.11mm), LVPWD(4.08±0.72 vs.5.03±0.86mm) and LVM(18.31±7.66 vs.31.71±10.17mm)($p<0.001$) were significantly reduced, while IVSD(4.76±1.18mm vs. 5.43±0.82mm), FS(34.39±3.73 VS. 35.25±3.13), EF(65.75±5.40 vs. 66.44±4.34) and LVMI(54.18±17.68 vs. 61.81±14.28) ($p>0.05$) were not changed in malnourished as compared to healthy children. FS (30.85±3.58vs.35.38±3.58 %) and EF (60.58±5.24vs.67.2±5.15%) were reduced in edematous malnourished group in comparison to non edematous malnourished group. Mean value of CPK-MB in malnourished group (51.5±30.71 mg/dl) was significantly higher than control group (23.5±12.27 mg/dl).**Conclusions:** in present study cardiac enzyme levels were found to be elevated and some of the left ventricular dimensions were found to be reduced in malnourished children, hence assessment of these parameters may proved to be an important tool in early detection of cardiac dysfunction in severe acute malnutrition, which may help in reducing morbidity and mortality related to severe acute malnutrition.

Key words: Children, myocardial function, Severe Acute Malnutrition, Echocardiography.

INTRODUCTION

Approximately one-third of the children suffer from protein energy malnutrition worldwide, NFHS-3 shows 30 million children in India suffer from acute malnutrition., 6.4% (9,800,000) of them are severely malnourished (having weight for age below 3 SD) [1], Malnourished children suffer from many alteration in body composition, with loss of heart and skeletal muscle mass, complicated by electrolyte abnormalities and mineral or vitamin deficiencies that could produce cardiac abnormalities, including hypotension, cardiac

arrhythmias and cardiomyopathy, cardiac failure and even sudden death.[2,3,4,5]

Keyes and associates[6] (1947) were first to focus attention on reduced heart size in semi starvation, after them various studies done to assess cardiac functions and dimensions in malnourished children. **Phornphatkul et al. (1994)** reported that children with malnutrition not only have cardiac muscle wasting but also have inherent ventricular dysfunctions as a result of severe malnutrition that responds to nutritional therapy[7]

Generally diagnosis of myocardial injury is based on clinical findings, suggestive electrocardiogram (ECG), echocardiographic patterns, classical biochemical markers as CPK-MB and cardiac troponin enzymes and decreased myocardial uptake of thalium etc[8].

METHODS

It was an observational cross sectional study which included children between age of 6 months to 59 months, 32 children with severe acute malnutrition and 32 well nourished children as controls.

Children of Age 6-59 months fulfilling the WHO's diagnostic criteria[13] for severe acute malnutrition on stabilization having one of the following criterion were included in the study-

A. Weight for height <-3 z score of the median WHO growth reference curve.

B. Visible severe wasting.

C. Presence of bipedal edema.

D. Mid upper arm circumference below 11.5 cm.

Children with Prematurity or intrauterine growth retardation at birth, any documented cardiothoracic event (congenital heart disease, pericarditis, cardiomyopathy, acute severe lower respiratory tract infection, etc.) and severe anaemia (blood haemoglobin level ≤6 g/dl) were excluded from the study

All cases as well as controls were undergone thorough history and clinical examination including anthropometry, routine investigations including complete blood counts, renal and liver function tests, serum total protein and albumin, chest X ray, ECG followed by cpk-MB and Echocardiography to assess cardiac function.

Echocardiography

M-mode echocardiography was done using PHILIPS HD7XE machine to record following parameters, Left ventricular end diastolic diameter (LVEDD); Inter ventricular septal diameter (IVSD) ; Left ventricular end systolic diameter (LVESD) and Left ventricular posterior wall diameter (LVPWD) using above parameters following cardiac function parameters were derived -

a) **Percentage of fractional shortening (FS):** LV FS was calculated using the following formula:
FS(%)=LVEDD-LVESD/LVEDD×100
where, LVEDD is the end diastolic diameter of the left ventricle and LVESD is the end systolic diameter of the left ventricle

b) **Ejection fraction (EF):** was calculated by the "cubed equation"[3]:
$EF(\%)=(LVEDD)^3-(LVESD)^3/(LVEDD)^3\times100$

c) **Left ventricular mass (LVM):**
$LV\ Mass\ (gms) = 0.8\{1.04[(LVEDD+IVSD+LVPWD)^3-(LVEDD^3)]\}+0.6$

d) **Left ventricular mass index (LVMI):**
Left ventricular mass (LVM)/Body Surface Area (BSA) (gm/mtr^2)

Other structural heart abnormalities were evaluated using 2D and color Doppler Echocardiography

STATISTICAL ANALYSIS

The numerical data, collected from cases and control groups have been compiled and statistically analyzed. The numerical data has been represented as mean±2SD.for comparison of the two groups, student's t-test has been used for parametric data. For all tests,

the difference has been considered significant if the probability (p) <0.05.

RESULTS

Mean STP(5.86±1.07mg/dl), S.albumin(3.37±0.88g/dl), Hb(9.07±1.96g/dl) and calcium (1.01±0.14) of malnourished group were significantly lower than mean STP(6.7±0.43g/dl), S.alb(3.72±0.23), Hb(10.86±1.84g/dl) and calcium (1.08±.13 mmol/l) of control group($p<0.05$); Mean value of CPK-MB in malnourished group (51.5±30.71 mg/dl) was significantly higher than control group (23.5±12.27 mg/dl), As shown in table-1.

Cardiac dimensions of malnourished group LVEDD(23.06±3.21mm) , LVESD (23.06±3.21mm), LVPWD(4.08±0.72mm) and LVM(18.31±7.66gms) were significantly lower in comparison to control group (LVEDD-28.36±4.23mm,LVESD-18.54±3.11mm, LVPWD-5.03±0.86mm,LVM-31.71±10.17)($p<0.001$); While there was no significant difference in IVSD(4.76±1.18mm vs. 5.43±0.82mm), FS(34.39±3.73 vs. 35.25±3.13), EF(65.75±5.40 vs. 66.44±4.34) and LVMI(54.18±17.68 vs. 61.81±14.28gm/m^2) ($p>0.05$), as shown in table-2.

Cardiac dimensions of edematous malnourished group IVSD(4.99±1.27mm), LVEDD(24.4±2.64mm), LVESD(16.36±2.04mm), LVPWD(4.33±0.74mm), LVM(21.71±7.77gm) and LVMI(58.71±16.71 gm/m^2) were not different in comparison to nonedematous group (IVSD-4.7±1.19mm,LVEDD-22.69±3.2mm,LVESD-14.71±2.33mm, LVPWD-4.08±0.65mm, LVM-17.36±7.66gm, LVMI-52.96±17.97gm/m^2) ($p>0.05$), While FS(30.85±3.58%) and EF (60.58±5.24) were significantly reduced in edematous group in comparison to nonedematous malnourished children group(FS-35.38±3.58%, EF-67.2±5.15%) ($p<0.01$), as shown in table-3.

DISCUSSION

In our study cardiac dimensions including LV end systolic diameter, LV end diastolic diameter, LV posterior wall diameter and LV mass were reduced in malnourished children, cardiac enzyme levels were found to be elevated in malnourished children in comparison to healthy controls. Cardiac functions in form of fractional shortening and ejection fractional were not affected.

Cardiac parameters were not different between edematous and nonedematous malnourished group but fractional shortening and ejection fraction were reduced significantly in malnourished children with edema in comparison to nonedematous malnourished children.

Similar results were obtained in previous studies done by **Ocal et al[4] (2001),** They found mean LV Mass, Left ventricular septal diameter and posterior wall thickness were to be reduced in malnourished children, However, the LV Mass index, ejection fraction, fractional shortening were not different in the patients with PEM and in the apparently healthy control group;

Jose´ L. Olivares, et al[9](2005) found, LVEDD, LVESD, LVM and LVMI were significantly lower in malnourished children, There were no statistical differences between the left ventricular fractional shortening and left ventricular ejection fration;

M. T. Olowonyo et al[5] 1995 reported that In patients with kwashiorkor, mean values obtained for end diastolic dimension, end systolic dimension, posterior ventricular wall thickness, and fractional shortening were significantly smaller than the corresponding values obtained in the controls,

Shoukry et al.[10] (1986) reported that infants with kwashiorkor have evidence of impairment of the LV function as evidenced by the reduction of the fractional shortening compared with age-matched healthy controls,

In previous two studies ejection fraction and fractional shortening was reduced, it may be due to their study groups including only edematous malnourished children,

Abu fadan et al[3](2010) found interventricular septal diameter, posterior wall diameter, left ventricular mass to be reduced in malnourished patients(45 cases) in comparison to apparently healthy controls (25 controls), fractional shortening and ejection fraction were also reduced, While end systolic diameter and end diastolic diameter were not significantly different among both groups, in this study;

CONCLUSION

Our observations concludes that some cardiac dimensions including LV end systolic diameter, LV end diastolic diameter, LV posterior wall diameter AND LV mass were affected by malnutrition, this may be because of adaptation of body in response to malnutrition and sparing cardiac functions,

Our study reveals that cardiac enzyme levels and echocardiography may proved to be an important tool in early detection of cardiac dysfunction in severe acute malnutrition, which may help in reducing morbidity due to cardiac cause and mortality related to severe acute malnutrition.

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Ethical approval: The study was approved by the institutional ethics committee

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Table-1: clinical and lab parameters of SAM patients compared with controls

parameters	Cases(n=32)	Controls(n=32)	p- value
Age (months)	16.81±10.55	28.25±16.79	>0.05
Weight (kg)	5.76±1.75	10.32±2.42	**<0.001**
Ht /lth (cm)	70.06±8.24	83.78±11.12	**<0.001**
BMI (wt/ht^2)	11.48±1.48	15.29±1.86	**<0.001**
STP (g/dl)	5.86±1.07	6.7±0.43	**<0.001**
S.albumin (g/dl)	3.37±0.88	3.72±0.23	**<0.05**
Hb (g/dl)	9.07±1.96	10.86±1.84	**<0.05**
Calcium (mmol/l)	1.01±0.14	1.08±0.13	**<0.05**
Cpk-MB	51.5±30.71	23.5±12.27	**<0.001**

Table-2: cardiac parameters of SAM patients compared with controls

cardiac parameters	Cases(n=32)	Controls(n=32)	p-value
IVSD(mm)	4.76±1.18	5.43±0.82	>0.05
LVEDD(mm)	23.06±3.21	28.36±4.23	**<0.001**
LVESD(mm)	15.07±2.4	18.54±3.11	**<0.001**
LVPWD(mm)	4.08±0.72	5.03±0.86	**<0.001**
FS(%)	34.39±3.73	35.25±3.13	>0.05
EF(%)	65.75±5.40	66.44±4.34	>0.05
LVM(gm)	18.31±7.66	31.71±10.17	**<0.001**
LVMI(gm/m^2)	54.18±17.68	61.81±14.28	>0.05

Table-3: comparison of cardiac parameters between edematous and nonedematous malnourished patients

cardiac parameters	Edematous (n=7)	Non edematous (n=25)	p- value
IVSD(mm)	4.99±1.27	4.7±1.19	>0.05
LVEDD(mm)	24.4±2.64	22.69±3.2	>0.05
LVESD(mm)	16.36±2.04	14.71±2.33	>0.05
LVPWD(mm)	4.33±0.74	4.08±0.65	>0.05
FS(%)	30.85±3.58	35.38±3.58	**<0.01**
EF(%)	60.58±5.24	67.2±5.15	**<0.01**
LVM(gm)	21.71±7.77	17.36±7	>0.05
LVMI(gm/m^2)	58.71±16.71	52.96±17.97	>0.05