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Assessment of Serum Vitamin D, Folic acid and Vitamin B_{12} in Congenital Heart Disease Patients in a Teritary Hospital

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ABSTRACT

Congenital heart disease patient suffers from malnutrition irrespective of the types of cardiac defects. These children are often admitted in hospitals owing to congenital heart defects. Corrective catherization, proper nutritional intake and counselling can improve the malnutrition. To assess the vitamin status in children with congenital heart disease patients admitted in paediatric general ward of tertiary hospital. The study was a prospective observational study, a total of 100 patients were evaluated for their nutritional deficiency such as serum vitamin D_3, folic acid and Vitamin B_{12} by employing ELISA KITS. The study observed a significant levels of vitamin D_3 and folic acid depletion in congenital heart disease patients. There was no severe depletion of vitamin B_{12} in the current study. The study had made an insight into the malnutrition status of congenital heart disease patients and recommends consumption of micronutrients in congenital heart defect patients.

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INTRODUCTION

Congenital heart disease (CHD) is a serious condition with an estimated prevalence of 9 per 1000 birth in the general population (Saxena, 2018; Meshram and Gajimwar, 2018). Congenital heart disease (CHD) patients are prone to malnutrition owing to several reasons such as decreased energy intake, increased energy requirements, or both (Varan *et al.*, 1999). Malnutrition among children suffering from CHD is widely reported, irrespective of the nature of the cardiac defect. Malnutrition condition arises when a person's diet doesn't contain the right amount of nutrients. Micronutrient malnutrition is a term used to refer to the diseases caused by a dietary deficiency of vitamins or minerals. Emerging literature suggests lack of vitamins and minerals to be a highly prevalent problem in CHD population (Zahr *et al.*, 2017; Looker *et al.*, 1988). Several reports suggest women using multivitamin supplements in the preconceptional period is at lower risk of having babies with congenital heart risk (Botto *et al.*, 2000). Monitoring of specific biochemical parameters can be helpful in assessment of child's nutritional status and the ade-

quacy and effectiveness of nutritional intervention. There are only few reported studies on assessing the vitamin levels in congenital heart patients (McNally *et al.*, 2013; Mcnally and Menon, 2013). Hence the current study was designed to determine the vitamin status in children with congential heart disease patients admitted in paediatric general ward of tertiary hospital.

MATERIALS AND METHODS

A prospective observational study design was adopted to carry out at a tertiary hospital at Chennai. The research protocol of the present study was approved by the Institutional Ethical Committee of Madras Medical Mission, Mogappair, Chennai (ECR/140/Ins/TN/2013/RR-16)

The sample size of the study population was calculated using an appropriate formula for a study estimating population prevalence. The sample size was calculated using a formula proposed by Daniel (1999) for the estimation of a population proportion with a specified relative precision (25) as follows:

$$n = \frac{Z^2P(1-P)}{d^{2da}} = \frac{(1.96)^2(0.6)(0.4)}{(0.1)^2} = \frac{(3.84)(0.6)(0.4)}{0.01} = \frac{0.9216}{0.01} = 92.16$$

Where,

n - the required sample size,

z- the statistic corresponding to level of confidence,

p - expected prevalence

d - precision (corresponding to effect size).

Minimum sample size required is 92

The sample size taken for the current study was 100. The study was conducted for a period of one year. Assuming the severe malnutrition with observed portion 0.6 at 80% power and 5% level of significance derived from the study conducted by Arodiwe *et al.* (2015). The samples were classified into three groups based on the age. Group I (0- 2 years) Group II (2-6 years) Group III (6-10years) and was compared with acyanotic and cyanotic heart.

Criteria for Sample Selection

The criteria that were followed for selection of study subjects are as follows:

Inclusion criteria

1. Children from one month to ten years with congenital heart disease confirmed with echocardiogram.
2. Children admitted for surgical or catheter based corrective intervention in the pediatric general ward was selected for the study.
3. Patients were selected on the basis of clinical and laboratory examinations including electrocardiography and echocardiography.
4. Both boys and girls were selected.

Exclusion criteria

1. Patients with a history of prematurity, intrauterine growth retardation, known genetic malformation
2. Dysmorphic features and neurologic disability were excluded from the study.

Estimation of serum Vitamin D_3, Vitamin B_{12} and folic acid

Serum Vitamin D_3, Vitamin B_{12} and folic acid estimation was done by ELISA estimation kit (procedure was carried out as per manufacturer's instructions)

Statistical method

Data were analyzed using SPSS software version 16.0 all values were expressed as mean ± SD. For inferential statistics, independent t test, one-way analysis of variance was used with considering 95% CI (5% error).

RESULT

Evaluation of Vitamin D_3 levels in congenital heart patients

The Table 1 describes the vitamin D_3 levels in the selected subjects. It was inferred that the mean vitamin D_3 was 14.7± 2.36 ng/ml, 14.4± 2.73 ng/ml and 13.8± 2.51 ng/ml in 0-2 years, 2-6 years and 6-10years respectively. Vitamin D_3 deficiency can be referred when the levels are below 20 - 30ng/ml. All the selected subjects had insufficient levels of vitamin D_3.

Comparison of Vitamin D_3 levels on type of congenital heart defect

Table 2 illustrates the vitamin D_3 levels on the type of congenital heart defect. It was inferred that in Acyanotic Congenital heart defect among 0-2 year 2-6 years and 6-10 years the mean vitamin D level was 15.8± 2.13 ng/ml, 15.3± 2.56 ng/ml and 14.5± 2.71 ng/ml respectively.

In Cyanotic Congenital heart defect among 0-2 year the mean vitamin D was 12.7± 1.12 ng/ml, 12.1± 1.50ng/ml in 2-6 year and 12.5± 1.49 ng/ml in 0-2 years, 2-6 years and 6-10 year respectively.

Overall, severe depletion of vitamin D_3 was found highest among subjects with cyanotic congenital

Table 1: Evaluation of Vitamin D_3 levels in congenital heart patients

Age	Observed mean vitamin D_3 (ng/ml)	Expected Vitamin D_3 (ng/ml)	P value
0-2 year	14.7± 2.36 (n= 45)	≤20 - 30ng/ml	0.45
2-6 year	14.4± 2.73 (n=35)		
6-10 year	13.8± 2.51 (n=20)		

Each value represents the mean ± SD of n observations, where n= total number of participants in the study, SD= standard deviation P value was calculated by ANOVA, P < 0.05 is statistically significant

Table 2: Comparison of Vitamin D_3 levels on type of congenital heart defects

Age	Acyanotic heart defect	Cyanotic heart defect	Expected Vitamin D	P value
0-2 years	15.8 ± 2.13 (n=29)	12.7± 1.12* (n=16)	≤20 - 30ng/ml	0.000
2-6 years	15.3± 2.56 (n=25)	12.1± 1.50 (n=10)		0.001
6-10 years	14.5± 2.71 (n=13)	12.5± 1.48 (7)		0.009

Each value represents the mean ± SD of n observations, where n= total number of participants in the study, SD= standard deviation P value was calculated by independent "t" test, P < 0.05 is $_{12}$ statistically significant

Table 3: Evaluation of Folic Acid and Vitamin B_{12} Levels in Congenital heart defect patients

Age	Observed mean Folic Acid (ng/L)	Expected Mean Folic Acid (ng/L)	Observed mean Vitamin B_{12} (pg/ml)	Expected Mean Vitamin B_{12} (pg/ml)
2 years (n =45)	4.3 ± 0.67	5.38 ng/ml	384±197	211-911pg/ml
2-6 years (n= 35)	4.5 ± 0.88		458±218	
6-10 years (n= 20)	4.5 ±0.67		442±245	

Each value represents the mean ± SD of n observations, where n= total number of participants in the study, SD= standard deviation, P value was calculated by ANOVA, P < 0.05 is statistically significant

Table 4: Comparison of folic acid and Vitamin B_{12} levels on type of congenital heart defect

Age	Acyanotic Heart Defect		Cyanotic Heart Defect		P value
	Observed mean Vitamin B12 (pg/ml)	Observed mean Folic Acid (ng/L)	Observed mean Vitamin B12 (pg/ml)	Observed mean Folic Acid (ng/L)	
2 years (n45)	503± 134*	4.6± 0.45*	166.8 ± 57*	3.5 ± 0.32*	0.000
2-6 years (n 35)	577± 122*	4.9±0.61*	160 ± 40*	3.9±0.63*	
6-10 years (n 20)	598.7± 139*	4.9±0.29*	152 ±22*	3.9±0.63*	

Each value represents the mean ± SD of n observations, where n= total number of participants in the study, SD= standard deviation P value was calculated by independent "t" test,* P < 0.05 is statistically significant

heart defect with significant level of 0.000 in 0-2 years, 0.001 in 2-6 year and 0.001 in 6- 10 years whereas mild to moderate depletion of vitamin D was predominant among subjects with acyanotic congenital heart defect.

Evaluation of Folic Acid and Vitamin B_{12} Levels in Congenital heart defect patients

Table 3 illustrates the folic acid and vitamin B_{12} levels in the CHD subjects. It was observed that the mean folic acid among 0-2 years.2-6 years and 6-10 years was 4.25 $\pm$ 0.67ng/ml, 4.4 $\pm$ 0.88 ng/ml and 4.5 $\pm$0.67ng/ml respectively. It was concluded that folic acid depletion was prevalent among all the ages among congenital heart defect. Subsequent findings on mean vitamin B_{12} levels was 384$\pm$197pg/ml, 458$\pm$218pg/ml and 421$\pm$216 pg/ml among 0-2 years, 2-6 years and 6-10 years respectively. It was found that vitamin B12 levels where within the normal range.

Comparison of folic acid and Vitamin B_{12} levels on type of congenital heart defect

Table 4 represents the comparison of mean folic acid and vitamin of B_{12} level between the age groups and type of congential heart defects it was observed that in acyanotic congenital heart defect that the mean folic acid among 0-2 year.2-6 years and 6-10 years was 4.6$\pm$ 0.45ng/ml, 4.9$\pm$0.61ng/ml and 4.9$\pm$0.29ng/ml respectively. In cyanotic congenital heart defect that the mean folic acid was 3.5 $\pm$ 0.32ng/ml, 3.9$\pm$0.63ng/ml and 3.9$\pm$0.63ng/ml among 0-2 years, 2- 6 years and 6-10 years respectively and was found to be statistically significant

It was observed that the mean vitamin B_{12} level in acyanotic congenital heart defect among 0-2 years. 2-6 years and 6-10 years was 503$\pm$ 134 pg/ml, 577$\pm$ 122 pg/ml and 598.7$\pm$ 139 pg/ml respectively. In cyanotic congenital heart defect, the mean vitamin B_{12} was 166.8 $\pm$ 57 pg/ml, 160 $\pm$ 40pg/ml and 152 $\pm$22 pg/g/ml in 0-2 years, 2-6 years and 6-10 years respectively. It was found that vitamin B_{12} levels where within the normal range.

DISCUSSION

Nutritional deficiencies are quite high in patients with CHD. Children suffering from CHD are often lean and underweight. Few studies have evaluated the micronutrient deficiency in CHD patients. Deficiency often is subclinical and only detected by laboratory investigation. The identification of malnutrition in congenital heart disease patients enables doctors, paramedics and dietitians to employ corrective surgical intervention along with nutritional strategies and helps to improve the growth status of children. In the current observational study, we have evaluated the Vitamin D_3, B_{12} and Folic acid levels of CHD patients admitted for surgical catheterization in a tertiary hospital.

The current study observed that there was moderate depletion of Vitamin D_3 levels in the serum while comparing between the age groups and this was not statistically significant, whereas on comparing the serum level of vitamin D_3 with the various type of congenital heart defects a statistically significance levels of vitamin D_3 depletion was observed with cyanotic congenital heart defect & acyanotic congenital heart defect patients. Our findings were in correlation with previous studies (Noori *et al.*, 2018). There were no depletion of vitamin B_{12} among the congenital heart patients, where as statistically significant observation of the levels of folic acid depletion was observed among cyanotic and acyanotic congenital heart defect patients. These findings were in lieu with previous findings (Rook *et al.*, 1973). A study by Elizabeth *et al.* (2017) demonstrated low folate levels in congenital heart patients with genetic polymorphisms, the study recorded nutrient gene interaction a modifiable risk factor by supplementing folic acid.

CONCLUSION

The study concluded that vitamin D_3 deficiency was prevalent among congenital heart disease patients. Deficiency of vitamin D_3 can be associated with cardiovascular dysfunction, prolongs ICU stay and worsens the outcome in critically ill patients. Folic acid deficiency increases the homocysteine levels which in turn is a risk factor for cardiovascular disease. Deficiency of vitamin B_{12} was ruled out in acyanotic heart defect patients whereas mild depletion was observed in cyanotic heart defect patients. The study suggests supplementation of vitamin D, Folic acid and Vitamin B_{12} rich foods to reduce the incidence of cardiovascular risk in CHD patients.

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Conflict of Interest

No conflict of interest was declared by the authors.

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