"A Cross-sectional Study on Anaemia in children with Congenital Heart disease"

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ABSTRACT

Congenital heart defect (CHD) is the most common birth defects representing a major global health problem.In India the prevalence ranges between 3.9 and 26.4/1000 live births in hospital-based studies in India, which is not uniform across the country.All major congenital anomalies comprise of heart defects[1] is Twenty-eight percent.

Methods – 52 children are taken who are having CHD; detailed clinical examination and all the relevant laboratory investigations were done. The children are categorised according to their age, sex, associated diseases, RBC indices, peripheral smear, iron studies and other relevant investigations tailored as per requirement. **Results -** In this study on 52 children, 67.3% were in the age group 5-12 years whereas 32.7% belonged to age group 12mon-59mon.The male to female ratio was 1:0.9. 80.8% had ACHD; out of which VSD was the most common(36,5%).19.2% had CCHD,out of which TOF was the most common(13.5%)of ACHD had anemia 17.4% of CCHD had polycythemia.21.2% had decreased red cell indices indicating microcytic hypochromic and 36.5% had increased RDW with p value 0.000 indicating nutritional anemia. According to Peripheral smear,15.3% had microcytic hypochromic anemia.

CONCLUSION: Congenital heart defect (CHD) is the most common congenital malformation among all birth defects leading to morbidity and mortality among children. Anemia is rampant among children with CHD with a significant impact on the intervention and the outcome of intervention.

Key words – Congenital Heart Defect, Anemia, Cyanotic congenital heart disease, Acyanotic congenital heart disease.

DOI Number:10.14704/nq.2022.20.8.NQ44569 **NeuroQuantology 2022; 20(8): 5386-5395**

INTRODUCTION:

Congenital heart defect (CHD) is the most common birth defects representing a major global health problem. In India the prevalence ranges between 3.9 and 26.4/1000 live births in hospital-based studies in India, which is not uniform across the country. While Congenital heart disease (Cyanotic and A cyanotic) occurs in approximately 0.8% of live births[2]. In India, the prevalence of CHD is not uniform across the country and varies from 0.8 to 5.2/1000 patients in community-based studies. All major congenital anomalies comprise of heart defects[1] is Twenty-eight percent. CHD is considered a real challenge because of the complex interplay between socio- economic factors, dietetic, surgical, medical. Most congenital defects are well tolerated in the fetus because of the parallel nature of fetal circulation. Only after birth when fetal pathways begin to close that the full

hemodynamic impact of anatomic abnormality becomes apparent.

Important risk factor for morbidity and mortality in patients with CHD is Anemia. An important contributing factor that affects the growth of the child which is frequently missed or underdiagnosed in daily practice is Anemia. Children with malnutrition commonly have anemia which is attributed to bone marrow hypoplasia, iron, vitamin B12, vitamin A and folate deficiency. Uncorrected congenital cyanotic heart lesions (and some a cyanotic lesion with the development of Eisenmenger's complex) keep the body in a state of constant hypoxia which triggers stimulation of bone marrow to produce more RBC's and thus improve oxygen delivery to tissues. RBC indices depend on the cyanosis level.Congenital heart disease (Cyanotic and A cyanotic) occurs in approximately 0.8% of live births.[2] About 2-3% will be symptomatic by 1st year of life and the diagnosis of CHD is established by 1 week of age in 40-50% and 1 month in 50- 60% of patients. Prevalence of CHD in India is reported to be between 2.5 to 5/1000 live births but recent studies by Bhat et al[3] and Smitha et al[4].have suggestedthe prevalence to be between 8.5 and 13.6.

Methods: This is a hospital based observational cross-sectional study conducted in Katuri Medical college and Hospital, Guntur, Andhra Pradesh between October 2021 to march 2022. Data collection was done by convenient sampling. During that period 80 children were admitted, 28 patients were excluded as 19 children had not given consent and another 09 patients was having chromosomal/genetic disorders/congenital syndromes. Data was collected from 52 children aged between 1-12 years. 1-12 years of age children admitted in the paediatric ward with various complaints were evaluated for congenital heart disease.

Inclusion criteria:

- Preoperative cases of congenital heart disease within the age group 1-12 years who consult as Outpatients as well as Inpatient for surgical and non-surgical interventions in Paediatrics Department, Katuri Medical college and Hospital, Guntur, Andhra Pradesh.

Exclusion criteria:

- Patients with chromosomal/genetic disorders/congenital syndromes
- Post-operative cases of congenital heart disease and trivial heart diseases
- Patients with acquired heart diseases
- Patients not given consent

Socio demographic data regarding age, gender and socio-economic statuswas collected using pre tested questionnaire. Data regarding birth order, mother ageat the time of conception, gestational age at the time of delivery and consanguinity of marriage was also collected. General examination and systemic examination were done.

Blood tests: Complete blood picture: including hemoglobin, hematocrit, RBC count, total leukocyte count, differential counts, platelets count, RBC indices were done. Other tests include TLC, CRP, peripheral smear and stool examination for ova or worm infestations and occult blood was done.

Table 1: WHO Hemoglobin levels to Diagnose Anemia at Sea level (gm/l), 2016.

Population	No Anemia	Anemia		
		Mild	Moderate	Severe
Children 6-59 months of age	110 or higher	100-109	70-99	Lower than 70
Children 5-11 years of age	115 or higher	110-114	80-109	Lower than 80
Children 12-14 years of age	120 or higher	110-119	80-109	Lower than 80
Non-pregnant women (15years of age and above)	120 or higher	110-119	80-109	Lower than 80

Pregnant women	110 or higher	100-109	70-99	Lower than 70
Men (15 years of age and above)	130 or higher	110-129	80-109	Lower than 80

***'Mild' is a misnomer; iron deficiency anemia is already advanced by the time anemia is detected.The deficiency has consequences even when no anemia is clinically apparent**

Echocardiography: Standard 2D echocardiogram was done for all patients enrolled in the study using phased array transducers of different frequencies tailored according to each patient's age, body built, and weight.

The collected data was spread on Microsoft excel and analyzed using SPSS version 20.0.1. data was summarized as mean and standard deviation for numerical variables and count and percentages for categorical data. Chi square test was applied Z test was used to test the significant difference.

RESULTS:

Among the 80-pediatrics admitted in Katuri Medical college during the study period October 2021 to march 2022, 52 patients were included in the study. 28 patients were excluded as 19children had not given consent and another 09patients was having chromosomal/genetic disorders/congenital syndromes. Data was collected from 52 children aged between 1-12 years.

In the present study, 32.7% belonged to 12mon-59mon and 67.3% belonged to 5-12years**.**

In this study, 52% were male and 48% were female.

Table -2 Distribution according to Age and Sex

Age	Sex				Total	
	Male		Female			
	Numbers	Percentage	Numbers	Percentage	Numbers	Percentage
12-59 Months	10	58.8 %	07	41.2 %	17	100 %
5-12 Years	17	51 %	18	49 %	35	100%
Total	27		25		52	100%

Comparing the distribution of age group and sex, out of the 17 children in the age group 12-59 moths, 58.8% are male and 41.2% are female, whereas out of 35children in the age group 5-12yrs, 51% are male and 49% are female.

Table -3Distribution According to type of Congenital Heart Disease (n=52)

Type		Numbers	Percentage (%)
Acyanotic	VSD	19	36.5 %
	ASD	15	28.8%
	PDA	05	9.6%
	OTHERS*	03	5.7%

Total ACHD		**41**	**80.8 %**
Cyanotic	**TOF**	**07**	**13.5 %**
	OTHERS*	**03**	**5.7 %**
Total CCHD		**10**	**19.2 %**

OTHERS*Pulmonary stenosis, Aortic Stenosis, Coarctation of Aorta
OTHERS**Complex Heart Disease, Double outlet right Ventricle,
Out of the 52 children enrolled with congenital heart disease, 80.8% had Acyanotic congenital heart disease and 19.2% had cyanotic congenital heart disease In ACHD group, VSD(36.5%) was more predominant followed by ASD(28.8%) and PDA(9.6%) and Others(5.7%) In CCHD group, TOF(13.5%) was more predominant and others(5.7%).

Table 04: Distribution according to Socio Economic Status

Socio Economic status	Numbers	Percentage (%)
Upper Class (I)	**Nil**	**Nil**
Upper Class (II)	**02**	**3.8 %**
Lower Middle Class (III)	**05**	**9.6 %**
Upper Middle Class (IV)	**33**	**63.5%**
Lower Class (V)	**12**	**23.1 %**
Total	**52**	**100 %**

In this present study, majority of the children with congenital heart diseasebelonged to upper lower class (63.5%) class with Lower class(23.1%) and Lower middle class(9.6%).

In this present study, only 1.9% of the family member (Maternal uncle) had a history of congenital heart disease (Acyanotic-VSD) corresponding to the lesion in the affected child for which surgical correction was not done.

Table – 05Distribution according to Maternal Age at time of conception

Maternal Age	Numbers	Percentage (%)
< 19 Years	**03**	**5.8 %**
19- 35 Years	**48**	**92.3 %**
> 35 Years	**01**	**1.9 %**
Total	**52**	**100 %**

In this study, 5.8% of the mothers were below 19 years, 92.3% belonged to 19-35years and 1.9% were above 35 years at the time of conception.

Majority of children with congenital heart disease had parents who were second degree(76.9%) consanguinity and only 22.5% were third degree consanguinity.

In this study, majority of the children with the congenital heart diseasebelonged to second birth order (55.76%) whereas 30.76% belonged to first and 113.46%third birth order.

In this study only 5.8% were preterm (<37weeks) and 94.2% were term(>37weeks).

DEGREE OF ANEMIA BASED ON HEAMOGLOBIN, RED CELL INDICIES, RDW AND PERIPHERAL SMEAR:

Table -6Distribution according to Haemoglobin (gm/dl):

Haemoglobin (gm/dl)	Numbers	Percentage (%)
Normal	32	61.5%
Anemia	11	21.1%
Mid Anemia	10	18.8%
Moderate Anemia	01	2.5%
Severe Anemia	Nil	Nil
Polycythaemia	09	17.4%
Total	52	100%

In this study, as per hemoglobin estimations and grading anemia according toWHO guidelines,61.5% of the children with congenital heart disease were normaland 21.1% had anemia (18.8% had mild anemia,2.5% had moderate anemia).17.4%had polycythaemia. Hemoglobin is not a sensitive marker in CCHD.

Table -7Distribution of Red cell indices (MCV, MCH and MCHC), RDW (%) and Peripheral smear.

Parameter		Numbers	Percentage %
Red Cell Indices MCV (fL), MCH (pg), MCHC (gm/dl)	Normal	41	78.8%
	Decreased	11	21.2%
	Total	52	100%
RDW (%)	Normal	33	63.5%
	Increased	19	36.5%
	Total	52	100%
Peripheral Smear	Microcytic Hypochromic	08	15.3%
	Normocytic Normochromic	44	84.6%
	Total	52	100%

In this study, 78.8% had normal red cell indices and rest 21.2% had decreased red cell indices.

In this study 36.5% had increased RDW indicating nutritional deficiency and 63.5% had normal RDW.

In this Study, 15.3% had microcytic hypochromic anemia and the rest (84.6%) hadnormocytic normochromic anemia.

Table -8 Comparison between ACHD and CCHD according to Red Cell Indices, RDW(%), Peripheral Smear.

		Acyanotic congenital heart diseases		Cyanotic congenital heart diseases			
Red Cell Indices MCV (fL), MCH (pg), MCHC (gm/dl)		**Numbers**	**Percentage (%)**	**Numbers**	**Percentage (%)**	**χ2**	**P-value**
	Normal	**34**	**82.9%**	**07**	**17.1%**	**0.58**	**0.445**
	Decreased	**08**	**72.4%**	**03**	**27.3%**		
RDW (%)	**Normal**	**32**	**97%**	**01**	**3%**	**15.26**	**0.000**
	Increased	**10**	**52.6%**	**09**	**47.3%**		
Peripheral Smear	**Microcytic Hypochromic**	**06**	**75%**	**02**	**25%**	**0.2026**	**0.652**
	Normocytic Normochromic	**36**	**81.8%**	**08**	**18.2%**		

In this study, comparison between ACHD and CCHD for**Red Cell Indices** showed 82.9% had normal red cell indices in ACHD and 17.1% had normal red cell indices in CCHD and 72.4% had decreased red cell indices in ACHD and 27.3% had decreased red cell in CCHD. Showing Statistical not significant.

Comparison between ACCHD and CCHD **for RDW** (%) showed 97% of ACHD having normal RDW (%) and 03% having normal RDW (%) in CCHD and 52.6% showing increased RDW (%) in ACHD and 47.3% showing increased RDW (%) in CCHD.

Statistically showing significant.

Comparison between ACHD and CCHD for Peripheral smear showed microcytic hypochromic is 75% in ACHD and 25% in CCHD and normocytic normochromic showed 81.8% in ACHD and 18.2% in CCHD.Statistically not significant.

DISCUSSION:

In developing countries like India, the burden of Congenital Heart Defect is high because of high birth rate and critical nature of Congenital Heart Defect require Expensive treatment. The most common congenital malformation among all birth defects causing morbidity and mortality among children is Congenital Heart Defect.

Congenital heart disease (Cyanotic and Acyanotic) occurs in approximately 0.8% of live births worldwide. In India, the prevalence of CHD is not uniform across the country and varies from 0.8 to 5.2/1000 patients in community-based studies while the prevalence ranges between 3.9 and 26.4/1000 live births in hospital-based studies in India, which is not uniform across the country [3,4]. Ten percent of the present under 5 infant deaths may be accounted for by CHD.

*e*ISSN1303-5150

The major risk factor that was reported to aggravate the malnutrition in these children leading to increased risk of mortality and morbidity is Anemia. The prevalence of unrecognized anemia in paediatric patients with different congenital heart diseases who were referred for cardiac surgery was found to be rampant.

We conducted a cross sectional study of 52 consenting children aged 1-12 years of age with congenital heart disease chosen by purposive sampling technique, attending as Outpatient and Inpatient in the Department of Paediatrics and Surgery, Katuri Medical College and Hospital over a period from October 2021 to march 2022.

AGE DISTRIBUTION:

In the present study, 32.7% belonged to 12mon-59mon and 67.3% belonged to 5-12years.This gives an outlook on the lack of parental education and information regarding their attitude for health care.

SEX DISTRIBUTION:

In this study, 25 (48%) were female and 27 (52%) were male children. In a study by Rubia et al,[5]Singh G et al,[6]observed male to female ration 0.9:1 and 1.1:1 respectively and study by Vaidyanathan B et al[7]observed male to female ratio as 1:1 and 0.8:1. This study shows male to female ratio as 1:0.9

DISTRIBUTION OF SEX ACCORDING TO AGE:

Comparing the distribution of age group and sex, out of the 17 children in the age group 12-59 moths, 58.8% are male and 41.2% are female whereas out of children in the age group5-12yrs, 51% are female and 49% are male.

DISTRIBUTION ACCORDING TO TYPE OF CONGENITAL HEART DISEASE:

Out of the 52 children enrolled with congenital heart disease, majority (80.8%) had Acyanotic congenital heart disease and 19.2% had cyanotic congenital heart disease.

Majority had VSD-36.5% followed by ASD 28.8%, TOF-13.5%,PDA-9.6%which was again correlating with similar studies by Smitha R et al (VSD-40.7%;ASD-19.06%; PDA-9.53%;TOF13.8%),[4]Kapoor R et al (VSD-21%;ASD-19%;PDA-14.6%;TOF- 4.6%),[8]Mishra et al (VSD-28%;ASD-6%;PDA-8%;TOF-6%)[9].

DISTRIBUTION ACCORDING TO SOCIO ECONOMIC STATUS:

In this present study, majority of the children with congenital heart disease belonged to lower (86.6%) class with Upper lower class (63.5%) and lower class(23.1%) according to Modified Kuppusamy Socio Economic Scale. A study byAgha MM et al,1[0]Tanden Set al[11]also reported a high prevalence of CHD inchildren belonging to low socio-economic status.

DISTRIBUTION ACCORDING TO FAMILY MEMBERS AFFECTED:

In our study, only one patient had a family member (paternal uncle) who had a history of congenital heart disease (Acyanotic) for which surgical correction was done. According to Nelson, the risk of occurrence increases if a 1st degree relative (parent/sibling) is affected (2-6%) whereas when two first degree relatives are affected with CHD, the risk of subsequent child may reach to 20-30%.[2] Oyen N.et al reported that strong familial clustering was present infirst-degree relatives, ranging from 3-fold to 80-fold compared with the populationprevalence. Ellesoe GS et al, also reported similar correlation between familial cocurrence and congenital heart disease[12]

DISTRIBUTION ACCORDING TO MATERNAL AGE AT TIME OFCONCEPTION:

In this study, 5.8% of the mothers were below 19 years, 92.3% belonged to 19-35years and 1.9% were above 35 years at the time of conception. Best K.E et al reported that that advanced maternal age is not a risk factor for CHD, however there was marginal risk of infants developing certain types of CHD, among mothers aged more than 35years[13]which was also supported by Miller et al who also observed that infants born to mothers older than 35 years of age seemed to be at 20% increased risk of CHDs, whereas Luo YL et al observed in his study that the occurrence of CHD was seen in younger mothers.[14]

DISTRIBUTION ACCORDING TO DEGREE OF CONSANGUINITY:

In the study, majority of children with congenital heart disease had parents who were second degree (76.9%) consanguinity and 22.5% were third degree consanguinity

and no first-degree consanguinity noted. Gnanalingam MG et al also observed that parental consanguinity was noted in 12.5% of the control group compared to 31.1% of the CHD group.[15]

DISTRIBUTION ACCORDING TO BIRTH ORDER:

In this study, majority of the children with the congenital heart disease belonged to second birth order (76.9%) and22.5%third birth order. A study by Howell EM concluded that birth order is significantly related to mortality and nutritional status in large African families, with later born children having poorer outcomes.[16]

A possible explanation for this association could be that higher order births are more likely to be unwanted which results in less attention and care from parents: antenatal and postnatal care and child check-up decreases with the higher birth order. Another explanation could be that intra-household allocation of food and resources decreases with an increasing number of births in the household.

DISTRIBUTION ACCORDING TO GESTATIONAL AGE AND BIRTH WEIGHT:

In this study 94.2% were term (>37 weeks) and only 6.2% were preterm (<37weeks) and 82.7% had normal birth weight(2.5-3kg) and only 17.3% out of the total children were low birth weight(<2.5kg). Miller et al reported there was no correlation between the incidence of low birth weight and preterm and congenital heart disease[17] whereas Steurer AM et al, stated that incidence of CCHD was highest at 29 to 31 weeks' GA (0.9%) and lowest at 39 to 42 weeks (0.2%) and that morbidity remains increased across all gestational groups in comparison with infants born at 39 to 42 weeks.[18]

In thisstudy shows that the changing attitude towards periodic antenatal care and care of fetal wellbeing by the mothers as well as the approach by health care workers and health care system in ensuring proper maternal nutrition, antenatal care and safe delivery.

DISTRIBUTION ACCORDING TO DEGREE OF ANEMIA BASED ON HEAMOGLOBIN, RED CELL INDICIES, RDW, PERIPHERAL SMEAR:

Anemia is an important risk factor for morbidity and mortality in patients with cyanotic and Acyanotic congenital heart disease. Heart failure may occur and worsen by anemia as a comorbidity. Children with malnutrition commonly have anemia which is attributed to bone marrow hypoplasia, iron, vitamin B12, vitamin A and folate deficiency.In a study by Gaiha et al, 1993, a prevalence of 18.2% anemia in children with congenital heart disease was reported.[19]H Amoozgar et al, reported a high prevalence of unrecognized anemia in pediatric patients with different congenital heart diseases who referred for cardiac surgery.[20]

DISTRIBUTION ACCORDING TO HEAMOGLOBIN:

In this study, as per hemoglobin estimations and grading anemia according to WHO guidelines, 61.5% of the children with congenital heart disease were normal and 21.1% had anemia (18.8% had mild anemia, 2.5% had moderate anemia). 17.4% had polycythaemia.

Hemoglobin is not a sensitive indicator for detecting anemia in CCHD children.

DISTRIBUTION ACCORDING TO RED CELL INDICES:

 In this study, 21.2% had all decreased red cell indices and rest(78.8%) had normal red cell indices

 In children with ACHD, 82.9% had normal red cell indices and 72.7% had decreased red cell indices vs children with CCHD, 17.1% had normal red cell indices and 27.3% had decreased red cell indices.

DISTRIBUTION ACCORDING TO RDW:

 In this study 36.5% had increased RDW and 63.5% had normal RDW

 In children with ACHD, 97% had normal RDW and only 52.6% had increased RDW whereas children with CCHD, 3% had normal RDW and 47.3% had increased RDW. This was statistically significant with p value 0.000.

DISTRIBUTION ACCORDING TO PERIPHERAL SMEAR:

 15.3% had microcytic hypochromic anemia and the rest(84.6%) had normocytic normochromic anemia

 In children with ACHD, only 75% had microcytic hypochromic and rest had normocytic normochromic whereas children

eISSN1303-5150

with CCHD, 25% had microcytic hypochromic and the rest had normocytic normochromic.

Hemoglobin, red cell indices were reduced in both ACHD AND CCHD. Even though the children with CCHD did not have clinical pallor or was polycythaemia, their red cell indices were greatly reduced red cell indices(27.3%) their RDW was also increased (47.3%) which was statistically significant with p value <0.050. The finding of high prevalence of nutritional anemia especially iron deficiency anemia shows the effect of poor diet and also paves the path for its corrective interventions like iron supplementation in optimum doses for prevention (2-3mg/kg/day) or treatment(4-6mg/kg/day).

CONCLUSION

Congenital heart defect (CHD) is the most common congenital malformationamong all birth defects leading to morbidity and mortality among children. Anemia is rampant among children with CHD with a significant impact on the intervention and the outcome of intervention.In this study 61.5% of the children with congenital heart disease were normal and 21.1% had anemia (18.8% had mild anemia, 2.5% had moderate anemia). 17.4% had polycythaemia. There is a significant difference in RDW in Cyanotic and Acyanotic heart disease.

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