International Journal of Clinical and Diagnostic Pathology

Dr. Ravi Prakash Agarwalla
Assistant Professor,
Department of Pathology,
Chalmeda Anand Rao Institute
of Medical Sciences,
Karimnagar, Telangana, India

Dr. S Swapna
Assistant Professor,
Department of Pathology,
IQ City Medical College
Hospital, Durgapur, Burden,
West Bengal, India

Clinicohematological profile of anaemia among paediatric patients at tertiary care teaching center

Dr. Ravi Prakash Agarwalla and Dr. S Swapna

Abstract
Introduction: Anemia is a major global health problem, especially in developing countries like India, despite the fact that this problem is largely preventable & easily treatable. It is the commonest disease affecting humankind and is responsible for morbidity and mortality among general population. About 30% or nearly one third of world's population is suffering from anemia due to various causes.
Materials and Methods: A prospective study over a period of 1 years at Department of Paediatrics, Tertiary Care Teaching Center. The children who were admitted in the hospital with sign of Pallor were selected as per inclusion criteria into the study. An informed consent was taken from parents, detailed history was recorded with particular emphasis on symptoms suggestive of anaemia such as weakness and easy fatiguability, breathlessness on exertion, pica. A thorough clinical examination of every child was done.
Result: 54 (60%) males had anemia while 36 cases (40%) were females. Maximum 14 cases (15.6%) were found within the age group of 1-5 years. Maximum 40 cases (44.4%) of moderate degree of anemia were present. Microcytic Hypochromic anemia with 49 cases (54.4%) was the most common morphological type. Iron deficiency anemia was more prevalent with 38 cases (42.2%) followed by anemia of chronic inflammation/infection with 22 cases (24.4%). Weakness, easy fatiguability, irritability were the most common symptoms presented by 70 cases (77.8%). Pallor was the commonest sign observed in 90 cases (100%).
Conclusion: Nutritional anemia is most common cause of anemia in childhood especially in developing countries which can be prevented by proper nutritional support in growing age. Parents and caregiver need awareness regarding effect and causes of anemia and how to prevent it.

Keywords: Nutrition, hemoglobinopathy, transfusion

Introduction
Anemia is a major global health problem, especially in developing countries like India, despite the fact that this problem is largely preventable & easily treatable. It is the commonest disease affecting humankind and is responsible for morbidity and mortality among general population [1]. About 30% or nearly one third of world's population is suffering from anemia due to various causes [2].
Anemia can be of various types, but most common in developing countries is nutritional anemia. Nutritional anemia can be due to Iron deficiency (most common cause), Folic acid deficiency, and Vitamin B12 deficiency or may be combination of these factors, which can present with dimorphic picture [3]. These conditions are seen in all types of medical practice ranging from neonatology to geriatrics and public health and are an ongoing concern to all physicians. Other types include hemolytic anemia, which can be either congenital or acquired [4]. Congenital causes include membrane defect, hemoglobin defects and enzyme defect while acquired causes can be immune or non- immune. Aplastic anemia, anemia due to blood loss and anemia of chronic disease are the some other types of anemia [5].
Iron deficiency is the most common and widespread nutritional disorder in the world [6]. It is the only nutrient deficiency which is also significantly prevalent in all industrialized nations. According to the data of the World Health Organization (WHO), the prevalence of iron deficiency anemia (IDA) in industrialized countries and in non-industrialized countries is 10–20% and 50–60%, respectively [7].
Iron deficiency impairs the cognitive development of children from infancy through adolescence. It also damages immune mechanisms and is associated with increased morbidity rates [8]. The importance of iron deficiency and anaemia as a public health problem

Correspondence
Dr. S Swapna
Assistant Professor,
Department of Pathology,
IQ City Medical College
Hospital, Durgapur, Burden,
West Bengal, India

has been increasingly recognized by health authorities and policy makers. Although efforts are targeted primarily to prevent iron deficiency, it is still the most common nutrient deficiency all over the world [9].

About half of the population in the developing countries has iron deficiency anaemia. Preschool, school and adolescent children and women in childbearing age are at increased risk. Iron deficiency anaemia affects 30% of the world population [10].

Materials and Methods

A prospective study over a period of 1 years at Department of Paediatrics, Tertiary Care Teaching Center. The children who were admitted in the hospital with sign of Pallor were selected as per inclusion criteria into the study. An informed consent was taken from parents, detailed history was recorded with particular emphasis on symptoms suggestive of anaemia such as weakness and easy fatiguability, breathlessness on exertion, pica. A thorough clinical examination of every child was done.

Routine Investigations for anaemia and its causes were done. Anaemia was classified morphologically based on peripheral smear findings. Packed-cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and red cell distribution width (RDW) were determined by automated cell counter. Hemoglobin was estimated by Sahli's method and expressed in gm %, peripheral smear was stained by Leishman's stain. Reticulocyte count was done by brilliant crystal stain method, serum iron determination was done by Ramany's dipyridyl method, Total iron binding capacity was determined by Ramsay's method, serum vitamin B12 and folic acid was determined by architect method.

Inclusion criteria used in the study was children of age group 6 months to 12 years with pallor, admitted in Medical College and Hospital, while exclusion criteria was infants less than 6 months of age and teenagers more than 12 years old, out patients who were not admitted in the hospital, patients who collapsed due to congestive cardiac failure within 12 hours of admission and patients with communicable diseases like human immune deficiency virus (HIV), tuberculosis and hepatitis were excluded.

Data were entered in Microsoft excel 2007 and all statistical analyses were performed. Statistical package for the social sciences (SPSS) for Windows version 25.0, Chicago, USA, was also used for data analysis. Descriptive characteristics (mean and standard deviation) and percentage were performed for each parameter separately. Chi-square and independent - test were used for proportions and mean comparisons between groups, respectively.

Results

The present study included 90 cases (100%), of which 54 cases (60%) were male and 36 cases (40%) were females. Most common age group affected was 1-5 years of age group with maximum 14 cases (15.6%). (Table-1).

Table 1: Distribution of Total 90 Cases of Anemia According To Age & Sex:

Age Group(Years)	Male	Female	Total	Percentage (%)
0-1Years	10	06	16	17.8%
1-5Years	08	06	14	15.6%
5-8Years	10	08	18	20%
8-13Years	12	10	22	24.4%
13-18Years	14	06	20	22.2%
Total	54	36	90	100%

Maximum number of 40 cases (44.4%) was of Moderate degree of anemia. (Table-2)

Table 2: Distribution of Cases According To Severity of Anemia In 90 Cases:

Age Group (Years)	Mild	Moderate	Severe
0-1Years	07	10	05
1-5Years	04	15	09
5-8Years	03	05	06
8-13Years	04	06	05
13-18Years	02	04	05
Total	20	40	30
Percentage (%)	22.2%	44.4%	33.3%

Microcytic Hypochromic, Normocytic Normochromic anemia, Normocytic hypochromic anemia, Macrocytic Hypochromic anemia & Macrocytic Normochromic anemia, were reported in 48.9%, 22.2%, 13.3%, 8.9% & 6.7% respectively. (Table-3)

Iron deficiency anemia was the commonest nutritional deficiency anemia seen in 38 cases (42.2%). Anemia of chronic inflammation/infection was the second most common etiology of anemia with 22 cases (24.4%). Megaloblastic anemia, Dimorphic anemia, β Thalassemia major, Sickle cell anemia & Aplastic anemia (Fanconi's anemia) were seen in 6.7%, 8.9%, 14.4%, 3.3% & 3.3% cases respectively. (Table-3)

Table 3: Etiological & Morphological Classification of 90 Cases of Anemia:

Etiological/Morphological Type	NC/NC	NC/HC	Mic/HC	Mac/NC	Mac/HC	Total
Nutritional anemia (53.4%)						
Irondeficiency anemia (35.79%)		08	30			38
Dimorphic anemia (10.80%)					08	08
Megaloblastic anemia (6.81%)				06		06
Anemia of Chronic inflammation/infection (27.84%)	14	04	04			22
Hemolytic anemia (17.62%) Thalassemia (16.48%) Sickle cell anemia (1.14%)	03		10			13
Aplastic anemia (1.14%) Fanconi anemia (1.14%)	03					03
Total	20	12	44	6	8	90
Percentage (%)	22.2%	13.3%	48.9%	6.7%	8.9%	100%

Weakness, easy fatiguability and irritability were the most common (77.8%) presenting symptoms in the present study followed by loss of appetite & weight with refusal of feeds (66.7%). (Table-5)

Table 4: Distribution of 90 Cases as Per Presenting Symptoms

Presenting symptoms	No of Cases	Percentage (%)
Weakness, easy fatiguability, irritability	70	77.8%
Loss of appetite and weight, refusal of feeds	60	66.7%
Fever	55	61.1%
Cough with or without expectoration	50	55.6%
Breathlessness and palpitations	44	48.9%
Pica	27	30%
Diarrhoea, vomiting	14	15.6%
Altered sensorium, convulsions	1	1.1%

Pallor was the commonest sign noted in all cases (100%) followed by tachycardia (83.3%) (Table-5)

Table 5: Distribution of 90 Cases According To Signs Observed

Signs	No of Cases	Percentage (%)
Pallor	90	100%
Tachycardia	75	83.3%
Signs of Malnutrition(Delayedmilestones,failuretothrive,decreasedweightforage)	73	81.1%
Hemic murmur	40	44.4%
Edema	20	22.2%
Splenomegaly	15	16.7%
Features of hemolytic faciesi.e.frontal bossing, malar prominence	10	11.1%
Hepatomegaly	9	10%
Lymphadenopathy	6	6.7%
Signs of meningeal irritation	01	1.1%
Features suggestive of Fanconi's anemia	01	1.11%

Table 6: HB, MCV and RDW Values in Iron Deficiency Anemia, Anemia of Chronic Infection and B Thalassemia Major

Type of Anemia		Hb gm%	MCV (fl)	RDW (%)
Iron deficiency Anemia	Range	6.7-13.7	52.4-78.1	15.5-30.6
	Mean	9.7	66.3	19.8
Anemia of chronic infection	Range	5.7to13.5	73.7-87.8	15.2-17.9
	Mean	9.5	78.0	16.7
B Thalassemia Major	Range	4.9to12.1	54.9-80.7	15.5to17.8
	Mean	8.58	66.8	16.8

The mean values of Hb were reduced in all three types of anemia. The mean values of MCV were much reduced in Iron deficiency anemia followed by β Thalassemia major and Anemia of chronic inflammation/infection. The mean RDW was strikingly raised in Iron deficiency anemia whereas near normal in Anemia of chronic inflammation/infection and β Thalassemia Major

In cases of Iron deficiency anemia, the present study showed decreased values of Hb, MCV, MCH and MCHC and raised values of RDW compared to normal. In all cases of Iron deficiency anemia serum iron and serum ferritin levels were decreased while TIBC was raised.

In cases of Megaloblastic anemia, decrease in Hb, TLC, RBC, Platelets & Vitamin B12 values in all cases while MCV and RDW were raised in all cases.

Discussion
According to WHO reports anemia is a serious global health problem specially affecting children and pregnant females with estimated prevalence rate 42% in under 5 children. It is more prevalent in developing countries with high prevalence rate - 51% in children between 0 -4 years and 46% between 5 – 12 years of age. [11] Prevalence of anemia in our study was 43% in children. NFHS survey 4 reported that prevalence of anemia in Indian fewer than 5 children is 58.4%. [12] In study by prevalence rate was 20.7% in school children aged between 6-15 years of age and 18% by Djokic et al. in school children aged between 4-15 years of age while prevalence rate 52.88% reported by Sudhagandhi et al. and 37.6% by Assefa et al. [13-15] In our study male predominance was found, similar results were found in some studies but female predominance reported by other studies and in one study no difference was found in anemia prevalence between genders.

Nutritional anemia was reported as commonest cause of anemia in children in this study. These results supported by many other studies especially from developing countries. [16] WHO estimated that iron deficiency anemia is responsible for 50% of cases of anemia in fewer than 5 children. Other micronutrients (eg.- vitamin A, B12, folate and zinc) deficiency are also common culprit for nutritional anemia and it is advised by WHO that diet should be supplemented with these essential micronutrients. In both age group [6 month to 23 months and 2 to 12 years] food fortification with micronutrient rich powder advocated by WHO [17]. WFI [weekly iron and folic acid supplementation] program for fewer than 5 children and school aged children is a promising initiative by Government of India involving angan wadies and schools [18].

In our study pallor was not a very common finding in mild anemia but found as an important sign in severe anemia. Other studies had similar results. Fever was also a common presentation in our study as well as other studies. Lower respiratory infection is most common cause for admission in our study while another study by found acute gastroenteritis as a common reason for admission. Admission only because

of anemia was in 25 children. History of deworming was given by many patients but worm infestation was reported in 12 patient which confirmed by stool examination in 2 patients.

In our study malnutrition significantly associated with anemia and its severity. Childhood under nutrition alone is responsible for approximately 45% cases of fewer than 5 mortality according to WHO estimation [19]. Malnutrition was significantly associated with anemia and responsible for multiple micronutrient deficiency including iron, zinc, vitamin A, B12 and folate. It is suggested that more than one micronutrient deficiency was responsible for anemia in malnourished children and proper supplementation is must to improve outcome in these patients [20].

Infection was most common reason for admission in this study. Similar results were reported in other studies. It can cause sudden fall of hemoglobin due to hemolysis or decrease RBC production in bone marrow but many times underlying micronutrient deficiency is responsible for decrease immunity and exposed children to severe infection requiring hospitalization. Anemia is a risk factor for increased morbidity and prolongs duration of hospital stay in patient with infections.

Pancytopenia is a very serious threat in hospitalized children. We found it in 10% and bicytopenia in 20% hospitalized children. Severe pancytopenia was present in 5 children and associated with poor out come. Causes for pancytopenia were aplastic anemia, B12 deficiency, sepsis and hemolytic anemia. Some other studies from South Asia reported aplastic anemia, infection and hematological malignancies are common cause for pancytopenia [21-23].

Conclusion

In our opinion nutritional anemia is a prevalent cause of anemia especially in fewer than 5 children and significantly associated with faulty dietary practices. It can be prevented by improving awareness in people about serious manifestations of anemia in children including effect on growth and development with emphasis on its association with malnutrition so micronutrient supplementation in diet adequately provided to children. Second preventable cause is hemolytic anemia (thalesemia and sickle cell anemia) requires social awareness for premarital and prenatal counseling and screening in first trimester of pregnancy for timely decision.

References

1. World Health Organization. The global prevalence of anaemia in Geneva: World Health Organization; c2015. Available from: http://apps.who.int/iris/bitstream/10665/177094/1/9789 241564960_eng.pdf?ua=1&ua=1. Accessed December 1, 2016.
2. Indian Institute for Population Sciences (IIPS) and Ministry of Health and Family Welfare (MoHFW). National Family Health Survey - 4. 2017. Available from: http://rchiips.org/nfhs/pdf/NFHS4/India.pdf. Accessed June 12, 2017.
3. Dhirar N, Dudeja S, Khandekar J, Bachani D. Childhood Morbidity and Mortality in India—Analysis of National Family Health Survey 4 (NFHS-4) Findings. Indian pediatrics. 2018 Apr;55(4):335-338.
4. World Health Organization. Hemoglobin concentrations for the diagnosis of anemia and assessment of severity. Vitamin and Mineral Nutrition Information System. Geneva: World Health Organization; c2011.
5. Kanchana, Madhusudan SR, Ahuja S, Nagaraj N. Prevalence and risk factors of anemia in under five-year-old children in children's hospital. Int J Contemp Pediatr. 2018;5:499-502.
6. Mahroof MK, Khan SA, Saldanha P. Clinical study of anemia in rural school children of Mangalore, Karnataka, India. Int J Contemp Pediatr. 2019;6:416-421.
7. Sudhagandhi B, Sundaresan S, William WE, Prema A. Prevalence of anemia in the school children of Kattankulathur, Tamil Nadu, India. International Journal of Nutrition, Pharmacology, Neurol Dis. 2011;1(2):184.
8. Assefa S, Mossie A, Hamza L. Prevalence and severity of anemia among school children in Jimma Town, Southwest Ethiopia. BMC Hematol. 2014;14(1):1-9.
9. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al, Nutrition Impact Model Study Group. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. The Lancet Global Health. 2013 Jul 1;1(1):e16-25.
10. Cardosa MA, Scopel KK, Muniz PT, Villomore E Ferrira UM. Underlying factors associated with anemia in Amazonian Children a population-based, cross-sectional study. PLOS ONE. 2012;7:e36341.
11. Santo LL, Fawzi WW, Cardoso MA. PLOS ONE. 2012;7:e36341.
12. Ramana Shastry CPV. Study on clinical and hematological profile of Anemia in children aged 5 to 12 years in rural Telangana. J Pediatr Res. 2017;4(07):488-493. doi:10.17511/ijpr.2017.07.09.
13. Bhargava M. Pediatric Hematology: A neglected specialty. Indian Pediatrics. 1982;19:467-468.
14. Paul VK, Bagga A. In: Ghai OP, editor. Essential Paediatrics. 9th ed. c2019.
15. Lukens JN. Iron metabolism and iron deficiency anemia. In: Denis et al., editors. Blood Diseases of Infancy and Childhood. 5th ed. C.V Mosby; c1984. p. 115-146.
16. Singh RK, Patra S. Extent of anaemia among preschool children in EAG states, India. A challenge to policy makers. Anemia. 2014;2014:9.
17. Gupte S, Gupta RK, Gupta R. Iron Deficiency Anemia: A diagnostic approach in children. J K Science. 2002;2:175-179.
18. Gardner B. Anemias, of Inadequate Production. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF, editors. Nelson Textbook of Pediatrics. 18th ed. Philadelphia: W.B. Saunders; c2008. p. 2011-4.
19. Currimbhoy Z. The value of Complete Blood Count in Children. In: Parthasarathy A, editor. IAP Textbook of Pediatrics. 4th ed. Vol 1. New Delhi: JAYPEE; c2009. p. 771-775.
20. Panigrahi A, Sahoo PB. Nutritional anemia and its epidemiological correlates among women of reproductive age in an urban slum of Bhubaneswar, Orissa. Indian J Public Health. 2011;55:317-320.

21. Keohane EM, Smith LJ, Walenga JM. Rodak's Hematology Clinical Principles And Applications. 5th ed. Elsevier Saunders; c2016. p. 1.
22. Gomber S, Bhawana, Madan N. Prevalence and etiology of nutritional anemia among school children in urban slums. Indian J Med Res. 2003 Oct;118:167-171.
23. Janjale A, Pande S, *et al*. A Study of Severe Anemia in Children in a Tertiary Care Institute. MVP Journal of Medical Sciences. 2018 Jan-Jun;5(1):33-38.