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Original Research Article

Clinical and biochemical outcome in pediatric patients with iron deficiency anemia

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ABSTRACT

Background: Iron deficiency is a global public health problem with unique cultural, dietary and infectious hurdles that are difficult to overcome. Aims and objectives were to study clinical and biochemical profile of iron deficiency anemia, risk factors for iron deficiency anemia, presenting illnesses associated with iron deficiency anemia, association of other nutritional deficiency with iron deficiency anemia, treatment of iron deficiency anemia and recovery rate.
Methods: This cross-sectional prospective study is conducted between June 2017 to May 2019in a tertiary care institute Gujarat state of India. All the children in the age group of 6 months to 5 years admitted in paediatric ward with anaemia were included in study. Data collection was done using a pretested questionnaire including socio-demographic factors. Data was analysed using statistical package for social sciences and excel and $p<0.05$ was considered as statistically significant.
Results: The prevalence of anemia is 62.31% in patients admitted during study period. Mild to moderate anemia is observed in 75% patients. In present study, 62% patients are in age group of 6 months to 2 years and 38% patients are >2 years to 5 years. Patients with dimorphic anemia have initial mean serum B12 level 31.36 ng/ml, which improved after treatment to 312.98 ng/ml falling in the range of normalcy.
Conclusion: Though anemia is common, most patients are stable and present with mild to moderate anemia. Only a fraction of patients presenting with congestive cardiac failure require packed red blood cells transfusion. Oral iron therapy for three months is the mainstay of treatment for iron deficiency anemia. Vitamin B12 therapy is also needed in patients with dimorphic anemia.

Keywords: Anemia, Iron deficiency, Hemoglobin, Iron

INTRODUCTION

Iron deficiency anemia (IDA) is one of the commonest nutritional disorders in children worldwide. Various studies in India have reported the prevalence of anemia in infants and children varying from 60% to 80%.[1] Iron deficiency is a global public health problem with unique cultural, dietary and infectious hurdles that are difficult to overcome. More than 30% of the world's population is suffering from anemia. According to United Nations Children's Fund (UNICEF) based statistics, the estimated prevalence of IDA in children under 5 years of age is 75%.[2] Iron deficiency is more common in developing countries where children consume iron poor food and are infected with malaria and infested with parasites.

Iron deficiency is probably the most common cause of anemia between ages of 6 and 24 months. It is caused by insufficient dietary iron to meet the needs of rapid growth. An infant maintained on milk and carbohydrate without

supplements of iron containing foods is likely to develop an iron deficiency anemia, the so-called milk anemia of infancy.

Iron deficiency, linked to low nutritional iron consumption is one of the critical causes of childhood anemia in India.[3] Other critical factors, equally associated with childhood anemia here, include vitamin deficiencies, especially folate, vitamin B12 and A, infections with malaria parasite, hookworm, and hemoglobinopathies.[3-5] In a study of childhood anemia in rural India, Pasricha et al. suggested that the level of hemoglobin was principally linked with the status of iron in children. it also revealed that maternal hemoglobin level, family wealth, and food insecurity were equally critical.[6]

The 2005/06 National Family Health Survey (NFHS) revealed that at least 80% of children between 12 and 23 months were anemic in India. And in children aged <5 years, 69.5% were anemic.[4] Unfortunately, recent economic development and the national anemia-control program have not translated to major reduction in the occurrence of anemia in India as shown in the 2015 figures.[7] The 2015 demographic health survey show only 11 percentage point decrease from 69.5% to 58.5% childhood anemia in India, still making it endemic. The elimination of iron deficiency anemia in children is a public-health priority, given the association of anemia with impaired cognitive and psychomotor development.[8,9]

Iron deficiency may cause preschool children to be less attentive. Studies initially conducted with infants with iron deficiency anemia demonstrated that these infants had lower scores on mental development index (MDI) of bailey scales of infant development. Low serum iron and akathisia is well correlated.[10] The most devastating consequence of iron deficiency is neurocognitive deficits, which affect children of all ages. Iron deficiency can result in hypomyelination which may be the basis of neuro cognitive deficits.

The present study is an attempt to understand the clinical and biochemical profile of iron deficiency anemia in admitted patients and their follow up, risk factors for iron deficiency anemia, symptomatology in iron deficiency anemia, presenting illnesses associated with iron deficiency anemia, association of other nutritional deficiency with iron deficiency anemia, treatment of iron deficiency anemia and recovery rate.

METHODS

Study area and duration

This cross-sectional prospective study is conducted between June 2017 to May 2019 at NHL Medical College and VS Hospital, a tertiary care institute of Ahmedabad city of Gujarat state of India.

Inclusion criteria

Patient with age of 6 months to 5 years, presenting anemia (Hb<11 g %) as per WHO criteria for diagnosis of anemia were included.

Exclusion criteria

Exclusion criteria for the study were children <6 months and >5 years known case of hemolytic anemias, known case of bleeding disorders and past history of blood transfusion.

Sample size

100 randomly selected children meeting inclusion criteria with parents giving valid consent are included in the study.

Study tool

Data collection was done using a pretested, semi structured questionnaire, designed for the study purpose. After discharge, follow up visits are advised at 2-week, 1 month and 3 months.

On 1st follow up (i.e. after 2 week) patients are advised for complete blood counts and reticulocyte count. On 2nd follow up (i.e. after 1 month) patients are reinforced to take regular iron supplementation and iron rich diet. On 3rd follow up (i.e. after 3 month) patients are examined and anthropometry is recorded and submitted following investigations complete blood count, serum iron, serum B12, serum ferritin level.

Data analysis

The data was analysed using Statistical package for social sciences (SPSS) trial version and Microsoft excel 2013. Descriptive statistics were performed for various variables. The chi-square test for association was used and $p<0.05$ was considered as statistically significant.

RESULTS

Out of 100 enrolled patients, 42% patients have mild anemia, 33% have moderate anemia and 25% have severe anemia. Mild to moderate anemia is observed in 75% patients in our study. 62% patients belong to age group of 6 months to 2 years and 38% patients belong to age group of >2 years to 5 years.

In age group 6 months to 2 years; mild, moderate and severe anemia is seen in 35.48%, 38.70% and 25.80% respectively; while in age group of >2 to 5 years mild, moderate and severe anemia is seen in 52.63%, 23.68% and 23.68% respectively. Severity of anemia does not differ in various age group. $p=0.071$ is statistically insignificant.

Out of 100 patients, 55 are male and 45 are female. Male patients having mild, moderate and severe anemia are 38.18%, 38.18% and 23.64% respectively; while female patients having mild, moderate and severe anemia are 46.67%, 26.67% and 26.67% respectively. p=0.151 is statistically insignificant.

Table 1: Treatment given.

Anemia	Packed RBC	Injectable iron	Oral iron therapy	Iron rich diet	B12 therapy
	N (%)		N (%)	N (%)	N (%)
Mild (n=42)	0 (0)	-	0 (0)	42 (100)	2 (4.76)
Moderate (n=33)	4 (12.12)	-	29 (87.87)	33 (100)	2 (6.06)
Severe (n=25)	12 (48)	-	22 (88)	25 (100)	3 (12)
Total	16 (15)	-	50 (50)	100 (100)	7 (7)

Table 2: Mean weight gain and anemia.

Anemia	Weight gain (gm/kg) at completion of 3 month follow up
Mild	6.43
Moderate	5.68
Severe	6.06

Table 3: Gain in mean serum iron and severity of anemia.

Anemia	Mean serum iron at admission	Mean serum iron at 3 months	Improvement of iron
Mild	53.27	82.26	+28.99
Moderate	32.78	72.30	+39.5
Severe	24.93	66.20	+41.27
Total	39.48	74.82	+35.34

Table 4: Laboratory parameters on admission and on discharge.

Mean	Mild		Moderate		Severe	
	On admission (n=42)	At 3 months (n=32)	On admission (n=33)	At 3 months (n=23)	On admission (n=25)	At 3 months (n=21)
Hemoglobin (12-18 g/dl)	9.96	11.45	8.16	10.15	5.87	8.6
Serum iron (50-150 ug/dl)	53.27	82.26	32.78	72.30	25.14	66.24
Mean corpuscular volume (MCV) (83-101 Fl/red cell)	71.80	78.31	68.83	80.30	61.41	75.23
Mean corpuscular haemoglobin (MCH) (27-32 pg/red cell)	21.85	27.60	20.16	27.17	15.77	26.44
Mean corpuscular haemoglobin concentration (MCHC) (31.5-34.5 ug /dl)	30.6	34.19	28.25	32.92	25.18	31.86
Reticulocyte count (0.5%-2.5%)	1.14	0.82	1	0.9	1.4	1.28
Red cell distribution width (RDW) (11.5-14.5%)	16.07	14.78	16.53	14.93	18.18	15.81
RBC count (4.5-5.5 million cells/ul)	4.58	4.87	4.50	4.94	4.52	5.04

28 patients consume vegetarian food in which 9 (32.14%) have mild anemia, 9 (32.14%) have moderate anemia and 10 (35.71%) have severe anemia whereas 72 patients consume mixed food, of which 33 (45.83%) have mild anemia, 24 (33.33%) have moderate anemia and 15 (20.83%) have severe anemia.

Breast feeding as a parameter is considered for enrolled patients with age <2 years i.e. 62 patients in the study. Here, 23 patients have exclusive breast feeding till 6 months age and later proper complementary feeding practice, while 39 patients have history of mismanaged feeding. Severity of anemia does not differ in two groups. p=0.169 is statistically insignificant.

48% patients have some degree of Potential energy malnutrition (PEM); of these, 37 patients have PEM grade I and II in which 26 (70.27%) patients have mild to moderate anemia, and 11(29.72%) patients have severe anemia. 11 patients have PEM grade III and IV of which 8 (72.72%) patients have mild to moderate anemia and 3 (27.27%) patients have severe anemia. p=0.121 which is statistically insignificant suggesting that severity of anemia does not correlate with severity of PEM. 9% of these patients have Severe acute malnutrition (SAM). 52% patients have no PEM.

72% patients are appropriately immunized, while 28% patients were inappropriately immunized. In present study, anemia is seen as a co-morbid condition in patients admitted to the ward and enrolled for study. Presenting complaints are fever (86%), increased frequency of stool and vomiting (47%), cough and cold (43%), seizure (26%), difficulty in breathing (23%), irritability (21%), pica (11%) and others (3%).

In present study, pallor as a presenting sign is seen in 89 patients, signs of other nutritional deficiencies seen in 42 patients, hepatosplenomegaly in 40 patients, hair changes in 16 patients, edema in 5 patients, nail changes in 4 patients, others (poor oral hygiene, superficial skin infection, signs of dehydration, lymphadenopathy, ear discharge) in 47 patients.

Out of 100 patients, 40 presented with respiratory complaints; 29 have Lower respiratory tract infection (LRTI) and 11 have upper respiratory tract infection (URTI). Seizures are seen in 22 patients, ADD in 15 patients, SAM in 9 patients; Others (urinary tract infection (UTI), enteric fever, hepatitis, measles, pyrexia of unknown origin (PUO), fluid refractory shock, obstructive cholestatic jaundice, acute metabolic encephalopathy) are also seen. Only one patient of malaria (*Plasmodium vivax*) is seen.

In the present study, total mean hemoglobin is 8.34 gm/dl. While mean hemoglobin is 9.95 gm/dl in mild anemia, 8.16 gm/dl in moderate anemia and 6.03 gm/dl in severe anemia.

93% show microcytic, hypochromic RBCs (anisopoikilocytosis) and 7% show dimorphic picture of red blood cells (RBCs) in peripheral smear. Serum iron level is low in all 100 patients. 7 patients of dimorphic anemia also have low serum B12 level.

All patients are advised iron rich diet on discharge. 42 patients with mild anemia are discharged on iron rich diet and 2 patients required B12 therapy. Patients of mild anemia did not require iron therapy on discharge or even on follow up. 33 patients have moderate anemia; 4 patients required packed RBC transfusion initially and are later discharged on oral iron therapy. Rest 29 patients are discharged on oral iron therapy and 2 patients required B12 therapy also. 25 patients have severe anemia; 12 patients required packed RBC transfusion during hospital stay. 22 patients are discharged with oral iron therapy and 3 patients with SAM started oral iron therapy 2 weeks after discharge. 3 patients also required B12 therapy. 7% patients having dimorphic anemia received injectable vitamin B12 according to protocol. Oral iron therapy was given with syrup containing ferrous fumarate.

All patients showed positive weight gain after 3 month of iron therapy. The weight gain was similar in all the degrees of anemia as shown in table.

Mean serum iron level was 39.48 ug/dl on admission which improved to 74.82 ug/dl at 3 months that shows deficiency was corrected.

Mean serum iron level for patients in the mild, moderate and severe anemia are 53.27 ug/dl, 32.78 ug/dl and 24.95 ug/dl respectively on admission. This corrected to 82.26 ug/dl, 72.30 ug/dl and 66.20 ug/dl respectively after 3 months of treatment. The gain in serum iron is 28.99 ug/dl, 39.50 ug/dl and 41.27 ug/dl in the 3 groups respectively suggesting that as the severity of anemia increases gain of iron also increases with the treatment. p=0.009 which is highly significant.

Lowest hemoglobin level observed in our study at admission is 3.42 g/dl with lowest serum iron level of 4.8ug/dl in patient of acute diarrheal disease with severe acute malnutrition.

This table shows comparative figures of laboratory parameters of patients at the starting and end of the study. Patients with dimorphic anemia have initial mean serum B12 level 31.36 ng/ml, which improved after treatment to 312.98 ng/ml falling in the range of normalcy.

DISCUSSION

The prevalence of anemia is 62.31% in patients admitted during study period. Mild to moderate anemia is observed in 75% patients.

In present study, 62% patients are in age group of 6 months to 2 years and 38% patients are >2 years to 5 years. A study

by James et al documented that iron deficiency was commonest in 2nd year of life, which is comparable with our study.[11] The severity of anemia does not differ in various age group. Gender is not a significant attributing factor for iron deficiency anaemia in children under 5 years.

The study shows 28 out of 100 patients with iron deficiency anemia are consuming vegetarian diet, whereas 72 were on mixed diet. Patients having mixed food predominantly had mild anemia, though this was statistically insignificant (p=0.075), this may be due to high iron content of nonvegetarian food.

Maximum number of children have history of consumption of mixed food. Nonvegetarians particularly red meat has greater content of heme iron. In the present study though most of the patients have dietary habit of mixed food but it is in form of egg rather than meat. So, the mixed food habit has no significant impact in frequency of anemia.

Most of the patients are fully immunized suggesting effective immunization program. Study done by Agarawal et al detected pica in 31% of patients. In present study 11% patients showed pica.[12]

International study done by Aukett et al suggest that there is a direct relation between iron deficiency and delayed psychomotor development, but such parameter is not studied in present study.[13]

Out of 25 patients with severe anemia; 3 with SAM, 5 with Congestive cardiac failure (CCF) and 4 with LRTI (total 12 patients- 48%) and 4 (12.12%) out of 33 patients with moderate anemia with LRTI received packed RBCs during hospitalization. All patients with moderate to severe anemia are treated with 3 months oral iron whereas patients with mild anemia are treated with dietary iron. 7 patients with dimorphic anemia received vitamin B12 therapy also.

All patients showed positive weight gain after 3 month of iron therapy; it was similar in all grades of anemia. As shown in table 3, all categories showed serum iron level in the range of normalcy at 3 months of treatment. As the severity of anemia increases gain of iron also increases with treatment. This reflects improved absorption of iron with increasing deficiency. p=0.009 is highly significant.

Patients with mild anemia are advised iron rich diet only. At 3 months they showed near normal improvement in hemoglobin, serum iron and RBC indices. Patients with moderate anemia are advised oral iron therapy along with iron rich diet. Packed RBCs are transfused when indicated. At 3 months hemoglobin value improved but still qualified for mild anemia, similarly serum iron and RBC indices improved. Patients of severe anemia are advised oral iron therapy along with iron rich diet. Packed RBCs are transfused when indicated. At 3-month hemoglobin level improved till moderate anemia. Improvement in serum iron as well as RBC indices are also partial only. A longer treatment and follow up is advocated, especially for patients with moderate to severe anemia. Patients with dimorphic anemia completely improved after appropriate B12 therapy.

Limitation of study

Out of 100 cases enrolled in the study, 15 were lost at 1 month follow up visit and another 9 cases at 3 months follow up visit. Thus only 76 cases were available for final analysis.

CONCLUSION

Anemia is frequently seen in admitted patients. Children under 2 years age are more commonly anemic than older children. No gender discrepancy is seen in anemia in children under 5 years. Though anemia is common, most patients are stable and present with mild to moderate anemia. Only a fraction of patients presenting with congestive cardiac failure require packed RBC transfusion. Oral iron therapy for three months is the mainstay of treatment for iron deficiency anemia. Vitamin B12 therapy is also needed in patients with dimorphic anemia.

Recommendation

As the present study showed complete improvement in hemoglobin, serum iron, all RBC indices with three months treatment in mild to moderate anemia whereas cases with severe anemia showed partial recovery, longer treatment and follow up is advocated in severe cases.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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