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Original Research Article

An Analytical Study Evaluating Iron Deficiency Anemia and its Association with Acute Bronchiolitis in Children Admitted at Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar.

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Abstract

Aim: The aim of the present study was to evaluate whether iron deficiency anemia is associated with acute bronchiolitis in children.

Material & Methods: This Analytical study was carried out in the Department of Paediatrics, at ANMMCH, Gaya, Bihar for the period between March 2022 to February 2023 (one-year) after obtaining ethical approval to explore the association between iron deficiency anemia and bronchiolitis. For this purpose, a total number of 100 patients were enrolled in the study and among them, 50 children with bronchiolitis were considered as cases, and 50 healthy children without bronchiolitis were considered as control, who were matched with age.

Results: Majority of the patients were in the age group between 13-18 months. The mean age was found 13.077±5.725 months in cases and 15.115±7.953 months in controls. The mean age difference was not significant between the two groups ($p>0.05$). Male participants (32, 64%) were the predominant group in the study and female participants (18, 36%). Exclusive breastfeeding was found in 15 cases and 32 controls respectively. The differences were statistically significant ($p<0.05$) between the two groups in the chi-square test. Overcrowding was found in 38 cases and 30 controls respectively. There was a significant difference in Hb (gm/dl) between cases and controls followed by MCV (fl) between cases and controls. The MCH (pg) level was statistically and significantly lower in cases compared to controls; followed by MCHC (g/dl) which was statistically and significantly lower in cases compared to controls. S. Iron (µg/dl) was statistically and significantly lower in cases compared to controls. Transferrin Saturation (%) was statistically and significantly lower in cases compared to controls. RDW-CV (%) was statistically and significantly higher in cases compared to controls. Among the 100 study subjects 40 cases had anemia, followed by 30 controls had anemia. Their difference was statistically significant between the two groups ($p<0.05$).

Conclusion: Iron deficiency anemia has a significant association with bronchiolitis. A larger and more extensive study was recommended.

Keywords: Iron deficiency anemia, Acute bronchiolitis, Children

Introduction

Acute bronchiolitis (AB) is the most common acute lower respiratory tract infection (LRTI) in the first 24 months of life. Respiratory syncytial virus (RSV) is the main etiological agent. [1] Several risk factors like gender, age, history of prematurity, underlying conditions like immunodeficiency or cardiopulmonary disease have been associated with the severity of bronchiolitis. Bronchiolitis is the leading cause of respiratory distress of small children. Bronchiolitis is mostly (95%) a viral disease. Multiple studies were conducted to identify the etiology of bronchiolitis. Respiratory syncytial virus (RSV), human rhinovirus (hRV) and human bocavirus (hBoV) are the most frequently detected viruses. [2] Respiratory syncytial virus (RSV) is responsible for >50% of cases. Bronchiolitis is one of the main causes of hospitalization due to respiratory infection in children. [3]

Ineffective erythropoiesis, hemolysis, and blood loss are the main mechanisms responsible for the development of anemia. The most common contributing factors for anemia are nutritional deficiencies, disease, and genetic hemoglobin disorders. The three most common causes of anemia worldwide are iron deficiency, hemoglobinopathies, and malaria. [4] Iron deficiency anaemia (IDA) is a serious public health problem that impacts mental and physical development, health maintenance and work performance. Worldwide in over 40% of children, IDA has been associated with infections. [5] The World Health Organization estimates that approximately 2 billion people worldwide are suffering from anemia, of which 50% is due to iron deficiency. [6] It is also assumed that approximately 600 million preschool and school-aged children suffer from anemia worldwide. [7] Around 40 to 50% of children and adult women in the world are considered anemic, and among its numerous types, iron deficiency anemia is assumed to be affecting around 50% of school children and women, and approximately 80% of preschool children from 2 to 5 years old. [6] The prevalence of anemia among children under 5 years in non industrialized countries is estimated to be 39%, and in industrialized countries, it is 20%.2 Anemia accounts for approximately 9% of the global total disability burden, and children under 5 years bear the highest burden of anemia. [4]

There are some risk factors for bronchiolitis like non breast feed baby, living in crowded conditions, passive smoking, wood burning stoves, prematurity, low birth weight etc. [8,9] Anemia is identified as a risk factor for lower respiratory tract infection. [10] Anemia is one of the most common nutritional problems in the world and is associated with increased risk for morbidity and mortality especially, among under the 5 years of age and iron deficiency is considered the most common cause of anemia in developing countries. [11] In developing nations, IDA exceeds 50% and inadequate nutrition is typically blamed for it. [12,13] As anemia and bronchiolitis is common in our country, so this study was carried out to find the association between anemia and bronchiolitis.

Material & Methods

A cross-sectional analytical study conducted in Department of Paediatrics, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India for the period between March 2022 to February 2023 (one year). Children from 1 month to 2 years of age with bronchiolitis admitted in the department of paediatrics, ANMMCH, Gaya, Bihar, were recruited as case and age matched healthy children from outdoor without acute lower respiratory tract infection (ALRTI) were recruited as control during the specified period of time. Control: age matched healthy children from outdoor without acute lower respiratory tract infection (ALRTI).

Inclusion Criteria

- Children from 1 month to 2 years of age attended in the Department of Paediatrics with clinical and radiological findings of bronchiolitis were included.

Exclusion Criteria

- Patients with Chronic respiratory disease.
- Congenital heart disease.
- Consolidation or atelectasis on a chest roentgenogram.
- Severe systemic illness (e.g., malnutrition, tuberculosis) were excluded.

Study Procedure

The study cases were selected from IPD who were from 1 month to 24 months old with a history of runny nose, cough, breathing difficulty, chest indrawing and rhonchi on auscultation. Age-matched control was selected from outdoor healthy children without ALRTI. Informed written consent were taken from the mother or father or any legal attendant of the child. Information was collected by interviewing, from clinical and laboratory findings. Data was collected in a structured questionnaire. Both study case and control were investigated for Hb, RBC count, RBC Indices, PBF, Serum Iron, TIBC, and Transferrin Saturation. Transferrin Saturation was calculated using the formula of Iron level/TIBC. The cutoff point for low hemoglobin level is 11 gm/dl as per WHO definition. Blood samples were taken from the antecubital vein of each child by phlebotomist. Sterile, disposable syringes and needles, and proper tubes were used. Each sample was divided into 2 parts: one part (2 ml) put into a K3EDTA tube for CBC and the other part (3 ml) put into plain vacutainers for serum iron and TIBC. Serum was obtained at 3000/RPM for 5 minutes by lab rotator. Serum ferritin level was not investigated as in cases with infection, it increases probably as acute phase protein.

Laboratory Analysis

Hb% and RBC indices were analyzed by fully Automated Pentra DX Nexus (Horiba Medical) Haematology Analyzer, Japan, and verified manually by Hematologist. S. iron and TIBC were determined by using Chemiluminescent Micropartical Immunue Assay (CMIA/ELIZA) by Mindray BS-230, Automated Biochemical Analyzer, China. Transferrin Saturation (%) is calculated by using the formula

$Transferrin\ Saturation = (S.Iron \div S.\ TIBC)\ x$ 100.

Statistical Methods

The numerical data obtained from the study, was analyzed, and the significance of differences was estimated by using statistical methods. Computer-based Statistical Package for Social Science (SPSS) version 23 was used. Qualitative values were expressed as frequencies and percentages and numerical data were expressed as Mean ± SD. The comparison between the groups was done for the qualitative variables using a Chisquare test. When the conditions for Chi-square validity were not met, it was replaced by Fisher's exact test. The association between pathology (bronchiolitis) and potential causal factors (IDA) was described by the relative risk and its confidence intervals. Continuous variables were compared through Student's t-test. P-value of 0.05 or less was considered significant.

Results

Table 1: Distribution of study subjects according to age in months

Age (months)	Case (N=50) Frequency	Control (N=50) Frequency	P value
1-6	20	10	
7-12	10	13	
13-18	12	13	0.316
19-24	8	14	
Mean±SD	13.077±5.725	15.115±7.953	

Majority of the patients were in the age group between 13-18 months. The mean age was found 13.077±5.725 months in cases and 15.115±7.953 months in controls. The mean age difference was not significant between the two groups (p>0.05).

Table 2: Gender distribution

Gender	N	%
Male	32	64
Female	18	36
Total	50	100

Male participants (32, 64%) were the predominant group in the study and female participants (18, 36%).

Table 3: Distribution of study subjects according to the risk factors

Risk Factors	Cases (N=35) Frequency (case)	Controls (N=36) Frequency (control)	OR	95%CI Lower	Upper	P value
Exclusive breastfeeding						
Present	15	32	0.178	0.066	0.444	0.001
Absent	35	18				
Overcrowding			2.316	0.852	6.306	0.088
Yes	38	30				
No	12	20				
Cooking						
Gas	36	42	0.525	0.140	1.832	0.315
Wood	14	8				
Smoking in family			1.095	0.406	2.842	0.889
Present	35	34				
Absent	15	16				
Family history of atopy						
Present	4	8	0.345	0.072	2.086	0.412
Absent	46	42				

Exclusive breastfeeding was found in 15 cases and 32 controls respectively. The differences were statistically significant (p<0.05) between the two groups in the chi-square test. Overcrowding was found in 38 cases and 30 controls respectively.

Table 4: Comparison of lab findings in between case and controls

Investigation findings	Case (N=35)	Control (N=36)	P value
	Mean±SD	Mean±SD	
Hb (gm/dl)	9.51±1.66	10.64±2.15	0.007
TWBC (cmm)	16032.34±23312.14	8886.34±2034.06	0.084
MCV (fl)	73.27±10.72	75.85±7.93	0.048
MCH (pg)	23.57±4.56	24.48±3.47	0.038
MCHC (g/dl)	31.62±1.66	32.67±1.78	0.018
S.Iron(µg/dl)	42.08±21.35	64.36±22.54	<0.001
TIBC (µg/dl)	386.84±74.16	352.94±72.08	0.089
Transferrin Saturation (%)	12.44±8.42	17.83±9.02	0.005
RDW-CV (%)	15.34±2.76	14.16±1.96	0.052
Mentzer Index	17.43±4.16	16.33±2.38	0.190

There was a significant difference in Hb (gm/dl) between cases and controls followed by MCV (fl) between cases and controls. The MCH (pg) level was statistically and significantly lower in cases compared to controls; followed by MCHC (g/dl) which was statistically and significantly lower in cases compared to controls. S. Iron (µg/dl) was statistically and significantly lower in cases compared to controls. Transferrin Saturation (%) was statistically and significantly lower in cases compared to controls. RDW-CV (%) was statistically and significantly higher in cases compared to controls.

Table 5: Association of anemia and IDA with acute bronchiolitis in study population

Case (N=50) Variables	Control (N=50)		95% CI			P value
			OR	Lower	Upper	
Frequency (%)		Frequency (%)				
Anemia						
Anemic	40	30				0.007
Non-anemic	10	20				
IDA						
Present	30	15	5.0	1.82	13.71	0.001
Absent120	20	35				

Among the 100 study subjects 40 cases had anemia, followed by 30 controls had anemia. Their difference was statistically significant between the two groups ($p<0.05$).

Discussion

A person can be considered anemic when the blood haemoglobin concentration is below 2 standard deviations below the mean for age. [14] Blood hemoglobin concentration is affected by different factors such as age, sex, altitude, ethnicity, active and passive smoking, and pregnancy. Therefore, these factors should be taken into the consideration and need to be adjusted before diagnosing anemia in a child. [8] Ineffective erythropoiesis, hemolysis, and blood loss are the main mechanisms responsible for the development of anemia. The most common contributing factors for anemia are nutritional deficiencies, disease, and genetic haemoglobin disorders. The three most common causes of anemia worldwide are iron deficiency, hemoglobinopathies, and malaria. Around 80% of hemoglobinopathies occur in low- and middle-income countries. Sickle cell disorder is the most common hemoglobinopathy, and it is predominant in sub-Saharan Africa. The next in line is β- and α-thalassemia, predominant in South-East Asia. [15]

Majority of the patients were in the age group between 13-18 months. The mean age was found 13.077±5.725 months in cases and 15.115±7.953 months in controls. The mean age difference was not significant between the two groups ($p>0.05$). Male participants (32, 64%) were the predominant group in the study and female participants (18, 36%). Kumar et al observed a male predominance in their study and male to female ratio was 1.3:1, which indicates male children are more prone to ALRI as compared to female children. [16] Exclusive breastfeeding was found in 15 cases and 32 controls respectively. The differences were statistically significant ($p<0.05$) between the two groups in the chi-square test. The differences were statistically significant ($p<0.05$) between the two groups found that non–breast- fed children had a 3.6-fold risk of ALRTI. [17] Overcrowding was found in 38 cases and 30 controls respectively.

Robledo-Aceves M et al [18] observed no significant (p>0.05) association with smoking history in the family showed that only exposure to cigarette smoking was an independent risk factor associated with severe bronchiolitis (OR, 3.5; 95% CI, 1.99-6.18; p=0.0001). There was a significant difference in Hb (gm/dl) between cases and controls followed by MCV (fl) between cases and controls. The MCH (pg) level was statistically and significantly lower in cases compared to controls; followed by MCHC (g/dl) which was statistically and significantly lower in cases compared to controls. S. Iron (µg/dl) was statistically and significantly lower in cases compared to controls. Transferrin Saturation (%) was statistically and significantly lower in cases compared to controls. RDW-CV (%) was statistically and significantly higher in cases compared to controls. Among the 100 study subjects 40 cases had anemia, followed by 30 controls had anemia. Their difference was statistically significant between the two groups (p<0.05). Behair et al [19] stated that there was a statistically significant increased incidence of anemia in group I compared with group II, with OR of 4.64 and 95% CI: (1.99-10.80). In their study, it was shown that 74 (74%) of 100 cases and 38 (38%) of 100 controls were anemic and 60 (60%) of cases and 24 (24%) of controls had IDA, with OR of 4.75 and 95% CI: 2.02-11.14 found a statistically higher percentage of IDA among cases (55%) than among controls (27.5%) (p=0.03) stated a total of 82 cases with ALRTI, 34 cases were IDA positive fulfilling all six criteria, remaining was labelled as IDA negative showed that among the anemic children, 62 (86%) in the study group had iron deficiency.

Conclusion

The study has shown that iron deficiency anemia is associated with acute bronchiolitis in children from 1 month to 2 years of age. Moreover, children with iron deficiency anemia are 5 times more susceptible to acute bronchiolitis as compared to healthy control.

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