ABSTRACT

Background: Acute lower respiratory tract infection is a major cause of death in under five years of age, and anemia is the commonest co-factor in pediatric patients seeking medical advice especially in developing countries.

Aim: To analyze whether a low hemoglobin level is a risk factor for acute lower respiratory tract infections (ALRTI) in children.

Materials and Methods: Prospective case control study on 220 children (110 cases and controls each) was carried out in our children’s hospital (G.B. Pant Hospital), an associated hospital of Government Medical College Srinagar, of Kashmir Northern India. All patients between the age of 1 month to 5 years of age who fulfilled the inclusion criteria were included. We used WHO criteria to diagnose ALRTI among the cases, and age and sex matched patients who did not have respiratory complaints were kept as controls. Patients who had congenital heart diseases, tuberculosis, malignancies, or dysmorphic features were excluded from the study. All patients were subjected to detailed history and thorough clinical examination followed by investigations like complete blood count (CBC), peripheral blood film (PBF) smear, blood culture and sensitivity test, X-ray chest, serum iron and iron binding capacity were done in all cases.

INTRODUCTION

Hemoglobin (Hb) level is the most reliable indicator of anemia among all individuals. Anemia is a major public health problem that can occur at any stage of the life cycle, but is more prevalent in pregnant women and young children having iron deficiency [1]. Approximately over 75% of children between the age of 1-3 years are anemic in India [2], and are at risk of developing various consequences of anemia including infections. Lower Respiratory Tract Infections (LRTI) includes all infections of the lungs and the airways below the larynx [3], and includes croup syndromes, bronchitis, bronchiolitis and pneumonia [4]. Acute lower respiratory tract infections (pneumonia) is the biggest single cause of childhood death under the age of 5 years in developing countries [5]. Approximately 150 million episodes of childhood pneumonia are reported every year from the world and there are about 3 million deaths, less than 5 years of age, each year due to pneumonia, of these deaths 90-95% are in the developing countries [6].

Various risk factors have been proposed to increase the chances of development of lower respiratory infections some of them are definite some are likely and few are possible [7]. Since infections of the lower respiratory tract are the major morbidity and mortality indicators among the children, gaining control over the risk factors will have a promising effect on the wholesome growth and development of children. Our study was conducted with the objective to know the association of low Hb levels among the children with LRTI.

RESULTS

Our study had slightly male preponderance 57.3% in study group and 59.1% in control group. Maximum number of children were between 3 months and 23 months both in the study (80.9%) as well as in the control (81.8%) group. In this study hemoglobin level <11 gm/dL was considered low. Mean Hb level was 8.8 gm/dL in the study group and 11.6 gm/dL in the control group. Anemia was found in 71 (64.5%) cases in the study group and in 31 (28.2%) cases in the control group. Anemic patients were found to be 4.6 times more susceptible to ALRTI in our study (Odds Ratio was 4.63), p-value <0.001. Iron deficiency was found in 78.9% of total anemic cases in the study group, p-value <0.001. In the study group, the mean serum iron level was 35.3 mcg/dL in the anemic cases and 57.1 mcg/dL in the non-anemic cases, while in the control group, these values were 52.4 mcg/dL and 62.6% mcg/dL respectively, (p-value <0.01).

CONCLUSION

Anemia, predominantly iron deficiency anemia, was significantly found in ALRTI patients, and these patients were found to be 4.6 times more susceptible to ALRTI. Early and accurate diagnosis of anemia in children suffering from various ailments in particular to ALRTI will serve the mankind in a better way.

Keywords: ALRTI, Anemia, Children, Iron deficiency, Pneumonia

MATERIALS AND METHODS

The present study was a hospital based prospective study conducted over a period of one year from March 2011 to February 2012, in the Department of Pediatrics, G.B Pant Hospital, which is an associated tertiary care hospital of Government Medical College Srinagar. For a 68%, and 21% prevalence of anemia among the cases and controls, and at a power of 90% with 95% confidence interval, the sample size for current study was 90 cases in each group, however, we took 110 cases in each group for convenience and more accuracy. We selected the LRTI patients using the WHO criteria i.e. patients having fever, cough, fast respiratory rate for age, chest in-drawing, and ronchi or crepitations on auscultation. All other patients who were suffering from other systemic illnesses like congenital heart diseases, tuberculosis (any evidence plus Montaux test positive cases), protein Energy Malnutrition (PEM > Grade III as per Indian Academy of Paediatrics (IAP) Classification), children who already received antibiotic from outside were excluded from the study. Hemoglobin level <11gm% was considered low in this study. Investigations like complete blood count (CBC), peripheral blood smear (PBF), blood culture and sensitivity test, X-ray chest, serum iron and iron binding capacity were done in all cases. Blood sample were taken from anti-cubital vein of each child by a trained phlebotomist. Sterile, disposable syringes and needles, and proper tubes were used. Hemoglobin level was estimated in the blood samples using cyanmeth method by automatic blood cell analyser.
Iron level and TIBC were measured by using the Ferrozine method without deproteinization.

**STATISTICAL ANALYSIS**

Data was described as mean ± SD/SE and percentages. Least significant difference for intergroup variance was measured at 95% confidence interval. The metric data was analysed by student's t-test whereas Mann-Whitney U-test and Fisher's exact test were used for non-parametric data. P-value was expressed up to three decimal places. SPSS version 19.0 and Excel software were used for data analysis.

**RESULTS**

Observations of our study are depicted in tables as under [Table/Fig-1,2]:

<table>
<thead>
<tr>
<th>AGE (month)</th>
<th>Study (110)</th>
<th>Control (110)</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>≤ 2</td>
<td>13</td>
<td>11.8</td>
<td>10</td>
</tr>
<tr>
<td>3 to 23</td>
<td>89</td>
<td>80.9</td>
<td>90</td>
</tr>
<tr>
<td>24 to 59</td>
<td>8</td>
<td>7.3</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Study (110)</th>
<th>Control (110)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>63</td>
<td>57.3</td>
<td>65</td>
</tr>
<tr>
<td>Female</td>
<td>47</td>
<td>42.7</td>
<td>45</td>
</tr>
</tbody>
</table>

**Clinical Features**

- **Fever**: 104, 94.5, 91, 82.7, 0.006
- **Cough**: 110, 100.0, 8, 7.3, 0.000
- **Fast Respiratory Rate**: 74, 67.3, 0, 0.0, 0.000
- **Chest in-drawing**: 92, 83.6, 0, 0.0, 0.000
- **Ronchi/Crepitations**: 64, 58.2, 0, 0.0, 0.000
- **Vomiting**: 23, 20.9, 56, 50.9
- **Diarrhea**: 6, 5.5, 38, 34.5
- **Pain Abdomen**: 3, 2.7, 32, 29.1
- **Dehydration**: 6, 5.5, 30, 27.3
- **Convolutions**: 9, 8.2, 28, 25.3
- **Poor Feeding/sore throat**: 60, 54.5, 66, 60.0

**DISCUSSION**

Anemia is the commonest ailment affecting human's health, socioeconomic development and overall betterment of the mankind. The most common cause for anemia is nutritional deprivation in particular, iron deficiency [8]. In Southeast Asia, the proportion of anemic population is the highest in the world, with 616 million people at risk [8]. In children, major health consequences include impaired cognitive and physical development and increased mortality and morbidity related to occurrence of infections [10]. Balanced and adequate nutritional supplementation to the growing children is of immense importance for development and maturity of immune, consequently development of resistance against the infections. So nutritional inadequacy including the iron deficiency forms an indirect risk factor for the contracting acute lower respiratory tract infection (ALRTI) [11]. Most common affected age group was 3 months to 23 months, which is quite comparable with the study conducted by Malla T et al., [12]. The common involvement of this age group could be because, supplementary and complementary feeding practices that might be inadequate and inappropriate, are practiced and advocated widely in this age, due to which Hb could touch the nadir.

As shown in [Table/Fig-1] there is no gender significance of having ALRTI among various studied populations [12-14] which is quite comparable to our study. Hemoglobin level less than 11 gm% was considered anemia in our study subjects. Out of the 220 children, 102 were anemic giving us a proportion of 46.36% a rate lower than the average national rate of our country [2], which could be because most people in Kashmir region possess the habit of taking religious feeding practices that might be inadequate and inappropriate, are practiced and advocated widely in this age, due to which Hb could touch the nadir.

Mean serum iron level was 35.3 mcg/dL in the anemic and 52.41 mcg/dL in the non-anemic ALRTI cases (p-value <0.01), while in control group, the mean serum iron level was 57.1 mcg/dL in the anemic and 62.6 mcg/dL in the non-anemic subjects, (p-value <0.01), pointing an association of low serum iron in ALRTI, a hypothesis needs consolidation of the previously held research [15, 16]. Although the early prospective interventional studies conducted, derived the support from the value of iron supplements in reducing rates of respiratory infections in infants [17, 18]. In our study anemic patients had 4.63 OR for developing ALRTI, while as it was 5.6 [12], 5.76 [13] and 2.08 [14] in previous studies, as shown in [Table/Fig-3]. A result that is showing consistent strength of association of anemia and ALRTI.

It seems noteworthy that oxygen (O₂) and carbon-dioxide (CO₂) transport is primarily facilitated by Hb, besides Hb acts as buffer for nitric oxide (NO) and other body derangements [19]. Therefore quantitative and/or qualitative reduction in Hb, may adversely affect the normal functions. Alveolar macrophages obtain iron primarily from Hb, because most people in Kashmir region possess the habit of taking religious feeding practices that might be inadequate and inappropriate, are practiced and advocated widely in this age, due to which Hb could touch the nadir.

**REFERENCES**

Available at: http://www.fao.org/ Docrep/W0073e/w0073e00.htm. [accessed
Mohd Ashraf et al., Low Hemoglobin Level a Risk Factor for Acute Lower Respiratory Tract Infections (ALRTI) in Children

[Table/Fig-3]: Comparison of present study with other studies showing association of LRTI with gender and anemia

<table>
<thead>
<tr>
<th>Sex</th>
<th>Present Study</th>
<th>Malla T et al.,</th>
<th>Mourad S et al.,</th>
<th>Ramakrishnan et al.,</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases (%)</td>
<td>Control (%)</td>
<td>Cases (%)</td>
<td>Control (%)</td>
</tr>
<tr>
<td>Males</td>
<td>57</td>
<td>60</td>
<td>71</td>
<td>67</td>
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<tr>
<td></td>
<td>Females</td>
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<td>40</td>
<td>29</td>
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<tr>
<td>p-value</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>37</td>
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</table>

Anemia

<table>
<thead>
<tr>
<th></th>
<th>Present (%)</th>
<th>Control (%)</th>
<th>Cases (%)</th>
<th>Control (%)</th>
<th>Cases (%)</th>
<th>Control (%)</th>
<th>Cases (%)</th>
<th>Control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>64.5</td>
<td>28.2</td>
<td>68.6</td>
<td>38.6</td>
<td>68</td>
<td>84</td>
<td>74</td>
<td>33</td>
</tr>
<tr>
<td>Absent</td>
<td>35.5</td>
<td>71.8</td>
<td>31.4</td>
<td>61.4</td>
<td>32</td>
<td>16</td>
<td>26</td>
<td>67</td>
</tr>
<tr>
<td>p-value</td>
<td>0.001 (S)</td>
<td>&lt;0.001 (S)</td>
<td>0.008 (S)</td>
<td>0.000 (S)</td>
<td>2.08 (Adjusted OR)</td>
<td>5.76</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


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