RELATION OF GRADES OF HYPONATREMIA ON SEVERITY OF BRONCHIOLITIS

Dr. Nirmal Georgie Ninan¹, Dr. Sanjeev Kumar TM²

¹Post graduate resident, Department of Paediatrics, JMMC & RI, Thrissur

²Professor, Department of Paediatrics, JMMC & RI, Thrissur

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Corresponding author: Nirmal Georgie Ninan

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Abstract:

Background and objectives: Hyponatremia often occurs among children with bronchiolitis. It is the most common electrolyte abnormality associated with severe disease course. Aim was to study relation between sodium levels and severity of bronchiolitis

Methodology: Cross-sectional study was conducted on 72 infants admitted with bronchiolitis to Pediatrics ward/ICU, JMMC. Infants with recurrent respiratory or super added bacterial infections, born <34weeks gestation, any chronic disorder or medications that can influence electrolyte levels or parents unwilling for consent were excluded. Severity of bronchiolitis was scored and classified into mild, moderate, severe. Sodium levels were determined and grouped (in mmol/L) into normonatremia (135-145) and hyponatremia (mild (130-134), moderate (125-129) and severe (≤ 124). The grade of hyponatremia with severity of bronchiolitis was compared. Chi square test was used to test the association of severity of bronchiolitis and category of hyponatremia. ANOVA test was done to compare the severity of bronchiolitis with sodium levels.

Results: Hyponatremia was seen in 50% of cases admitted with severe bronchiolitis, which when compared to mild and moderate bronchiolitis, was statistically significant ($p < 0.001$). ANOVA showed mean sodium levels of mild, moderate and severe bronchiolitis were 138.44 ± 1.81 , 137.37 ± 1.76 and 135.43 ± 3.93 respectively; these were statistically significant ($p < 0.001$). A pairwise comparison between mild and moderate bronchiolitis with hyponatremia was not found to be statistically significant ($p = 0.769$) but comparison between mild and severe bronchiolitis with hyponatremia was statistically significant ($p < 0.001$)

Conclusion: There is statistically significant relation between hyponatremia and severity of bronchiolitis. Hyponatremia could be considered as a marker to assess the severity of bronchiolitis.

Keywords: Bronchiolitis, Hyponatremia, Respiratory distress

Introduction:

Bronchiolitis is a virus-induced inflammation of bronchioles and their surrounding tissue. The age limit varies from 6 months to 2 years.(1) RSV is the most important causative agent of bronchiolitis during infancy, detected in 50-80% of the hospitalized bronchiolitis cases.(2) Mortality rate is approximately 2 per 100 000 infants and is higher in developing countries.(3) Acute bronchiolitis is a clinical diagnosis. In infants, few days of runny nose, fever and cough typically precede the signs of lower respiratory distress (nasal flaring, tachypnoea and subcostal recessions) along with wheeze.(4) Clinically, bronchiolitis is characterized by expiratory breathing difficulty in infants. Other symptoms include cough, tachypnea, hyperinflation, chest retraction and wheezing (5&6). Management is primarily supportive treatment, i.e. oxygen, nasal suctioning, mechanical ventilation and hydration.(7) High flow oxygen

therapy using nasal cannula has shown promising results.(8) Hyponatremia often occurs among children with bronchiolitis.(9) It is the most common electrolyte abnormality seen and associated with more severe disease course such as mechanical ventilation and increased ICU length of stay. (10) Thirst and anti-diuretic hormone maintain circulating Na^+ between 135 and 145mmol/L.(11) Regulation of fluid volume is controlled by the renin-angiotensin-aldosterone system, which promotes renal Na^+ retention, by the natriuretic peptides, which promote Na^+ -wastage and by the anti-diuretic hormone, which promotes water retention.(12) In acute lower respiratory tract infections, extracellular fluid volume depletion might result from poor fluid intake, excessive sweating, or vomiting. There can also be depressed myocardial contractility with arterial under filling.(13) Tumor necrosis factor- α and interleukin- 1β or -6, cause a volume-independent release of anti-diuretic hormone (or increase the function of its renal receptor).(14)

Children with hyponatremia have significantly higher risks of mechanical ventilation use and longer ICU length of stay.(10) Hyponatremia is a marker of higher severity.(15) In most cases, hyponatremia is secondary to either reduced effective circulating blood volume or to true extracellular fluid volume depletion. Drops in Na⁺-level can lead to brain swelling and pulmonary edema.(16). Aim of this cross-sectional study was to assess circulating sodium by ion electrophoresis in infants with moderate-severe bronchiolitis.

Aims & Objectives

To assess hyponatremia in acute bronchiolitis and study the relation between serum sodium levels and severity of acute bronchiolitis

Methodology

Study design: Cross sectional study

Study period: 18 months

Setting: Pediatrics ward and PICU, Jubilee Mission Medical College & Research Institute, Thrissur

Sample size:

The proportion of hyponatremia in acute bronchiolitis observed in an earlier publication “Milani GP, Rocchi A, Teatini T, Bianchetti MG, Amelio G, Mirra N, et al. Hyponatremia in infants with new onset moderate-severe bronchiolitis: A cross-sectional study. *Respir Med.* 2017 Dec 1;133:48–50” with 95% confidence level a 20% relative allowable error, minimum sample size comes to 72.

$$N = \frac{Z^2 p(1-p)}{d^2}$$

Inclusion criteria:

All infants <24 months with acute bronchiolitis admitted in the pediatric ward/ICU after consent from parents (father/mother)

Exclusion criteria:

Infants admitted with recurrent respiratory infections, bronchiolitis with super added bacterial pneumonia, infants born <34 weeks gestation, parents unwilling for consent, any chronic respiratory, renal, metabolic or cardiac disorder or recent medications that can potentially influence serum electrolyte levels.

Sampling procedure

1. The diagnosis of bronchiolitis is made in infants ≥ 1 month and ≤ 24 months of age with acute onset of

worsening respiratory distress, cough and wheeze on auscultation. The study is conducted on infants admitted to the Pediatric ward/ICU with a diagnosis of acute bronchiolitis.

2. Severity of bronchiolitis is assessed using the following parameters are used: Respiratory rate (<45/min = 0; 45–60/ min = 1; >60/min = 2), O₂-saturation in ambient air (>95% = 0; 95–90% = 1; <90% = 2), presence of thoracic retractions (none = 0; present = 1; present and associated with nasal flare = 2) and ability to feed (normal = 0; reduced = 1; strongly reduced = 2) are used to calculate the disease severity as mild (<4), moderate (4–6) or severe (≥ 7).

Based on the above parameters, bronchiolitis was classified into mild (< 4), moderate (4–6) , severe (>6).(17)

3. After classification of bronchiolitis based on above parameters, venous blood was taken for determination of whole blood ionized sodium.

Methods of data collection:

Data collected by referring case sheets and investigating forms of infants included under study. Informed consent taken from father /mother. Data presented using tables, graphs and charts.

Outcome measurement:

Depending on serum sodium levels, patients will be grouped into: **Normonatremic** (135-145mmol/L), Hyponatremic- Mild (130-134mmol/L), Moderate (125-129mmol/L), Severe (≤ 124 mmol/L)

Analysis, interpretation and results:

Data was collected from 72 subjects meeting the inclusion criteria

Methods of Data Collection:

Brief personal data of the patient

Data collected by referring case sheets and investigation forms of infants included in the study

Statistical analysis

The effects of hyponatremia with severity of bronchiolitis was compared and studied. The obtained data was recorded and entered into Excel. Qualitative data was entered in proportions. For example: Severity score (Categories of severity). Chi square test was used to test the association of severity of bronchiolitis and category of hyponatremia. An independent ANOVA test was also done to compare the severity of

bronchiolitis with serum sodium levels. p value of <0.05 was considered significant. Data was analyzed by the statistical software IBMSPSS version 25

Results and analysis

The study group had slightly higher male predominance with male to female ratio 1.1:1. Majority of the children presented within 1-2 and 3-5 days of onset of symptoms (44.4% each respectively) while 5.6% each presented within 24 hours and more than 5 days of onset of symptoms. Majority of the study group had running nose as the first symptom of presentation (44.4%). 27.8% had fever, 16.7% had cough and 11.1% had breathing difficulty as the first symptom of presentation. Majority of the children in the study population had tachypnoea as a complication (61.1%). 38.9% of the study group had respiratory rate of <45 and 45-60 each, while 22.2% had a respiratory rate >60 per minute (mild, moderate and severe respectively). 61.1% had early initiation of complementary feeds in the study group. Only 11.1% had hyponatremia in the study group. 38.9% maintained oxygen saturation above 95%, while 44.4% and 16.7% had saturation levels between 90-95% and $<90\%$ respectively. 22.2% of study group required oxygen support. Majority of the study group did not require any form of oxygen support; Of the 16 who required oxygen support, 50% was given HFNC and 50% was given CPAP support. 50% of the study population had prematurity. 33.3% of the study population had an exposure to passive smoking. 61.1% of the study population had a positive family history of reactive airway disease. Majority of the study group had mild bronchiolitis (66.7%), with 11.1% and 22.2% having moderate and severe bronchiolitis respectively

Fig 1: Age distribution among study population

Fig 2: Symptom distribution among the study population

Fig 3: Relation of hyponatremia to severity of bronchiolitis

Table 18: ANOVA and pairwise comparison between hyponatremia and severity of bronchiolitis

Severity	N	Sodium Levels		p Value
		Mean	SD	
Mild bronchiolitis	48	138.44	1.81	<0.001
Moderate bronchiolitis	8	137.38	1.77	
Severe bronchiolitis	16	135.44	3.93	
Pairwise Comparison				
Severity				p Value
Mild	Moderate			0.769
	Severe			<0.001

Discussion

The present study is a prospective cross sectional study conducted on children admitted with bronchiolitis to the Paediatrics ward and ICU of Jubilee Mission Medical College, Thrissur. Severity of bronchiolitis was assessed on admission, sodium levels were determined and their relation were studied. The study population had a slight male predominance

(52.8%), which is in accordance with study by Martinez FD et al which showed that bronchiolitis mainly affects male children.(17) Majority of the affected children were less than 6 months of age (50%) which is similar to the study conducted by Boyce et al, which revealed that children less than 6 months of age contracted bronchiolitis of the severe kind and required higher rates of hospitalisation(18).

Bronchiolitis was seen in 50% of preterm and 50% of term infants in this study. This is in contrast to studies by Pezzotti et al, Garcia et al and Hall CB et al, which had shown that rates of bronchiolitis were higher and more severe in premature babies(19). However, study by Bockova et al, has showed similar incidence of bronchiolitis in both term and preterm infants. All children included in this study were immunised for age. Studies by Law et al and Simoes et al showed that bronchiolitis was more in unimmunized children.(20).

61.1% of the infants had a family history of reactive airway disease which is in accordance with study by Martinez et al, which showed that infants of mothers with asthma or wheezing were more likely to develop bronchiolitis(17). 50% of the infants admitted with severe bronchiolitis had hyponatremia of the mild variant which was statistically significant. Hyponatremia is the most common electrolyte imbalance known to poorly affect the disease course of any lower respiratory tract infection particularly bronchiolitis as shown by Luu R et al and Hasegawa K et al.(9&10)

Limitations:

Only mild hyponatremia could be identified in all the cases of severe bronchiolitis in this study. This could probably be due to the fact that being a tertiary centre, most of the children would already have received intravenous fluids from the referring hospitals before coming here. Also, the method of testing sodium may also influence its levels. In this study serum sodium levels have been measured using the ion electrophoresis method that is available in the hospital which may lead to such an interpretation.

Conclusion:

Hyponatremia often occurs among children with bronchiolitis. It is the most common electrolyte abnormality seen and associated with more severe disease course such as mechanical ventilation and increased ICU length of stay. Thus, a cross sectional study between the grades of hyponatremia on severity of bronchiolitis was conducted on 72 infants admitted

with bronchiolitis to the Pediatric ward and ICU of Jubilee Mission Medical College, Thrissur. There was a statistically significant association between hyponatremia and severe variant of bronchiolitis. Prematurity, early initiation of complementary feeds, family history of RAD, exposure to passive smoking and male sex were the other contributory factors noticed. Thus, hyponatremia can be used as a marker to assess the severity of bronchiolitis

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