RELATION OF GRADES OF HYponатRєMIA 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

Conflicts of Interest: Nil
Corresponding author: Nirmal Georgie Ninan
DOI: https://doi.org/10.32553/ijmsdr.v5i3.774

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 <34 weeks 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 20% relative allowable error, minimum sample size comes to 72.

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

**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.

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.
In this study serum sodium ch showed that infants of mothers c intensive ract infec 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 at 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

References:

1. Jartti T, Lehtinen P, Vuorinen T, Ruuskanen O. Bronchiolitis: age and previous wheezing episodes are linked to viral etiology and atopic characteristics. Pediatr Infect Dis J. 2009 Apr;28(4):311–7.
2. Mansbach JM, Piedra PA, Teach SJ, Sullivan AF, Forgey T, Clark S, et al. Prospective multicenter study of viral etiology and hospital length of stay in children with severe bronchiolitis. Arch Pediatr Adolesc Med. 2012 Aug;166(8):700–6.
3. Dudlez NM, Esteban-Cruciani N, Khan A, Douglas LC, Shi Y, Southern WN. Risk Factors for Respiratory Decompensation Among Healthy Infants With Bronchiolitis. Hosp Pediatr. 2017 Sep;7(9):530–5.
4. Jartti T, Gern JE. Role of viral infections in the development and exacerbation of asthma in children. J Allergy Clin Immunol. 2017 Oct;140(4):895–906.
5. Ralston SL, Lieberthal AS, Meissner HC, Alverson BK, Baley JE, Gadomski AM, et al. Clinical practice guideline: the diagnosis, management, and prevention of bronchiolitis. Pediatrics. 2014 Nov;134(5):e1474-1502.
6. Meissner HC. Viral Bronchiolitis in Children. N Engl J Med. 2016 Jan 7;374(1):62–72.
7. Florin TA, Plint AC, Zorc JJ. Viral bronchiolitis. Lancet Lond Engl. 2017 14;389(10065):211–24.
8. Franklin D, Babi FE, Schlappbach LJ, Oakley E, Craig S, Neutze J, et al. A Randomized Trial of High-Flow Oxygen Therapy in Infants with Bronchiolitis. N Engl J Med. 2018 Mar 22;378(12):1121–31.
9. Luu R, DeWitt PE, Reiter PD, Dobyns EL, Kaufman J. Hyponatremia in children with bronchiolitis admitted to the pediatric intensive care unit is associated with worse outcomes. J Pediatr. 2013 Dec;163(6):1652-1656.e1.
10. Hasegawa K, Stevenson MD, Mansbach JM, Schroeder AR, Sullivan AF, Espinola JA, et al. Association Between Hyponatremia and Higher Bronchiolitis Severity Among Children in the
ICU With Bronchiolitis. Hosp Pediatr. 2015 Jul 1;5(7):385–9.
11. Schrier RW. The Science Behind Hyponatremia and Its Clinical Manifestations. Pharmacotherapy. 2011 May;31(5S):9S-17S.
12. Sterns RH, Hix JK, Silver SM. Management of hyponatremia in the ICU. Chest. 2013 Aug;144(2):672–9.
13. Sreeram N, Watson JG, Hunter S. Cardiovascular effects of acute bronchiolitis. Acta Paediatr Scand. 1991 Jan;80(1):133–6.
14. Bertini A, Milani GP, Simonetti GD, Fossali EF, Faré PB, Bianchetti MG, et al. Na+, K+, Cl−, acid–base or H2O homeostasis in children with urinary tract infections: a narrative review. Pediatr Nephrol. 2016;31(9):1403–9.
15. Moritz ML, Ayus JC. Hospital-acquired hyponatremia—why are hypotonic parenteral fluids still being used? Nat Clin Pract Nephrol. 2007 Jul;3(7):374–82.
16. Lavagno C, Milani GP, Uestuener P, Simonetti GD, Casaulta C, Bianchetti MG, et al. Hyponatremia in children with acute respiratory infections: A reappraisal. Pediatr Pulmonol. 2017 Jul;52(7):962–7.
17. Milani GP, Plebani AM, Arturi E, Brusa D, Esposito S, Dell’Era L, et al. Using a high-flow nasal cannula provided superior results to low-flow oxygen delivery in moderate to severe bronchiolitis. Acta Paediatr Oslo Nor 1992. 2016 Aug;105(8):e368-372.
18. Martinez FD, Wright AL, Holberg CJ, Morgan WJ, Taussig LM. Maternal age as a risk factor for wheezing lower respiratory illnesses in the first year of life. Am J Epidemiol. 1992 Nov 15;136(10):1258–68.
19. Boyce TG, Mellen BG, Mitchel EF, Wright PF, Griffin MR. Rates of hospitalization for respiratory syncytial virus infection among children in medicaid. J Pediatr. 2000 Dec;137(6):865–70
20. Pezzotti P, Mantovani J, Benincori N, Mucchino E, Di Lallo D. Incidence and risk factors of hospitalization for bronchiolitis in preterm children: a retrospective longitudinal study in Italy. BMC Pediatr. 2009 Sep 10;9(1):56.
21. Law BJ, Langley JM, Allen U, Paes B, Lee DSC, Mitchell I, et al. The Pediatric Investigators Collaborative Network on Infections in Canada study of predictors of hospitalization for respiratory syncytial virus infection for infants born at 33 through 35 completed weeks of gestation. Pediatr Infect Dis J. 2004 Sep;23(9):806–14.