

Correlation of hyponatremia in children presenting with acute lower respiratory tract infection in a tertiary care hospital

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Abstract

Background: Hyponatremia (serum sodium <135mEq/L) has been found to be the major electrolyte abnormality in children admitted with pneumonia in various studies throughout the world. Hyponatremia increases morbidity and mortality of children if not evaluated and treated appropriately. Hyponatremia in pneumonia was found to be mainly dilutional and secondary to Syndrome of Inappropriate secretion of Antidiuretic Hormone (SIADH). **Objectives:** This is a prospective study to know the incidence of hyponatremia and SIADH in children with severe pneumonia, morbidity and mortality due to hyponatremia and its management in children with severe pneumonia. **Materials and Methods:** The study group comprised of 60 children in the age group of 2 months to 5 years admitted with severe pneumonia as defined by modified WHO-BTS guidelines and confirmed radiologically. Investigations were done on the day of admission for serum electrolytes. In patients who were clinically euvolemic and had an initial serum sodium value <135mEq/L, work up for diagnosis of SIADH was done. Renal function tests were also done. Statistical analysis was done to know the frequency of hyponatremia, morbidity and mortality associated with hyponatremia. **Results:** Of the 60 children enrolled in the study, 28(46.7%) children had hyponatremia. Of the 28 hyponatremic children, 18(64.3%) had dilutional hyponatremia secondary to SIADH. The duration of hospitalization was significantly prolonged in children who had hyponatremia. There were 3 mortalities and all the 3 had hyponatremia, of which 2 were found to have SIADH. **Conclusion:** Almost half of the children with severe pneumonia developed hyponatremia which was predominantly due to SIADH. Hence careful fluid management is needed in children with pneumonia.

Key words: Hyponatremia, pneumonia, SIADH.

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INTRODUCTION

Pneumonia is a common illness affecting children especially in developing countries accounting for approximately 20% of childhood deaths.¹ The incidence of pneumonia has declined drastically in the developed world due to advances made in the field of immunization and antimicrobials. Up to 10% of all new cases of pneumonia progress to severe episodes and require

hospitalization.² Electrolyte disturbances have been described in a wide variety of acute infections including pneumonia,³ which complicate the management and prognosis. Most of the studies have shown hyponatremia due to Syndrome of Inappropriate Antidiuretic Hormone secretion (SIADH) as the most common electrolyte abnormality.^{4,5} Acute hyponatremia poses an immediate danger to the central nervous system. The rapid shift of fluids associated with this condition frequently results in brain edema. Administration of hypotonic maintenance fluids may worsen this edema.⁶ This study was taken up to know the incidence of hyponatremia and SIADH in children with severe pneumonia, morbidity and mortality due to hyponatremia and its management in children with severe pneumonia.

METHODOLOGY

This was a prospective observational study carried out in the pediatric ward of Father Muller Medical college Hospital, Mangalore, India. The study was carried out

after approval from institute's ethical committee and taking written informed consent from parents. A total of sixty children between the age group of 2 months to 5 years admitted with radiologically confirmed pneumonia were included in the study. Severe pneumonia was defined according to modified WHO-British Thoracic Society (BTS) guidelines.⁷⁻⁹ Children with gastroenteritis, renal disorders, CNS infections, congestive heart failure, adrenocortical disorders and those on drugs which can cause electrolyte imbalance such as diuretics were excluded from the study. Detailed history was elicited from the parents/guardians with relevance to the case and detailed clinical examination was done. At the time of admission, two venous blood samples were collected. The first urine sample was also collected. One venous blood sample was used for the estimation of serum sodium. The second serum sample and the urine sample were refrigerated and were used for the work up for diagnosis of SIADH, whenever required. Urine spot sodium, urine osmolality and serum osmolality were estimated in patients who were clinically euvolemic and had an initial serum sodium value <135mEq/L. Blood urea and creatinine were also measured to rule out any renal dysfunction. The patients' clinical data including age,

RESULTS

Table 1: Demographic features and laboratory data of all children with severe pneumonia

Characteristics		All patients (n=60)
Age	2 months to 1 year	17(28.3%)
	1-5 years	43(71.7%)
Sex	Male	31(51.7%)
	Female	29(48.3%)
Serum Sodium (mEq/L) (Mean \pm SD)		135.22 \pm 5.89
Hyponatremia		28(46.7%)
Hyponatremia due to SIADH		18(64.3%)
Duration of hospital stay (days) (Mean \pm SE)		7.91 \pm 0.34
Number died		3(5%)

Table 2: Frequency of hyponatremia according to age and sex

Variables	Hyponatremia (n= 28)		χ^2 -test P value	Significance
	N	%		
Age	2 months to 1 year	10	58.8	0.235 NS
	1-5 years	18	41.9	
Sex	Male	14	45.2	0.809 NS
	Female	14	48.3	

Table 3: Characteristics of children with hyponatremia Vs children with normal levels of serum sodium

Characteristics	Hyponatremia (n=28)	No hyponatremia (n=30)	P-value	Significance
Serum Sodium (mEq/L) (Mean \pm SD)	129.93 \pm 2.88	139.20 \pm 2.30	0.0001*	HS
Duration of hospital stay (days) (Mean \pm SE)	8.85 \pm 0.56	7.03 \pm 0.27	0.0001*	HS
Number died	3 (10.7%)	0	0.033**	Significant

*t-test, **Z test for proportion

sex, duration of hospital stay and the final outcome (discharged or death) were recorded in all the cases. Serum sodium concentration <135mEq/L was considered as hyponatraemia.¹⁰ Serum sodium concentrations of 131-134mEq/L represents mild hyponatremia, 126-130mEq/L moderate hyponatremia, and \leq 125mEq/L severe hyponatremia.¹¹ Hypernatremia was defined as a serum sodium concentration >145mEq/L.¹⁰ Laboratory criteria for the diagnosis of SIADH included (1) hyponatremia together with decreased effective serum osmolality <275mOsm/kg (2) Spontaneous urinary osmolality >100mOsm/kg (3) Spot urinary sodium concentration >40mEq/L (4) Normal renal function.^{12,13}

STATISTICAL ANALYSIS

Frequency of hyponatremia was calculated for the total sample and in relation to age, sex and expressed as the percentage. Statistical significance of the comparisons was determined by chi-square, t-test or Z test for proportions whichever was appropriate. P value \leq 0.05 was considered as significant. The analysis was done using SPSS ver.13 statistics package.

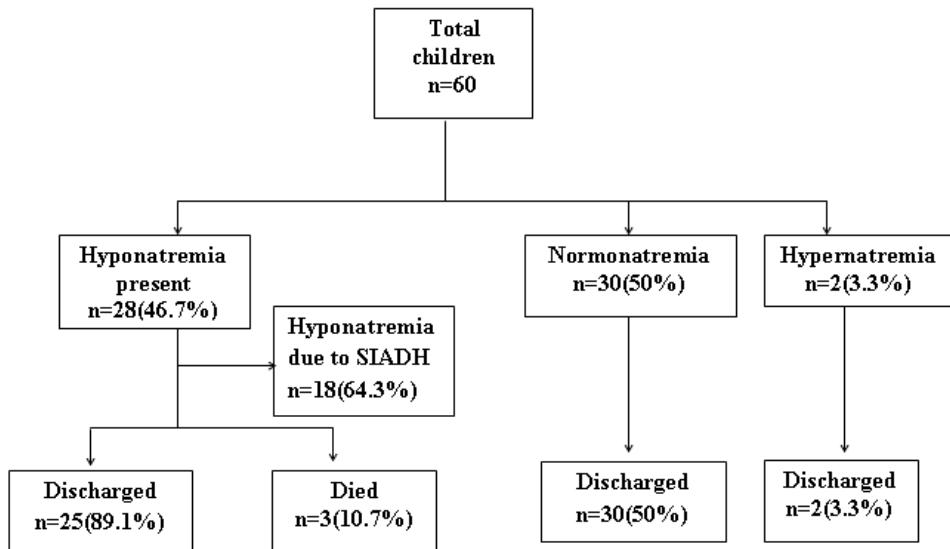


Figure 1: Profile of sodium abnormalities in children with severe pneumonia

The baseline characteristics of the study population are shown in Table 1. The study population consisted of 60 children. There were 17(28.3%) children in the age group of 2 months to 1 year and 43(71.7%) children in the 1-5 years age group. There were 31 males (51.7%) and 29(48.3%) females. On admission, the patients' serum sodium concentration ranged from 121mEq/L to 150mEq/L. Hyponatremia was seen in 28(46.7%), and hypernatremia in 2(3.3%) patients. (Figure 1) There were 11(39.3%) cases of mild, 15(53.6%) cases of moderate and 2(7.1%) cases of severe hyponatremia respectively. The mean serum sodium concentration was 129.9 ± 2.9 mEq/L in hyponatremic patients and 139.2 ± 2.3 mEq/L in normonatremic patients. As shown in Table 2, the incidence of hyponatremia in children < 1 year and 1-5 years was 58.8% (10/17) and 41.9%(18/43) respectively. This difference was statistically not significant. ($p= 0.235$, χ^2 -test) The incidence of hyponatremia in males and females was 45.2% (14/31) and 48.3%(14/29) respectively. This difference was also statistically not significant. ($p= 0.809$, χ^2 -test) Of the 28 hyponatremic children, 18(64.3%) had dilutional hyponatremia secondary to SIADH.

Outcome: The mean duration of hospital stay for 60 patients was 7.91 ± 0.34 days. As shown in Table 3, the mean duration of hospital stay for 30 normonatremic patients was 7.03 ± 0.27 days. The mean duration of hospital stay for 28 hyponatremic patients was 8.85 ± 0.56 days. The duration of hospital stay was significantly prolonged in children who had hyponatremia ($p<0.05$). There were 3(5%) deaths in total and all of them had hyponatremia.

DISCUSSION

Hyponatraemia could result from a sodium deficit, or surplus of water. Primary illness, impaired water

excretion, inappropriate release of vasopressin, use of hypotonic fluids, redistribution of sodium and water, sick cell syndrome, and several drugs may contribute to hyponatraemia.³ In various studies hyponatremia was the most frequent electrolyte abnormality in children hospitalized due to pneumonia.^{5,6,14} and was associated with a more severe disease and a poorer outcome.¹⁵ In our study 28(46.7%) children had hyponatremia which is similar to the study done by Don *et al*¹⁶ in which hyponatremia was found in 45.4% of children with community acquired pneumonia. The distribution of hyponatremia was not related to age and sex. (Table 2) In our study, of all the hyponatremia, 64.3% were secondary to SIADH. This observation is similar to the study done by Prasad *et al*⁶ in which 64% of hyponatremia cases were due to SIADH. In another study done by Singhi *et al*⁵ SIADH was the cause in 68% of hyponatremia cases. Administration of sodium and frusemide is indicated only if there are life threatening neurological complications attributable to severe hypo-osmolality. Most patients are best treated by simply reducing the intake of water.¹⁴ Morbidity, as determined by duration of hospital stay, was significantly higher in patients with hyponatremia when compared to those with normonatremia. ($p=0.0001$, t-test) (Table No.3) This observation is in agreement with the study done by Singhi *et al*.¹⁷ Yet another study done by Singhi *et al*⁵ showed that hyponatremia was associated with a 60% longer hospital stay. Sakellaropoulou *et al*³ showed that hyponatremia had a longer duration of hospitalization. In our study, 3(5%) children died during the hospital stay and all the deaths occurred in patients with hyponatremia while no deaths occurred in the normonatremia patients. ($p=0.033$) (Table No.3) A number of other studies showed similar observations. A prospective study done by Singhi *et al*¹⁷ concluded that

presence of severe hyponatremia is associated with a threefold increase in the risk of death. Another prospective study by Dhawan *et al*⁵ also noticed a 3.5 times higher mortality in patients with hyponatremia when compared to those with normonatremia. Limitation of our study was the relatively small size of our study group. Larger studies are needed in order to evaluate whether hyponatremia could impact the outcome of hospitalized children with severe pneumonia.

CONCLUSION

Our findings confirm that hyponatremia is common among children hospitalized with severe pneumonia. Hyponatremia was commonly due to Syndrome of Inappropriate Anti diuretic Hormone secretion (SIADH). Presence of hyponatremia significantly increases the morbidity and mortality. Thus, regular estimation of serum electrolyte concentration and plasma and urine osmolality is necessary to guide appropriate fluid and electrolyte management of children with severe pneumonia requiring hospitalization. The fluid therapy in children with severe pneumonia should be individualized and those with hypo-osmolality need fluid restriction.

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