

Prevalence of Hyponatremia in Children with Pneumonia -Cross-Sectional Study

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Abstract: Pneumonia remains the leading single cause of childhood mortality. It's associated with several complications and the commonest metabolic complication being hyponatremia. Studies done in the western countries have reported a high prevalence of hyponatremia, an indicator of disease severity. No study has been done to evaluate the prevalence of hyponatremia in children in Kerala

Objectives : The objectives of this study were; 1, Determine the prevalence of hyponatremia in children aged two months to twelve years admitted with pneumonia at TDMC Alappuzha. 2, Describe selected socio-demographic and clinical characteristics of children with hyponatremia. 3, Determine the association of hyponatremia and severity of pneumonia.

Methodology: A descriptive cross-sectional study was carried out at TDMC ALAPPUZHA on children aged 2 months to 12 years admitted with pneumonia. Those who met the inclusion criteria were recruited. History and physical examination was done to confirm diagnosis and classify the severity of pneumonia. A 2ml blood sample was then withdrawn from the patient and taken to the laboratory for electrolyte analysis.

Results: A total of 100 pediatric patients admitted at TDMC were reviewed. Prevalence of hyponatremia was 6% (6/100). Hyponatremia was significantly associated with ICU admission ($p=0.009$). Hyponatremia was significantly associated with increased number of ICU days ($p=0.001$). There was a no significant association between severity of pneumonia and hyponatremia ($p=0.083$). No association could be obtained between factors like acute phase reactants, age, sex, choice for higher antibiotics

Conclusion: Hyponatremia at admission is more associated with ICU admission. There is a no high prevalence of hyponatremia in children admitted with pneumonia at TDMC. Hyponatremia is not an indicator of severe illness

Keywords : hyponatremia , pneumonia

I. Introduction

Pneumonia remains the leading single cause of childhood mortality. It accounts for 16% (920/136) of all under five deaths. Pneumonia affects children and families everywhere, but is most prevalent in South Asia and sub-Saharan Africa where it accounts for 85% of deaths. India has a mortality rate of 322 per 100,000 under-five population

Despite the various strategies put in place to curb this disease (vaccination, vitamin A and zinc supplementation, exclusive breastfeeding for six months, early detection and treatment etc), prevention and treatment remains a challenge. Most children with pneumonia can be treated safely at home. However studies done have shown that only 27% of these children actually get the appropriate treatment [1]. Failure to institute timely treatment results in progression of the disease necessitating hospitalization. Children admitted with pneumonia are critically ill and often times have complications which include electrolyte abnormalities, the commonest being hyponatremia. Studies done in the western countries have shown up to 45.4% of children hospitalized with pneumonia had hyponatremia (2-4).

Hyponatremia in pneumonia has been linked to the syndrome of inappropriate secretion of antidiuretic hormone (SIADH) (5). ADH excess results in water retention and volume expansion leading to fall in Serum osmolality below the reference range. Hyponatremia does not develop unless the patient is ingesting or receiving some source of free water. Most children with pneumonia cannot maintain adequate fluid intake due to breathlessness, fatigue, or risk of aspiration (6) necessitating fluid therapy. Administration of hypotonic fluids may lead to development of acute hyponatremia which leads to a rapid shift of fluids into brain cells (16, 20). The resultant cerebral edema is associated with high mortality. Hyponatremia has also been documented as a marker of severe illness and increases mortality (7,8). It's therefore paramount for clinicians to understand common electrolyte abnormalities, have a high index of suspicion and timely recognize them. This will facilitate institution of appropriate treatment resulting in better outcomes.

Aim

What is the prevalence of hyponatremia in children aged two months to twelve years admitted with severe pneumonia at TDMC Alappuzha and to determine the association of hyponatremia and severity of pneumonia.

II. Materials And Method

Study Design : This was a descriptive cross-sectional study

Study Site : The study was carried out at TDMC Alappuzha, paediatric icu and paediatric wards.

Study Population : Children aged two months to twelve years admitted at TDMC Alappuzha with a diagnosis of pneumonia

Sample Size: 100

Sampling Procedure

Patients were identified by the principal investigator at the Paediatric casualty, icu and the wards during the day, complete history and physical examination was then done to confirm diagnosis. If a child met the inclusion criteria, informed consent was sought from the guardian or the parent after explaining to him or her about the study.

Socio-demographic data and clinical characteristics of each patient were captured in the questionnaire. Clinical characteristics included axillary temperature and respiratory rate were also taken. Patients were then categorized into either having severe or very severe pneumonia based on the WHO classification.

Using aseptic technique, 2mls of blood was withdrawn from the antecubital fossa of each patient during admission and after 48 hours. The blood samples were then transported to the central laboratory within an hour of collection for analysis of complete blood cell count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), serum concentrations of sodium (Na), urea, creatinine

Inclusion Criteria

1. Children 2 months to 12 years admitted at TDMC Alappuzha with a diagnosis of pneumonia.
2. All children for whom consent is obtained from parent(s) or legal guardian(s) to participate in the study.

Exclusion Criteria

1. All children with pneumonia and diarrhea. Diarrhea is associated with electrolyte abnormalities.
2. All children with known renal disease. Patients with renal disease have fluid retention which results in dilutional hyponatremia.
3. All children with a known cardiac disease which results in volume overload leading to dilutional hyponatremia.
4. All children whose parent(s) or guardian(s) refuses to give consent.

Statistical Analysis: Appropriate statistical software will be used for analysis.

Ethical Considerations: Permission to conduct the study will be obtained from institutional research committee and ethical committee of TDMC

III. Result

In this study of 100 children, majority belonged to the age group 1-5 yrs (52%), whereas 32% belonged to 2m -1year age group and 16 % belong to 5-12 years age group. Out of 100 children, 56 were males (56%) and 44 were females (44%). Out of 100 75 patients diagnosed to have simple pneumonia, 23 patients diagnosed to have severe pneumonia and 2 patients with very severe pneumonia. At admission hyponatremia seen in 7 patients and at 48 hr after admission hyponatremia seen in only 6 patients. There is no statistical significance obtained between presence of hyponatremia both at admission and at 48hr after admission with severity of pneumonia (16%; $p=0.083$), acute phase reactants (CRP: 7.8%, $p=0.413$, ESR: 6.1%, $p=0.363$) and age of the child, choice of antibiotics, and number of hospital days. Statistical significance obtained between hyponatremia at admission and increased ICU admissions (17.9%, $p=0.000$) and increased number of days (>2days) in icu ($p=0.001$)

Hyponatremia		Diagnosis				2	P
		Pneumonia		Severe/Very severe pneumonia			
		Count	Percent	Count	Percent		
Sodium level at admission	Normal	71	94.7	20	80.0	4.97	0.083
	Hyponatremia	3	4.0	4	16.0		
	Hypernatremia	1	1.3	1	4.0		
Sodium level at 48 hr of admission	Normal	69	92.0	22	88.0	0.37	0.833
	Hyponatremia	4	5.3	2	8.0		
	Hypernatremia	2	2.7	1	4.0		

Association of hyponatremia and diagnosis

Investigations		Sodium level at admission				2	P
		Normal		Hyponatremia			
		Count	Percent	Count	Percent		
CRP	Positive	83	92.2	7	7.8	0.67	0.413
	Negative	8	100.0	0	0.0		
ESR	Positive	77	93.9	5	6.1	0.83	0.363
	Negative	14	87.5	2	12.5		
Total count	Normal	13	100.0	0	0.0	1.15	0.283
	High	78	91.8	7	8.2		
Type of fluid intake	Oral	91	93.8	6	6.2	13.13**	0.000
	IVF	0	0.0	1	100.0		

Table Association of sodium level at admission and treatment.

Treatment		Sodium level at admission				2	P
		Normal		Hyponatremia			
		Count	Percent	Count	Percent		
ICU admission	Present	23	82.1	5	17.9	6.78*	0.009
	Not	68	97.1	2	2.9		
Days in ICU	No ICU	68	95.8	3	4.2	14.67**	0.001
	<2 days	23	88.5	3	11.5		
	>2 days	0	0.0	1	100.0		
Days of hospital stay	<5 days	82	94.3	5	5.7	2.28	0.131
	>5 days	9	81.8	2	18.2		
Antibiotic	Baseline	82	94.3	5	5.7	2.28	0.131
	Highier	9	81.8	2	18.2		

**:- Significant at 0.01 level, *:- Significant at 0.05 level

V. Discussion

Hyponatremia has been shown to be the commonest electrolyte abnormality in hospitalized patients. It complicates many conditions including respiratory, central nervous system, malignancies e.t.c and it's a marker of severe illness resulting in high mortality and morbidity. The purpose of our study was to find if hyponatremia was commonly seen in children with pneumonia and also to investigate a possible correlation between the hyponatremia as measured by serum sodium level and the severity of pneumonia symptoms according to who guidelines. This study was a descriptive cross sectional study done in children diagnosed to have pneumonia as per the WHO ARI guidelines at the Pediatrics ward and PICU at Government T. D. Medical College, Alappuzha. The overall prevalence of hyponatremia was 5%. This rate was 5.4 times lower than that reported in similar studies elsewhere. In a previous Indian study a study done by S.D.Subba Rao et.al, the prevalence of hyponatremia was 27% which is 5.4 times lower than that found in the current study². In recent study done in Kenya national hospital study, the prevalence of hyponatremia is 71% which is 14.2 times higher than this study. These findings could be attributed to the fact that the use more hyponatremic fluids for the management for severe pneumonia.

In my study children with severe pneumonia is 25%. There is no correlation between the prevalence of hyponatremia in severe and very severe pneumonia is low as 16% (p=0.083). In previous study done at Kenya national hospital children with very severe pneumonia were more likely to have hyponatremia a proportion of 81.8% compared to those with severe pneumonia (59.7%). A significant association between very severe pneumonia and hyponatremia (p=0.002) was observed. This may be due to the more use of hyponatremic fluids for initial treatment, as well as the poor nutritional status of the children there.

In our study the children admitted in PICU with severe pneumonia and hyponatremia is 17.9% ($p=0.009$) is significant, and they had more number of days (>2 days) in ICU setting 14.67% ($p=0.001$), significant. Studies have also demonstrated that, respiratory compromise is a comorbid factor in patients with hyponatremia markedly increasing the risk of death from pneumonia [35-37]. The underlying mechanism is probably hypoxia, a major risk factor for the development of hyponatremic encephalopathy (38). Studies of hyponatremic animals have revealed that hypoxia impairs volume regulation of brain cells, decreases cerebral perfusion, and increases the probability of neuronal lesions developing (39). Adaptation of the brain to hyponatremia largely depends on extrusion of sodium from the intracellular space via sodium-potassium ATPase pumps. This energy-dependent process is impaired under hypoxic conditions. The combination of systemic hypoxia and hyponatremia is more deleterious than is either condition alone, because hypoxia impairs the ability of the brain to adapt to hyponatremia, worsening hyponatremic encephalopathy (40).

Although the study was not powered for analysis of hospital acquired hyponatremia due to the low numbers of children who had treated with IV fluids. It was also observed that children who received intravenous fluids were more likely to develop hyponatremia compared to those who were on oral fluids 50% ($p=0.009$). This could be attributed to the fact that the commonest fluid given was Half Strength isolyte-p, a hypotonic fluid. Studies have shown that use of hypotonic fluids is associated with development of hyponatremia which has a poor outcome (5,30,31). These observations support the fact that the main cause of hyponatremia in pneumonia is SIADH(). In SIADH the release of ADH is not inhibited by a reduction in plasma osmolality when the individual ingests water and the osmolality of the plasma drops. As the main solute of plasma is sodium, this hypoosmolar state is usually detected as a low sodium level on laboratory testing. SIADH is therefore primarily a condition that results in the abnormal handling of water loading and not a problem with excessive solute loss. This is why it is usually treated with fluid (in particular water) restriction. In our study we couldn't find any correlation between acute phase reactants and hyponatremia at admission.

IV. Conclusion

Our study did not find an increased prevalence of hyponatremia in children with pneumonia. It also did not find any significant correlation between the severity of pneumonia and the serum sodium levels. But we could find a significant correlation between hyponatremia at admission and the prolonged days of ICU admission. We also couldn't find a correlation between hyponatremia and acute phase reactants at admission.

Limitations

The study did have several limitations. First of all, the sample size was very small hence evidence based on this study cannot be extrapolated to a larger population. Another major limitation was the lack of a control group. We didn't consider the aetiology of hyponatremia at admission like nutritional status of the child.

Recommendation

Closely monitor serum electrolyte level in patients admitted in PICU, as well as who was getting IV fluids. Also avoid hypotonic fluids in children with pneumonia.

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