Original Article

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Paediatrics Section

Evaluation of Hyponatraemia among Paediatric Patients having Lower Respiratory Tract Infections Visiting a Tertiary Care Centre

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ABSTRACT

Introduction: Serious health risks arise from Lower Respiratory Tract Infections (LRTI). In particular, this infection is very evident in children among less than 5 years of age group, who require hospital admission and sadly contributes to the thirty percent of annual deaths worldwide.

Aim: To evaluate the incidence of Hyponatremia in Lower Respiratory Tract Infections among paediatric patients less than five years.

Materials and Methods: The prospective study was conducted from January 2019 To February 2020. All patients having quantifiable indications evocative of heightened lower respiratory tract infectivity were assessed in detail at hospital, on Inpatient Department (IPD) basis. Patients having serum sodium value <135 mEq/L were assessed for Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH) with the refrigerated sample of urine and the second serum sample. Estimation of the following parameters was done in these patients-blood urea, blood glucose, urinary sodium, serum creatinine, serum osmolality, urinary creatinine, urinary urea, and urine osmolality.

Results: Fifty eight of the total numbers had hyponatremia that ranges to the 38.66% of the total count. Out of these cases, forty nine, comprising a total percentage of 84.4% were due to SIADH. Out of the total 59 hyponatremic cases, four were suggested to have difficulty in the form of seizures followed by altered sensorium that comprise 12.12% of the total figures.

Conclusion: Existence of hyponatraemia in LRTIs further increases the morbidity in the affected children in the form of extended hospital stay and incidence of seizure attacks, followed by deranged sensorium, in a number of cases. Hence, children admitted for LRTIs should be assessed not just clinically, but also for their serum levels sodium at the time of hospital admission.

Keywords: Creatinine, Pneumonia, Sodium, Wheeze associated lower tract infection

INTRODUCTION

Approximately 10% of the entire novel cases of pneumonia become serious and require hospital admission. One of the major variety of heightened infection include electrolyte disturbances together with pneumonia, which worsens the prognosis and management of the disease [1-3].The crucial mainstay in the conservation of body homeostasis is fluids and electrolytes. Sodium is the most essential among electrolytes which is the major solute of the extracellular fluid [4]. The most common electrolyte in ICUs is hyponatremia, it considered to be indiscretion with an episode as high as thirst rate in some cases. Hyponatraemia is witnessed as a leading cause of acute meningitis, febrile convulsions, acute lower respiratory tract contagion, and Kawasaki illnesses in infants [3,5].

Lower respiratory tract contagion like bronchiolitis and pneumonia are the most common ailments that are found in children with severe hyponatraemia due to oversecretion of antidiuretic hormone [6-8]. Due to SIADH in paediatric pneumonia, hyponatraemia is very common. SIADH consists of hyponatremia, inappropriately elevated urine osmolality, excessive urine sodium and decreased serum osmolality in a euvolemic patient without edema [9]. Gavage tube feeds, hypotonic intravenous fluids, and humidified air in the ventilator circuit are the sources of free water ingestion in these infants [10]. Heightened hyponatraemia in these patients can give vent to swift budge of liquid in central nervous system, resulting in brain oedema and other threatening results [11]. The aim of this study was to evaluate the incidence of hyponatraemia in LRTIs among paediatric patients, within the age group of one month to five years.

MATERIALS AND METHODS

This prospective study was conducted in PICU at Adichunchanagiri Institute of Medical Sciences (AIMS), Taluk, Mandya, Karnataka from January 2019 To February 2020. All

patients having quantifiable indication sevocative of heightened lower respiratory tract infectivity were assessed in detail at hospital, on IPD basis. This work was permitted by Institutional Ethical Committee, (IEC) and ethical reference number was ACIMS/ER/PD:863.

The study population comprised of patients aged between one month to five years, who were admitted with a diagnosis of LRTI. The sample size of 150 was calculated by the mathematical formula of single proportions [12].

Inclusion criteria

1. Children between the ages of one month to five years with a diagnosis of LRTI.
2. All children for whom permission was sought from their guardians.

Exclusion criteria

1. Children less than one month and five years with a diagnosis of LRTI.
2. Children whose parents did not gave permission or consent.
3. Children having other complications except LRTI.

In the study, two venous samples were collected at the time of admission. First urine sample was also taken. The inference of serum potassium and serum sodium was also sought with one of the venous samples. Patients having serum sodium value <135 mEq/L were further evaluated with the refrigerated sample of urine and the second serum sample to diagnose SIADH. Estimation of the following parameters was done in these patients-blood urea, blood glucose, urinary sodium, serum creatinine, serum osmolality, urinary creatinine, urinary urea, and urine osmolality. An X-ray of chest too was performed in all the patients to substantiate the diagnosis of lower respiratory infections. The demographic and clinical data of patients including the age, gender, hospital stay duration and the final result (release or demise) were proof recorded in all cases.

A serum sodium level of 135-145 mEq/L was considered as normal, whereas a concentration of <135 mEq/L was recorded as hyponatraemia. Sodium concentration of 131-134 mEq/L was considered as mild hyponatraemia, 126-130 mEq/L as moderate hyponatraemia and ≤125 mEq/L as severe hyponatraemia. Other investigations (White Blood Cell count (WBC), C-Reactive Protein (CRP), Blood Urea Nitrogen (BUN), serum creatinine, urinary sodium, serum osmolality, urinary creatinine, urinary urea and urine osmolality) were performed in these patients to diagnose SIADH [13].

STATISTICAL ANALYSIS

The data were computed in Microsoft Excel and statistically analysed by using SPSS version 20.0 and Chi-square test.

RESULTS

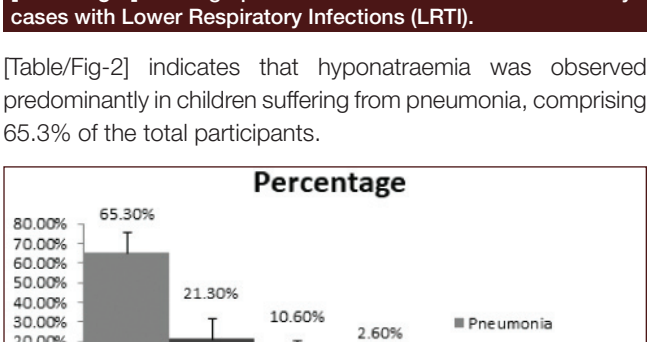
One hundred and fifty children reported to have LRTIs were subjected to various biochemical, clinical and radiological assessment, which resulted in the following observations.

The figure shown in [Table/Fig-1] clearly displays the total of admitted children that is 150 in numbers. Preponderance of age one month to one year comprising to the 60% of the total admittance. While 40% of the total patients comprised to the one to five years of age group. Out of all admissions, 110 were male encompassing a total of 73% of all admissions and 40 were female comprising a total of 27% of the rest. Fifty eight of the total numbers had hyponatremia that ranges to the 30% of the total count. Out of these cases, 49, comprising a total percentage of 84.4% were due to SIADH. Out of the total 58 hyponatremic cases, four were suggested to have difficulty in the form of seizures followed by altered sensorium that comprise 12.12% of the total figures.

	Characteristics	Patients (n=150)	Percentage (%)
Age	1 month- 12 months	90	60.0
	13 months- 5 years	60	40.0
Sex	Male	110	73.0
	Female	40	27.0
Serum sodium levels (in mEq/L) (Mean±SD)	Isonatraemic	137.15±2.84 mEq/L	
	Hyponatraemic	130.34±3.47 mEq/L	
	Hyponatraemia (n=150)	58	38.66
	Hyponatremia due to SIADH (n=58)	49	84.4
	No. of Patients with complications (n=33)	4	12.12

[Table/Fig-1]: Demographic features and other data of all study cases with Lower Respiratory Infections (LRTI).

[Table/Fig-2] indicates that hyponatraemia was observed predominantly in children suffering from pneumonia, comprising 65.3% of the total participants.



[Table/Fig-2]: Prevalence of different lower respiratory tract conditions in the study group.

[Table/Fig-3] indicates that in 1 to 5 year of age group, hyponatremia was found in 9, encompassing 15.6% of the total cases and 16 children comprising 17.4% of the total ratio were isonatremic. Out of 110 male children, 43 had hyponatremia, encompassing 74.1% of the total and rest 67 (including 72.9% of the total intake) were isonatremic. In addition to this ratio, in a total of 40 female, 15 (covering 25.9%) had hyponatremia whereas 25 (comprising 27.1% of the ratio) were isonatraemic. Seizure followed by impaired sensorium was observed in two cases of hyponatraemia, but there was no such complication in isonatremia cases (p<0.001).

	Characteristics	Hyponatraemia (n=58)	Normonatraemia (n=92)
Age	1 months-12 months	49 (84.4%)	76 (82.6%)
	1-5 years	9 (15.6%)	16 (17.4%)
Sex	Male (n=110)	43 (74.1%)	67 (72.9%)
	Female (n=40)	15 (25.9%)	25 (27.1%)

[Table/Fig-3]: Age and sex wise distribution of study cases.

Other investigations done to assess hyponatraemia revealed that parameters like CRP, BUN, osmolality and urea levels were statistically significant in these patients [Table/Fig-4].

Variables	Hyponatraemia	Non-hyponatraemia	p-value
WBC (/µL)	9,891.7±3623.6	10639.2±3765.1	0.13
CRP (mg/dL)	2.6±2.3	1.9±3.1	<0.0001
BUN (mg/dL)	8.86±2.83	8.1±3.42	<0.0001
Creatinine (mg/dL)	0.431±0.062	0.397±0.086	0.71
Osmolality	281.4±5.3	287.7±6,6	0.05
Urea	17.1±8.3	18.4±8.6	0.05
Hospital stay (days)	8.4±3.7	5.8±4.1	0.067

[Table/Fig-4]: Comparison of laboratory findings of patients with and without hyponatraemia.
WBC: White blood cell; CRP: C-reactive protein; BUN and creatinine p<0.05 was considered as statistically significant

DISCUSSION

This potential research was conducted with a sample of 150 children aging one month to five years. In this study, 60% of the participants aged between one to twelve months and 40% of them belonged to age group of 13 months to five years. The male female ratio in the study was 2.7:1. However, demographic factors like age and gender had no association with hyponatraemia in our set up when compared to the study by Don M et al [3]. Heightened relentless hyponatraemia that progresses within 48 hours may result in severe cerebral oedema and lead to a variety of problems like headache, lassitude, fits, and cardiac arrest due to brain stem herniation. Children, in this connection, are very much susceptible than adults, since the intracranial volume ratio is advanced in children than in higher age groups [14-16]. Fifty eight of the total numbers had hyponatremia that ranges to the 38.66% of the total count. Similar studies by Wrotek A et al, Don M et al, Guruswamy NT et al and Sakellaropoulou A et al reported the percentage of hyponatraemia cases as 33.3%, 45.4%, 46.7% and 35.2% respectively [17-20].

Latest data recommend that even patients with chronic hyponatraemia could be associated with subtle neurological deficiency, like impairments in balance and concentration that can lead to the occurrence of falls [16]. The major cause of hyponatraemia is considered to be the non-osmotic discharge of ADH as a consequence of underlying medical conditions like hypovolemia, fever, and respiratory tract infections [6,7,21]. Hyponatraemia resulting in infants with pneumonia contains an element of the SIADH. Anti-diuretic hormone is usually secreted by the pituitary gland in response to elevated plasma osmolality. Nevertheless, in various medical situations including fever, hypercarbia, hypoxia, ache, queasiness, and vomiting, non-osmotic stimulation of antidiuretic hormone discharge can direct to hyponatraemia [7]. Bronchiolitis and pneumonia are most commonly related with hyponatraemia amongst patients with respiratory tract infections [6,7].

In this study, hyponatraemia was coupled with increased complexity in the form of seizure followed by altered sensorium. Two cases with hyponatraemia were found to have seizures which was followed by distorted sensorium, however there was no difficulty in isonatremic cases (p<0.001). Singhi S and Dhawan A [2] reports in their work that hyponatraemia is associated with 60% longer hospital stay owing to two-fold increase in complications as compared to that of isonatremia. The same was also established by a study performed by Patil J [22]. The rate of seizure and distorted sensorium in connection with hyponatraemia has been reported by different authors.

Adaptation of the brain to hyponatraemia mostly rely on ejection of sodium from intracellular space via Na+kATPase pumps. This energy reliant procedure is inhibited in hypoxic circumstances. The blend of hyponatraemia and systemic hypoxia is rather more lethal in comparison to either of them alone. Since hypoxia spoils the capability of the brain to become accustomed to hyponatraemia, hyponatremic encephalopathy may follow, leading to death [23].

Limitation(s)

This study has a relatively small sample size. This study included all patients with hyponatraemia and it was not done exclusively on patients with hyponatraemia due to SIADH. So, furthermore studies are required to precisely evaluate hyponatraemia and its impact on lower respiratory tract infection.

CONCLUSION(S)

Presence of underlying respiratory pathology paves way to the severity of hyponatraemia. Existence of hyponatraemia in LRTIs further increases the morbidity in the affected children because of extended hospital stay and incidence of seizure attacks, followed by deranged sensorium in a number of cases. Thus, such admitted patients suffering from LRTIs should be assessed not just clinically but also for their serum levels of sodium at the time of hospital admission. Watchful fluid supervision, particularly in the form of fluid constraint adding to the resolution of primary pathology may help in reducing the mortality of this illness.

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