



Original Research Article

Prevalence of Hyponatremia in Diagnosed cases of Pneumonia at AIIMS Patna: A hospital based study

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Abstract

Objective of our study was to evaluate the prevalence of hyponatremia in various age groups of patients with pneumonia.

Methods: A detail history, clinical examinations and relevant investigations were performed in all admitted patients with pneumonia. Patients were diagnosed to have pneumonia based on clinical signs and symptoms, and confirmed with chest radiograph showing lobar/segmental or patchy consolidation. Electrolyte analysis was performed by Eshweiler electrolyte analyser based on the principle of Direct ISE.

Results: Data was analyzed by using One -sample statistics methods with the help of IBM SPSS version 26 software. Pair wise comparison was performed. Mean \pm Standard deviations and *t* values were observed. *P* value was taken less than or equal to ($p \leq 0.05$) 0.05 for significant differences.

Conclusions: Hyponatremia is the most significantly seen in ($age \leq 5$ years) admitted paediatric patients. Male is more suffered than female. Mild hyponatremia is very common in patients with pneumonia. Hence, Initial measurement of serum sodium is recommended in all hospitalized pneumonia patients and patients showing hyponatremia on admission should get special attention as it is a strong independent indicator of higher morbidity and mortality. Hyponatremic patients should undergo further study of urine sodium and osmolality to assess fluid status before imposing fluid restriction. Hospital acquired and Hospital aggravated hyponatremia are also well-known events in paediatric practice due to routine use of hypotonic fluid are maintenance and one should be cautious about fluid management of those diseases prone to cause SIADH including pneumonia. Regular follow up of serum sodium level during the period of hospital stay should be considered to pick up the high risk cases at an early stage.

Keywords: Hyponatremia, pneumonia, age group.

Introduction

About 90 per cent of the acute respiratory infections deaths are due to pneumonia which is

usually bacterial in origin. Childhood pneumonia is an important cause of morbidity in the developed world, and morbidity and mortality in

the developing world^[1]. The World Health Organization estimates that 156 million cases of pneumonia occur each year in children younger than five years, with nearly 20 million cases severe enough to require hospital admission^[2].

LRTI is infection below the level of the larynx and may be taken to include: Bronchiolitis, Bronchitis, Pneumonia and empyema. It is inflammation of the airways/pulmonary tissue, due to viral or bacterial infection, below the level of the larynx^[3].

Hyponatremia is the most common electrolyte abnormality seen in the intensive care unit (ICU), with an occurrence as high as 30% in some reports^[4,5]. Hyponatremia typically establishes in severe inflammatory diseases such as meningitis, breathing tract infections, febrile convulsions, and Kawasaki disease in children^[6]. Patients with pneumonia the most typical diseases that come across in pediatric basic practice, are at particular danger of establishing hyponatremia due to antidiuretic hormonal (ADH) oversecretion^[7]. Hyponatremia related to paediatric pneumonia is most typically due to the syndrome of inappropriate antidiuretic hormone secretion (SIADH)^[8]. Hyponatremia is defined as a serum sodium level below 135 mmol/L. It is the most common clinical electrolyte imbalance^[9]. The hyponatremia rate in patients is 15%-30%^[10]. Hyponatremia can be classified into three groups as mild (131-135 mmol/L), moderate (126-130 mmol/L), and severe (≤ 125 mmol/L)^[11]. Mild hyponatremia is the most common type and usually produces no clinical findings. Severe hyponatremia is rare and has high morbidity and mortality rates if not treated^[12]. The main causes of hyponatremia are volume depletion (bleeding, vomiting, diarrhea, and urinary loss), syndrome of inappropriate antidiuretic hormone (SIADH) secretion, congestive heart failure, thiazide diuretics, cirrhosis, renal failure, primary polydipsia, adrenal insufficiency, hypothyroidism, and pregnancy^[13]. Several lung disorders, including pneumonia, can cause SIADH through unknown mechanisms^[14].

Aims & Objectives

This present study was conducted in department of Biochemistry, AIIMS, Patna, Bihar, India during a period from August 2018 to April 2019.

Attendants/entire subjects signed an informed consent approved by institutional ethical committee of AIIMS, Patna was sought.

A total of 150 patients of pneumonia with suspicion of hyponatremia were enrolled in this study. Random sampling method was used. All subjects were included with irrespective of age and sex. And we were evaluated the prevalence of hyponatremia in various age groups of patients with pneumonia.

Materials & Methods

A detail history, clinical examinations and relevant investigations were performed to all admitted patients with pneumonia.

Inclusion criteria: patients who were diagnosed as pneumonia at the time of admission.

Exclusion criteria: All secondary causes of hyponatremia were excluded like tuberculosis, chronic kidney disease, dehydration and vomiting. Patients were diagnosed to have pneumonia based on clinical signs and symptoms, and confirmed with chest radiograph showing lobar/segmental or patchy consolidation. Mild hyponatremia (130–134 mmol/L) has traditionally been regarded to be asymptomatic, with nausea, headaches, and anorexia occurring at moderate hyponatremia (125–129 mmol/L) and more severe hyponatremia (< 125 mmol/L) associated with confusion, coma, seizures or even death. However, the classic publication of Arieff and colleagues demonstrated clearly that symptoms can occasionally occur at higher plasma sodium concentrations, with severe hyponatremia sometimes producing no perceived ill effects^[24]. Electrolyte analysis was performed by Eshweiler electrolyte analyser based on the principle of Direct ISE.

Statistical Analysis

Data was analyzed by using One -sample statistics methods with the help of IBM SPSS version 26

software. Pair wise comparison was performed. Mean ± Standard deviations and t values were observed. P value was taken less than or equal to ($p \leq 0.05$) 0.05 for significant differences.

Observations

In this present study, we were enrolled a total 150 patients of pneumonia with suspicion of

hyponatremia. Male and female ratio was 2 : 1. We were categorised the patients into eight groups. Which are as follows: group I= ≤ 5 years. Group II= 6-15 years, group III = 16-25 years, group IV = 26-35 years, group V= 36-45 years, group VI = 46 – 55 years, group VII= 56- 65 years, and group VIII = >65 years.

Table.1. Showing the age and level of sodium (mEq/L) of patients (N=150) with pneumonia.

Age group (Years)	Mean ± S.D (Age)	t-value	p-value	Mean ± S.D. [Level of sodium (mEq/L)]	t-value	p-value
Group I (N=62)	1.2073 ± 1.468	6.472	0.000	130.290 ± 4.495	228.208	0.000
Group II (N=15)	10.133 ± 2.325	16.874	0.000	130.800 ± 3.726	135.947	0.000
Group III(N=10)	21.200 ± 3.735	17.946	0.000	135.100 ± 5.195	82.236	0.000
Group IV (N=10)	33.300 ± 2.584	40.750	0.000	131.400 ± 4.550	91.305	0.000
Group V (N=15)	42.400 ± 2.693	60.958	0.000	130.533 ± 3.681	137.328	0.000
Group VI(N=14)	52.142 ± 3.416	57.111	0.000	131.142 ± 5.347	91.765	0.000
Group VII(N=15)	62.266 ± 2.763	87.259	.000	126.800 ± 4.329	113.435	0.000
Group VIII (N=9)	72.666 ± 6.344	34.362	0.000	131.222 ± 9.884	39.828	0.000

In this present study, significant differences were seen in mean age of all group patients. Mean age of group VII (56-65 years) had greater t value (87.259). Hence, it was the most significant among other age group cases. Similarly, t value (6.472) was smaller in mean age of group I(≤ 5 years). It shown that data was less significant differences with respect other age group patients. Here majority of patients were also belonged in group I (age ≤ 5 years).

In this present study, when level of sodium (mEq/L) was analyzed of patients with pneumonia. Mean of level of sodium (mEq/L) were significant differences in all group patients. In group I (≤ 5 years) t value (228.208) was greater than all other group patients. It shown that greater changes of level sodium of patients was happened in this group I (age ≤ 5 years) patients. Hence, data was the most significant. Similarly, t value (39.828) was smaller in group VIII (> 65 years) patients. Less changes of level of sodium (mEq/L) was seen of patient with pneumonia in this group (>65 years). It shows, data was less significant difference with respect to other group patients.

Table.2. Pair wise comparison of mean ± S.D. of level of sodium (mEq/L) of all age group of patients with pneumonia.

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.
Group II-Group I	-1.000	1.018	-.982	.326
Group II-Group III	-1.000	1.018	-.982	.326
Group II-Group IV	-2.000	1.018	-1.964	.050
Group II-Group V	-3.000	1.018	-2.946	.003
Group II-Group VI	-4.000	1.018	-3.928	.000
Group II-Group VII	-5.000	1.018	-4.910	.000
Group I-Group III	-2.000	1.018	-1.964	.050
Group I-Group IV	-3.000	1.018	-2.946	.003
Group I-Group V	-4.000	1.018	-3.928	.000
Group I-Group VI	-5.000	1.018	-4.910	.000
Group I-Group VII	-6.000	1.018	-5.892	.000
Group III-Group IV	-1.000	1.018	-.982	.326
Group III-Group V	-2.000	1.018	-1.964	.050
Group III-Group VI	-3.000	1.018	-2.946	.003
Group III-Group VII	-4.000	1.018	-3.928	.000
Group IV-Group V	-1.000	1.018	-.982	.326
Group IV-Group VI	-2.000	1.018	-1.964	.050
Group IV-Group VII	-3.000	1.018	-2.946	.003
Group V-Group VI	-1.000	1.018	-.982	.326
Group V-Group VII	-2.000	1.018	-1.964	.050
Group VI-Group VII	-1.000	1.018	-.982	.326

In this present study, pair wise comparison of level of sodium was performed to all groups of patients. Data was found significant difference ($p=0.05$) in group II versus group IV, group I versus group III, group III versus group V, group IV versus group VI and group V versus group VII.

Very significant differences ($p=0.003$) was found in group II versus group V, group I versus group IV and group IV versus group VII patients.

And data was the most significant difference ($p=0.000$) in group II versus group VI, group II versus group VII, group I versus group V, group I versus group VI, group I versus group VII and group III versus group VII patients .

Hence, we were found that level of sodium was greatly changed in group I patients with compared to group V, VI and VII.

Discussions

Hyponatremia is the most common electrolyte disorder in hospitalized patients^[15]. Water retention in extravascular compartment and increase in plasma volume leads to this hyponatremia and inappropriate secretion of Antidiuretic hormone (SIADH) has been proposed to be one of the most important mechanisms for this change, that occurs in various pulmonary diseases including pneumonia, cerebral and malignant diseases and with some drugs also^[16].

In this present study, 150 patients of pneumonia with age group ≤ 5 years to > 65 years were included. All patients were categorized into eight groups. Which are as: group I= ≤ 5 years. Group II= 6-15 years, group III = 16-25 years, group IV = 26-35 years, group V= 36-45 years, group VI = 46 – 55 years, group VII= 56- 65 years, and group VIII = >65 years.

In our study males were twice more commonly affected than females with hyponatremia in pneumonia. Similar results were found in the study done by Chaitra K M et al. where 59% males were affected as compared to 41 % in females^[17]. Similarly in study done by Yilmaz et al 61% of males were affected as compared to 39% seen in females^[18].

In this present study, majorities of cases 62(41.33%) were belonged in group I (≤ 5 years). And least number of patients 9(6%) were belonged in group VIII. There were 15(10%) patients in group II, 10(6.67%) in group III and group IV, 15(10%) in group V, 14(9.33%) in

group VI, 15(10%) in group VII and 9(6%) patients in group VIII. It shows that, prevalence of pneumonia was more in paediatrics patients as compared with older age group patients.

Mean \pm standard deviations (130.290 ± 4.495) of level of sodium of Group I patients had greater t value (228.208) with compared to mean \pm standard deviations of all others group (II, III, IV, V, VI, VII and VIII) of patients. This shows, level of sodium of group I (≤ 5 years) had most significant differences among others group patients. Thus, we were seen that hyponatremia was commonly associated with admitted pneumonic paediatrics patients with compared as others age group patients.

Hyponatremia associated with paediatric pneumonia is most commonly due to the syndrome of inappropriate antidiuretic hormone secretion (SIADH)^[19]. This syndrome is characterized by Hyponatremia and hypoosmolality and results from the inappropriate and continued secretion and/or action of antidiuretic hormone despite normal or increased plasma volume^[20]. Hyperinflation of the lungs, a hallmark of the bronchiolitis, wheezing, asthma, reduces blood flow to the right atrium and stimulates the release of AVP from the posterior pituitary^[21]. Arginine vasopressin release is triggered by os-motic stimuli such as hyperglycemia or uremia, and by non-osmotic stimuli such as hypovolemia, hypercapnia, pain, and anxiety^[22]. Sources of free water intake in this population include hypotonic intravenous fluids, gavage tube feeds, and humidified air in the ventilator circuit^[22,23]. These factors are common in children admitted to the ICU with respiratory diseases^[3].

In this present study, when pair wise comparison was performed for the level of sodium of all age group of patients. P value was found to be 0.000 in group II versus group VI, VII and group I versus group V, VI and VII. It shown greater changes of level of sodium were occurred in age group of I and II patients with respect to older age

group patients. Hence data was the most significant differences.

Acute, severe hyponatremia that develops within 48 hours can result in acute cerebral oedema and various complications such as headache, lethargy, seizures, and cardiac arrest due to brain stem herniation. Children are more vulnerable than adults to above complications because the brain/intracranial volume ratio is higher in children than in adults^[24].

Recent evidence suggests that even mild chronic hyponatremia can be related to subtle neurologic defects, such as impairments in balance and attention that can increase the incidence of falls^[25].

Conclusions

This present study concluded that the hyponatremia is the most significantly seen in (age \leq 5 years) admitted paediatric patients. Male is more suffered than female. Mild hyponatremia is very common in patients with pneumonia. Hence, Initial measurement of serum sodium is recommended in all hospitalized pneumonia patients and patients showing hyponatremia on admission should get special attention as it is a strong independent indicator of higher morbidity and mortality. Hyponatremic patients should undergo further study of urine sodium and osmolality to assess fluid status before imposing fluid restriction. Hospital acquired and Hospital aggravated hyponatremia are also well-known events in paediatric practice due to routine use of hypotonic fluid are maintenance and one should be cautious about fluid management of those diseases prone to cause SIADH including pneumonia. Regular follow up of serum sodium level during the period of hospital stay should be considered to pick up the high risk cases at an early stage.

References

1. Park K. Acute respiratory infections. In: Park's text book of preventive and social medicine, 20th ed. Jabalapur: M/s Banarasidas Bhanot Publishers; 2009. p.151-9.
2. World Health Organization programme for the control of acute respiratory infections. Acute Respiratory Infections in children: Case Management in small hospitals in developing countries. A manual for doctors and other senior health workers, Geneva: WHO; 2004.
3. Chaitra K. M., Mohan Kumar N., Saipraneeth Reddy G. Hyponatremia in lower respiratory tract infections. *Int J Contemp Pediatr.* 2016 May;3(2):381-384.
4. Kabra SK, Verma IC. Acute lower respiratory tract infec_on; The forgo_en pandemic.1999; 66: 873-5.
5. Upadhyay A, Jaber BL, Madias NE. Incidence and prevalence of hyponatremia, *American Jour-nal of Medicine.* 2006;119(7):30-5.
6. Kaneko K, Shimojima T, Kaneko K. Risk of exacerba_on of hypona-tremia with standard maintenance fluid regimens. *Pediatr Nephrol.* 2004;19(10):1185-6.
7. Watanabe T, Abe Y, Sato S, Uehara Y, Ikeno K, Abe T. Hyponatremia in Kawasaki disease. *Pediatr Nephrol.* 2006;21(6):778-81.
8. Szabo FK, Lomenick JP. Syndrome of inappropriate an_diure_c hor-mone secre_on in an infant with respiratory syncy_al virus bronchioli_s. *Clin Pediatr (Phila).* 2008;47(8):840-2.
9. Hoorn EJ, Lindemans J, Zietse R. Development of severe hyponatraemia in hospitalized patients: Treatment-related risk factors and inadequate management. *Nephrol Dial Transplant* 2006; 21: 70-6.
10. Upadhyay A, Jaber BL, Madias NE. Incidence and prevalence of hyponatremia. *Am J Med* 2006; 119: 30-5.
11. Spasovski G, Vanholder R, Allolio B, et al. Clinical prac_ce guideline on diagnosis and treatment of hyponatraemia. *Nephrol Dial Transplant* 2014; 29: 1-39.

12. Moritz ML, Ayus JC. Disorders of water metabolism in children: hyponatremia and hypernatremia. *Pediatr Rev* 2002; 23: 371-80.
13. Al-Salman J, Kemp D, Randall D. Hyponatremia. *West J Med* 2002; 176: 173-6.
14. Pillai BP, Unnikrishnan AG, Pavithran PV. Syndrome of inappropriate antidiuretic hormone secretion: Revisiting a classical endocrine disorder. *Indian J Endocrinol Metab* 2011; 15(3): 208-15.
15. Hoorn EJ et al. Development of severe hyponatraemia in hospitalized patients: treatment related risk factors and inadequate management. *Nephrol Dial Transplant* 2006; 21: 70–6.
16. Moritz ML, Ayus JC Hospital-acquired hyponatremia— why are hypotonic parenteral fluids still being used? *Nature Clinical Practice Nephrology* 2007; 3:374-82.
17. Chaitra KM, Kumar MN, Reddy SG. Hyponatremia in lower respiratory tract infections. *International journal of contemporary Pediatrics* 2016;3(2):381-4.
18. Yilmaz Y, Candar T, Kara F, et al. Serum sodium levels in children with lung infections. *J Pediatr Inf* 2016;10:10-3.
19. Nair V, Niederman MS, Masani N, Fishbane S. Hyponatremia in community-acquired pneumonia. *Am J Nephrol*. 2007;27:184Y190.
20. Bartter FC, Schwartz WB. The syndrome of inappropriate secretion of antidiuretic hormone. *Am J Med*. 1967.
21. Van Steensel-Moll HA, Hazelzet JA, Vander Voort E, Neijens HJ, Hackeng WHL. Excessive Secretion of Antidiuretic Hormone in Infections with Respiratory Syncytial Virus, *Archives of Disease in Childhood*. 1990;65:237-9.
22. Halberthal M, Halperin M, Bohn D. Acute Hypo-natraemia in Children Admitted to Hospital: Retrospective Analysis of Factors Contributing to Its Development and Resolution, *British Medical Journal*. 2001;322:780-2.
23. Sladen A, Laver M, Pontoppidan H. Pulmonary Complications in Mechanical Ventilation, *The New England Journal Medicine*.1968;279:448-53.
24. Moritz ML, Ayus JC. New aspects in the pathogenesis, prevention and treatment of hyponatremic encephalopathy in children. *Pediatr Nephrol* 2010;25(7):1225-38.
25. Moritz ML, Ayus JC. Maintenance intravenous fluids in acutely ill patients. *N Engl J Med* 2016;374(3):290-1.