

Hyponatremia among Critically Ill Children Admitted to Pediatric Intensive Care Unit (PICU)

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Abstract

Background: Hyponatremia in critically ill children can lead to significant increase in morbidity and mortality. Early diagnosis followed by proper treatment can help decrease adverse events in such cases. This study was conducted to ascertain the magnitude of problem in our local population. **Objective:** To determine the frequency of hyponatremia among children admitted in pediatric intensive care unit (PICU). **Material and Methods:** These study cases were registered from Department of Pediatrics, Nishtar Hospital, Multan which were admitted to Paediatric Intensive Care Unit (PICU). Duration of the study was 6 months from January 2017 to June 2017. Once registered in the study, three milliliters (ml) of venous blood sample was drawn. This blood sample was sent to laboratory for serum sodium level estimation. Confidentiality of the patient record was maintained. Child was considered hyponatremic, if serum sodium (Na^+) levels are <135 mEq/L and malnourished if weight for height/length less than -3 SD (Less than 70% of expected). All the data was entered and analyzed using SPSS-20 and mean and standard deviation for disease duration, serum sodium levels and the age of the patients were taken. **Results:** Of these 135 study cases, 79 (58.5%) were boys while 56 (41.5%) were girls. Mean age of our study cases was 4.31 ± 2.29 years. Multiorgan dysfunction was major cause of admission to PICU i.e. 36 (26.7%), pneumonia in 28 (20.7%), trauma in 28 (20.7%), cardiovascular diseases in 18 (13.3%), complicated gastroenteritis in 16 (11.9%) and viral bronchiolitis in 9 (6.7%). Mean disease duration was 8.16 ± 4.62 days. Of these 135 study cases, 38 (28.1%) were malnourished and 92 (68.1%) had history of hypotonic IV fluid therapy. Mean stay at PICU was 6.92 ± 4.11 days. Mean Serum Sodium level was 134.46 ± 3.23 mEq/L (with minimum serum sodium level was 130 mEq/L while maximum level was 140 mEq/L). Hyponatremia was noted in 61 (45.2%) of our study cases. **Conclusion:** Frequency of hyponatremia was high in our study which was significantly associated with gender, disease duration, cause of admission, nutritional status and use of hypotonic IV fluid therapy. Hyponatremia was significantly associated with prolonged duration of hospitalization in pediatric intensive care unit which exerts extra burden on hospital authorities. Timely diagnosis and correction of hyponatremia can lead to decrease disease morbidity and duration of hospitalization.

Keywords: Hyponatremia, pediatric intensive care unit, frequency.

Introduction

Hyponatremia is one of the most common potentially life threatening electrolyte disturbances encountered in critically ill patients. Under normal conditions serum sodium levels are specifically regulated by certain osmoreceptors which interact with thirst center as well as vasopressin axis of kidneys. In conditions of excessive anti-diuretic hormone (ADH) consumption of hypotonic fluid will lead to the retention of water and hyponatremia.¹ Symptoms of hyponatremia include nausea and malaise having reduced levels of serum sodium to lethargy, some degree of unconsciousness, headache, seizures and coma with more severe reduction in the serum sodium levels.² Acute hyponatremia leads to significant increase rates of mortality among hospitalized patients than chronic states and early diagnosis followed by treatment can prevent worsening conditions and prolonged hospital stays.^{3, 4}

Hyponatremia occurs up to 22% of hospitalized patients with daily incidence of 0.97% and often remains undiagnosed and untreated.⁵ Hence, it is important to explore its frequency and implications⁶ but there is still lack of knowledge on this important issue. A study conducted by Seifert et al⁷ in USA reported 73 % hyponatremia in critically ill children. Another study from India reported 9.5% frequency of hyponatremia.⁸

Hyponatremia is associated with increased morbidity, mortality and longer hospital stays with worse outcomes in critically ill children^{9, 10}; various studies conducted abroad have reported varying frequencies of hyponatremia in the targeted population ranging from 9.5 % to 73%.^{7,8}

This study was planned to ascertain the rates of hyponatremia in our local population admitted to Paediatric Intensive care Unit (PICU). Early diagnosis and management of hyponatremia can help to decrease longer hospital stays and morbidities which are beneficial for national health economies as well as for the suffering

families.

Material and methods

All the patients (n=135) who met inclusion criteria (All children aged 2-12 years of either gender admitted, on treatment irrespective of presenting complaint, to pediatric intensive care unit for the duration more than 24 hours) were taken. Patients with history of diuretic use, taking relevant therapy and intake of hypertonic solution were excluded from our study. These study cases were registered from Department of Pediatrics, Nishtar Hospital, Multan which were admitted to Paediatric Intensive Care Unit (PICU). Duration of the study was 6 months from January 2017 to June 2017. Once registered in the study, three milliliters (ml) of venous blood sample was drawn. This blood sample was sent to laboratory for serum sodium level estimation. Confidentiality of the patient record was maintained. Child was considered hyponatremic, if serum sodium (Na⁺) levels are <135 mEq/L and malnourished if weight for height/length less than -3 SD (Less than 70% of expected). All the data was entered and analyzed using SPSS-20 and mean and standard deviation for disease duration, serum sodium levels and the age of the patients were taken and percentage were drawn for the categorical variables like hypotonic IV fluid therapy (Yes/No), age groups, gender and hyponatremia (Yes/No).

Results

Our study included a total 135 study cases who were admitted to pediatric intensive care unit of Nishtar Hospital, Multan. Of these 135 study cases, 79 (58.5%) were boys while 56 (41.5%) were girls.

Mean age of our study cases was 4.31 ± 2.29 years (ranging; 2- 12 years). Mean age of boys was 4.39 ± 2.73 years while that of girls was 4.20 ± 1.47 years (p = 0.626) while 89 (65.9%) were aged less than 5 years of age.

Multiorgan dysfunction was major cause of admission to PICU i.e. 36 (26.7%), pneumonia in 28 (20.7%), trauma in 28 (20.7%), cardiovascular diseases in 18 (13.3%), complicated gastroenteritis in 16 (11.9%) and viral bronchiolitis in 9 (6.7%).

Mean disease duration was 8.16 ± 4.62 days (ranging; 3 -21 days) while 80 (59.3%) had duration of illness less than 1 week. Of these 135 study cases, 38 (28.1%) were from poor social background, 61 (45.2%) from middle income and 36 (26.7%) were from poor families. Most of the mothers of these children i.e. 55 (40.7%) were un-educated, 62 (45.9%) had education up to matriculation and 18 (13.3%) were educated to intermediate and above.

Of these 135 study cases, 38 (28.1%) were malnourished and 92 (68.1%) had history of hypotonic IV fluid therapy. (Table No. 7-8).

Mean stay at PICU was 6.92 ± 4.11 days (minimum duration of stay was 3 days while maximum duration was 18 days).

Mean Serum Sodium level was 134.46 ± 3.23 mEq/L (with minimum serum sodium level was 130 mEq/L while maximum level was 140 mEq/L). Hyponatremia was noted in 61 (45.2%) of our study cases.

Table No. 1

Stratification of hyponatremia with regards to gender.

Gender	Hyponatremia		P – value
	Yes (n = 61)	No (n = 74)	
Male (n = 79)	42	37	0.035
Female (n = 56)	19	37	
Total	135		

Table No. 2

Stratification of hyponatremia with regards to age.

(n = 135)

Age groups	Hyponatremia		P – value
	Yes (n = 61)	No (n = 74)	
Less than 5 years (n = 89)	42	47	0.586
5-12 years (n = 46)	19	27	
Total	135		

Table No. 3
Stratification of hyponatremia with regards to cause of admission.
 (n = 135)

Cause of admission	Hyponatremia		P – value
	Yes (n = 61)	No (n = 74)	
Multiorgan dysfunction (n = 36)	36	00	0.000
Pneumonia (n = 28)	00	28	
Cardiovascular diseases (n = 18)	00	18	
Trauma (n = 28)	09	19	
Complicated Gastroenteritis (n = 16)	16	00	
Viral Bronchiolitis (n = 09)	00	09	
Total	135		

Table No. 4
Stratification of hyponatremia with regards to Hypotonic IV fluid therapy.
 (n = 135)

Hypotonic IV fluid	Hyponatremia		P – value
	Yes (n = 61)	No (n = 74)	
Yes (n = 92)	36	56	0.043
No (n = 43)	25	18	
Total	135		

Table No. 5
Stratification of hyponatremia with regards to pediatric intensive care (PICU) stay.
 (n = 135)

Hyponatremia	PICU stay		P – value
	Mean	SD	
Yes (n = 61)	9.84	4.48	0.000
No (n = 74)	4.51	1.21	

Discussion

Hyponatremia in critically ill children can lead to significant increase in morbidity and mortality. Early diagnosis followed by proper treatment can help decrease adverse events in such cases^{11,12}. This study was conducted to ascertain the magnitude of problem in our local population. Our study included a total 135 study cases who were admitted to pediatric intensive care unit. Of these 135 study cases, 79 (58.5%) were boys while 56 (41.5%) were girls. This male gender predominance over female gender has been reported in other studies as well. Haque et al¹³ from Karachi also reported 60.9 % male gender predominance in children admitted to pediatric intensive care unit (PICU). Our study results are in compliance with that of Haque et al¹³. Another study from Karachi also reported 66 % male gender predominance¹⁴. Ahmed et al¹⁵ reported 58 % boys admitted to PICU showing predominance over female patients. Rady HI¹⁶ from Egypt also reported 56 % male gender preponderance. Volakali et al¹⁷ also reported 64 % boys being admitted to PICU.

Mean age of our study cases was 4.31 ± 2.29 years (ranging; 2- 12 years). Mean age of boys was 4.39 ± 2.73 years while that of girls was 4.20 ± 1.47 years ($p = 0.626$) while 89 (65.9%) were aged less than 5 years of age. Haque et al¹³ from Karachi reported 63 % children admitted to PICU were less than 5 years of age which is

similar to that of our study results. Similar results have been reported in another study from Karachi¹⁴. A study from Ahmed et al¹⁵ reported 41 months mean age of the children admitted to PICU. Rady et al¹⁶ from Egypt also reported children less than 5 years of age predominating (87%) admitted to PICU. Volakali et al¹⁷ reported 54.26 ± 49.93 months mean age of the children admitted to PICU. Abebe et al¹⁸ reported same findings.

Multiorgan dysfunction was major cause of admission to PICU i.e. 36 (26.7%), pneumonia in 28 (20.7%), trauma in 28 (20.7%), cardiovascular diseases in 18 (13.3%), complicated gastroenteritis in 16 (11.9%) and viral bronchiolitis in 9 (6.7%). Our findings are similar to that of Haque et al¹³ and Ahmed et al¹⁵ from Karachi. Rady et al from Egypt¹⁶ reported pneumonia being major cause of PICU admission. Volakali et al¹⁷ reported respiratory illnesses to be 22.3 %, trauma being 15.3% and cardiovascular diseases as 4.7 %. These findings are similar to that of our study results. Abebe et al¹⁸ from Ethiopia reported similar results.

Mean disease duration was 8.16 ± 4.62 days and 80 (59.3%) had duration of illness less than 1 week. Haque et al¹³ from Karachi reported 54.9 % duration of illness less than a week which is close to our study results.

Of these 135 study cases, 38 (28.1%) were from poor social background, 61 (45.2%) from middle income and 36 (26.7%) were from poor families. Most of the mothers of these children i.e. 55 (40.7%) were un-educated, 62 (45.9%) had education up to matriculation and 18 (13.3%) were educated to intermediate and above. Of these 135 study cases, 38 (28.1%) were malnourished and 92 (68.1%) had history of hypotonic IV fluid therapy. Ahmed et al¹⁵ reported 62 % infusion which is similar to that of our study results.

Mean stay at PICU was 6.92 ± 4.11 days (minimum duration of stay was 3 days while maximum duration was 18 days). Mean duration of stay at PICU was 3.89 days (range 1 - 15 days) in a study reported by Ahmed et al¹⁵ which is close to our findings. Volakali et al¹⁷ reported 8.85 ± 23.28 days mean duration of PICU stay.

Mean Serum Sodium level was 134.46 ± 3.23 mEq/L (with minimum serum sodium level was 130 mEq/L while maximum level was 140 mEq/L). Hyponatremia was noted in 61 (45.2%) of our study cases. A study conducted by Seifert et al⁷ in USA reported 73 % hyponatremia in critically ill children. Another study from India reported 9.5% frequency of hyponatremia.⁸ Montañana et al¹⁹ randomized 122 patients admitted to the pediatric intensive care unit (PICU) to receive either isotonic (NaCl = 140 mEq/L) or hypotonic (NaCl <100 mEq/L) IV fluids. The primary endpoint was the percentage of patients who were hyponatremic at 6 and 24 hours after fluid therapy. Hyponatremia ($\text{Na}^+ < 135$ mEq/L) occurred at 6 hours in 20 patients (31.7%) receiving hypotonic saline solution and in 15 patients (25.4%) receiving isotonic saline solution ($p=0.53$), and at 24 hours in 13 patients (20.6%) receiving hypotonic saline solution and 3 patients (5.1%) receiving isotonic saline solution ($p=0.02$). Severe hyponatremia ($\text{Na}^+ < 125$ mEq/L) occurred in 4 patients (6.3%) in the hypotonic saline group and no patients in the isotonic saline solution at 6 hours ($p=0.12$)

Conclusion

Frequency of hyponatremia was high in our study which was significantly associated with gender, disease duration, cause of admission, nutritional status and use of hypotonic IV fluid therapy. Hyponatremia was significantly associated with prolonged duration of hospitalization in pediatric intensive care unit which exerts extra burden on hospital authorities. Timely diagnosis and correction of hyponatremia can lead to decrease disease morbidity and duration of hospitalization. This will not only provide relief to the suffering families but will also help health authorities in terms of availability of more beds and space.

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