



PREVALENCE OF HYPONATREMIA AMONG PATIENTS WITH ACUTE URINARY TRACT INFECTION (UTI) IN BANDAR ABBAS PEDIATRIC HOSPITAL DURING 2012-15

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ABSTRACT

Introduction: Urinary tract infection (UTI) is among the most prevalent bacterial infections among children. There is scarce research on the correlation of UTI and the emergence of hyponatremia. The present research aimed to investigate the prevalence of hyponatremia among patients with an acute UTI. **Methods:** The present research is of a cross-sectional and retrospective in type and was conducted on 1-month to 15 year-old child patients suffering from an acute UTI hospitalized in Bandar Abbas Pediatric Hospital within 2012-15. The sample size was 1,096 and the data were collected from the patients' medical records. The subjects were divided into two groups: with or without hyponatremia. The data were recorded in terms of the existence of upper and lower urinary infection, lab parameters and DMSA scan results as well as renal anomalies. The data were finally analyzed via SPSS ver.16 through Mann-Whitney U-test, Chi-squared test and Fisher's exact test. The level of significance was set at $p < .05$. **Results:** 71 subjects (6.5%) were afflicted with a reduced serum level of sodium. In the hyponatremia group, ESR, CRP and WBC levels in blood showed a statistically significant increase ($p = .001$, $p = .001$, $p = .006$). The two groups showed to be significantly divergent in terms of the presence of kidney photopenic area and upper urinary infection ($p = .016$, $p = .043$). **Discussion:** The present findings revealed that hyponatremia can be a symptom of urinary tract inflammation. It is also correlated with an inflammation degree in children with UTI. ESR, CRP and WBC levels are negatively correlated with the serum level of sodium. In patients with a kidney photopenic area the emergence rate of hyponatremia is higher. **Conclusion:** Hyponatremia and high levels of CRP can be considered as two independent factors involved in predicting the emergence of renal damage in DMSA scan.

KEYTERMS: urinary tract infection, hyponatremia, children.

INTRODUCTION

Urinary tract infection (UTI) is the most prevalent disease afflicting the urinary system and is the second most prevalent infection among children. About 8% of girls and 2% of boys get afflicted at least once with UTI up until the age of 11. This disease is considered as a factor involved in kidney failure. As the majority of clinical symptoms are vague in these patients,^[1] the lack of a timely diagnosis and care in the long run leads to such side effects as chronic high blood pressure, renal failure and reflux in children. Therefore, attention should be paid to the timely diagnosis and treatment of the disease and prevention of the side effects. Moreover, patients get occasionally afflicted with electrolytic disorders such as hyponatremia and hyperkalemia. The former is the most prevalent electrolytic disorder that

results from a disruption of body water and sodium levels and is defined as a serum level lower than 135 mEq/lit in hospitalized patients.^[2,3] Although the majority of patients with hyponatremia lack any symptom, they might show a number of medical emergencies such as epilepsy, comma, respiratory arrest and perennial brain trauma that exacerbate patient's condition. Hyponatremia not only emerges in chronic diseases but also along with acute diseases. In their research, Wetanabe et al. indicated that the reduced serum level of sodium in patients with pneumonia, Kawasaki and meningitis exacerbates patients' prognosis significantly. Moreover, the serum level of sodium in an acute phase of the UTI infection is significantly reduced as compared to the chronic level.^[4] On the other hand, Se Jin Park showed in another investigation that 33.6% of children afflicted with UTI with fever suffered from

hyponatremia as well. The fever lasted longer among children with renal cortical defects and the WBC and CRP levels were higher in patients without such defects.^[2] There have been various reports on the emergence of hyponatremia in children with UTI which shows that these findings have not been infrequent.^[5-8] However, there is a dearth of research with this concern to show that hyponatremia in children afflicted with UTI and fever is correlated with an inflammation degree and hyponatremia can be regarded as an inflammatory marker.^[2] The reduced serum level of sodium in children with fever afflicted with UTI can be a symptom of leukocytosis, increased ESR, CRP and acute pyelonephritis.^[9] Hyponatremia is prevalent in pediatric urinary infections and diagnosing the severity of damage to kidney is significant in diagnostic and therapeutic measures as well as scar formation in kidney. Therefore, the present research aimed to investigate the prevalence of hyponatremia in patients afflicted with an acute UTI hospitalized in Bandar Abbas Pediatric Hospital.

METHODOLOGY

The present descriptive-analytical research was of a retrospective type and was conducted on 1-month to 15 year old children afflicted with UTI hospitalized in Bandar Abbas Pediatric Hospital during 2012-15. No sex or frequency of affliction limits were set in the design of the present research. All the data were compared and contrasted in terms of hyponatremia, clinical as well as lab parameters along with the relevant anomalies such as hydronephrosis and vesicoureteral reflux (VUR). A census was followed to do the sampling. The subjects were divided into two groups with or without hyponatremia. They were studied in terms of Dimercaptosuccinic acid scan (DMSA), white globule count, CRP, ESR, temperature and relevant anomalies. This research made use of the data in patients' records in pediatric nephrology ward. Blood and urine samples were taken from patients upon reception at hospital before any oral or injected medication, for the required CRP, ESR, CBC tests, tests of the serum levels of sodium and potassium, urinary analysis test and urine culture. The results were recorded. Urine samples were obtained as urinary middle samples in older children and via a urine bag from younger children. In case the culture result turned out positive, it implied urinary infection. If the culture showed more than 100,000 colonies of a single pathogen or more than 10,000 colonies in marked children, it would be taken as urinary infection. As for bagged samples, in case the urinary analysis test result was positive in marked children along with over 100,000 colonies in the culture of a single pathogen, the result would imply urinary infection.^[10,11] Pyelonephritis diagnosis in these patients was according to disease symptoms and urinary analysis and culture results. In the present research, hyponatremia was defined by a serum level of sodium below 135 mEq/lit and a temperature above 38 degrees of Celsius.^[12-14] Similarly, leukocytosis and increased ESR and CRP were defined respectively as WBC>15,000 mm³, ESR>25mm/h and CRP>20. The

sampling followed a census procedure. The data were collected from patients' medical records in the target hospital. Finally, the results of the study were analyzed statistically via SPSS ver.16 through Mann-Whitney U test and chi-squared test. The significance level was set at $p < .05$.

RESULTS

In the present research, 1,096 patients participated including 807 girls (73.6%) and 289 boys (26.4%) whose average age was 23.57 ± 30.559 months. 25% of the subjects aged lower than 3 months while 75% were younger than 36 months. From the 71 patients in the hyponatremia group, 6.5% (n=52) were boys and 6.6% (n=19) were girls. In the non-hyponatremia group, 93.5% (n=747) were girls while 93.4% (n=268) were boys. The girls and boys did not show to differ significantly in terms of the prevalence of hyponatremia ($p = .947$) (Table 1). The average age of the patients was $21.78 \text{ SD} \pm 27.43$ months in the hyponatremia group and $23.84 \text{ SD} \pm 30.85$ months in the non-hyponatremia group. The two groups did not diverge significantly in terms of age ($p = .697$) (Table 2).

In this study, among the 1086 patients whose serum level of sodium was recorded upon reception, 6.5% (n=71) had a serum level of sodium below 135 and were afflicted with hyponatremia. Their DMSA scan results of 103 patients were available. In 38.8% (n=40) of the DMSA scan results, the presence of photopenic area in kidney was reported. In the hyponatremia group, 69.2% (n=9) possessed a photopenic area in their kidney. In the non-hyponatremia group, 34.4% (n=31) possessed a photopenic area in their kidney which showed a statistically significant difference ($p = .016$) (Table 3).

Among all subjects, 85% (n=932) revealed no sign of urinary malformation. 15% (n=164) showed to have a urinary malformation. Among those suffering from hyponatremia, 19.7% (n=14) had urinary malformation recorded in their file. In the non-hyponatremia group, 14.8% (n=150) had urinary malformation recorded in their files. The two groups showed no statistically significant divergence ($p = .261$) (Table 4). In the hyponatremia group, WBC level exceeded 15,000 in 32.4% (n=23) of patients. In the non-hyponatremia group, the same parameter exceeded 15,000 in 19% (n=193) patients. The two groups showed to diverge significantly with this respect ($p = .006$) (Table 5). In the hyponatremia group, ESR exceeded 25 in 66.7% (n=46) of patients while in the other group the same parameter exceeded the same value in 37.2% (n=366) of patients. The two groups showed a statistically significant difference with this regard ($p = .001$) (Table 6). Moreover, in the hyponatremia group, CRP showed to exceed 20 mg/L in 45.9% (n=28) of patients while in the non-hyponatremia group the same parameter exceeded the same value in 23.1% (n=204) of cases. The two groups showed to diverge significantly with respect to this parameter ($p = .001$) (Table 7).

Table 1: Prevalence of hyponatremia in terms of sex.

			SEX		Total	X ²	df	P-value
			Female	Male				
Hyponatremia	Negative	n.	747	268	1015	0.004	1	0.947
		%	93.5	93.4	93.5			
	Positive	n.	52	19	71			
		%	6.5	6.6	6.5			
Total			n.	799	287	1086		
			%	100	100	100		

Table 2: Prevalence of hyponatremia in terms of age.

	Hyponatremia				Mann-Whitney test	P-value
	Negative		Positive			
	mean	SD	mean	SD		
Age	23.84	30.85	21.78	27.43	-0.389	0.697

Table 3: Prevalence of hyponatremia in terms of the presence of photopenic area in DMSA scan.

			DMSA scan		Total	X ²	df	P-value
			No photopenic area	With a photopenic area				
Hyponatremia	Negative	n.	59	31	90	5.787	1	*0.006
		%	65.6	34.4	100			
	Positive	n.	4	9	13			
		%	30.8	69.2	100			
Total			n.	63	40	103		
			%	61.2	38.8	100		

× Prevalence of hyponatremia in terms of the presence of a photopenic area in DMSA scan which showed a statistically significant difference (p-value=.016)

Table 5: prevalence of hyponatremia in terms of WBC.

			WBC		Total	X ²	df	P-value
			<15	>15				
Hyponatremia	Negative	n.	821	193	1.14	1.263	1	0.261
		%	81.1	19	100			
	Positive	n.	48	23	71			
		%	67.6	32.4	100			
Total			n.	869	216	1085		
			%	80.1	19.9	100		

Table 6: Prevalence of hyponatremia in terms of ESR.

			WBC		Total	X ²	df	P-value
			<25	>25				
Hyponatremia	Negative	n.	619	366	985	23.584	1	< 0.001*
		%	62.8	37.2	100			
	Positive	n.	23	46	69			
		%	33.3	66.7	100			
Total			n.	624	412	1054		
			%	60.9	39.1	100		

× Prevalence of hyponatremia in terms of ESR revealed a statistically significant difference (p<.001)

Table 7: Prevalence of hyponatremia in terms of CRP.

			CRP		total	X ²	df	P-value
			<20	>20				
Hyponatremia	negative	n.	678	204	882	15.950	< 0.001 *	
		%	76.9	23.1	100			
	positive	n.	33	28	61			
		%	54.1	45.9	100			
total		n.	711	232	943			
		%	75.4	24.6	100			

× Prevalence of hyponatremia in terms of CRP revealed a statistically significant difference (p<.001)

DISCUSSION

Hyponatremia can emerge as a result of consuming cytotoxic medications, affliction with pediatric respiratory infections, meningitis, heart infarction, subarachnoid hemorrhage (SAH) and Kawasaki.^[2,15,18] A variety of mechanisms have been suggested for the emergence of hyponatremia. One is an inappropriate secretion of ADH anti-urinary hormone induced by such cytokines as IL-1B, IL-6 and TNF which reduce the emergence and functioning of sodium channels as well as sodium/potassium pumping (Na⁺/K⁺-ATPase).^[4,19,20] The second mechanism might be a severe inflammation of proximal tubule and collective tracts. The third mechanism is the emergence of Pseudohypoaldosteronism (PHA) in children with an acute pyelonephritis induced by a failed tubular response to aldosterone.^[5,20,21] In fact, PHA can emerge either as a result of pyelonephritis or only obstructive uropathy. Influenced by renal anomalies, tubular internal pressure can lead to secondary PHA.^[22] A number of subjects in the present study had anatomic anomalies in their urinary system. Therefore, the emergence of hyponatremia showed no statistically significant correlation with urinary malformations. The last mechanism is an increased production of atriopeptins. It can originate from an increased amount of secondary water shut off in the Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH).^[2] Atriopeptins comprise a peptide family produced in the atrial cardiac muscle and help to excrete the urinary sodium (Natriuresis), Diuresis, vascular dilation and inhibition of aldosterone secretion. This family were not explored in the present study though hyponatremia was indicated in diseases entailing fever or inflammation in several investigations.^[4,23] There is a dearth of research on the prevalence of hyponatremia in acute UTI or the correlation between hyponatremia and the severity of renal inflammation. The present study showed that hyponatremia can be regarded as a symptom of urinary tract inflammation and is significantly correlated with an inflammation degree in children with UTI. In the present research, CRP, ESR and WBC showed to be negatively correlated with the serum level of sodium. In patients with a photopenic area in kidney, the emergence rate of hyponatremia showed to be higher in DMSA scan results. These findings along with the higher emergence of hyponatremia in upper UTI than lower UTI can show a positive correlation between hyponatremia and a degree of inflammation (p=.016).

Similarly, Park et al. observed that hyponatremia was correlated with severe inflammation especially acute pyelonephritis in children with UTI. The same researchers found a negative correlation between the serum levels of WBC/CRP and hyponatremia.^[2] The present research showed no correlation between the emergence of hyponatremia and urinary malformations. In their investigation of children afflicted with an acute pyelonephritis and mild hyponatremia and hyperkalemia, Watanabe et al. reported an insignificant correlation with urinary tract anomalies.^[24] In the present study, no correlation was observed between vesicoureteral reflux and the emergence of hyponatremia (p=.261). However, Yousefichaijan et al. reported the prevalence of hyponatremia in children with a nephropathy reflux.^[25]

Park et al.'s retrospective research of 140 children with a temperature suffering from UTI revealed that children who showed a cortical damage in DMSA scan had a longer duration of fever and higher ESR and CRP than those without a cortical damage. However, the former group showed to have a significantly lower serum level of sodium than the latter group. Similarly, in the present study, the serum level of sodium showed to be negatively correlated with the white cell counts (p=.006) and ESR level (p=.001). Hyponatremia and high levels of CRP were found as two independent prognostic factors of the severity of renal damage in DMSA scan (p=.001).

In the present research, the two research groups could have been compared more precisely if there had been a possibility of adding to the specific weight of urine and serum potassium. The present research showed hyponatremia as a key inflammatory marker in renal infections. Diagnosis of hyponatremia increases the probability of pyelonephritis company or more severe inflammation.

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