

Acidosis Frequency in Children of Pediatric Acute Diarrhea

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Abstract

Objectives: To Found out the frequency of aidosis in patients of paediatric accute diarrhea.

Methods: Two hundred and eighty children fulfilling the inclusion/exclusion criteria admitted in Department of Paediatrics, Services Hospital, Lahore was taken. Informed consent of the parents of children was obtained to include their data in the study. Every children with acute diarrhea was followed through 1-2cc arterial sample sent to the hospital laboratory of the hospital.

Results: out of the total 280 patients, 83(29.5%) had acid base abnormality and 197(70.5%) had normal acid base imbalance. Out of 83(29.5%) patients who had acid base abnormality 50(17.5%) males and 22(8%) females had acidosis while only 8(3%) males and 3(1%) females had alkalosis.

Conclusion: Acidosis is the most common abnormalities. Its incidence increase with increase in duration of diarrhea.

Key Words: Acidosis, paediatric acute diarrhea

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Introduction

In developing countries, Diarrhea still plays key role in both morbidity and death among under-5 children and accounts for 9% of 5.9 million global under-5 deaths.¹ Children with diarrhea often present with respiratory difficulties with or without dehydration, and this is mainly due to the presence of metabolic acidosis² resulting mainly from a loss of bicarbonate in feces.³ Dehydration is the most frequent and dangerous complication and is the main reason for metabolic acidosis in such children.⁴

The gastrointestinal tract (GIT) helps to regulate

acid-base homeostasis. Large amounts of H⁺ and HCO₃ cross the specialized epithelia of the various components of the gut every day, but under normal conditions, only a small amount of alkali (approximately 30 to 40 mmol) is lost in the stool.⁵ The small amount of alkali lost as a byproduct of these transport events is easily regenerated by renal net acid excretion, which is regulated by the kidney to maintain body alkali stores. Disruption of normal gut function, however, uncovers its power to overwhelm acid-base homeostasis. Acid-base disorders can vary from severe acidosis to severe alkalosis, depending on the site along the gastrointestinal tract affected and the nature of the losses that ensue.⁶ These disruptions in acid base equilibrium are associated with disorders of either potassium imbalance or sodium imbalance.⁷

The type of diarrhea depends on which part of the GIT has been targeted and the causative agent.⁸ Commonly observed acid base disturbances in diarrhea are hyperchloremic metabolic acidosis and metabolic alkalosis occurs in very few types.⁹ In secretory diarrhea, like caused by Vibrio Cholera, there is hyperchloremic metabolic acidosis. Lactic acidosis may supervene as a result of tissue hypoperfusion.¹⁰ In

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inflammatory diarrhea, there is no acid base disturbance initially as kidney is compensating for the loss, however, in severe cases, volume depletion and hyperchloremic metabolic acidosis may occur. In case of autoimmune diarrhea, incidence of metabolic alkalosis is more.¹¹ A study was conducted in Bangladesh reported higher incidence of morbidity and mortality in children who developed metabolic acidosis and suggested that early recognition of features of acidosis may help clinicians to have prompt management that may further help reduce mortality in such children.¹² As it is a common cause of morbidity and mortality in Pakistan, and limited literature is available in reference to acid base imbalance and there is no research done on this important issue in my center. Young children die of this simple problem, so my rationale is to highlight the major cause which lead to death from this simple problem.

Methods

It was a cross sectional study which includes 280 cases. Sampling was done by Non probability consecutive sampling technique. Our inclusion criteria was children between 3 months to 5 years of age and children with acute diarrhea (Passage of loose or watery stools at least 3 times in 24 hours, for less than 14 days). Children having any chronic GI illness like celiac disease and congenital adrenal hyperplasia and children having other systemic disease like renal (urea > 20mg/l, creatinine > 1.3mg/dl), gastrointesti-

nal and metabolic diseases were excluded from the study because these cases will act as effect modifiers and if included in the study will introduce bias in the result. The collected data was entered and analyzed using SPSS version 16. The frequency and percentage of children with acid base imbalance whether acidosis or alkalosis were noted. Data was stratified for age, acid base imbalance, gender, duration of diarrhea to address the effect of modifiers. Chi-square test was used to compare qualitative data. p < 0.05 was considered as significant.

Results

We found out that, out of 280 cases 140(50%) were in the age range of 3-12 months. When they were divided according to gender, 148(53%) were male and 132(47%) were females. When acid base balance was checked. Out of the total 280 patients, 83(29.5%) had acid base abnormality and 197(70.5%) had normal acid base balance. Out of 83(29.5%) patients

Table 1: Distribution of Acid Base Imbalance (n=280).

Acid Base Imbalance	Male	Female	Total	P-value
Acidosis pH <7.35	50(17.5%)	22(8%)	72(25.5%)	0.005
Alkalosis pH >7.45	8(3%)	3(1%)	11(4%)	0.001
Normal pH 7.35-7.45	109(39%)	88(31.5%)	197(70.5%)	0.054

who had acid base abnormality, 50(17.5%) males and 22(8%) females had acidosis while only 8(3%) males

Table 2: Stratification of Acid Base Imbalance with Regard to Age Range, Number of Diarrheal Episodes and Severity of Dehydration (n=280).

Stratification of frequency acid base imbalance with regard to age range	Age Range			p-value
	3 - 12 months (n=140)	13 - 24 months (n=81)	25 months - 5 years (n=59)	
Acidosis	51(36.4%)	20 (31%)	6 (10%)	0.025
Alkalosis	6 (4.5%)	2(4.6%)	0 (0%)	0.300
Normal	90 (64.2%)	62 (69%)	53 (90%)	0.001
Stratification of frequency acid base imbalance with regard to number of episodes	Number of episodes			
	1-3 (n=146)	4-5 (n=78)	-	
Acidosis <7.35	21(25.5%)	26 (28%)	25 (38%)	0.001
Alkalosis >7.45	4(4%)	2 (2%)	5 (7.6%)	0.025
Normal 7.35-7.45	57(70%)	65 (70%)	25 (38%)	0.005
Stratification of frequency acid base imbalance with regard to severity of dehydration	Severity of Dehydration			
	No dehydration	No dehydration	No dehydration	
Acidosis <7.35	11 (20%)	30(18.3%)	31(47%)	0.001
Alkalosis >7.45	3(5%)	2(1.9%)	6(9%)	0.025
Normal 7.35- 7.45	31(86%)	87 (73%)	26(40%)	0.005

and 3(1%) females had alkalosis as shown in **Table-1**. Data was than stratified with age, number of diarrhea episodes and severity of dehydration using chi-square test as shown in **Table-2**.

Discussion

Acidosis is the most common acid base imbalance in our study population. 25.5% who presented with diarrhea also had acidosis. In a study conducted by Sharifuzzaaman et al in 2017 in Bangladesh they reported acidosis in 96% of the children who presented with watery diarrhea.¹² These results are very higher than ours it may be due the fact that they have included patient only with complain of acute watery diarrhea whereas we included cases of diarrhea with any cause of origin. In a study conducted in Kathmandu, Nepal 94% children who presented with diarrhea had acidosis whereas only one 6% had alkalosis.¹³ Similar results have been reported by Habib Ullah.¹⁴ Narchi reported that there is no significant difference between the serum bicarbonate concentrations in relation to the degree of dehydration in diarrhea patients.¹⁵ Shah reported that increase incidence of acidosis in diarrhea is due to more loss of bicarbonate from gastrointestinal tract.¹³ When frequency of acidosis is stratified with age range, it is found that acidosis is more frequent in the 3-12 months age group. Similarly, in a study conducted by Eke C Bet al in Nigeria they reported Children less than 12 months of age were three times more likely to have acidosis (odds ratio = 3.098) than those above 12 months. This may be related to the high body surface area in the younger infants, thereby predisposing them to greater loss of fluid and electrolytes.¹⁶ Acidosis is also more common in the group with diarrhea of more than 6 days (44.4%in the third group). This is due to the fact that as duration of diarrhea prolongs increase faecal losses of sodium, potassium and bicarbonate leads to more loss which are not being replaced properly due to the improper rehydration methods and lack of awareness about continuation of breastfeeding during diarrhea in Pakistani mothers, according to Bello DA.¹⁷ This also suggest that early presentation and prompt correction of this derangement may reduce the duration of diarrhea and by extension associated mortality as corroborated by other studies.^{18,19} Acidosis is present in the group with no dehydration The reason is that in these patients, loss of water was replaced by hypotonic solutions but the loss of elec-

trolytes were not properly compensated. However, its incidence is much higher in the group with severe dehydration. Loss of more bicarbonate as compare to Hydrogen leads to increase incidence of acidosis in severely dehydrated patients.²⁰

Conclusion

Acidosis is the most common acid base abnormality in children with acute watery diarrhea. Children less than 2 years of age are most affected. Frequency of acidosis increases with an increase in duration of diarrhea and occur more frequently in patients who are severely dehydrated. All children especially less than 2 years of age must be properly dehydrated. ORS should be started immediately and in proper amounts once diarrhea starts.

Conflict of Interest: None

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Author's Contribution

- AZM:** Sampling, introduction & results
ZA: Critical review & hypothesis development
TS: Sampling & discussion
AM: Sampling & introduction
MK: Sampling & results
FM: Sampling & statistical analysis