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ORIGINAL ARTICLE

Effect of electrolyte addition in fluids to reduce mortality in neonates.

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ABSTRACT… Objective: To monitor the effect of electrolyte addition in fluids to reduce mortality in neonates and reduce the days of hospital stay. **Study Design:** Case Control study. **Setting:** Aziz Bhatti Shaheed Hospital, Gujrat. **Period:** January 2017 to December 2018. **Material & Methods:** Babies inborn during the study period of gestational age between 32 to 36 weeks and birth weight range from 1.5 to 2 kg were included in the study. To compare the effect of potassium in both groups, SPSS analysis was carried out. **Results:** The study resulted in decreased mortality rate with a p value of 0.006. The overall hospitalization time was also reduced presented with early discharge from the hospital setting. **Conclusion:** The study concluded that early administration of potassium through intravenous fluids demonstrated a rapid recovery and decreased hospitalization of the infants.

Key words: Electrolytes, Fluid Balance, Neonates, Potassium.

INTRODUCTION

Disorders of fluids and electrolyte balance are one of the most common problems encountered in critically ill neonates. The main aim of electrolyte therapy and cautious fluid is to ensure a smooth transition to an ex-uterine environment. Neonates proportionally have excess of total body water, mainly extracellular water. This proportion decreases with increasing gestational age. We may expect 10 to 15 % weight loss for preterm babies and 5 to 10% for term babies.[1]

Potassium is one of the main ions in the body with 98% intracellular and 2% extracellular distribution. Extracellular potassium is closely regulated between 3.5 to 5.5 meq/L.[2] Serum potassium levels are responsible for controlling various important physiological and metabolic processes in the infant, including carbohydrate metabolism, cell volume and electric potential across cell membrane which actually controls the stability and contractility of muscular tissues.[3,4]

The low levels of potassium between 3 to 3.5 mEq/L are known as mild hypokalemia and it is usually asymptomatic with only mild muscle weakness at times. Moderate hypokalemia is the condition which occurs when the levels of potassium are between 2.5 to 3 mEq/L. It manifests as proximal muscle weakness and abdominal distension, constipation and ileus due to reduced contractility of smooth muscles of intestines, while severe hypokalemia is characterized as potassium levels are below 2.5 mEq/L. It can cause severe muscle weakness, haemoglobinuria, rhabdomyolysis, respiratory arrest and even respiratory compromise. The most fatal complication of severe hypokalemia is cardiac dysrhythmias. ECG changes not always correlate well with serum potassium levels so prompt treatment of severe hypokalemia is required to prevent any life-threatening complications even in the absences of ECG changes. The most common causes of hypokalemia in neonates are, diarrhoea, vomiting, ileostomy, drugs e.g., use of diuretics in babies with Broncho pulmonary dysplasia and persistent low intake of potassium.[5,6]

This treatment aims to prevent life threatening muscular and cardiac complications, primarily

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and secondary aim is to replenish the body stores. The best and safe treatment for these complications is via enteral route, but in case of severe hypokalemia and ileus it is essential to give potassium in IV fluids with not more than 40 mEq/L of potassium. In case of any emergency 0.3 -1mEq /Kg can be given intravenously over the time of an hour.[7]

MATERIAL & METHODS

This study followed a prospective, case–control research design. It is a hospital record-based review that covered the period from January 2017 to December 2018. The study was conducted at Aziz Bhatti Shaheed Hospital, Gujrat which is a teaching hospital of central Punjab and covers the whole Gujrat district and a number of neighbouring cities.

Sample Size

For the sample size calculation, the proportion of mortality in group A was assumed 22% based on pilot study. A mortality reduction rate of 10% assumed for group B. Therefore, a sample of 348 patients (174 per group) was required to have a 90% power of study to detect the difference between both groups.

The inclusion criteria of patients' data were inborn during the study period of gestational age between 32 to 36 weeks and birth weight range from 1.5 to 2 kg. Babies born outside the respective hospital were also included in the study as long as they presented within a time frame of 4 hours after birth and met the initial inclusion criteria of birth weight and gestational age. Any babies showing clinical and or biochemical evidence of sepsis were excluded from the study. This was equally applicable for both early onset sepsis and late onset sepsis including nosocomial infections. Also excluded were babies with any congenital malformations and birth asphyxia. All the babies were given intravenous antibiotics as per the unit's protocol. The data was collected manually in the "NICU admission log book'' during the study period. Babies born from January 2017 to December 2017 were included in Group A and babies born from January 2018 to December 2018 were included in Group B. Potassium was added to intravenous fluids on Day 3 for babies included in group A and for babies in Group B it was added at day 2.

Data analysis was performed by an experienced medical statistician by using the tool, Statistical Package for the Social Sciences (SPSS).

Method of Chi square testing was used to calculate the mortality difference between the two groups and an independent sample t-test was used for the comparing of the mean hospital stay between two groups. One sided hypothesis test was used to make the population proportions comparable between two groups. Research and Ethics Committee at AMCH approved this study. Full confidentiality was maintained throughout the study, and the collected data was exclusively used for research purposes. This was a self-funded study by the researchers, with no conflict of interest.

RESULTS

On average 300 babies per month were admitted in the neonatal department during the study period (2017–2018). Both group A and group B had 174 babies each. On average 10 to 15% of babies were excluded from both groups at some point during the study due to the reasons mentioned above.

Chi square test was employed to compare the mortality rate between both groups. 54 (31%) patients expired in the group A and 32 (18.4) patients expired in group B. This difference found had statistically significant (p value of 0.006).

			Group		Total	P-Value
			Group A	Group B		
Row	Expired	n (%)	54 (31.0%)	32 (18.4%)	86 (24.7%)	0.006*
	Discharged	n (%)	120 (69.0%)	142 (81.6%)	262 (75.3%)	
Total		n (%)	174 (100.0%)	174 (100.0%)	348 (100.0%)	

Group	N	Mean (Days)	Std. Deviation	P-Value
Group A (Hospital Stay)	120	4.62	2.12	< 0.001*
Group B (Hospital Stay)	142	3.66	1.10	

Group Statistics.

T-test of an independent sample was used in this study to compare the statistics of mean hospital stay between both groups. The mean hospital stay was relatively higher in group A in comparison to the group B (p value < 0.001). The primary discharge criteria were 24 to 48 hours of satisfactory oral feeding.

DISCUSSION

In Pakistan, the neonatal mortality rate is 40 per thousand live births. Risk factors include birth asphyxia, sepsis, prematurity, RDS and NEC. Proper nutrition management and fluid electrolyte therapy is very necessary because almost all babies in a neonatal intensive care unit (NICU) need administration in the form of switching of fluids among extracellular, intracellular, and vascular compartments through IV fluids.[8] Thus, it is important to manage fluid and electrolyte balance. If the fluids which are given are inappropriate, major health impacts can occur. If proper attention to nutrition is not paid in the neonatal period, it may lead to conditions such as osteopenia of prematurity, failure of growth and other complications.[9]

In our study meticulous attention was paid to make two groups comparable. The important confounding variables that could have led to a significant difference in the primary outcome were controlled by setting the strict inclusion and exclusion criteria. Preterm babies below 32 weeks of gestation and very low birth weight babies were excluded from the study. The main focus of the study was fairly well babies who temporarily require IV fluids for one or another reason and to find out whether adding electrolytes early to IV fluids administered to these babies would help in early establishment of oral feeding which was the main primary outcome of study. Secondary outcomes were the average duration of stay in hospital and mortality. It appears from the results that early administration of electrolytes does help in achieving a favourable outcome in terms of shorter hospital stay, reduced mortality and most importantly early establishment of oral feeding in the neonatal population.

A neonates' fluid and electrolyte status are partially reflected by the maternal status and multiple maternal factors can affect baby's hydration and electrolytes status e.g., if excessive hypotonicor oxytocin is given to the mother then it can also cause life threatening condition like hyponatremia in the baby at time of his birth.[10] Maternal conditions like hypertension and stress can cause intrauterine growth restriction (IUGR).[11] These babies will have extra nutritional requirement in postnatal period to have catch up growth. A number of factors in mother like diabetes, use of medications like ACE inhibitors, aminoglycosides etc can have detrimental effects on baby's renal system which in turn can cause electrolyte disturbances in baby.[12] Excessive use of antenatal steroids in mother can affect skin maturation in infants causing excessive IWL (Infant Water Loss), putting infant at risk of dehydration. One of the limitations of our study is that we did not look at any of the above-mentioned maternal factors.

The environment in which an infant is kept has an impact on the hydration status.[13] Using a comparatively warm environment or phototherapy helps the increase of an infant's IWL whereas, high ambient humidity environment may decrease IWL.[14] In intubated infants in sufficient inspired gas humidification is also known increase IWL. If we fail to keep an infant sufficiency warm, it can lead to the occurrence of increased IWL. Latent heat of the evaporation is responsible for cooling effect which occurs with IWL, it is comparable to cooling effect which occurs due to production of sweat in adults and children.

A change in body water is responsible for the sudden changes in an infant's weight. The affected compartment depends upon the age

of gestation and the risks related (e.g., sepsis, respiratory system distress syndrome and necrotizing enter colitis).[15] Premature babies have less keratinized skin which may lead to an elevation in IWL. Mucosal and histologic display is also observed in loss of water. However, a sunken anterior fontanelle, an altered skin turgor or dry mucous membranes may not indicate dehydration in baby's sensitively.[16] Growth charts are available which are helpful in following nutritional status and growth parameters over time. However, they play a very less significant role in the balancing of fluid and electrolytes. Tachycardia, cold peripheries resulting from peripheral vasoconstriction and hypotension are more reliable measures of neonate's hydration. We carefully controlled these factors in our study as infants in both groups were provided the same standard care as per unit protocol and any sick babies with sepsis, NEC, birth asphyxia was excluded from the study thus making both groups more comparable and results more reliable.

Few tests (Creatinine, Serum electrolyte, plasma osmolarity and urea nitrogen levels) are run through, depending on the clinical condition of fluid aetiology and derangements of electrolytes. Minding these test results, particularly the levels of creatinine, may show maternal values over the initial 12-24 hours. Decrease of creatinine levels in serum usually happens postnatally, however in highly premature babies the decrease of serum creatinine levels is delayed.[17] An Accurate estimation of the total fluid intake and total urine output is noted. In the infants who do not have urinary catheters or urine bags, weighing of diapers is employed to estimate the fluid output.[18]

Babies with less output of urine and an abnormal creatinine level in serum which does not decrease postnatally or may increase, are suspected to have acute kidney injury.[19] The levels of electrolytes in urine and specific gravity are measured. In the neonates who are being treated with diuretic condition, interpretation of test results is difficult.[20]

The calculation of excretion urinary sodium in comparison to creatinine (FENa) and blood gas analysis may be indicated; metabolic acidosis can act as marker for insufficient tissue perfusion.[21] We did not include any biochemical markers in our study and clinical condition of baby was the sole indicator of all the outcomes. Though it could be argued that babies who took longer to establish full oral feeds might have had serum potassium levels on lower side. Furthermore, future studies should include the biochemical data about fluids and electrolytes also to establish a correlation between clinical and laboratory parameters in terms of neonate's fluid and electrolytes requirement.

CONCLUSION

Early administration of potassium in intravenous fluids for new born babies significantly reduces the average hospital stay and mortality. More studies are required nation-wide to gather further evidence in order to design a uniform fluids and electrolytes management protocol for different neonatal units in the country.

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4	Syed Zulfiqar Haider	Study design, literature review, Content Analysis.	
5	Aqeela Ayub	Writing the paper.	
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