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Original Article

Paediatrics Section

Clinical Profile and Epidemiology of Neonates Presenting with Acute Gastroenteritis with Special Emphasis on Acute Kidney Injury

RAMAN SHARMA[1], VIPUL TANEJA[2], KAJAL KHAJURIA[3], RASMEEN KAUR[4], AK BHARDWAJ[5]

ABSTRACT

Introduction: Acute Gastroenteritis (AGE) is one of the most common causes of hospitalisation in children as well as neonates. According to World Health Organisation (WHO), 80% of deaths due to diarrhoea occur in first two years of life. Acute Kidney Injury (AKI) is one of the most common complications associated with gastroenteritis and dehydration. Neonates constitute major bulk of infant mortality and morbidity. The goal of this study was to identify risk factors, feeding pattern and electrolyte abnormalities in neonates presenting with AGE.

Aim: To study the clinical profile and epidemiology of neonates presenting with AGE with special emphasis on AKI.

Materials and Methods: A prospective observational study was conducted in the Neonatal Intensive Care Unit (NICU) of Department of Paediatrics between December 2019 to May 2021 at MMIMS Research and Hospital, Mullana, Ambala, Haryana, India. Ethical clearance was obtained from the ethical committee prior to the study. A total of 510 neonates were admitted during this period in NICU. Out of them 151 neonates of AGE who met the inclusion criteria were enrolled in the study. Clinical Data and lab investigations i.e., serum electrolytes and Renal Function Test (RFT) were collected and entered in pretested proforma meeting the objectives of the study. Kidney Disease Improving Global Outcome (KDIGO) was used to diagnose AKI.

Results: In this study, out of the 151 patients of AGE, 56 (37.09%) patients developed AKI. Hyperkalaemia in 85 (56.29%) patients was the most common electrolyte abnormality followed by hypernatremia 35 (23.18%). Hyponatraemia was present in only 15 (9.9%) patients. Acidosis was present in 41 (27.15%) patients. Exclusive formula feeding was the single most modifiable risk factor for AKI.

Conclusion: It was found that feeding pattern is the most important and modifiable risk factor associated with increased incidence of AGE and AKI in neonates. Exclusive formula fed babies are more prone to AGE due to improper composition of feeds as compared to mixed feeding or exclusive breast feeding. Thus, exclusive breast feeding must be promoted. Hyperkalaemia remained the most common electrolyte abnormality in these patients.

Keywords: Diarrhoea, Electrolytes, Formula feeding, Hyperkalaemia, Renal failure

INTRODUCTION

Diarrhoea is still one of the leading causes of morbidity and mortality in children of developing countries [1-3]. About 80% of deaths due to diarrhoea occur in the first two years of life. WHO estimated that worldwide, one child dies of diarrhoea every six second [4,5]. In India, at least 1.5 million children under the age of five years die every year due to acute diarrhoea [6].

The high incidence of diarrhoeal disease in developing countries is related to under nutrition, increased vulnerability to infection, poor education, socioeconomic status and trend of bottle feeding, which plays an important role. Presence of different types of electrolyte disorder is associated with significant increase in mortality rate among children with diarrhoea [7]. AGE is an important cause of AKI in India [8]. AKI is characterised by sudden impairment of renal function resulting in retention of waste products that are normally cleared by kidney and disturbance of water and electrolyte homeostasis. There are many causes of AKI, however in case of AGE, there is decreased renal blood flow because of dehydration. This starts causing functional problems in the kidney. Neonates constitute major bulk of infant mortality and morbidity. In infants and older children, the incidence and prevalence of AKI in AGE have been studied extensively. The studies evaluating clinical profile of neonates presenting with AGE are not very common, hence this study was planned.

The aim of the present study was to assess the risk factors, feeding pattern and electrolyte abnormalities of neonates presenting with AGE and their relation with AKI.

MATERIALS AND METHODS

A hospital based, prospective observational study was conducted in the NICU of postgraduate Department of Paediatrics, Maharishi Markandeshwar Institute of Medical Sciences and Research (MMIMSR) and Hospital Mullana, Ambala. The study was conducted over a period of 18 months, from December 2019 to May 2021. The study was approved by Institutional Ethical Committee of MMIMSR, Mullana, Ambala.

Inclusion criteria: All neonates aged <1 month, presenting with loose stools and vomiting for more than 48 hours, were included in the study.

Exclusion criteria: Neonates with congenital anomalies, age >1 month and sick neonates requiring mechanical ventilation were excluded from the study.

Study Procedure

A total of 151 neonates were selected for study who satisfied all inclusion and exclusion criteria. A written informed consent was obtained from parents and the purpose of the study was explained. Detailed history was taken from the patients, who fulfilled inclusion criteria and necessary investigations were undertaken. The clinical data (signs of dehydration) and lab investigations i.e., serum electrolytes and RFT were collected at admission and then on daily basis till discharge. The final outcome was entered into a predesigned proforma. Regarding electrolyte disturbance, potassium levels below 3.5 mmol/L and above 5 mmol/L were categorised as hypokalemia and hyperkalaemia respectively. Sodium levels <135 mmol/L and 145 mmol/L were categorised as hyponatremia and hypernatremia respectively [9].

KDIGO classification was used to diagnose AKI in this study [9], according to which AKI is defined as:

1. Serum creatinine raised by ≥0.3 mg/dL from baseline within 48 hours. Or Increase in Serum creatinine to ≥1.5 times baseline within the prior 7 days.
2. Urine volume ≤0.5 mL/kg/hr for 6 hours.

STATISTICAL ANALYSIS

Data was entered into Microsoft excel sheet and was analysed by Statistical Package for the Social Sciences (SPSS) version 21.0.

RESULTS

A total of 510 neonates were admitted in NICU of our hospital during one and a half year study period. Out of them only 151 patients had AGE and were included in the study. None of them died.

The cases of AGE patients were significantly more in males (59.6%) in our study as shown in [Table/Fig-1]. According to age of neonates, AGE was more common in first week i.e., (40.4%) followed by 4th week (29.8%) then 2nd week (16.6%) and then 3rd week (13.2%) as shown in [Table/Fig-2]. According to birth weight of the neonates, it was more commonly present in babies of birthweight between 2000-2499 g as shown in [Table/Fig-3]. By analysing the feeding pattern of neonates, it was seen that the incidence of AGE was increased in neonates with exclusive formula feeding i.e., 78 (51.6%) than others who were on either mixed feeding i.e., 33 (21.9%) or exclusively breast feeding i.e., 25 (16.6%) as shown in [Table/Fig-4].

Sex	Frequency	%
Male	90	59.6%
Female	61	40.4%

[Table/Fig-1]: Shows the distribution of AGE patients according to their gender (N=151).

Age (in weeks)	Frequency	%
1st week	61	40.4%
2nd week	25	16.6%
3rd week	20	13.2%
4th week	45	29.8%

[Table/Fig-2]: Shows the distribution of AGE patients according to their age (N=151).

Birth weight (gm.)	Frequency	%
1500 to 1999	12	7.9%
2000 to 2499	74	49%
2500 to 2999	25	16.6%
>3000	40	26.5%

[Table/Fig-3]: Shows the distribution of AGE patients according to birth weight (N=151).

Types of feeding	Frequency	%
Exclusively breast feeding	25	16.6%
Breast feeding with formula feed (mix feeding)	33	21.9%
Exclusive formula bottle feed	78	51.6%
Others (cow's milk)	15	9.9%

[Table/Fig-4]: Feeding pattern of neonates with AGE (N=151).

In this study, regarding electrolytes abnormality we found that, hyperkalaemia 85 (56.29%) was the commonest electrolyte abnormality followed by hypernatremia in 35 (23.18%) patients. Hyponatremia was found in only 15 (9.93%) of patients as shown in [Table/Fig-5].

Electrolytes	Low	Normal	High
Sodium	15 (9.93%)	101 (66.89%)	35 (23.18%)
Potassium	12 (7.95%)	54 (35.76%)	85 (56.29%)

[Table/Fig-5]: Electrolyte profile of neonates with AGE (N=151).

Out of these 151 neonates presenting with AGE, 56 (37.08%) patients developed AKI, in which 33 (21.85%) patients had

serum Creatinine level >0.3 mg/dL over 48 hours and 23 (15.23%) patients had urine output <0.5 mL/kg/hr for 6 hours. Acidosis i.e., pH <7.35 was present in 41 (27.15 %) patients and 11 (7.28%) of them presented with alkalosis i.e., pH >7.45 as shown in [Table/Fig-6].

	S.creat >0.3 mg/dL for 48 hr	Urine output <0.5 mL/kg/hr for 6 hr	Acidosis (pH <7.35)	Alkalosis (pH >7.45)
No. of patients	33 (21.85%)	23 (15.23%)	41 (27.15%)	11 (7.28%)

[Table/Fig-6]: Shows AKI pattern and Acid base disturbances in neonates with AGE.

DISCUSSION

The high incidence of diarrhoeal disorders requiring patient hospitalisation confirms the immense importance of AGE with regards to public health. AGE in neonates is not given importance because of varying stool frequency in neonates [10]. Here the feeding pattern and electrolyte abnormalities of neonates presenting with loose stools and regurgitation of feeds and their direct or indirect association with AKI was studied. There was higher incidence of AGE in neonates with exclusive formula feeding as compared to mixed feeding, which was further less in exclusive breast feeding neonates. The case of AGE were significantly more in males in our study which was almost similar to Alimelu M et al., study in which 53.3% were males and 46.6% were females [11]. However, there was no gender difference in the study by Gupta N et al., [12].

In this study, hyperkalaemia (56.29%) was the commonest electrolyte abnormality however the incidence of hypernatremia (23.18%) was increased in this study as compared to a study by Chouchane S et al., which showed that hypernatremia was present in 11.51% cases of all kinds of dehydration [13]. This increased incidence of hypernatremia in this study may be attributed to formula feeding of neonates with concentrated milk and poor composition of the feeds [14]. Similar results were noted in Mahajan S et al., where it was noted that the volume depletion was the most common precipitating factors for AKI and in Jayakumar M et al., study it was found that among the medical cases of AKI, acute diarrhoeal disease was the most common [15,16]. Disorders of sodium levels among AGE cases constitute a medical emergency requiring a prompt and adequate diagnosis and management.

Acute Kidney Injury was present in 56 (37.08%) patients in this study, which was in accordance with study conducted by Prakash J et al., who noted that the main aetiological factor for AKI encountered was volume depletion secondary to gastrointestinal fluid loss (35.2%) [14]. The AKI diagnosed by abnormal Serum creatinine level was reported in 33 (21.85%) cases and AKI diagnosed by decreased urine output was present in 23 (15 %) cases.

AKI following volume depletion due to gastrointestinal fluid loss is common in India. Diarrhoeal disease are common in India due to poor socioeconomic conditions, poor access to treatment, ignorance about personal hygiene, overcrowding and climatic conditions which support the propagation of infection. Lack of health care facilities in rural areas and delay in correction of dehydration are probably responsible for AKI following AGE.

In this study, AGE was more common in neonates having exclusive formula feeding (51.6%) that was due to improper preparation of formula milk. Only 25 (16.6%) patients in our study were exclusively breast feed. Quigley MA et al., observed that compared with neonates who were not breast fed, those who were exclusively breast fed had a large and statistically significant reduction in risk for hospitalisation for diarrhoea [17]. Exclusively breast feeding is the best possible protection for the child. In our study, very few belong to this group.

Similar to present finding, a study in Bangladesh reported inadequate secretion of breast milk as a reason among 64% mothers due to which high proportion of infants were bottle fed [18]. This may be attributed to lack of awareness of detrimental effects leading to higher rates of contamination. In a study done by Kumar V et al., infants on exclusive breast feeding were associated with a significantly lower risk of diarrhoea and other infections compared with mixed or bottle feeding [19].

Limitation(s)

As it was a NICU based study, incidence and prevalence of AKI could not be applied to general population. Only sick patients are admitted to NICU who are expected to be more serious as compared to patients managed on community level. The definition of AGE is not well defined in neonates as compared to older children. As a result many of patients with AGE may not be included in study.

CONCLUSION(S)

In this study, there was increased incidence of diarrhoea in neonates presenting with exclusive formula feeding as compared to mixed feeding. Educating the family about proper preparation of formula milk can reduce the burden of diarrhoea in nursery. Exclusive breast feeding must be promoted. AKI following AGE is not uncommon in developing countries like ours. As supported by other studies, hyperkalaemia remained most common electrolyte abnormality in AGE. However, increased incidence of hypernatremia in this study further elaborates the role of feeding pattern in this area. Hypernatremic dehydration develops more commonly in neonates fed with improper preparation of formula milk. Therefore, general improvement in standards of living, promotion of health awareness, exclusive breast feeding, female literacy, health education will go a long way in reducing morbidity and mortality associated with AGE.

More studies are warranted to evaluate the risk of AKI in neonates at community level. Feeding pattern in neonates with AKI needs further studies at both hospitals as well as community level.

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PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Paediatrics, MMIMS&R, Mullana, Ambala, Haryana, India.
2. Assistant Professor, Department of Paediatrics, MMIMS&R, Mullana, Ambala, Haryana, India.
3. Senior Resident, Department of Immunohaematology and Blood Transfusion, MMIMS&R, Mullana, Ambala, Haryana, India.
4. Senior Resident, Department of Anaesthesia, MMIMS&R, Mullana, Ambala, Haryana, India.
5. Professor and Head, Department of Paediatrics, MMIMS&R, Mullana, Ambala, Haryana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Raman Sharma,
H1 Flat, H Block, MMIMS&R, Mullana, Ambala, Haryana, India.
E-mail: ramanmagotra21@gmail.com

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