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Study of outcome of patients with acute kidney injury following acute gastroenteritis

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Abstract

Background: Acute kidney injury (AKI), formerly called acute renal failure (ARF), is commonly defined as an abrupt decline in renal function, clinically manifesting as a reversible acute increase in nitrogen waste products—measured by blood urea nitrogen (BUN) and serum creatinine levels—over the course of hours to weeks.. It is one of the common and dramatic syndromes encountered in clinical practice. Gastroenteritis is inflammation of stomach and small intestine producing nausea, vomiting and diarrhea.

Methods: This was a Descriptive study conducted after getting the approval from the hospital ethical management committee after giving details about the study. This study was conducted on 200 patients who were diagnosed with Acute Kidney Injury (AKI) following Acute Gastroenteritis fulfilling inclusion and exclusion criteria, admitted at MGM Medical college & LSK Hospital, kishanganj, Bihar during the period of December 2019 to November 2020. All patients of either sex diagnosed as having acute kidney injury due to gastroenteritis and Presence of clinical manifestations of gastroenteritis were taken for the study. Patients were categorized into Pre-Renal group and ATN group. Detailed history and clinical profile was recorded in these patients. Duration of GE and time period elapsed between GE and development of Acute Renal Failure was recorded. Laboratory parameters such as CBC, Renal function tests, Serum electrolytes, Urine Examination and Stool Examination were done at the time of admission. The clinical and laboratory parameters were analyzed to assess the role of each of these factors as possible outcome (Recovery or Death)

Results: The commonest type of renal Injury in our study was acute tubular necrosis 54% and followed by pre renal azotemia 46%. Out of 200 patients 82% survived and 18% expired. 128 patients had diarrhoea less than 5 days with 43.75% in Pre renal and 56.25% in ATN Group and in 72 patients it was > 5 days with 50% in Pre renal and 50% in ATN group. The Range of Urine output was from 0 to 1300ml with an average of 415.7 ± 314.80. 30% had moderate dehydration. The mean interval between onset of GE and development of AKI was 3.14 ± 2.25 days. The mean peak creatinine was 5.478±3.58 with 4.503±3.54 in pre renal and 6.309±3.43 in ATN group. At admission the urea levels ranged between 30 to 401 mg/dl with mean of 150.51±95.68. The Mean peak urea level was 166.24±96.14.

Conclusions: Gastroenteritis was one of the leading causes of AKI. Male preponderance was noted. The highest incidence of disease was seen during April to August coinciding with the period of peak incidence of gastroenteritis in tropics. Morbidity was more in patients with higher creatinine levels than those with lower creatinine levels. Hypokalemia is important electrolyte disturbance in ARF due to gastroenteritis. Urinary output and septicemia can be considered as the important prognostic factors for the disease with septicemia being the main cause of death.

Keywords: acute kidney injury (ARF), gastroenteritis, acute tubular necrosis, pre-renal azotemia

Introduction

Acute kidney injury (AKI) is generally defined as a sudden decline in renal function over hours or days.

AKI is a common medical condition affecting up to 15% of emergency hospital admissions and the mortality associated with severe AKI can be up to 30-40%. A decline in renal function can lead to dysregulation of fluid balance, acid-base homeostasis and electrolytes.

A number of different staging systems have been proposed to help grade the severity of AKI including the 'RIFLE' criteria, 'AKIN' criteria and more recently the 'Kidney Disease: Improving Global Outcomes' (KDIGO) criteria.

Based on the KDIGO criteria, an AKI is defined by one of the following parameters:

- An increase in serum creatinine by ≥ 26.5 micromol/L within 48 hours
- An increase in serum creatinine to ≥ 1.5 times baseline within 7 days
- Urine output < 0.5 mL/kg/hr for six hours.

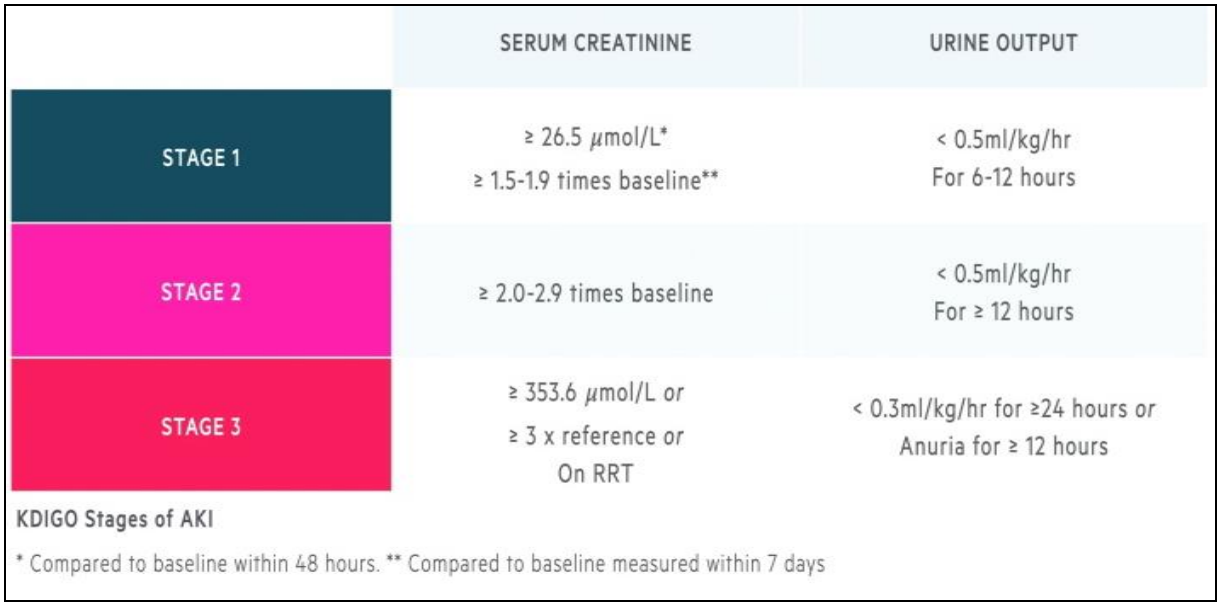

Fig 1

Acute renal failure occurs in response to a wide range of insults to kidney, some overt and obvious such as septic shock, others covert and subtle such as drug toxicity[1]. Acute Kidney Injury (AKI) complicates 5-7% of acute care hospital admissions and up to 30% of admissions to intensive care unit[2]. AKI may be due to hypoperfusion of kidneys (pre-renal azotemia), disease directly involving kidney itself (renal azotemia) or diseases associated with urinary tract obstruction (post renal).

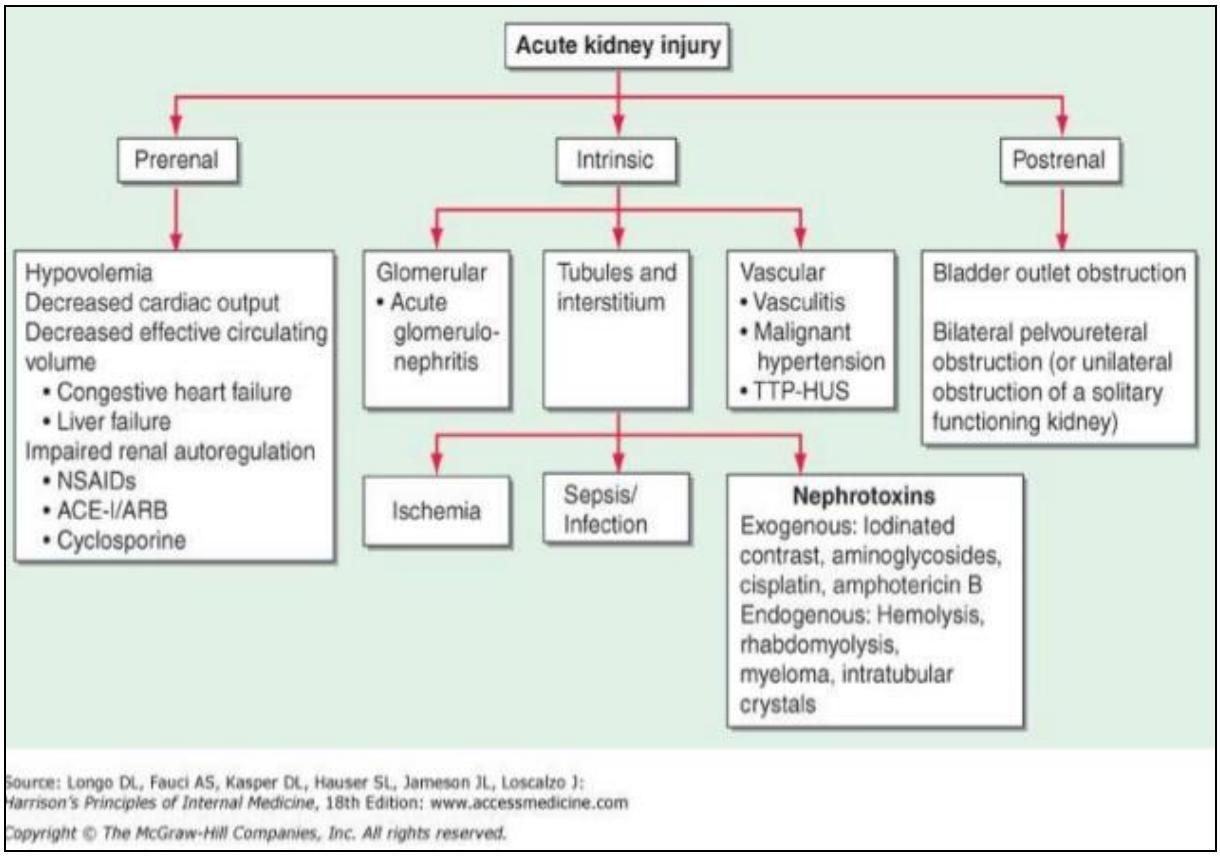

Fig 2

The pattern of acute renal failure in tropics is slightly different from that of developed countries. Poor socioeconomic conditions, prevalence of tropical infections and poor obstetrical care in rural areas exercise significant influence in determining the pattern of disease in tropics. Reduced intravascular volume in patients with viral gastro enteritis, bacillary dysentery, cholera and food poisoning are amongst leading causes of AKI in tropics[3]. As diarrhea is one of the common causes of AKI in tropics, this study was conducted to evaluate clinical and biochemical aspects and outcome of AKI due to gastroenteritis.

This Study was carried out with the following Objectives

1. To assess the clinical profile, laboratory parameters and their correlation with clinical outcome in patients with acute kidney injury (AKI) following Acute Gastroenteritis.
2. To evaluate outcome of prompt rehydration and treatment in patient presenting with acute kidney injury (AKI) following Acute Gastroenteritis.
3. To find out the poor prognostic factor in patients with acute kidney injury (AKI) following acute gastroenteritis.

Methods

This was a Descriptive study conducted after getting the approval from the hospital ethical management committee after giving details about the study. This study was conducted on 200 patients who were diagnosed with Acute Kidney Injury (AKI) following Acute Gastroenteritis fulfilling inclusion and exclusion criteria, admitted at MGM Medical college & LSK Hospital, kishanganj, Bihar during the period of December 2019 to November 2020.

Inclusion Criteria

1. All patients above 18 years of age diagnosed to have acute kidney injury (AKI) due to Acute Gastroenteritis. (I.e. Progressive Increase in Serum Creatinine by 0.3mg/dl (26.5 mmol/l) within 48 hours; or
2. Increase in Serum Creatinine to 1.5 times baseline in <7 days; or decrease in Urine volume 0.5ml/kg/h for 6 hours)

Exclusion Criteria

1. All patients diagnosed as acute kidney injury (AKI) due to causes other than Gastroenteritis.
2. Patients with Chronic Kidney Disease (CKD) presenting with Acute Gastroenteritis.

Data Collection

A detailed history, clinical and laboratory data of these patients at admission and then on daily basis was recorded as per the Performa. The duration of gastroenteritis and the time period elapsed between onset of GE and development of renal failure was recorded.The hydration status at time of admission was recorded.

Blood urea, serum creatinine and electrolytes (sodium and potassium) were done daily and recorded. Other laboratory parameters such as CBC, ESR, Urine examination Stool Examination including Hanging drop, HIV, Blood glucose, Total leukocyte count and differential count, erythrocyte sedimentation rate, liver function test (serum bilirubin, total serum protein, serum albumin, SGOT,SGPT, ALP) were also done.

Results

The commonest type of renal failure in our study was Acute Tubular Necrosis 54% followed by Pre-Renal Azotemia 46%.Out of 200 patients prospectively studied 164 patients (82%) survived. All other 36 patients (18%) who expired belong to ATN group.

Out of 200 patients 124 (62 percent) were Males and 76 (38 percent) were Females. The age of these 200 patients ranged from 21 to 99 years with mean age of 48.05±15.720. The age of presentation was over 40 years in 132 (66%) patients and less than 40 years in the remaining 68 patients (34%). The maximum number of patients belonged to age group between 51 to 60 years of age.

Table 1

Age Group	Sex		Total
	Male	Female	
18-30	24	6	30(15%)
31-40	28	10	38(19%)
41-50	28	18	46(23%)
51-60	24	28	52(26%)
>60	20	14	34(17%)

128 patients had diarrhea of less than 5 days prior to development of ARF and in 72 patients it was ≥ 5 days, majority of survivors (104 out of 200) had diarrhea for less than 5 days.

32 patients presented with Anuria. Oliguria was observed in 148 patients. No Oliguria was seen in 20 patients. All the patients who died belonged to anuria and oliguria group.

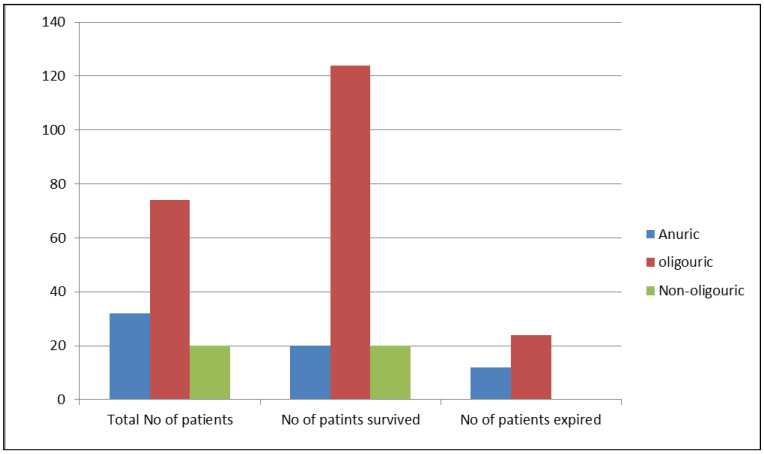

Fig 3

Majority of patients 60 (30%) had moderate dehydration. 52 (26%) patients had mild dehydration and in 26 (13%) patients it was severe. Fluid overload was observed in 36 (18%) patients and there was no dehydration in 26 (13%) patients. Majority of non survivors belong to group of severe dehydration.

Other manifestations at the time of admission included**:** Fever in 32 (16%) patients, followed by abdominal pain in 16 (8%) patients, altered sensorium 8 (4%), paralytic ileus in 4 (2%) patients.

The mean interval between onset of GE and development of ARF was 3.14 ± 2.25 days.

It was 3.09±2.234in survivors and 3.39±2.404in non survivors. In pre-renal it was 3.30±2.269, and ATN was 3.00±2.257.

Baseline creatinine or Creatinine at the time of admission ranged from 1.2 to 20 mg/dl with average of 4.706±3.32. It was 3.853±3.21 in pre-renal and in ATN group it was 5.431±3.25.The mean peak creatinine was 5.478±3.58 with 4.503±3.54 in pre renal and 6.309±3.43 in ATN group. The Mean creatinine at the time of discharge was 2.329±1.99. The mean peak was 5.717±2.04 in non survivors.

Table 2: Mean Creatinine Levels -Baseline, Peak and Time of Discharge

Creatinine(Mean)	Overall Patients	Pre-renal	ATN	Survivors	Non-Survivors
Base Line	4.706±3.32	3.853±3.21	5.431±3.25	4.352±3.29	6.317±3.00
Peak	5.478±3.58	4.503±3.54	6.309±3.43	4.975±3.47	7.772±3.24
At time of discharge	2.329±1.99	1.691±1.06	2.872±2.39	1.585±0.91	5.717±2.04

At admission the urea levels ranged between 30 to 401 mg/dl with mean of 150.51±95.68. The Mean peak urea level was 166.24±96.14. The mean urea level at the time of discharge was 81.89±61.92. The mean baseline urea level in survivors was 134.75±88.79 and in non survivors was 222.32±95.35.

54 patients (27%) had hyponatremia (<125meq/l) at the time of admission. During hospital course 36 more patients developed hyponatremia. Overall 90 (45%) patients had hyponatremia. 56 (28%) patients had hypernatremia (>145 meq/L), 6 at the time of admission and rest during the course of the hospital stay.

Serum potassium ranged from 1.9meq/l to 6.2meq/l. The mean potassium at the time of admission was 4.251±0.744. In survivors it was 4.296±0.77 where as in non survivors it was 4.044±0.53. 160 patients (80%) had hypokalemia out of them 12 had patients had at the time of admission. Hyperkalemia (>5 meq/dl) was observed in 66 (33%) patients. 46 out of them presented at the time of admission. All non survivors had hypokalemia.

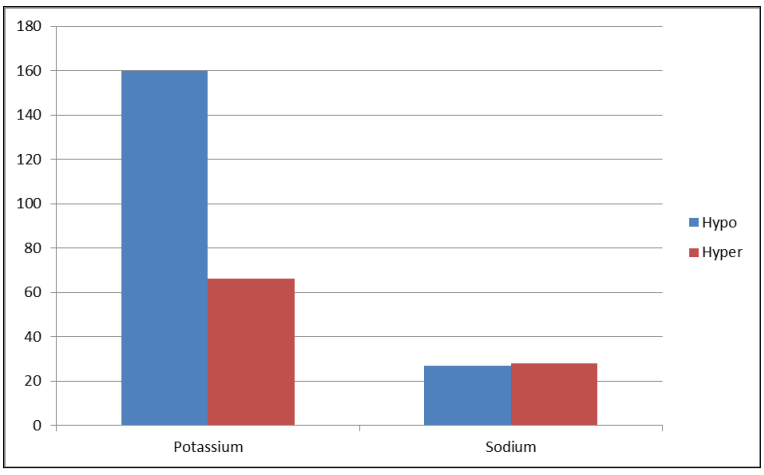

Fig 4

Anemia (Hb <10 gm %) was seen in 48 patients and 16 of the patients expired.None of the patients was positive for HIV. Hanging drop examination for V cholera was negative in all patients. No specimen showed either cyst of ova.
Pneumonia was seen in 20 (10%) patients, pulmonary Edema in 8(4%) patients. Pleural effusion was observed in 16 (8%) patients.
40 patients of ATN group improved with conservative management. 68 patients of ATN group required hemodialysis. All the 92 patients of Pre-renal group responded to conservative management and none of the patients required hemodialysis.
Out of 164 patients who survived 132 patients improved with conservative treatment, whereas 32 patients required hemodialysis. All the 36 patients who died, died in spite of hemodialysis.
Out of 36 patients, 24 died due to septicemia and 12 patients due to Multi organ failure and they all belonged to ATN group.

Discussion
Gastroenteritis was a cause of ARF in 200 patients prospectively studied. All cases were community acquired.
The incidence of ARF due to gastroenteritis is slightly more in males than females (62% v/s 38.
Some studies implicated age per se as one of the predictors for outcome in ARF but others established that age per se is not predictor of ARF. Mortality was higher in males (20 out of 36patients) in our study, in contrast with other studies[4], where the mortality was similar in both sexes. Similarly there was no significant difference in mean age of pre-renal group v/s ATN group.
Majority of patients (64%) had diarrhoea of less than 5 days prior to development of ARF. Majority of the survivors (63.4%) had diarrhoea of less than 5 days.Sustained hypovolemia is usually a cause of development of ATN in gastroenteritis, the duration of hypovolemia could not be estimated.However, on the basis that the development of ARF with short duration of gastroenteritis the mechanism other than sustained hypovolemia could be responsible.
The most common presentation in our study was oliguria (74%) followed by Anuria (16%). Anderson *et al* [5]. reported that compared to oliguric renal failure, non-oliguric renal failure is characterized by less fluid overload and lower mortality (25% v/s 50%). In our study patients with non-oliguric renal failure were only 20 and all of them survived.
The fact that 12 of 32 anuric patients v/s 24 of 148 oliguric patients died indicates that the urinary output can be considered as one of the prognostic factors for ARF due to gastroenteritis.
Severity of dehydration alone is not a determinant factor of outcome in ARF due to gastroenteritis in our study.
Persistent hypotension is associated with poor outcome of ARF was observed in our study. All patients with hypotension due to hypovolemia recovered. 24 patients died due to hypotension due to septic shock. Hence septic shock per se was one of the main predictor of outcome of ARF due to GE.
The interval between the onset of gastroenteritis and development of ARF was nearly equal in pre-renal and ATN groups and no statistical difference was seen.
The baseline and peak creatinine values of ATN group were higher than that of pre-renal group. It reflects higher morbidity in patients with higher creatinine level. This is true with study of Kaufman *et al* [6] The peak urea level was also not associated with higher mortality.
Hyponatremia is a common complication of ARF due to absolute or relative increase in free water intake and loss of sodium from the body through vomiting and diarrhoea.
Hypokalemia is a minor and unusual complication during recovery phase of ATN. But in our study 80% of the patients had hypokalemia and in 11% of the patients it was severe. All patients who expired were associated with hypokalemia. Hyperkalemia, a common complication of ATN was seen in 75% of patients in the study conducted by Minuty *et al*. [7] whereas it was only 33% in our study. It can be concluded that hypokalemia is a major complication than hyperkalemia in patients of ARF due to gastroenteritis.
Infectious complications are leading causes of death. In study conducted by Frankel *et al* [8] it was 30%. In our study most sites of infection were UTI (22%), lungs (10%) and septicemia was observed in 28% patients.
Presence of oliguria, sustained hypotension, infection was associated with significantly higher mortality despite the etiology [1]. In our study oliguria, sustained hypotension and coma were significantly associated with higher mortality.
Overall mortality in our study was 18%, most of them belonged to ATN group
Septicemia was the main cause of death in Beaman *et al*5[09] study group. In our study the sepsis was the cause in 24 cases.

Conclusions
The conclusion drawn from the study is that Gastroenteritis is one of the leading causes of ARF. Male patients are more affected compared to Females as males are more commonly exposed to contaminated food and poor sanitary conditions during their course of occupation. The highest incidence of ARF following gastroenteritis is seen during late months of summer and early months of the rainy season in tropics.
The fact that deaths included only anuric and oliguric patients indicate that the urinary output can be considered as one of the prognostic factors for ARF due to gastroenteritis. It can also be concluded that compared to oliguric

renal failure, non-oliguric renal failure is characterized by lower mortality. Severity of dehydration alone is not a determinant factor of outcome in ARF due to gastroenteritis.

Hyponatremia is a common complication of ARF due to absolute or relative increase in free water intake and loss of sodium from the body through vomiting and diarrhoea. 80% of the patients had hypokalemia. All patients who expired were associated with hypokalemia. Hence hypokalemia is an important electrolyte disturbance in ARF due to gastroenteritis.

In the study septicemiawas observed in 28% patients. 24 out of 56 patients with septicemia expired. Patients who died due to septicemia also had hypotension. Hence it can be inferred that though the underlying cause of ARF is gastroenteritis, septic shock per se is one of the main predictor of outcome of ARF due to gastroenteritis and also that persistent hypotension and septicemia is associated with poor outcome of ARF. We can also conclude that septicemia is main cause of death in ARF due to gastroenteritis.

Sustained hypovolemia is usually a cause of development of ATN in gastroenteritis. All of the patients who died belonged to ATN group. It is similar to previous studies and hence it can be concluded that ATN is associated with poor outcome. But, ARF due to gastroenteritis definitely has lower mortality compared to ARF due to other causes.

Some studies implicated age per se as one of the predictors for outcome in ARF. The. However, it is not possible to conclude whether age, sex andinterval between the onset of gastroenteritis and development of ARF are independent predictors in outcome of ARF from our study as it included only a small number of patients belonging to restricted age group. Study of more number of patients is required.

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