Outcomes of Acute Kidney Injury in Patients Requiring Dialysis in a Tertiary Care Hospital of a Developing Country

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Acute kidney injury (AKI) requiring dialysis (AKI-D) is an important health care burden and is associated with very high in-hospital mortality. Timely initiation of dialysis in AKI is fundamental to achieve treatment goals and to provide solute clearance and removal of excess fluid while awaiting the recovery of kidney function. The primary outcome of interest of the study was recovery of sufficient kidney function to discontinue haemodialysis therapy and complete recovery of renal function. This prospective observational study has been conducted in Mymensingh Medical College Hospital, Bangladesh from September 2019 to February 2021. All adult patients with AKI-D were included in the study. All patients were followed up till death or complete recovery or for a maximum period of six month. A total of 134 patients of AKI-D were included in the study with the mean age of 42.3±15.7 years. Male (54.5%) were slightly more than female with a male to female ratio of 1.2:1. Diabetes and hypertension were present in 16 (11.9%) and 47 (35.1%) patients respectively. The causes of AKI were sepsis (35.1%), urinary tract infection (34.3%), acute watery diarrhoea (9.7%), leptospirosis (11.2%), obstetric (10.4%), malignancy (8.2%), post renal obstruction (8.2%), drugs (7.5%), surgery (18.7%), rapidly progressive glomerulonephritis (6%), COVID 19 (5.2%), rhabdomyolysis (4.5%), intestinal obstruction (3.7%), acute gastroenteritis (2.2%), wasp bite (2.2%), insecticide poisoning (1.5%), star fruit toxicity (1.5%), haemolytic uremic syndrome (0.7%) and unknown (1.5%). Mean number of dialysis requirement was 5.9±8.6 and length of hospital stay was 15.4±10.5 days. Out of 134 patients, 95(70.9%) were discharged from hospital and 39(29.1%) died in hospital. Total death of patients during the study period were 49(36.6%) including home death of 10(7.5%) patients. Complete recovery of kidney function was achieved in 70(52.2%) patients and partial recoveries of kidney function who can survive without dialysis were observed in 12(9%) patients. Three (2.2%) patients remain on dialysis and 85(63.4%) patients survived during the study period. Survival rate was significantly higher in patients with ≤40 years (72.6%) and significantly lower in patients with malignancy (18.2%) and post renal obstruction (27.3%). Outcomes of patients with AKI-D remain poor. Advanced stage of AKI, older age, late presentation, malignancy, nutritional deficiency and delay at initiation of dialysis were associated with high mortality and reduced survival.

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Key words: Acute kidney injury, Dialysis, Outcomes

Introduction

Acute kidney injury (AKI) is a common cause of hospitalization and remains as an important health care burden, as it is associated with high morbidity and mortality[1,2,3]. The global burden of AKI is estimated at 13.3 million cases per year, with 85.0% from developing countries[4,5]. AKI has been defined by the kidney disease- Improving Global Outcomes (KDIGO) clinical practice guidelines for AKI by any of the following: (a) An increase in serum creatinine by ≥0.3 mg/dl within 48 hours, (b) an increase in serum creatinine to 1.5 times from baseline within the prior 7 days, or (c) an urine volume of less than 0.5 ml/kg/hour for 6 hours[6]. Severe AKI requiring dialysis (AKI-D) is one of the most ominous clinical complications, associated with in-hospital mortality rates exceeding 40.0%[7].

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AKI may result from many causes (e.g. ischemia, nephrotoxins, sepsis, obstruction etc.) and is associated with immune dysfunction, sepsis, and multi organ dysfunction, which may lead to poor and often catastrophic outcomes. Possible outcomes for patients with AKI include death, complete recovery of renal function, development of progressive chronic kidney disease (CKD) or irreversible loss of renal function leading to end-stage renal disease (ESRD)[2]. Outcome of patients with AKI is very poor in developing countries with an overall mortality of 32.0% in adults. This mortality increases with the severity of AKI which is estimated at 50.0-60.0% amongst patients requiring renal replacement therapy (RRT) and to 82% in whom dialysis is required but could not receive it. Residual renal impairment is prevalent in ~30.0% of the survivors with 12.5% still need to continue dialysis at hospital discharge. Shorter periods of dialysis requirement, non-oliguria and better baseline renal function prior to the insult are reported to be associated with better outcome[8]. Recovery of kidney function may occur during the initial period of hospitalization or in the outpatient setting after discharge from hospital[9]. According to Hickson et al., recovery of enough kidney function in most of the patients to discontinue the dialysis treatment did so by 3 months (73.0%) and 6 months (94.0%) after RRT initiation. Recovery of kidney function in the remainder of the patients was achieved by 12 months[2,10]. The need for meticulous oversight of the medical management of patients with AKI is very important in whom continuation of outpatient dialysis is required. Often medications need to be adjusted according to the change of blood pressure, volume status, and GFR. Residual kidney function, serum electrolytes, and urine output should be monitored and recorded in every week and dialysis prescription should avoid excessive ultrafiltration and episodes of hypotension. Beyond 6 months, recovery is less likely in the study by Hickson et al. and recovery of kidney function was achieved only in 6.0% of patients after this time period[2,10]. As there is no effective specific pharmacologic therapy to delay the progression of AKI or to speed up recovery of renal function, the management of these patients remains supportive, with optimization of fluid balance, prevention or treatment of electrolyte and acid-base disturbances, adjustment of the dose of potentially nephrotoxic medications or avoidance of secondary haemodynamic and nephrotoxic kidney injury. Timely initiation of RRT in AKI-D is fundamental to achieve treatment goals and to provide solute clearance and removal of excess body fluid while awaiting the recovery of kidney function. Emergency initiation of RRT in AKI is required in volume overload including pulmonary oedema unresponsive to diuretic therapy, refractory hyperkalaemia, acid base disturbances refractory to medical management ($p^H \leq 7.2$ or serum bicarbonate ≤ 12 mmol/l) and overt uremic manifestations, such as encephalopathy or pericarditis[11,12]. The decision to initiate RRT should be based on the clinical context of the AKI patient, presence of conditions that can be modified with RRT and trends of laboratory tests rather than single blood urea nitrogen (BUN) or creatinine thresholds alone[11]. The initiation of RRT may be deferred if underlying clinical condition shows improvement. The KDIGO clinical practice guidelines for AKI, recommend discontinuation of RRT when it is no longer required, either because recovery of intrinsic kidney function is adequate to meet patients demands or because RRT is no longer consistent with the goals of care[6,7]. Urine output was found to be the most important predictor of successful discontinuation of dialysis[11]. Standard clinical assessment and management plan (SCAMP) by Mendu et al. in 2017 recommended RRT discontinuation if urine output exceeded 500 ml/24 hours[7]. If kidney function is deemed to be inadequate after a period of RRT discontinuation, RRT may be reinstituted at the discretion of the treating physician[12]. The aim of the study was to evaluate the etiology and outcomes of all adult AKI-D patients treated with conventional intermittent haemodialysis (HD) in a nephrology unit of a tertiary care hospital in Bangladesh. The primary outcome of interest was complete recovery of renal function and/or discontinuation of RRT.

Methods

All adult patients with AKI-D in the Department of Nephrology, Mymensingh Medical College Hospital, Bangladesh from September 2019 to February 2021 were prospectively analyzed. Mymensingh medical college hospital, one of the largest government-run tertiary care hospitals in Bangladesh has 1000 beds and serves a population of 15 million inhabitants. A 24 hours nephrology

service including a ward and a separate HD unit is available in the hospital. Ethical clearance was obtained from the Institutional Review Board (IRB) of Mymensingh Medical College (Memo no.- MMC/IRB/2020/247, dated 07.05.2020) and the study objectives were described to the patient/patient's guardian and who gave consent consciously and voluntarily meeting the enrollment criteria were included in the study. During the study period, a total of 134 patients required HD and were included in the study. Patients with CKD, AKI on CKD, renal transplant or previous history of dialysis were excluded from the study. Purposive type of non probability sampling technique was used and Data were collected in a structured data collection sheet which includes demographic data, clinical and laboratory profiles at presentation and subsequently for the follow up period, as well as the indications for HD[3]. Identification of cause was sought from history, physical examination, urine analysis, haematology and biochemistry, x-ray and ultrasonography of KUB region[13]. Creatinine was measured by Jaffe's method in the hospital laboratory. HD was initiated for one or more of the following indications: presence of uraemic features, volume overload with pulmonary oedema inadequately controlled by diuretics, refractory hyperkalaemia, severe metabolic acidosis refractory to medical management, oliguria with urine volume <100 ml/day and the need for surgery. Dialysis was terminated when blood urea nitrogen or serum creatinine dropped significantly and the patient became stable with improvement of clinical condition and/or urine output increased significantly[14]. HD sessions were performed for 4-hours except for the initial HD session which lasted for only 2-3 hours to prevent disequilibrium syndrome. Double lumen central venous catheter was used for vascular access of HD and was placed in internal jugular or femoral vein. High flux polysulfone HD filter, bicarbonate buffered dialysate and standard water treatment was used. Blood flow and dialysis solution flow rates were within 150-250 ml/min and 500 ml/min, respectively and ultrafiltration volume depended on patient's haemodynamic status. All the patients were anticoagulated with unfractionated heparin based on clinical risk assessment. All patients were followed up till death or complete recovery or for a maximum period of six months. Complete recovery of renal function was defined when the patient remains alive and serum creatinine within the six months remains equal to or lower than baseline/reference value or ≤1.3 mg/dl and partial recovery of renal function was defined when the patient remains alive and the patient no longer required dialysis and serum creatinine falls below lower than the diagnosis value but not to baseline or reference value[4,15]. Data were analyzed by SPSS (Statistical Package for the Social Sciences) version 23.0 (IBM Corp.). Quantitative variables were summarized by number and percentage. Qualitative variables were summarized by mean±Standard Deviation (SD). The comparisons of quantitative and qualitative variables were made by student's t test and Chi-squared or Fisher's exact test. Two sided P value of <0.05 was considered as statistically significant. Overall survival was estimated by the Kaplan-Meier method.

Results

The mean age of the patients was 42.3±15.7 years and male (54.5%) were slightly more than female with a male to female ratio of 1.2:1. Diabetes, hypertension and malignancy were present in 11.9% (16), 35.1% (47) and 8.2% (11) of the patients respectively. Oligo-anuria and dehydration were observed in 102 (76.1%) and 90 (67.2%) patients respectively and mean urine output was 496±694 ml/day (Table I).

The causes of AKI were sepsis (35.1%), urinary tract infection (34.3%), surgery (18.7%), leptospirosis (11.2%), obstetric (10.4%), acute watery diarrhoea (9.7%), malignancy (8.2%), post renal obstruction (8.2%), drugs (7.5%), rapidly progressive glomerulonephritis (6%), Covid-19 (5.2%), rhabdomyolysis (4.5%), intestinal obstruction (3.7%), acute gastroenteritis (2.2%), wasp bite (2.2%), insecticide poisoning (1.5%), starfruit toxicity (1.5%), haemolytic uremic syndrome (0.7%) and unknown (1.5%) (Table III). Mean number of dialysis requirement was 5.9±8.6 and length of hospital stay was 15.4±10.5 days. Out of 134 patients, 95(70.9%) were discharged from hospital and 39(29.1%) died in hospital. Total death of patients during the study period were 49 (36.6%) including home death of 10(7.5%) patients. Complete recovery of kidney function was achieved in 70(52.2%) patients and partial recovery of kidney function who can survive without dialysis were observed in 12(9%) patients. 3(2.2%) patients

remain on dialysis and total survival during the study period was observed in 85(63.4%) patients. Survival rate was significantly higher in patients with ≤40 years (72.6%) and significantly lower in patients with malignancy (18.2%) and post renal obstruction (27.3%) (Table V).

Table I: Baseline clinical characteristics of the study subjects (n=134)

Variables	n (%)	Mean±SD
Age in years	-	42.3±15.7
Sex (Male)	73 (54.5)	-
DM	16 (11.9)	-
Hypertension	47 (35.1)	-
Malignancy	11 (08.2)	-
Oligo-anuria	102 (76.1)	-
Oedema	93 (69.4)	-
Dehydration	90 (67.2)	-
Urine Output (ml/day)	-	496±694

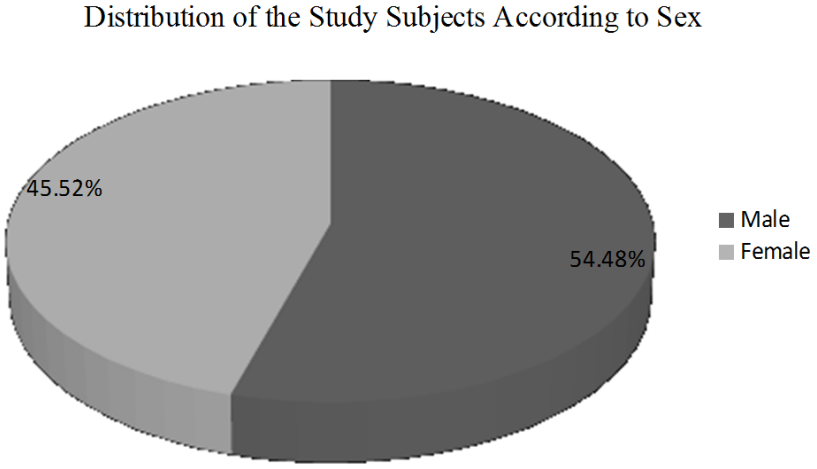

Figure 1: Distribution of the study subjects according to sex

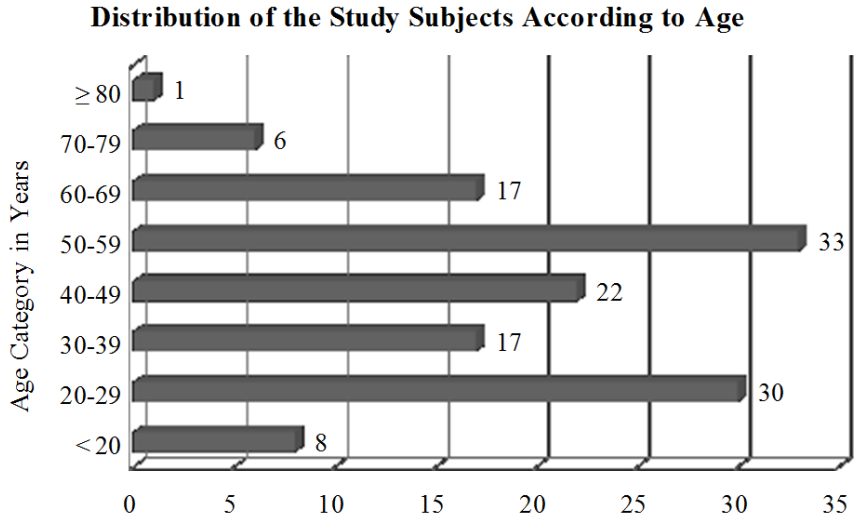

Figure 2: Distribution of the study subjects according to age

Table II: Baseline laboratory characteristics of the study subjects (n=134)

Variables	n (%)	Mean±SD
Proteinuria	82 (61.2)	-
Haematuria	30 (22.4)	-
Leucocyturia	75 (56.0)	-
Leucocytosis	97 (72.4)	-
Haemoglobin (gm/dl)	-	9.5±2.3
Blood urea (mg/dl)	-	208±60
Serum creatinine (mg/dl)	-	10.9±9.7
Hyponatraemia	68 (50.7)	-
Hypokalaemia	10 (07.5)	-
Hyperkalaemia	49 (36.6)	-
Metabolic acidosis	74 (55.2)	-

Table III: Etiology of AKI among the Participants (n=134)

Variables	Total	≤40 years	>40 years	p value
	n (%)	n (%)	n (%)	
Urinary tract infection	46 (34.3)	20 (43.5)	26 (56.5)	0.72
Sepsis	47 (35.1)	19 (40.4)	28 (59.6)	0.37
Leptospirosis	15 (11.2)	08 (53.3)	07 (46.7)	0.59
Acute gastroenteritis	03 (02.2)	01 (33.3)	02 (66.7)	1.00
Acute watery diarrhoea	13 (09.7)	05 (38.5)	8 (61.5%)	0.77
RPGN	08 (06.0)	05 (62.5)	03 (37.5)	0.47
Drugs (NSAIDs)	10 (07.5)	05 (50.0)	05 (50.0)	1.00
Insecticides poisoning	02 (01.5)	02 (100.0)	00 (00.0)	0.21
Rhabdomyolysis	06 (04.5)	05 (83.3)	01 (16.7)	0.09
Wasp bite	03 (02.2)	02 (66.7)	01 (33.3)	0.60
Starfruit toxicity	02 (01.5)	02 (100.0)	00 (00.0)	0.21
Malignancy	11 (08.2)	01 (09.1)	10 (90.9)	0.01
Post Renal obstruction	11 (08.2)	03 (27.3)	08 (72.7)	0.22
Surgery	25 (18.7)	16 (64.0)	09 (36.0)	0.07
Intestinal obstruction	05 (03.7)	04 (80.0)	01 (20.0)	0.18
HUS	01 (00.7)	00 (00.0)	01 (100.0)	1.00
Covid-19	07 (05.2)	01 (14.3)	06 (85.7)	0.12
Obstetric	14 (10.4)	14 (100.0)	00 (00.0)	0.00
Unknown	02 (01.5)	01 (50.0)	01 (50.0)	1.00
Multiple etiology	87 (64.9)	42 (48.3)	45 (51.7)	0.59

Table IV: Indication of dialysis (n=134)

Characteristics	n (%)
Uraemic encephalopathy	88 (65.7)
Acute pulmonary oedema	33 (24.6)
Metabolic acidosis	11 (08.2)
Hyperkalaemia	02 (01.5)
Urine output <100 ml	47 (35.1)
Surgery	01 (00.7)

Table V: Outcomes of AKI in the Study Subjects (n=134)

Characteristics	Total	≤40 Years	>40 Years	p value
	n (%)	n (%)	n (%)	
Number of dialysis required (Mean±SD)	5.9±8.6	7.7±11.7	4.4±3.9	0.03
Length of hospital stay (days) (Mean±SD)	15.4±10.5	17.2±12.1	13.8±8.7	0.06
Readmission	15 (11.2)	08 (53.3)	07 (46.7)	0.59
Discharged home	95 (70.9)	48 (50.5)	47 (49.5)	0.13
Death in hospital	39 (29.1)	14 (35.9)	25 (64.1)	0.13
Death at home	10 (07.5)	03 (30.0)	07 (70.0)	0.34
Total death	49 (36.6)	17 (34.7)	32 (65.3)	0.04
Complete recovery	70 (52.2)	37 (52.9)	33 (47.1)	0.12
Partial recovery	12 (09.0)	05 (41.7)	07 (58.3)	0.77
Remain on dialysis	03 (02.2)	03 (100)	00 (00.0)	0.09
Total survival	85 (63.4)	45 (52.9)	40 (47.1)	0.04

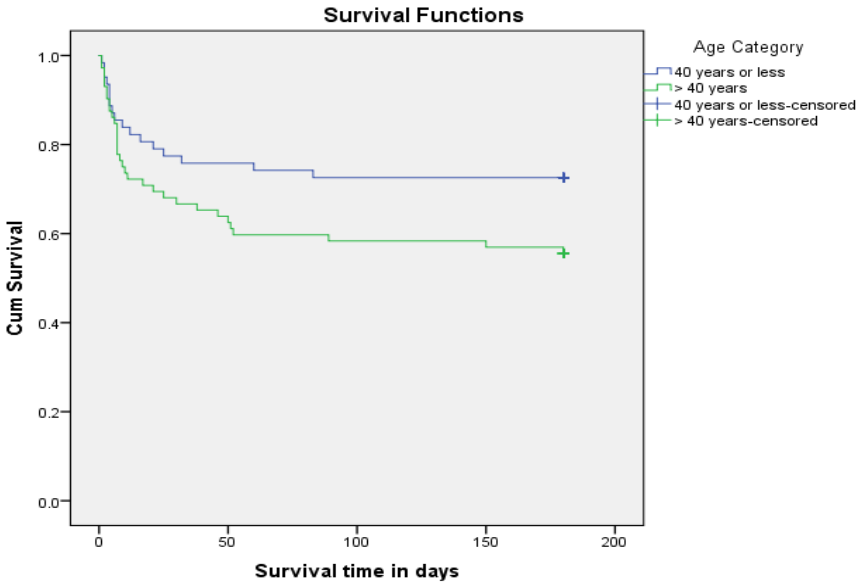

Figure 3: Kaplan-Meier survival curve in patients with AKI requiring dialysis

Mean age among survivors and non-survivors were 39.9±14.6 years and 46.6±16.8 years respectively. Duration of hospital stay were 17.3±9.3 days in survivors and 11.9±11.6 days in non-survivors and mean

haemoglobin among survivors and non-survivors were 9.8±2.5 gm/dl and 8.9±1.9 gm/dl respectively which were statistically significant. Malignancy and post renal obstruction were found more common among non survivors who were statistically significant.

Table VI: Comparison of characteristics of survivors versus non-survivors (n=134)

Characteristics	Survivors	Non-survivors	p value
Age in years (Mean±SD)	39.9±14.6	46.6±16.8	0.16
Sex Male [n (%)]	47 (64.4)	26 (35.6)	0.86
Female [n (%)]	38 (62.3)	23 (37.7)	0.86
DM [n (%)]	08 (50.0)	08 (50.0)	0.27
Hypertension [n (%)]	26 (55.3)	21 (44.7)	0.19
Oligo-anuria [n (%)]	65 (63.7)	37 (36.3)	1.00
Haemoglobin (gm/dl) (Mean±SD)	9.8±2.5	8.9±1.9	0.04
Serum creatinine (mg/dl) (Mean±SD)	10.7±8.4	11.3±11.8	0.72
Hyponatraemia [n (%)]	43 (63.2)	25 (36.8)	1.00
Hyperkalaemia [n (%)]	25 (51.0)	24 (49.0)	0.03
Urinary tract infection [n (%)]	25 (54.3)	21 (45.7)	0.13
Sepsis [n (%)]	29 (61.7)	18 (38.3)	0.85
Leptospirosis [n (%)]	12 (80.0)	03 (20.0)	0.25
Acute watery diarrhoea [n (%)]	08 (61.5)	05 (38.5)	1.00
RPGN [n (%)]	03 (37.5)	05 (62.5)	0.14
Rhabdomyolysis [n (%)]	06 (100.0)	00 (00.0)	0.08
Malignancy [n (%)]	02 (18.2)	09 (81.8)	0.02
Post renal obstruction [n (%)]	03 (27.3)	08 (72.7)	0.02
Surgery [n (%)]	19 (76.0)	06 (24.0)	0.17
Obstetric [n (%)]	11 (78.6)	03 (21.4)	0.25
Covid-19 [n (%)]	04 (57.1)	03 (42.9)	0.71
Number of dialysis required (Mean±SD)	06.5±9.8	05.1±5.9	0.37
Duration of hospital stays (Days) (Mean±SD)	17.3±9.3	11.9±11.6	0.004

Discussion

Patients with AKI were predominantly identified by non-nephrologist at the respective departments and involvement of nephrologist started after consultation was requested. This study showed that AKI-D primarily affected young adults (mean age 42.3±15.7 years) which is close to a previous study from Bangladesh where it was nearly 38 years[13]. This finding is contrary to the reports from western countries where the most frequently affected people were elderly but similar to the findings from African studies[3,16,17]. Male (54.5%) were slightly more than female with a male to female ratio of 1.2:1. Similar sex distribution with a male to female ratio of 1.2:1 was observed by Halle et al. in Cameroon[4]. Diabetes, hypertension and malignancy were present in 11.9% (16), 35.1% (47) and 8.2% (11) of the patients respectively in this study which were 17.6%, 32.2% and 9.3% respectively in the study by Halle et al.[4]. There is paucity of data till date from Bangladesh on clinical characteristics, etiologies and outcomes of patients with AKI-D. The clinical and laboratory profiles of the patients in this study were characterized by poor status with severe azotemia, uraemic encephalopathy, persistent oligo-anuria, metabolic acidosis, sepsis and anaemia. Mean serum creatinine, blood urea and haemoglobin in the current study were 10.9±9.7 mg/dl, 208±60 mg/dl and 9.5±2.3 mg/dl respectively (Table II) which were found 10.2±5.2 mg/dl, 218±135 mg/dl and 10.1±2.9 mg/dl respectively by Ibrahim et al. in Ethiopia, similar to this study[18]. In more than half (64.9%) of the

patients, the etiology of AKI-D was multi-factorial with infective etiology being the leading one. Common causes of AKI-D in this study were sepsis (35.1%), urinary tract infection (34.3%), surgery (18.7%), leptospirosis (11.2%), obstetric (10.4%), acute watery diarrhoea (9.7%), malignancy (8.2%), post renal obstruction (8.2%), drugs (7.5%), rapidly progressive glomerulonephritis (6%), Covid-19 (5.2%), rhabdomyolysis (4.5%) etc (Table III). In a previous study from Bangladesh, the most common cause of AKI-D was acute gastroenteritis (40.9%)[13] and we found gastrointestinal causes in 11.9% of patients which indicate overall improvement in the management of these patients. Sepsis was found as the most common cause of AKI-D in a study from Brazil[19]. In contrast to the developed countries, infections, hypovolaemia, obstetric complications and nephrotoxins are the major cause of AKI in the developing countries[18]. This is also reflected in this study, with the exception of postsurgical cause among the top where most of the patients had undergone caesarean section. Covid-19 was found to be an important cause in our study due to its outbreak during the study period. Mean number of dialysis requirement was found 5.9±8.6 and length of hospital stay was 15.4±10.5 days. Average number of dialysis was 4.8 and duration of hospital stay was 20.7 days by Ibrahim et al. in Ethiopia[18]. Out of 134 patients, 95(70.9%) were discharged from hospital and 39(29.1%) died in hospital. Total death of the patients during the study period was 49(36.6%) including home death of 10(7.5%) patients. Delay in initiation of dialysis either due to delayed presentation or wasting of time in providing consent by the patient's guardian was associated with higher in hospital mortality in some patients. Similar in hospital and total mortality of 29.7% and 36.7% respectively were observed in a study by Jaryal, Vikrant and Gupta in India[1]. Previous report from Bangladesh by Rashid, Hossain and Khanam showed a higher total mortality (40.0%)[13]. The mortality rate of 36.6% in this study was much lower than the data from a global meta-analysis of studies done across the globe which showed a pooled mortality rate of 49.4% for patients with AKI-D[18,20]. Interestingly, no significant difference in frequency of mortality was apparent among oligo-anuric and septic patients in our study which was not supported by Halle et al., Yashuda et al. and most other studies.[4,21] Complete recovery of kidney function was achieved in 70(52.2%) patients and partial recovery of kidney function who can survive without dialysis was observed in 12(9.0%) patients. Three (2.2%) patients remain on dialysis and total survival during the study period was observed in 85(63.4%) patients. Complete and partial recoveries were 39.0% and 14.1% respectively and 2.3% remained dialysis-dependent in a study by Jaryal, Vikrant and Gupta in India[1]. In this study, survival rate was significantly higher in patients with ≤40 years (72.6%) and significantly low in patients with malignancy (18.2%) and post renal obstruction (27.3%). All of the patients were managed on nephrology ward and there were records of treatment with inotropes in two patients without mechanical ventilation and both patients recovered completely. Duration of hospital stay was 17.3±9.3 days among survivors and 11.9±11.6 days among non-survivors which was statistically significant. This low duration of hospital stay among non-survivors can be explained by the higher in hospital mortality compared to in home mortality. Mean age among survivors and non-survivors were 39.9±14.6 years and 46.6±16.8 years respectively and mean haemoglobin among survivors and non-survivors were 9.8±2.5 gm/dl and 8.9±1.9 gm/dl respectively. The non-survivors however had a statistically significant lower haemoglobin and hyperkalaemia. Malignancy (81.8%) and post renal obstruction (72.7%) were found statistically significant among non-survivors (Table VI). Older age, lower baseline haemoglobin, malignancy and post renal obstruction were found as strong predictors of mortality in our study and consistent with a study in USA[9]. The strength of our study was its prospective nature and the data relied on the original and complete patient charts. All patients were treated by the same group of physicians in this single center study and the indication for initiation of haemodialysis was established by the same medical team over the entire study period. All patients were followed up till death or complete recovery or for a maximum period of six months. This study has several limitations. The sample size was small and specific causes of mortality especially those that may be attributable to renal versus non-renal conditions were not assessed in this study. Unfortunately, continuous renal replacement therapy (CRRT) is not available

in our center which is better tolerated in haemodynamically unstable patients and patients from ICU settings were not included in the study. Our study did not include the long term outcomes of AKI-D patients and the risk of ESRD after six months.

Conclusion

Despite advances in medical science, AKI-D is associated with high in-hospital and short term mortality with a high risk of development of CKD in those who survived. Early detection of AKI with appropriate supportive and specific treatment along with timely initiation of dialysis may reduce mortality and increase survival. Advanced stage of AKI, late presentation, older age, malignancy, nutritional deficiency and delay at initiation of dialysis are associated with high mortality and reduced survival.

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