AN OBSERVATIONAL STUDY ON SEPSIS WITH ACUTE KIDNEY INJURY

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ABSTRACT

Objective: The aim is to investigate the clinical characteristics, outcomes, and management of patients suffering from sepsis acute kidney injury.

Methodology: This prospective observational study evaluated the frequency of acute kidney injury in sepsis patients admitted to the general medicine department of a tertiary care hospital between October 2021 and March 2022. These patients underwent laboratory and radiographic examinations. The APACHE II and SOFA scores were computed in addition to the RIFLE risk, injury, and failure categories. Treatment management was closely monitored until the patients were discharged.

Results: The study included 90 people who had been diagnosed with acute kidney injury due to sepsis. Most patients (56%) are men, with an average age of 53.7. The most common primary cause of sepsis that resulted in AKI was discovered to be urogenital (41%), while 22% of people with the concomitant disease have both type 2 diabetes and hypertension. The average hospital stay was 18 days, with the longest admission lasting 25 days. The mortality rate was observed to be 23%. The use of diuretics, vasopressors, and the need for dialysis was also estimated.

Conclusion: Patients with septic AKI are more likely to be ill, have a higher risk of disease, and have more abnormalities. According to this study, age, gender, SOFA score, and APACHE II score are all independent factors in acute kidney injury; however, pre-existing comorbidities and the severity of sepsis and kidney injury were found to increase mortality.

Key words: Sepsis acute kidney injury, diuretics, vasopressors, sequential organ failure assessment score (SOFA).

INTRODUCTION

Acute kidney injury is defined as the abrupt loss of kidney function (within 48 h) caused by a rise in serum creatinine, a decrease in urine output, the requirement for dialysis, or a combination of these events [1,2]. Sepsis Acute Kidney Injury (S-AKI) is described as a sudden and typically considerable decrease in the kidney's capacity to filter blood and remove nitrogen by-products that develop within hours to days after the onset of sepsis. S-AKI is a serious consequence with a dismal prognosis that worsens sepsis. The most prevalent symptom of sepsis is severe renal injury (AKI). More than 20% of sepsis patients are anticipated to suffer immediate renal impairment, and mortality in this subgroup is likely to increase by up to 35% [3].

AKI and Sepsis have a back-and-forth interaction. While sepsis is the most common cause of acute kidney injury, persons with kidney failure are more likely to develop sepsis in the hospital [3,4]. Because of an older population and growing comorbidity conditions, sepsis is the main cause of death and morbidity. Sepsis is a multi-organ systemic inflammatory syndrome that has a cascading effect on a patient's prognosis. The most affected organs in sepsis are the lungs (18%) and kidneys (15%), and renal impairment is linked to a higher risk of death. Pathophysiological variables associated with AKI have been connected to organ dysfunction in other organs, implying that AKI is frequently accompanied by multiple organ failure syndromes [5].

As a result, we conducted a study with the objectives of analysing the clinical characteristics of sepsis acute kidney injury, exploring the severity of acute kidney injury effects on clinical outcomes of patients, and determining the management of sepsis acute kidney injury given a view of the limited information available on septic AKI and its likely significance on patient management and outcome.

Setting and design

Study protocol

This prospective observational study included all patients with sepsis acute kidney injury, admitted to the general medicine department of a tertiary care hospital in south India between October 2021 - March 2022. After obtaining approval from the institutional ethical committee and due to limited time period of 6months only a total of 90 patients were included in this study.

MATERIALS AND METHODS

Study population

A total of 90 patients, ranging in age from 20 to 90, who were diagnosed with sepsis acute renal injury, who appeared to have a total SOFA score > 2 and serum creatinine levels of > 0.3 mg/dl within 48 h, as well as urine output of 0.5 ml/kg/h for 6 h are included. Pediatrics, patients on renal replacement treatment, patients who left the hospital against medical advice or absconded during treatment procedures, and pregnant individuals were excluded.

Case definition

As per the definition of sepsis, it is "a potentially fatal organ malfunction brought on by an abnormal host response to infection." An acute and infection-related increase of at least 2 points on the sequential organ failure assessment (SOFA) score, which is connected to mortality of about 10%, can be used to detect organ dysfunction [(6)].

AKI is defined by the SSCG 2012 as an organ dysfunction variable characterized by a serum creatinine rise of more than 0.5 mg/dL. Serum creatinine, a commonly studied renal function marker in sepsis, is used to measure it. AKI is interpreted as a 0.3 mg/dL increase in blood creatinine within 48 h of the kidney disease: Improving Global Outcomes (KDIGO), and the RIFLE criteria (Risk Injury Failure Loss End-stage renal disease) have been proposed by the Acute Dialysis Quality Initiative (Risk Injury Failure Loss End-stage renal disease) (6,7,8). In this study both RIFLE and KDIGO were used to determine the creatinine levels and urine output levels and categorized according to KDIGO stages 1, 2, and 3 or Risk, Injury, and Failure according to RIFLE. This study's evaluation of RIFLE categories did not include loss of renal function and end-stage kidney disease. In the cases chosen for this investigation, sepsis was the only factor that led to AKI development; all other causes of AKI were excluded.

Data collection

Complete physiological, clinical, and demographic information was prospectively compiled. Age, sex, admission source, and admission date are all considered demographic information. The clinical and physiological information, includes the patient's past medical and surgical history, the primary diagnosis, any underlying kidney disease, comorbid conditions, pulse rate, blood pressure, blood glucose levels, oxygen saturation, serum creatinine levels, urine output levels, complete blood test, blood culture test, bilirubin, serum potassium levels, and arterial blood gas results. However, x-ray and ultrasound scans were also performed on a few patients.

Sequential Organ Failure Assessment score (SOFA) and Acute Physiology and Chronic Health Evaluation (APACHE II) scoring systems were used to determine the severity of the patient's condition and patients were categorized according to risk, injury, and failure. The management and outcome of the study were evaluated by following up on the patients until they were discharged. Management was based on the need for fluid therapy, diuretics, vasopressors, dialysis, and dialysis dependency after discharge, and outcomes were based on length of stay, death, and favourable outcome.

Statistical analysis

All observational parameters were descriptively assessed in frequency and proportions for categorical variables and mean and standard deviation for discrete variables. The Chi-square test was used to examine outcome measures such as length of stay, dialysis procedure requirement, and the number of hospital survivors and non-survivors, and a multivariate logistic regression test was performed to determine the factors of mortality. The SPSS package, version 22.0, was used to conduct the statistical analysis, and $p < 0.05$ was considered significant.

RESULTS

Data of a total of 90 patients (n=90) with septic acute kidney injury were collected as per inclusion, exclusion criteria, documents, clinical characteristics, and management and were analysed in our study. The following tables despite the inference of our study.

A total of 90 patients with a provisional diagnosis of sepsis acute kidney injury were included in this study. The majority of cases were male (56%). The male-to-female ratio was 7:1.25. The patients who were ≤ 51 years were 37.7% (n=34) and those who were ≥ 61 years were 26.6 % (n=24) and patients who were between 51 and 60 were 35.5 % (n= 32). The mean age study group was 53.74 ± 13.4 years.

Table 1: Gender-wise categorization of collected cases of sepsis acute kidney injury (n=90)

Gender	No. of cases	Percentage (%)
Male	50	56
Female	40	44
Total	90	100

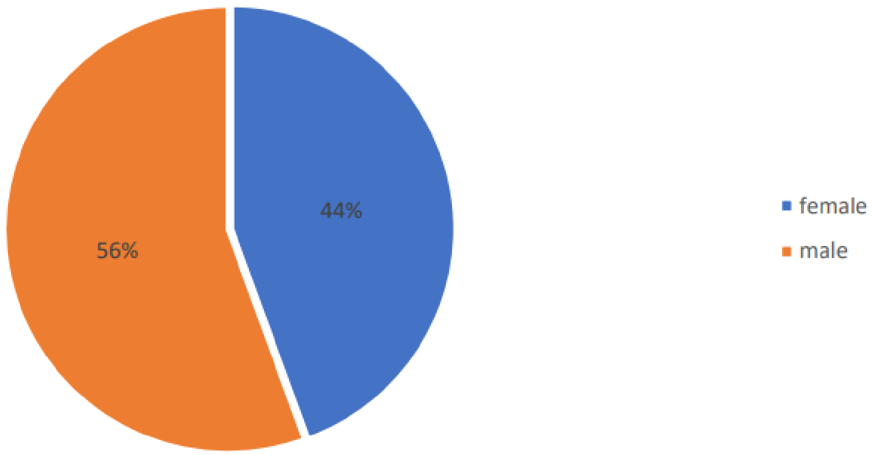

Figure 1: Gender wise distribution

Table 2: Source of sepsis (n=90)

S. No.	Source	No. of cases	Percentage (%)
1	Urogenital	37	41
2	Thoracic	18	20
3	Intra-abdominal	17	19
4	Central Nervous System	6	7
5	Skin	6	7
6	Post-Surgery	6	6
Total		**90**	**100**

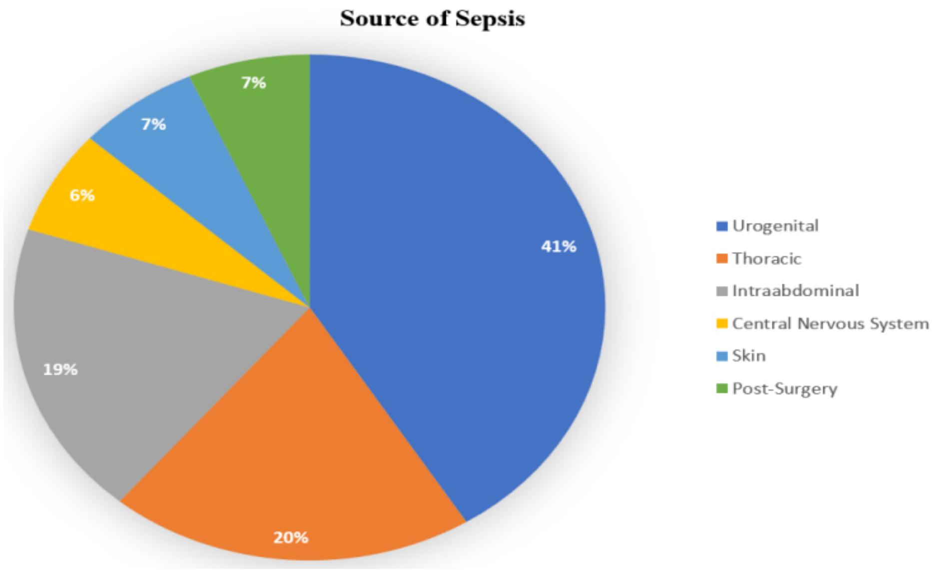

Figure 2: Source of sepsis

Among 90 cases of sepsis - AKI patients, 22% of patients have both diabetes mellitus and hypertension, 22% of them have only hypertension, 17% of them have diabetes mellitus, 19% of them have coronary artery disease and 20% have tuberculosis. Whereas, the primary source of sepsis was observed to be the urogenital source 41% (n=37), followed by the thoracic source 20 (n=18), subsequently by the intraabdominal source 19% (n=17), but however the sepsis caused due to the central nervous system and skin infections share equal proportions 7% each and the least source was observed as the post-surgery complication 6%.

A chi-square test was performed to determine the dependency of categorical variables with risk, injury, and failure of the RIFLE category or KDIGO stages 1, 2, and 3 (Table 3). From this table it can be depicted that the use of diuretics at risk, injury, and failure was observed as 7.8%, 59.4%, and 32.8% respectively with a p-value 0.001, and vasopressor usage was found to be 9.8%, 51.2%, and 39% at risk, injury, and failure stages respectively.

According to RIFLE and KDIGO criteria, 16.6 % were at the risk stage, 51.1% were at a stage of injury, and 32.2% were at the failure stage. The mean SOFA score at risk was observed to be 12.13, at an injury stage it was found to be 11.3, and in the failure stage, it was observed to be 11.8 and the mean APACHE II score was found to be 21.8 at the risk stage, 21.7 at a stage of injury, and 22.7 at the failure stage.

The percentages of the length of stay at risk were observed to be 32, at an injury stage 50.7, and at failure, it was observed to be 17.2 with a p-value of 0.049, whereas, the mean length of stay of patients at the hospital was observed to be 17.8 days with a median of 18 days and the maximum and a minimum number of days are 25 and 8 respectively.

Table 3: Baseline characteristics of renal function

		RIFLE – risk or KDIGO (Stage 1) (n=15)	RIFLE- injury or KDIGO (Stage 2) (n=46)	RIFLE - failure or KDIGO (Stage 3) (n=29)	p-value
Age (%)		15.8	49.9	34.2	0.009
Gender	**Males (%)**	12	54	34	0.0414
	Females (%)	22.5	47.5	30	
Source of sepsis	**Urogenital (%)**	16.2	56.8	27	0.618
	Thoracic (%)	11.1	55.6	33.3	
	Intra-abdominal (%)	17.6	47.1	35.3	
SOFA score (%)		17.3	49.7	32.8	0.069
APACHE II score (%)		16.4	50.3	33.2	0.409
Use of diuretics (%)		7.8	59.4	32.8	0.001
Use of vasopressors (%)		9.8	51.2	39	0.198
Use of dialysis (%)		27	40.5	32.4	0.067
Length of stay (%)		32	50.7	17.2	0.049
Mortality (%)		28.6	38.1	33.3	0.197

In terms of outcome, 23.3% (n=21) were expired, and 76.6% (n=69) are found to be recovered. Among that 76.6% of recovered patients, 26.1% (n=18) patients require long-term treatment, and data indicating a multivariate logistic regression analysis was used to assess the determinants of death in sepsis - AKI was mentioned in Table 4.

Table 4: Multivariate logistic regression analysis was used to assess the determinants of death in sepsis-AKI

	ODDS ratio	95% CI	p-value
Age	1.05	1.005-1.096	0.027
Gender	3.3	1.181-9.262	0.019
APACHE II score	1.54	1.214-1.968	< 0.001
SOFA score	1.41	1.209-1.646	<0.001
Use of vasopressor	2.57	0.894-7.412	0.044
Use of diuretics	2.03	0.718-5.786	0.176
Use of dialysis	0.42	0.158-1.151	0.088
Length of stay	0.90	0.793-1.033	0.139

DISCUSSION

Septic acute kidney injury is a frequent complication in critically ill patients and is associated with unacceptable morbidity and mortality. This study is based on the clinical characteristics, the severity of AKI, and the management of sepsis acute kidney injury.

A total of 90 cases were analysed as per inclusion and exclusion criteria. Among the 90 cases of male and female patients, male patients 50 (56%) are more affected by sepsis acute kidney injury than female patients (44%), a similar study stated by Heng-Chih Pan [(5)]. Based on the findings of this study, we observed that the age group 51-60 with an average ± standard deviation of 53.74 ± 13.4 years was adversely impacted by sepsis with Acute Kidney Injury similar study stated by José Antonio Lopes [(9)].

In concordance with previous studies, we have observed that most of the patients (72 patients) are presented with pre-existing comorbid conditions among which maximum comorbidities are found to be hypertension and diabetes mellitus (22%), hypertension (22%), diabetes mellitus (17%), diabetes mellitus and coronary artery disease (13%), hypertension and tuberculosis (11%), diabetes mellitus and tuberculosis (8%), and hypertension and coronary artery disease (7%) which is also supported by Ruchita Sharma[(10)]. Based on the findings and the data collected during the study we observe that the primary source of the septic acute kidney is the urogenital source of sepsis (41%) is found to be the most common, followed by thoracic (20%), which includes pulmonary infections, and intrabdominal (19%) where a similar study is also stated by Ruchita Sharma [(9)] and Sang Heon Suh [(11)].

In our study, we have observed that patients having pre-existing comorbid conditions like hypertension, diabetes mellitus, and coronary artery disease have decreased renal recovery rates than patients who do not have any pre-existing comorbidities which are also stated by Hoi-Ping Shum [(12)].

According to our study, the maximum length of stay was found to be 18 days whereas the highest number of days patients were admitted to the hospital was found to be 25 days and the lowest was found to be 8 days, the maximum length of stay in hospital by females was found to be 15 days than males 15 days as it was already shown in the males have the faster and higher recovery rate than females which is also supported by Glenn m. Chertow [(13)]. It is also said that the severity of acute kidney injury increases the length of stay.

In our study, we observe that initiating dialysis at the right time when the serum creatine levels are greater than 4 mg/dl decreases the mortality rate but it is also that inserting a dialysis catheter increases the sepsis condition leading to mortality in most of the patients but in the study, we observed that when dialysis has conducted the recovery rate was high than when dialysis was not conducted similar study was stated by Ankit Sakhuja [(14)] and Wei-yan Chen [(15)].

According to our study in comparison of gender and recovery rate, we have observed that males have a higher recovery rate, mortality rate, and requirement of dialysis than females which is also supported by Jiaojiao Zhou [(16)] and Sean M. Bagshaw [(17)].

Among 90 patients with sepsis AKI, a mortality rate of 21% was observed overall, which contrasted with a large-scale study by Neveu et al [(18)]. that reported an in-hospital mortality of 75% for patients with septic AKI. We also noticed that as acute renal injury and sepsis severity escalated ($p=0.197$ and $p=0.005$ respectively), mortality also increased considerably. RIFLE criteria were found to have a graded connection with unfavourable outcomes, according to a comprehensive review. It also implies that even modest renal impairment could harm the outcome.

Multiple logistic regression demonstrated that high APACHE II, SOFA score, as well as patient sex and age, were independent risk variables impacting mortality in acute kidney damage in our study. Similar findings were reported in a prior study by Ruchitha Sharma [(10)], who utilized a multivariable model to examine the impact of multiple determinants on mortality in a prospective observational cohort. And a few significant links between mortality and the use of dialysis (Odds ratio 0.42), use of diuretics (Odds Ratio 2.03), and vasopressor usage (Odds Ratio 1.95) were also observed in this study.

CONCLUSION

An observational study was carried out to document patients' clinical characteristics, management, and outcomes with septic acute kidney injury. We discovered that most critically ill patients develop acute kidney injury due to sepsis as the etiologic factor and acute kidney injury can be the major cause of mortality in sepsis patients. Septic acute kidney injury was mostly seen in people between the ages of 51 and 60, with men being more affected than women. Patients who developed AKI as a result of sepsis had more physiological and biological problems than those who did not develop AKI, and it was discovered that the severity of acute kidney injury, associated with pre-existing comorbidities, increases the length of stay in the hospital and reduces favourable outcomes by increasing the mortality rate. In most cases, diuretics, vasopressors, and antimicrobials were found to promote good outcomes. Even though the fact that septic AKI patients require RRT, they have had better results than non-septic AKI patients, and starting dialysis at the proper time may also improve the patient’s condition.

Main Points

- Sepsis can lead to multiple organ damage involving the kidney, liver, lungs, sepsis even the gastrointestinal system knowing the source of sepsis can help prevent multiple organ dysfunction.
- In sepsis kidneys are the primarily affected organs and patients were presented with increased creatinine levels and decreased urine output levels, where creatine levels were measured using the KDIGO and RIFLE scores and were used to categorize the patients accordingly to Risk or KDIGO stage 1, Injury or KDIGO stage 2, and Failure or KDIGO stage 3.
- Mortality rate was observed to be high in KDIGO stage 2 patients than in patients with stages 1 and 3.
- Having pre-existing comorbidities such as hypertension, diabetes mellitus, and cardiovascular problems have decreased the trend in renal rates compared to those who do not have any comorbidities.
- Recovery rates were found to be high when dialysis was conducted.

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