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Study of sepsis and its markers in renal failure patients on haemodialysis

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Abstract

Aim: The present study was conducted to study the presence of bacteremia, markers of sepsis and Inflammation in renal failure patients on hemodialysis.

Materials and Methods: The present study was conducted on total of 200 patients of both sexes who were diagnosed as case of renal failure which include both acute kidney injury (AKI) and CKD on basis of clinical history, examination, biochemical markers and were advised for hemodialysis were included in the study.

Results: In a study of 200 renal failure patients on haemodialysis, the mean age was 44.76±14.46 years, including 120 male patients. Out of 200 patients, 40 (20%) had positive blood and catheter tip culture and 160 (80%) had negative. Out of 40 sepsis patients 8 (20%) were 15-25, 8 (20%) were 26-35, 6 (15%) were 36-45, and 18 (45%) were above 45. All 40 (100%) patients exhibited fever with chills and rigour, 18 (45%) had redness and discomfort at the haemodialysis catheter site, 12 (30%) were confused, disoriented, or unconscious, and 8 (20%) had hypotension. None of 40 renal failure with sepsis patients had TLC less than 4.8/cumm (leucopenia), 10 (25%) had 4.8-10.8/cumm, and 30 (75%) had more than 10.8/cumm. 32 (80%) patients had positive blood cultures for S. aureus, E. coli, Acinectobacter, and Candida. From 40 renal failure patients on haemodialysis with sepsis 10 (25%) had internal jugular haemodialysis lines, 2 (5%) had subclavian lines, and 28 (70%) had femoral lines.

Conclusion: In order to limit the number of infections that occur, it is important to exercise control over patients who require haemodialysis and who have risk variables that cannot be altered, such as age, gender, and other risk factors for infection.

Keywords: Sepsis, chronic kidney disease, haemodialysis, blood stream infection

Introduction

Sepsis is defined as the dysfunction of organs caused by an unregulated response to infection. Septic shock is characterized by persistent hypotension despite adequate fluid resuscitation, the need for vasoactive drugs to maintain a mean arterial pressure (MAP) of at least 65 mmHg and an elevated plasma lactate level exceeding 2 mmol/L.Approximately 60% of individuals with sepsis get acute kidney injury (AKI) [1].

Consequently, sepsis and acute kidney injury will be commonly encountered in severely sick patients in intensive care units. Furthermore, sepsis and acute kidney injury synergistically elevate the death rate among ICU patients. No particular pharmacological treatment for sepsis and acute kidney injury is currently available in clinical practice. Chronic kidney disease (CKD), characterized by a glomerular filtration rate (GFR) of less than 60 mL/min/1.73 m^2 for a duration of three months, is on the rise globally due to the heightened incidence of obesity, diabetes, and hypertension, as well as increased life expectancy. The incidence of chronic kidney disease in intensive care units is also rising. Chronic kidney disease has recently been identified as a significant risk factor for the development of acute kidney injury and worse outcomes in sepsis. The complication of renal damage exacerbates severe illness. Enhanced care of renal damage will enhance sepsis outcomes. Epidemiology of renal injury in the intensive care unit Acute Kidney Injury (AKI) is a significant complication in critically sick patients, since it profoundly impacts outcomes, including death and healthcare expenditures [2-4].

Recently, KDIGO has established diagnostic criteria and severity stages for AKI [5]. A recent meta-analysis of 154 studies encompassing over 3,000,000 persons indicated that one in five adults and one in three children globally experienced acute kidney injury (AKI) during a hospital stay [6]. The total prevalence of acute kidney injury (AKI) in intensive care unit (ICU) patients varies between 20% and 50%. The degree of acute kidney injury was substantially correlated with death [7]. Dialysis-dependent acute kidney injury in the ICU has the greatest fatality rate. Recent data from the Nationwide Inpatient Sample indicate a fast rise in the incidence of dialysis-dependent acute kidney injury (AKI) during the previous decade in the United States [8].

The risk of infection may also be influenced by the kind of vascular access utilised for haemodialysis, practices of reuse, and the selection of membrane [9]. Patients using temporary catheters had a 50% increased risk of septicaemia compared to those with a native fistula. Catheter-related bloodstream infection (CRBSI), commonly referred to as catheter-related sepsis, is characterized by the presence of bacteraemia originating from a central intravenous catheter. It is among the most common and fatal consequences of central venous catheterisation. Nearly all HD catheters exhibited biofilm growth on their surfaces, which acts as an effective reservoir for bacteria [10].

This study aimed to investigate the presence of bacteremia, sepsis indicators, and inflammation in patients with renal failure undergoing haemodialysis.

Materials and Methods

The present study was conducted on total of 200 patients of both sexes who were diagnosed as case of renal failure which include both acute kidney injury (AKI) and CKD on basis of clinical history, examination, biochemical markers and were advised for hemodialysis were included in the study.

The kidney disease outcomes quality initiative (KDOQI) defines CKD as either kidney damage or a decreased glomerular filtration rate (GFR) of less than 60 ml/min/1.73 m2 for 3 or more months [11].

Inclusion Criteria

Patients with renal failure and a newly inserted haemodialysis catheter, subclavian venous catheter, internal jugular venous catheter, or femoral catheter who develop systemic signs and symptoms of sepsis, such as fever, chills, and rigour, tachycardia, tachypnea, hypotension, confusion, disorientation, and agitation, and patients with local swelling, redness, pain, or pus discharge at the catheter site.

Exclusion Criteria

Patients with septicaemia, post-operative renal failure, history of haemodialysis, known infection sources including diabetic foot, pyelonephritis, bedsore, or A-V fistula.

After enrolling patient, clinical history, relevant blood and radiological tests (haemoglobin, TLC, DLC, and platelet count), renal function test (RFT), serum phosphorus, C-reactive protein, liver function test (LFT), and thyroid function test (TFT) were performed. blood culture, central line catheter tip culture sensitivity, CXR P/A view, USG abdomen, and KUB were conducted. To rule out bacteremia, a peripheral vein sample was taken before catheter placement and leukocyte count and blood culture were done. The patient was excluded from the trial if positive. Second, two 5 ml blood samples were taken after 72 hours of implantation, one from the peripheral vein and one from the catheters after at least 12 hours of haemodialysis.

The laboratory subcultured Hartley's broth onto blood agar (BA) and MacConkey medium overnight at 37° C and on the 2nd, 4th, and 7th days. Negative subcultures were discarded [12]. Microbiology lab received aseptically collected mid-stream urine sample in boric acid container. A colony counter counted colonies on MacConkey agar and 5% sheep blood agar plates after streaking 0.002 ml of mid-stream urine with a standard calibrated loop for 24 hours at 37 0C under aerobic circumstances. A pure bacterial growth of ≥105 cfu/ml was considered serious bacteriuria. Repeat levels between 104-105 cfu/ml, whereas counts below 104 are deemed negative [13]. Only catheter tips from individuals who had their catheters removed after HD sessions or exhibited symptoms of infection were collected. Maki's semi-quantitative blood agar culture was followed by trypticase soy broth.

Statistical Analysis

A colony count of ≥15 was considered significant for cultures done by Maki‘s method.[12] If the same organisms grew from both peripheral and central venous catherer (CVC) blood cultures confirmation was done by the pour-plate quantitative method [14]. Association and correlation assessment were done by statistical package for the social sciences (SPSS).

Results

Table 1: Patients on hemodialysis with sepsis and gender distribution

Parameter	Renal failure patients on hemodialysis with symptoms of sepsis	
	N=200	%
Positive blood/catheter tip culture	40	20
Negative blood/catheter tip culture	160	80
Gender		
Male	120	60
Female	80	40

In our study among 200 patients of renal failure on hemodialysis the mean age in our study was 44.76±14.46 years with 120 male patients. Out of 200 patients 40 (20%) had positive blood and catheter tip culture and 160 (80%) of patients had negative blood and catheter tip culture.

Table 2: Distribution of patients according to age groups, symptoms and TLC

Age groups	N%
15-25 years	8 (20)
26-35 years	8 (20)
36-45 years	6 (15)
>45 years	18 (45)
Symptoms	
Fever with chills and rigor	40 (100)
Redness and Pain at hemodialysis catheter site	18 (45)
Confused, Disoriented or comatose	12 (30)
Hypotension	8 (20)
TLC	
Less than 4.8/cumm (leucopenia),	0
Between 4.8-10.8/cumm	10 (25)
More than 10.8/cumm	30 (75)

Out of 40 patients with sepsis 8 (20%) were in the age group between 15-25 years, 8 (20%) were in the age group between 26-35 years, 6 (15%) were in the age group 36-45 years and 18 (45%) were above 45 years of age. All 40 (100%) patients had episode of fever with chills and rigor, 18 (45%) patients had redness and pain at hemodialysis catheter site, 12 patients (30%) were confused, disoriented or comatose and 8 (20%) patients had hypotension. Among 40 patients of renal failure with sepsis, none had TLC less than 4.8/cumm (leucopenia), 10 (25%) patients had count between 4.8-10.8/cumm and 30 (75%) patients had TLC more than 10.8/cumm.

Table 3: Bacteria found on patients with sepsis

Type of bacteria	Renal failure patients on hemodialysis with sepsis	
	N=40	%
S. aureus	32	80
E. coli	4	10
Acinectobacter	2	5
Candida	2	5
Total	40	100

32 (80%) patients' blood culture was positive for S. aureus, and E. coli found in blood culture 4 (10%) patient, Acinectobacter in 2 (5%) patient and Candida in 2 (5%) patients.

Table 4: Most common catheter site associated with infection

Site of hemodialysis catheter	Renal failure patients on hemodialysis with sepsis	
	N=40	%
Internal jugular venous catheter	10	25
Femoral catheter	28	70
Subclavian catheter	2	5
Total	40	100

Among 40 patients of renal failure on hemodialysis with sepsis 10 (25%) patients had internal jugular line for hemodialysis, 2 (5%) had subclavian line and 28 (70%) had femoral line for hemodialysis.

Table 5: Distribution of patients according to catheter duration and serum phosphate and albumin levels

Catheter duration	N%
7-14 days	6 (15)
14-21 days	6 (15)
>21 days	28 (70)
Serum phosphate levels	
Less than 3.5 mg/dl	0
Between 3.5-5.5 mg/dl	8 (20)
>5.5 mg/dl	32 (80)
Serum albumin levels	
Less than 3.4 gm/dl	24 (60)
More than 3.4 gm/dl	16 (40)

Catheter duration of 7-14 days was found in 6 (15%), 6 (15%) patients had central line between 14-21 days, and 28 (70%) patients had central line >21 days. 30 patients of renal failure on hemodialysis with sepsis none had serum phosphate level less than 3.5 mg/dl, 8 (20%) had serum phosphorus level between 3.5-5.5 mg/dl and 32 (80%) patients had serum phosphorus level >5.5 mg/dl. Albumin level less than 3.4 gm/dl was found in 24 (60%) patients, 16 (40%) had serum albumin level more than 3.4 gm/dl.

Discussion

Sepsis-associated acute kidney damage (S-AKI) is a prevalent consequence in hospitalised and critically sick patients, elevating the risk of chronic comorbidities and correlating with very high fatality rates. Acute Kidney Injury (AKI) of any aetiology is correlated with an increased risk of developing sepsis.[15] The diagnosis of acute kidney injury (AKI) is now determined by an elevation in blood creatinine levels and/or a reduction in urine output [16, 17]. Similar to other types of acute kidney injury (AKI), serum creatinine may serve as an inadequate marker of renal damage, and oliguria can be vague in salt-avid acute kidney injury (S-AKI). Septicaemia is one of the most severe and life-threatening illnesses in dialysis users. Sepsis is compounded by the use of immunosuppressive medications for managing underlying conditions, exacerbated by dietary shortages, dialysis procedures, and the breakdown of cutaneous or mucosal barriers to infection [18]. It constitutes more than three-quarters of fatalities attributable to infections [19].

In our research of 200 patients with renal failure undergoing haemodialysis, the mean age was 44.76±14.46 years, comprising 120 male patients. Among 200 patients, 40 (20%) exhibited positive blood and catheter tip cultures, whereas 160 (80%) had negative results. Among 40 individuals diagnosed with sepsis Eight (20%) individuals were aged 15-25 years, eight (20%) were aged 26-35 years, six (15%) were aged 36-45 years, and eighteen (45%) were above 45 years of age. All 40 (100%) patients experienced episodes of fever accompanied by chills and rigour; 18 (45%) exhibited redness and discomfort at the haemodialysis catheter site; 12 (30%) presented with confusion, disorientation, or coma; and 8 (20%) displayed hypotension. The incidence of sepsis was higher in persons over 45 years of age. The longitudinal cohort research by Powe *et al*. demonstrated that sepsis was more prevalent in the older age demographic [20]. A 2013 research by Gupta including 45 chronic kidney disease patients revealed a 17.78% frequency of catheter-related bloodstream infections in individuals over 65 years old [21]. Our result aligns with previous research indicating that advanced age is a risk factor for CRBSI. Robinson *et al*. discovered that fever was the most prevalent symptom during the beginning of CRBSI, occurring in 28 out of 32 patients [22]. Kairaitis *et al*. conducted a study involving 105 haemodialysis catheters in 52 patients to assess patient outcomes and analyse the impact of patient and catheter factors on the incidence of infectious complications. They discovered that exit-site infection necessitated catheter removal in 8% of cases, with fever being the most prevalent clinical symptom [23].

In a cohort of 40 patients with renal failure and sepsis, none exhibited a total leukocyte count (TLC) below 4.8/cumm (leucopenia); 10 patients (25%) had counts ranging from 4.8 to 10.8/cumm, while 30 patients (75%) had TLC over 10.8/cumm. Research by Punit G including 45 chronic kidney disease patients undergoing haemodialysis found a correlation between catheter-related infections and total leukocyte count (TLC) [23]. Thirty-two (80%) patients had positive blood cultures for S. aureus, whereas Escherichia coli was identified in four (10%) patients, Acinetobacter in two (5%) patients, and Candida in two (5%) patients. Nagarika *et al*. conducted a research in 2006-2007 with 210 patients, revealing that bacteremia was seen in 17 (47.22%) patients with femoral catheters, 8 (22.22%) patients with subclavian catheters, and 11 (30.55%) patients with jugular haemodialysis catheters [24]. Among 40 individuals with renal failure undergoing haemodialysis and experiencing sepsis Ten (25%) patients had an internal jugular line for haemodialysis, two (5%) had a subclavian line, and twenty-eight (70%) had a femoral line for haemodialysis. Oliver *et al*. demonstrated that the incidence of bacteremia was 5.4% following three weeks of catheter implantation in the internal jugular vein and 10.7% after one week in the femoral vein [25].

Six patients (15%) had catheter durations of 7-14 days, six patients (15%) had central lines for 14-21 days, and twenty-eight patients (70%) had central lines for more than 21 days. Thirty individuals with renal insufficiency undergoing haemodialysis and experiencing sepsis No individuals had blood phosphate levels below 3.5 mg/dl; 8 (20%) had serum phosphorus levels ranging from 3.5 to 5.5 mg/dl, while 32 (80%) had serum phosphorus levels beyond 5.5 mg/dl. Twenty-four patients (60%) exhibited albumin levels below 3.4 gm/dl, whereas sixteen patients (40%) had blood albumin levels beyond 3.4 gm/dl. Research by Plantinga shown that elevated phosphorus levels were correlated with infections in dialysis patients, corroborating our findings.[26] We observed that hypoalbuminemia contributes to an elevated incidence of catheter-related infections, consistent with the findings of Powe *et al* [26]. He proposed that hypoalbuminemia is prevalent in catheter-related bloodstream infections.

Conclusion

The incidence of renal failure necessitating haemodialysis has risen, leading to an increasing use of vascular access for the administration of haemodialysis treatment. Patients undergoing haemodialysis are susceptible to infections due to risk factors such as advanced age, male gender, diabetes, anaemia, hypoalbuminemia, hyperphosphatemia, and extended duration of haemodialysis. The location of vascular access is a significant risk factor for the onset of sepsis. GPC (S. aureus) is the most prevalent etiological agent causing sepsis.

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