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Original Research Article

Study of Bacteremia and Sepsis in Renal Failure Patients on Hemodialysis

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Abstract

Aim: To investigate bacteraemia, sepsis and their correlation with haematological abnormalities in renal failure patients on haemodialysis.

Material & Method: The study was conducted in the Department of Medicine at GMC, Azamgarh, Uttar Pradesh, India. A total of 100 haemodialysis patients of both sexes, diagnosed with renal failure (including acute kidney injury (AKI) and chronic kidney disease (CKD)), were included. Detailed histories and examinations were conducted, followed by evaluations of complete blood count, serum electrolytes, kidney function, blood culture, urine culture, catheter tip/port culture, to assess sepsis.

Setting and Design-This study is a hospital based cross-sectional observational study conducted in Department of Medicine at GMC, Azamgarh, Uttar Pradesh, India. All haemodialysis patients of diagnosed with renal failure (including acute kidney injury (AKI) and chronic kidney disease (CKD)), were included.

Results: In our study among 100 patients of renal failure on haemodialysis the mean age in our study was 44.76±14.46 years with 65 male patients. Out of 100 patients 20 (20%) had positive blood and catheter tip culture and 80 (80%) of patients had negative blood and catheter tip culture. Out of 20 patients with sepsis 4 (20%) were in the age group between 15–25 years, 4 (20%) were in the age group between 26–35 years, 3 (15%) were in the age group 36–45 years and 9 (45%) were above 45 years of age. All 20 (100%) patients had episode of fever with chills and rigor, 9 (45%) patients had redness and pain at haemodialysis catheter site, 6 patients (30%) were confused, disoriented or comatose and 4(20%) patients had hypotension. Among 20 patients of renal failure with sepsis, none had TLC less than 4.8/cumm (leucopenia), 5 (25%) patients had count between 4.8–10.8/cumm and 15 (75%) patients had TLC more than 10.8/cumm.

Conclusion: Patients requiring haemodialysis, who are having non modifiable risk factors like age, sex other risk factors for infection should be controlled to reduce incidence of infection.

Keywords: Sepsis, Chronic kidney disease, haemodialysis, Blood stream infection

Introduction

Chronic kidney disease (CKD) is fast emerging as a major public health problem in the 21st century. The national kidney foundation disease outcomes quality initiative guidelines defined CKD as kidney damage or a glomerular filtration rate of less than 60 ml/min per 1.73 m2 for at least 3 months. [1] New classification system standardizes categories for the various stages of kidney damage. Three intermediary stages follow, with kidney failure or end-stage renal disease (ESRD), as the final stage, defined by a glomerular filtration rate of less than 15 ml/min per 1.73 m2. Haemodialysis (HD) acts wonders by improving the quality of life in patients of end stage renal disease. HD machine removes wastes from the blood stream and regulates the body‘s fluid and chemical balances. The CKD population is predisposed to adverse infectious events because of overwhelming uraemia, which is

associated with alterations in primary host defence mechanisms and increases the risk of bacterial infections. Neutrophils exhibit impaired chemotaxis, oxidative metabolism, phagocytic activity, degranulation, intracellular killing, and deregulated programmed cell death. These patients had a higher risk of contracting bacterial infections and three most commonly seen infectious complications are urinary tract infections (UTI), pneumonia, and sepsis. [2] These immunologic abnormalities are complicated by the use of immunosuppressive drugs to treat and control underlying diseases and exacerbated by nutritional deficiencies, the dialysis procedure and the disruption of cutaneous or mucosal barriers to infection. [3] The annual percentage of mortality secondary to sepsis is approximately 100 to 300 fold higher in dialysis patients. [4] Gram-negative bacteria were previously the most common cause of sepsis, in the last decade, gram-positive bacteria, most commonly staphylococci cause more than 50% of cases of sepsis. [5]

The diagnosis of AKI is currently based on an increase serum creatinine concentration and/or a decrease in urine output. [6,7] As in other forms of AKI, serum creatinine can be an insensitive indicator of kidney injury, and oliguria can be nonspecific in S-AKI. However, in sepsis, oliguria appears to carry increased significance, and even by 3 to 5 hours, an association between oliguria and AKI may be detectable. [8,9] Serum creatinine is also limited by the absence of baseline value in many patients, and a consensus is lacking as to the best way to handle this missing information. [10]

The present study was conducted to study the presence of bacteraemia, markers of sepsis and Inflammation in renal failure patients on haemodialysis, along with correlation of haematological abnormalities with sepsis in such patients.

Material & Methods

The present study was conducted in the Department of Medicine, GMC, Azamgarh, Uttar Pradesh, India for one year and total of 100 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 haemodialysis were included in the study. The criteria used for AKI in the study was risk, injury, failure, loss of kidney function, and end-stage kidney disease (RIFLE) criteria. [11] 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.[3] Criteria for the systemic inflammatory response syndrome, adapted from the American college of chest physicians/society of critical care medicine consensus conference. [12]

Inclusion Criteria:

Patients of renal failure with newly inserted haemodialysis catheter subclavian venous catheter, internal jugular venous catheter or femoral catheter who developed systemic signs and symptom of sepsis e.g. fever, chills and rigor, tachycardia, tachypnea, hypotension, confusion, disorientation, and agitation after haemodialysis catheter insertion and haemodialysis and patients with local swelling, redness, pain or pus discharge at the site of haemodialysis catheter.

Exclusion Criteria;

Those patients who had renal failure due to septicaemia or post-operative renal failure, had history of haemodialysis in past, had known source of infection e.g. diabetic foot, pyelonephritis, bedsore, or had A-V fistula.

After recruiting patient for study, clinical history and relevant blood and radiological investigation (haemoglobin, total leukocyte count (TLC), differential leukocyte count (DLC), and platelet count), renal function test (RFT) (serum creatinine, blood urea, and serum electrolyte), serum phosphorus, C-reactive protein, liver function test (LFT) (serum bilurubin, serum total protein, serum albumin, alkaline phosphatase), thyroid function test – TFT (T3, T4, and thyroid stimulating hormone-TSH), urine routine and microscopy, urine culture and sensitivity. blood culture, central line catheter tip culture sensitivity, chest X-ray (CXR) P/A view, ultrasonography (USG) abdomen and kidney, ureter and bladder (KUB) were performed. Leukocyte count and blood culture were done prior to catheter insertion and a single sample was collected from the peripheral vein before insertion of the catheter to rule out any existing bacteraemia. If positive, the patient was excluded from the study. Secondly, after 72 hours of the insertion, two 5 ml samples of blood were collected, one from the peripheral vein and the other from the catheters; the latter being collected after at least 12 hours of haemodialysis.

In the laboratory, subcultures were done from Hartley‘s broth onto blood agar (BA) and MacConkey medium after overnight incubation at 37 0C and also on the 2nd, 4th and 7th days and were then discarded, if negative. [13] Aseptically collected mid-stream urine sample in sterile bottle containing boric acid was transported to microbiology laboratory. Bacterial culture was performed by streaking 0.002 ml of mid-stream collected urine with a standard calibrated loop on MacConkey agar and 5% sheep blood agar plates which was incubated at 37 ^{0}C for 24 hours, under aerobic conditions and the colonies was counted by a colony counter. Sample that yielded pure bacterial

growth of ≥105 cfu/ml was regarded as significant bacteriuria. Counts between 104 and 105 cfu/ml repeated while counts ≤104 cfu/ml considered as negative. [14] Catheter tip was collected only from patients who had their catheters removed on completion of their HD sessions or in case they showed any signs of infection. It was cultured by Maki's standard semi quantitative method on blood agar and then put in trypticase soy broth (TSB).

Statistical Analysis

A colony count of ≥15 was considered significant for cultures done by Maki's method. [13] If the same organisms grew from both peripheral and central venous catherer (CVC) blood cultures confirmation was done by the pour-plate quantitative method. [15] Association and correlation assessment were done by statistical package for the social sciences (SPSS).

Results

Table 1: Patients on haemodialysis with sepsis and gender distribution

	Renal Failure Patients On Hemodialysis	
Parameter	**N=100**	**%**
Positive blood/ catheter tip culture	20	20
Negative blood/ catheter tip culture	80	80
Total	100	
Gender		
Male	65	65
Female	35	35

In our study among 100 patients of renal failure on haemodialysis the mean age in our study was 44.76±14.46 years with 65 male patients. Out of 100 patients 20 (20%) had positive blood and catheter tip culture and 80 (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	4 (20)
26-35 years	4 (20)
36-45 years	3 (15)
>45 years	9 (45)
Symptoms	
Fever with chills and rigor	20 (100)
Redness and Pain at haemodialysis catheter site	9 (45)
Confused, Disoriented or comatose	6 (30)
Hypotension	4 (20)
TLC	
Less than 4.8/cumm (leucopoenia),	0
Between 4.8–10.8/cumm	5 (25)
More than 10.8/cumm	15 (75)

Out of 20 patients with sepsis 4 (20%) were in the age group between 15–25 years, 4 (20%) were in the age group between 26–35 years, 3 (15%) were in the age group 36–45 years and 9 (45%) were above 45 years of age. All 20 (100%) patients had episode of fever with chills and rigor, 9 (45%) patients had redness and pain at haemodialysis catheter site, 6 patients (30%) were confused, disoriented or comatose and 4(20%) patients had hypotension. Among 20 patients of renal failure with sepsis, none had TLC less than 4.8/cumm (leucopenia), 5 (25%) patients had count between 4.8–10.8/cumm and 15 (75%) patients had TLC more than 10.8/ cumm.

Table 3: Bacteria found on patients with sepsis

	Renal failure patients on haemodialysis with sepsis	
Type of bacteria	**N=20**	**%**
S.aureus	16	80
E.coli	2	10
Acinectobacter	1	5
Candida	1	5
Total	20	100

16 (80%) patients' blood culture was positive for S. aureus, and E. coli found in blood culture 2 (10%) patient, Acinectobacter in 1 (5%) patient and Candida in 1 (5%) patient.

Table 4: Most common catheter site associated with infection

Site of hemodialysis catheter	Renal failure patients on haemodialysis with sepsis	
	N=20	%
Internal jugular venous catheter	5	25
Femoral catheter	14	70
Subclavian catheter	1	5
Total	20	100

Among 20 patients of renal failure on haemodialysis with sepsis 5 (25%) patients had internal jugular line for haemodialysis, 1 (5%) had subclavian line and 14 (70%) had femoral line for haemodialysis.

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

Catheter duration	N%
7-14 days	3 (15)
14-21 days	3 (15)
>21 days	14 (70)
Serum phosphate levels	
Less than 3.5 mg/dl	0
Between 3.5–5.5 mg/dl	4 (20)
>5.5 mg/dl	16 (80)
Serum albumin levels	
Less than 3.4 gm/dl	12 (60)
More than 3.4 gm/dl	8 (40)

Catheter duration of 7-14 days was found in 3 (15%), 3 (15%) patients had central line between 14–21 days, and 14 (70%) patients had central line >21 days.15 patients of renal failure on haemodialysis with sepsis none had serum phosphate level less than 3.5 mg/dl, 4 (20%) had serum phosphorus level between 3.5–5.5 mg/dl and 16 (80%) patients had serum phosphorus level >5.5 mg/dl. Albumin level less than 3.4 gm/dl was found in 12 (60) patients, 8 (40%) had serum albumin level more than 3.4 gm/dl.

Discussion

Sepsis-associated acute kidney injury (S-AKI) is a common complication in hospitalized and critically ill patients, which increases the risk of developing chronic co morbidities and is associated with extremely high mortality. [16-18] As individual syndromes, sepsis and acute kidney injury (AKI) render the host susceptible to each other. Although sepsis is the most common contributing factor for developing AKI, AKI of any origin is associated with higher risk of developing sepsis.5 Sepsis has a complex and unique pathophysiology, which makes S-AKI a distinct syndrome from any other phenotype of AKI. [19]

Out of 20 patients with sepsis 4 (20%) were in the age group between 15–25 years, 4 (20%) were in the age group between 26–35 years, 3 (15%) were in the age group 36–45 years and 9 (45%) were above 45 years of age. All 20 (100%) patients had episode of fever with chills and rigor, 9 (45%) patients had redness and pain at haemodialysis catheter site, 6 patients (30%) were confused, disoriented or comatose and 4(20%) patients had hypotension. We noted the incidence of sepsis was more in patients of age group greater than 45 years of age. Longitudinal cohort study conducted by Powe et al showed that sepsis was more common in older age group. [20] In 2013 a study conducted by Gupta in 45 patients of CKD showed that the prevalence of CRBSI was 17.78% in patients above 65 years of age. [21] So, our study conforms with other studies, who had shown that advanced age is risk factor for CRBSI. Robinson et al found that was fever was the most consistent symptom at onset of CRBSI (28 of 32 cases). [22] Kairaitis et al conducted a study of 105 haemodialysis catheters in 52 patients in order to identify patient outcomes and to analyse the effect of patient and catheter factors on the incidence of infectious complications, they found that exit-site infection was the cause for removal in 8% and most common clinical symptom was fever. [23]

Among 20 patients of renal failure with sepsis, none had TLC less than 4.8/cumm (leucopoenia), 5 (25%) patients had count between 4.8–10.8/cumm and 15 (75%) patients had TLC more than 10.8/cumm.A study conducted by Gupta on 45 CKD patient on haemodialysis, catheter related infections were correlated with TLC. [21] 16 (80%) patients' blood culture was positive for S. aureus, and E. coli found in blood culture 2 (10%) patient, Acinectobacter in

1 (5%) patient and Candida in 1 (5%) patient. Nagarika et al in 2006-2007 conducted a study in 210 patients and found that bacteraemia occurred in 17 (47.22%) patients with femoral catheter, 8 (22.22%) patients with subclavian catheter and 11 (30.55%) patients with jugular haemodialysis catheter. [24] Among 20 patients of renal failure on haemodialysis with sepsis 5 (25%) patients had internal jugular line for haemodialysis, 1 (5%) had subclavian line and 14 (70%) had femoral line for haemodialysis. Oliver et al had shown that incidence of bacteraemia was 5.4% after three weeks of placement in internal jugular vein and 10.7% after one week in femoral vein. [25]

Catheter duration of 7-14 days was found in 3 (15%), 3 (15%) patients had central line between 14–21 days, and 14 (70%) patients had central line >21 days.15 patients of renal failure on haemodialysis with sepsis none had serum phosphate level less than 3.5 mg/dl, 4 (20%) had serum phosphorus level between 3.5–5.5 mg/dl and 16 (80%) patients had serum phosphorus level >5.5 mg/dl. Albumin level less than 3.4 gm/dl was found in 12 (60) patients, 8 (40%) had serum albumin level more than 3.4 gm/dl. study conducted by Plantinga had shown high phosphorus level was associated with infection in dialysis patients which supports our finding too. [26] We noted hypoalbuminemia is contributing to increased risk of catheter related infection matches with studies of Powe et al. [20] He suggested hypoalbuminemia was common in catheter related blood stream infection.

Conclusion

This study highlights the significant risk of bacteraemia and sepsis in renal failure patients undergoing haemodialysis, with a 20% infection rate. Older age, particularly above 45, and prolonged catheter use were identified as key risk factors. Staphylococcus aureus was the most common pathogen, and elevated serum phosphorus levels were frequently associated with sepsis.

The findings underscore the need for rigorous infection control measures, regular screening, and patient education on infection symptoms. Addressing these risks through improved catheter management and early intervention can enhance patient outcomes. Future research should focus on targeted interventions to reduce infection rates and improve the overall care of haemodialysis patients.

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