Volume : 3 | Issue : 4 | April 2014 • ISSN No 2277 - 8160

Research Paper | Medical science

Incidence of Aerobic Bacterial Infections in Hemodialysis Patients

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ABSTRACT

Central venous catheters were a major advance in end stage renal disease patient care until the burden of catheter related complication became obvious. Vascular access is a major risk factor for bacteremia, infection related hospitalization and mortality. Material And Methods Study included all patients attending hemodialysis in Medical college hospital Vijayanagar Institute of Medical Sciences, Bellary. Study period from 1st January 2009 to 31st December 2009 or 100 cases whichever is earliest. Blood samples were collected from Central venous catheter site as well as peripheral site in patients presenting with fever attending dialysis and processed as per standard microbiology procedures. Results In the present study among 100 patients 54 had a Central venous catheter and 46 had a arterio venous fistula. Among the catheter group 35.2 % had infection and it was zero in the fistula group. Infections were higher in people who had Central venous catheter for prolonged period of time. The most common isolate was Staphylococcus aureus constituting 73.68%. Gram negative bacteria (Klebsiella and Pseudomonas) constituted 21% of the isolates. Conclusion The most common cause of Central venous catheters associated infection was Gram positive cocci. The incidence of infection rises with prolonged use of these Central venous catheters. Hence fistulas should be recommended whenever applicable. Central venous catheters need to be handled with aseptic precautions and should be changed when any signs of infection occurs.

KEYWORDS: Hemodialysis, central venous catheters, arteriovenous fistula, bacteremia

INTRODUCTION

Central venous catheters were a major advance in end stage renal disease patient care until the burden of catheter related complication became obvious.(1) Number of patients with end-stage renal disease is increasing by 9% per year. Among those undergoing hemodialysis (HD), the majority will require at least one hospitalization every year. Once hospitalized, these patient have an intrinsic susceptibility to developing a infection as a result of numerous comorbid conditions. (2)

Vascular access is a major risk factor for bacteremia, infection related hospitalization and mortality.(3) It is the leading cause of nosocomial blood stream infections.(4) Sepsis ranks second behind cardiovascular disease as the cause of death in dialysis patients.(5)

Patients with chronic kidney disease have abnormality in their immune system to fight infections. There is decreased production of immunoglobulins to specific stimuli and decreased proliferative capacity of T lymphocytes due to cellular defects.(6)

Majority of the bacteremias are caused by indwelling catheters than fistulas or synthetic graft. One of the risk factors for infection is the prolonged duration of catheter usage. Femoral catheters left in place for > 3 days are associated with increased bacteremia.(7)

Staphylococcus aureus is a leading cause of bacteremia among HD patients. Complications of Staphylococcus bacteremia include sepsis, endocarditis, osteomyelitis, septic arthritis and metastatic abscesses. (8) Infection in HD units can be prevented by better supervision, strict infection control and effective training of dialysis staff. There should be training and supervision in the implementation of sterile techniques to prevent dialysis related infections. These measures when followed reduce HD related infections and overall cost treatment of ESRD(End stage renal disease) patients.(9)

OBJECTIVES OF STUDY

1 To know the incidence of bacterial infections in hemodialysis patients.
2 Isolation of the organisms from suspected cases of septicemia in hemodialysis patients.
3 To know the antibiotic susceptibility of the isolated organism.
4 To compare the incidence of infection between patients on catheter and arteriovenous fistula

MATERIAL AND METHODS

Study included all patients attending hemodialysis in Medical college hospital Vijayanagar Institute of Medical Science, Bellary.

Study period from 1st January 2009 to 31st December 2009 or 100 cases whichever is earliest.

Inclusion criteria :

Adult and paediatric patients of both sexes who attend hemodialysis, presenting with fever.

Exclusion criteria:

Diagnosed cases of ARF(acute renal failure) secondary to septicemia after first time of dialysis.

Blood samples were collected from the patient presenting with fever following hemodialysis before administration of antimicrobial therapy. About 5ml of blood was drawn. One sample was drawn from the catheter or fistula and other sample from the peripheral vein under aseptic precautions. The samples were collected in blood culture bottles containing Brain Heart infusion broth.

The bottles were inucubated overnight at 37^{0}C. This was later subcultured onto MacConkey and Chocolate agar and incubated at 37^{0}C. The subcultures were repeated on 4th and 6th day. Organisms were identified by standard techniques

Antibotic susceptibility was carried by Kirby- Bauer disk diffusion method. Isolates were grown in peptone water by incubating at 37^{0}C and turbidity was matched with 0.5 MacFarland standards. Then lawn culture was done on Mueller Hinton agar plate and commercial antibiotic disks were placed. The plates were incubated at 37^{0}C overnight and the zones of inhibition were interpreted according to NCCLS (now CLSI) guidelines.

RESULTS

The following tables and figures illustrate the results in detail. The results obtained were analyzed.

Table:1 Distribution of study subjects based on age and type of procedure

Age group	Catheter group	Fistula group	Total
< 30 yrs	13 (24.1%)	05 (10.9%)	18 (18%)
31 – 60 yrs	32 (59.3%)	36 (78.3%)	68 (68%)
> 60 yrs	09 (16.7%)	05 (10.9%)	14 (14%)
Total	54 (100%)	46 (100%)	100 (100%)

This study included two types of patients based on the procedure i.e. catheter group and fistula group. Catheter group and Fistula group constituted 54% & 46% respectively. Comparatively patients in the age group of 31 to 60 years were more among fistula group (78.3%) than the catheter group (59.3%). Whereas patients of age less than 30 years were more in catheter group (24.1%) compared to Fistula group (10.9%).

Table:2 Distribution of study subjects based on sex and type of procedure

Sex	Catheter group	Fistula group	Total
Male	36 (66.7%)	30 (65.2%)	66 (66%)
Female	18 (33.3%)	16 (34.8%)	34 (34%)
Total	54 (100%)	46 (100%)	100 (100%)

The study subjects composed of males and females. Males and females constituted 66% & 34% respectively. There is no much difference in male & female composition between catheter and fistula group.

Table:3 Incidence of infection among the study subjects based on type of procedure*

Infection	Catheter group	Fistula group	Total
Present	19 (35.2%)	00 (00.0%)	19 (19%)
Absent	35 (64.8%)	46 (100.0%)	81 (81%)
Total	54 (100%)	46 (100%)	100 (100%)

*** Fischer exact test p value – 0.00**

Among the total study subjects, incidence of infection is 19%. Incidence of infection among catheter group is 35.2% whereas among fistula group, incidence of infection is nil and this association is found to be statistically significant.

Table:4 Incidence of infection among the study subjects of catheter group based on duration of catheter*

Duration	Infection present	Infection absent	Total
< 15 days	01 (05.7%)	02 (05.7%)	03 (05.6%)
16 – 30 days	18 (94.7%)	33 (94.3%)	51 (94.4%)
Total	19 (100%)	35 (100%)	54 (100%)

*** Fischer exact test p value – 1.00**

The incidence of infection is more with the increased duration of catheter use. The infection rate was higher when the catheter was placed for more than 15 days (94.7%).

Table :5 Number and Percentage of organisms isolated from blood culture at catheter site

ORGANISMS	NUMBER	PERCENTAGE (%)
Gram positive bacteria		
Staphylcoccus aureus	14	73.68
Coagulase negative Staphylcoccus	1	5.26
Gram negative bacteria		
Klebsiella species	2	10.52
Pseudomonas aeruginosa	2	10.52
Total	19	100

Staphylococcus aureus was isolated in 14 cases (73.68%) from catheter site. Gram negative organisms constituted 21.04% in the study. Among them Klebsiella pnuemoniae and Pseudomonas constituted 10.52% respectively

Table:6 Number and Percentage of organisms isolated from blood culture at peripheral vein

ORGANISMS	NUMBER	PERCENTAGE (%)
Gram positive bacteria		
Staphylcoccus aureus	13	76.4
Gram negative bacteria		
Klebsiella species	2	11.76
Pseudomonas aeruginosa	2	11.76
Total	17	100

Staphylococcus aureus was isolated in 13 (76.4%) from peripheral vein. Gram negative organisms constituted 23.52 % in the study. Among them Klebsiella pnuemoniae and Pseudomonas constituted 11.76% respectively.

Coagulase negative Staphylcoccus was isolated only in one case only from the catheter similarly in one patient Staphylococcus aureus was isolated only from the catheter which would most probably a colonizer.

Table:7 Antibiotic susceptibility pattern of organisms isolated from catheter site

Gram positive bacteria	Pencillin	Erythromycin	Vancomycin	Amoxyclav	Amikacin	Tetracycline	Cefoxitin	Ceftriaxone	Ciprofloxacin
Staphylococcus aureus (14)	-	-	14	10	13	2	7	7	9
Coagulase negative staphylococcus (1)	-	1	1	1	1	-	1	1	1
Gram negative bacteria	**Ampicillin**	**Amikacin**	**Amoxyclav**	**Ceftriaxone**	**Cefipime**	**Cefeperazone**	**Ciprofloxacin**	**Piperecillin**	**Imipenem**
Klebsiella spp (2)	-	2	2	1	1	1	1	1	2
Pseudomonas aeruginosa (2)	-	-	-	-	-			1	2

92.85% of Staphylococcus aureus isolated showed sensitivity to Vancomycin 100%, Amikacin, 71.42% showed sensitivity to Amoxicillin – clavulinic acid, 64.28% to Ciprofloxacin, 14.28% to Tetracycline and 50% to Ceftriaxone .

Coagulase negative staphylococci showed sensitivity to Vancomycin, Amikacin, Erythromycin, Amoxicillin – clavulinic acid, Ciprofloxacin and Ceftriaxone.

Sensitivity to Amikacin , Imepenem and Amoxicillin -clavalunic acid was 100% ,and to Ceftriaxone , Cefaperazone, Cefepime , Pipericillin and Ciprofloxacin was 50% in Klebsiella spp.

Only 50% of the isolates of Pseudomonas showed sensitivity to Piperacillin, 100% sensitivity to Imepenem and were resistant to all other antibiotics

Table: 8 Antibiotic susceptibility pattern of organisms from peripheral vein

Gram positive bacteria	Pencillin	Erythromycin	Vancomycin	Amoxyclav	Amikacin	Tetracycline	Cefoxitin	Ceftriaxone	Ciprofloxacin
Staphylococcus aureus (13)	-	-	13	10	12	2	6	6	6
Gram negative bacteria	Ampicillin	Amikacin	Amoxyclav	Ceftriaxone	Cefipime	Ciprofloxacin	Cefeperazone	Pipirecillin	Imepenem
Klebsiella spp (2)	-	2	2	1	1	1	1	1	2
Pseudomonas aeruginosa (2)	-	-	-	-	-			1	2

Antibiotic sensitivity pattern seen from isolates of peripheral vein is similar to that seen from isolates of catheter site.

Table:9 Organisms isolated from Catheter site infections (wound infection)

Organisms Total no of cases	Number 2	Percentage
Staphylococcus aureus	2	100
TOTAL	2	100

There were 2 cases of catheter site infection .*Staphylococcus aureus* was isolated in both the cases from pus.

DISCUSSION

Hemodialysis catheter related infections (HCRI) are one of the major causes of increasing mortality, morbidity and cost of therapy in hemodialysis patients. Prevention of HCRI requires the identification of predisposing risk factors. Proper vascular access is essential to hemodialysis therapy. Temporary vascular access can be established by the percutaneous insertion of a catheter into a large central vein. However, temporary catheters have many complications that include infection, which can manifest as life threatening events such as septicemia, suppurative thrombophlebitis, and endocarditis. These complications result in a considerable increase in health care costs, morbidity and mortality.

Determining risk factors of catheter associated infections may aid in its prevention and subsequently lower therapeutic cost and improve patient survival and quality of life life.(10)

Table:10 Role of Diabetes mellitus as risk factor

Studies	Year	Cases with DM
Bruno Hoen et al (11)	1994	18%
Geoffrey taylor et al (12)	1997	34.3%
Erica M C et al (2)	1997	43%
Bekir tanriover et al (13)	1998	35%
Robert N Foley et al (5)	1999	46.7%
Michele H Mokrzyche et al(14)	2000	46%
Michael Allon et al (15)	2000	50.1%
Timmy lee et al (16)	2004	61.1%
Susan Sangvi et al (17)	2004	41%
Present study	2010	45%

Risk factors in patients :

The most common risk factor associated with renal failure are hypertension and diabetes mellitus. Diabetes mellitus was seen in 45% of our cases.this is in corespondance to the study conducted by Robert N Foley et al (46.7%), Michele H Mokrzyche et al (46%) and Michael Allon et al (50.1%).

Table:11. Various studies showing incidence of blood stream infections

Studies	Year	BSI
Erica M C et al (2)	1997	28%
Robert N Foley et al (5)	1999	46%
Anil K saksena et al (18)	2000	40.6%
Michael Allon et al (15)	2000	42.4%
Zahid Nabi et al (19)	2007	19.3%
Present study	2010	17%

Blood stream infections in HD patients in the present study was 17%. similar results were observed by studies conducted by Zahid Nabi *et al* (19.3%) . higher rates of BSI were observed in some studies by Anil K Saksena *et al* (40.6%) , Michael Allon et al (42.4%) and Robert N Foley *et al* (46%).

Bacteremia in HD patients occurs by 4 routes

(i) Movement of the organism from the catheter skin entry site down the catheter site of the catheter to the catheter tip in the blood stream
(ii) Migration of the organism inside the catheter to the catheter tip (20)
(iii) Hematogenous seeding to the catheter from another focus of infection; and

Very rarely, intraluminal contamination of the catheter with solvent/ infusate (21)

Table:12 Comparison of organisms isolated in various studies

Studies	Year	Staphylococcus aureus	CoNS	Pseudomonas	Klebsiella spp
Bruno Hoen et al (11)	1994	39.2%	29.4%		
Erica M C et al (2)	1997	8%	8%	8%	54%
Bekir tanriover et al (13)	1998	71%		29%	
Geoffrey taylor et al (12)	1999	36.8 %	35.8%	2.5 %	1.4%
Michele H Mokrzyche et al (14)	2000	43%	-	36%	
Susan sangvi et al (17)	2004	42%	20%	4%	1%
Present study	2010	73.68%	5.26%	10.52%	10.52%

Organisms isolated :

In the presented study Gram positive organisms constituted 78.94% and Gram negative organisms 21.05%. Our study is comparable with results of Bekir Tanrioveret et al (gram positive 71% and Gram negative 29%). Staphylococcus was the predominant organism isolated (73.68%) which is in correlation with studies of Bruno Hoen et al (39.2%) and Susan Sangvi et al (42%) who isolated Staphylococcus as the major pathogen. Coagulase negative staphyloccus was isolated in 1 case but was not isolated from repeat sample after 48hrs. It could most probably be a contaminant .

Pseudomonas was isolated from 2 cases(10.52%). It was isolated from both patients on repeated samples. It is comparable with results obtained by Erica M C et al (8%) and Susan Sangvi et al (4%).

Klebsiella was isolated from 2 (10.52%) cases. But study by Erica M C et al showed isolation rate of 54%.

Table:13 Studies showing vascular assess site infection

Studies	Year	Catheter	Fistula
Bruno Hoen et al (11)	1994	36.0%	50%
Geoffrey Taylor et al (12)	1999	32%	4%
Anil K Saksena et al (18)	2000	86.2%	8.8%
Jula K Inrig et al (3)	2006	48.5%	42.5%
Present study	2010	100%	nil

The present study showed that all patients who had BSI(blood stream infection) had catheter. Similar results were observed in a study by Anil K Saksena *et al* which showed 86% of infectionwere seen in patients with catheter and 8.8% with fistula. But study by Bruno Hoen *et al* showed that 50% of AV(arteriovenous) fistula and 36% of the patients with catheter showed bacteremic episode.

The treatment modality was based on clinical symptoms:

- Minimal symptoms : clean exit site, change of catheter over guide wire within 48 hours
- Minimal symptoms with exit-site or tunnel infection- change of catheter over guide wire within 48 hours plus new tunnel
- Severe symptoms- catheter removal

A three weeks course of antibiotic administration is prescribed in all cases. (22)

CONCLUSION.

- It is more common in 4th decade of life.
- Diabetes mellitus is one of the most common risk factors for infection.
- Males are more commonly affected than females.
- Gram positive bacteria predominated the study.
- Majority of isolates were Staphylococcus aureus.
- Klebsiella spp and Pseudomonas aeruginosa constituted 21% of the study
- Catheter site infection rate was 2% (2 cases).
- Hence fistulas should be recommended whenever applicable. Central venous catheters need to be handled with aseptic precautions and should be changed when any signs of infection occurs.

ACKNOWLEDGEMENT: I Thank Dr. Vidhya, incharge of Hemodialysis unit at Vijayanagar institute of medical sciences for giving me permission to conduct this study.

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