PharmacologyOnLine

Archives • 2021 • vol.3 • 877-882

BACTERIAL INFECTIONS IN HEMODIALYSIS PATIENTS AT PELTIER HOSPITAL, DJIBOUTI

Mohamed Abdoul-Latif, Fatouma[1]*; Aouled Aden, Said[2] ; Abdoulkarim Omar, Daher[2] ; Wambua, Josephat [1] ; Mohamed Abdoul-Latif, Talal [1]; Ainane, Tarik[2]

[1]Medicinal Research Institute, Center for Research and Study of Djibouti, BP 486, Djibouti.

[2]Peltier hospital of Djibouti, BP 2123, Djibouti

[3]Superior School of Technology of Khenifra (EST-Khenifra), University of Sultan Moulay Slimane, BP 170, Khenifra 54000 Morocco.

*fatouma_abdoulatif@yahoo.fr

Abstract

Hemodialysis is a renal replacement therapy for end stage renal disease to filter waste materials using artificial kidneys. Hemodialysis is indicated by renal failure with uremic complications and its frequency is based upon plasma urea levels and electrolyte abnormalities. The duration of hemodialysis is 3.5 hours on average, and the frequency may be three (3) times weekly. The process requires use of large catheters to access patient's bloodstream to move large blood volumes in and out of the dialysis equipment. Bloodstream infections are among other complications of hemodialysis. The article summaries a retrospective study that is based on 300 inpatients admitted between March 10, 2019 to July 30, 2021 at Peltier hospital, Djibouti, with end stage renal disease. Two (2) blood specimens were collected, one from the catheter site and the second from a peripheral body site at the time of a feverish peak or a chill and cultured. A culture outcome was considered positive when 2 out of 2 blood cultures had the same pathogen. The purpose of this study was to establish the common causes of blood infections in patients undergoing dialysis at Peltier Hospital, Djibouti. A total of 138 (46 %) participants had end stage renal disease and clinical signs of bacteremia with 92 (67 %) having positive blood cultures. There was no significant gender variance between number of men and women with end stage renal disease. The age of the patients is advanced (average ± SD = 71 ± 3 years). In this study, 16 (17 %) of the positive cultures had *Candida albicans* and 76 (83 %) having polymicrobial infection. Agents found in patients with hemodialysis infections at Peltier hospital, Djibouti included: *Staphylococcus epidermidis* (30 %), *Escherichia coli* (23 %), *Staphylococcus aureus* (20 %), *Klebsiella pneumoniae* (12 %), *Enterococcus faecalis* (9 %), *Pseudomonas aeruginosa* (4 %) and *Acinetobacter baumannii* (2 %). Methicillin resistance was exhibited by 44 % of *Staphylococcus aureus* and 25 % of *Staphylococcus epidermidis*. Carbapenem resistance was exhibited by 47 % of *Escherichia coli* and 33 % of *Klebsiella pneumoniae*. All *Enterococcus faecalis* isolates were penicillin resistant. Imipenem, fosfomycin and vancomycin were the drugs of choice for managing hemodialysis infections at Peltier hospital, in doses adapted to renal failure and antimicrobial stewardship is necessary to safeguard their effectiveness in the future.

Keywords: *Hemodialysis, catheter, bacteremia, antibiotic treatment, bacterial resistance.*

Introduction

Hemodialysis is a renal replacement therapy for end stage renal disease to filter waste materials using artificial kidneys. Hemodialysis is indicated by renal failure with uremic complications and its frequency is based upon plasma urea levels and electrolyte abnormalities. The duration of hemodialysis is 3.5 hours on average, and the frequency may be three (3) times weekly. Patients who undertake maintenance hemodialysis have a higher risk for infections due to uremia that affects part of the immune system that enhances ability of antibodies and phagocytic cells to fight microorganisms **[1-2]**. The process of dialysis requires frequent use of hemodialysis catheters or needles to access the patient's bloodstream **[3-4]**. The use of hemodialysis catheters is the most important risk factor for bacteremia **[5-7]**. Infection-related mortality rate is 100 times higher than in the general population **[2,8]**. Deaths from infections are the second leading cause of death, 12 to 22 % in this population [8, 9]. Bacteremia causes 75 % of infectious deaths **[8-9]**. Predisposing factors for infections include, old age, under nutrition, diabetes, compromised immune system, chronic kidney disease, use of invasive devises and previous antibiotic use, among others **[10-13]**. Clinical signs are fever, chills, malaise and hypotension **[14]**.

Prevention measures are essential. The use of catheter should be done in a strict sterile environment **[15-16]**. Betadine antiseptics, chlorexidine or alcohol would be equally effective **[17-18]**. Recent recommendations favor a dressing made with dry compresses and not protective films transparencies that would promote the colonization of the outlet port **[19]**. Strict aseptic measures must be maintained at the dialysis connection site.

The purpose of this retrospective study was to establish the common causes of blood infections in patients undergoing dialysis at Peltier Hospital, Djibouti.

Materials and methods

This retrospective study is based on 300 inpatients admitted between March 10, 2019 to July 30, 2021 at Peltier hospital in Djibouti. The independent risk factors associated with these infections were the existence of diabetes and immune deficiency.

Bacterial infection was strongly suspected on the basis of a prolonged fever, a chill, leukocytosis and requires hemocultures prior to empirical antibiotic therapy.

The biological examination is decisive in the diagnosis of hemodialysis infections. Two (2) blood specimens were collected, one from the catheter site and the second from a peripheral body site at the time of a feverish peak or a chill and cultured. Serial blood culture sets were drawn aseptically into Oxoid Signal Blood Culture System Medium, from Thermofischer Scientific Oxoid signal Blood Culture System, prior to administration of empirical therapy, incubated at 37 °C incubator and examined for microbial growth for ten consecutive days.

Positive blood cultures were sub-cultured into MacConkey agar, Mueller-Hinton blood agar, chocolate agar and Mueller-Hinton blood agar for sensitivity testing and incubated at 37 °C incubator with the blood agar and chocolate agar under microaerophilic conditions. Negative blood cultures where further incubated for 30 days and sub-cultured at day 14, 21 and 28 to rule out presence of slow-growing bacteria.

The Kirby Bauer Method was used for microbial susceptibility testing. BioMerieux Analytical Profile Index panels were used for microbial identification **[20-22]**.

A culture outcome was considered positive when 2 out of 2 blood cultures from the same patient had the same pathogen **[2,23]**.

Results and discussion

A total of 138 (46 %) participants had end stage renal disease and clinical signs of bacteremia with 92 (67 %) having positive blood cultures. There were no significant gender variance between number of men and women with end stage renal disease. The age of the patients is advanced (average ± SD = 71 ± 3 years). In this study, 16 (17 %) of the positive cultures had *Candida albicans* and 76 (83 %) having polymicrobial infection.

A total of 62 % patients were hypertensive and 49 % diabetic. Obesity was noted in 38 %. The level of personal hygiene was poor in 31 % of cases.

The germs responsible for hemodialysis infections are shown in Table 1.

Agents found in patients with hemodialysis infection at Peltier hospital, Djibouti included: *Staphylococcus epidermidis* (30 %), *Escherichia coli* (23 %), *Staphylococcus aureus* (20 %), *Klebsiella pneumoniae* (12 %), *Enterococcus faecalis* (9 %), *Pseudomonas aeruginosa* (4 %) and *Acinetobacter baumannii* (2 %). The offending organisms are gram-positive cocci in 59 % of cases and *Escherichia coli* in 23 % of cases.

Methicillin resistance was exhibited by 44 % of *Staphylococcus aureus* and 25 % of *Staphylococcus epidermidis*. Carbapenem resistance was exhibited by 47 % of *Escherichia coli* and 33 % of *Klebsiella pneumoniae*. All *Enterococcus faecalis* isolates were penicillin resistant. The antibiotics for hemodialysis infections were imipenem, fosfomycin and vancomycin in doses adapted to renal failure. The parenteral route remains the most used to administer an anti-infectious in the hospital. In our study, gram-positive cocci were the most common pathogens responsible for hemodialysis infections with predominance of *Staphylococcus* (50 %). The most resistant hospital germs were *Escherichia coli* and *Staphylococcus aureus*. The death rate was 45 %. This high rate can be explained by:

- The high levels of multidrug-resistant bacteria;
- The inadequate initial antibiotic therapy (70 %);
- Complications of hemodialysis infections lead to the development of endocarditis and septic shock.

According to the literature, the mortality rate is estimated between 30 and 50 % for *Staphylococcus aureus* **[24-26]**. *Staphylococcus aureus* sepsis is associated with metastatic infections, of which endocarditis is the most common **[26]**. In methicillin-sensitive *Staphylococcus aureus*, cefazolin is preferred over vancomycin because it reduces the rate of hospitalization and mortality **[27]**. The catheter is considered to be the source of bacteremia because the same microorganism is isolated in the peripheral body site and the catheter site. Central venous catheters are essential tools for use in chronic hemodialysis. But they associated with excess mortality and a high risk of infection **[25-30]**. There is a risk of thrombosis and central venous stenosis **[31]**. The use of antimicrobial locks could reduce the rate of catheter-related bacteremia by three **[32- 33]**. The hemodialysis access sites (including old sites), patients immunocompromised states, diabetes, obesity, malnutrition, virulence and resistance of organisms, increased the risks of bloodstream infections **[28-29]**. The study recommended antimicrobial stewardship through establishment of an infection control committee to reduce microbial resistance and decrease the spread of infection caused by multidrug resistant organisms.

conclusion

Hemodialysis infections remain a serious transplant disease with high mortality. Its diagnosis is mainly based on blood cultures. Improving the management of hemodialysis infections relies on earlier diagnosis. In our study, gram-positive cocci were the most common pathogens found to be responsible for hemodialysis infections with predominance of *Staphylococcus* (50 %). The most resistant hospital germs were *Escherichia coli* and *Staphylococcus aureus*. Imipenem, fosfomycin and vancomycin were the drugs of choice for managing hemodialysis infections at Peltier hospital and antimicrobial stewardship is necessary to safeguard their effectiveness in the future.

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Table 1. Main pathogens responsible for hemodialysis infections in hospitalized patients at Peltier Hospital. Bacteremia was caused by either or a combination of two of the following listed microorganisms.

Bacteria isolated	Numbers	Percentage (%)
Staphylococcus epidermidis	24	30
Escherichia coli	19	23
Staphylococcus aureus	16	20
Klebsiella pneumoniae	10	12
Enterococcus faecalis	7	9
Pseudomonas aeruginosa	3	4
Acinetobacter baumannii	2	2
Total	81	100