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Original Research Article

Microbiological surveillance of dialysis unit-prefogging verses postfogging in a tertiary care hospital: A cross-sectional study

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ABSTRACT

Introduction: Haemodialysis is the most effective modality in treatment of end stage renal disease (ESRD). Patients undergoing the haemodialysis treatment are at a higher risk of acquiring systemic infections.
Objective: Microbiological surveillance of Dialysis Unit both prefogging and postfogging by air culture and swab culture.
Materials and Methods: This observational retrospective study was conducted at the department of Microbiology in a super speciality Post Graduate institute. The mean bacterial and fungal load and surface swab cultures pre and post fogging from the dialysis unit of the hospital were evaluated. Antibiotic resistance testing of isolates was performed by modified Kirby Bauer's disc diffusion method as per CLSI 2017 and EUCAST guidelines.
Conclusions: This study provides a comparative Microbiological surveillance of Dialysis Unit both prefogging and postfogging by Air culture and Swab cultures.
Results: Total of 42 Air culture (21 pre and 21 postfogging) and 588 swab culture (294 pre and 294 post fogging) samples were received in the microbiology department and the mean bacterial and fungal load were evaluated and calculated. Prefogging results were within the normal limits and the load was futher reduced postfogging, according to standard guidelines. Aerobic culture and sensitivity of surface swab cultures were done, out of which 11 (32.34%) prefogging swab culture samples, showed single growth of gram positive bacteria that were reduced to no growth post fogging.

1. Introduction

Haemodialysis is the most effective modality in treatment of end stage renal disease (ESRD).[1,2] Patients undergoing the haemodialysis treatment are at a greater risk of acquiring systemic infections.[3] Nosocomial infections (NIs) are infections acquired in a hospital or healthcare service unit that appear 48 hours or more after hospital admission or within 3 days after discharge.[4] The hand contact surfaces, floors, and air of the hospital environments are the main source of different pathogens that can cause Nis.[5,6] About 5% to 10% of admitted patients to modern hospitals in the western countries acquire one or more Nis.[7,8] In contrast, the magnitude of NIs is much higher in the developing countries due to different reasons[9] like poor ventilation system, high dusting, overcrowded setting, spread through sneezing and coughing, high movement of personnel, and suboptimal management of the hospital environment.[10] The hospital environment is the highest dissemination reservoir of pathogenic microbes which cause big challenges in the hospital environment, particularly in terms of NIs because it contains diverse population of microorganisms.[10] This study provides was done to evaluate the microbiological surveillance of Dialysis Unit

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both prefogging and postfogging by air culture and swab cultures.

2. Materials and Methods

2.1. Study setting, design, and period

An observational retrospective study was undertaken on microbiological surveillance of dialysis unit from April 2018 to December 2019 (21 months) at the department of Microbiology in a super specialty Post Graduate institute. The hospital has 2 Heamodailysis Units, 2 isolation rooms and one Peritoneal Dialysis Unit.

The method of sampling is Air culture for bacterial and fungal organisms. Airborne bacteria and fungi were sampled using AccuBas^{TM} Ax1, a microbial air monitoring system based on Andersen Impaction Principle. The general operating principle is that air is sucked through the sampling port and strikes on agar plate. The air is aspirated through the sieves of the perforated lid of the air sampler and the petri dish containing growth medium sits in a holder and the perforated lid locks in place over the medium. A fan mechanism is placed below and draws air in through the lid. The resulting air stream directly impacts the petri dish, forcing the microorganisms to stick to the surface of the agar. After a collection cycle the petri dish is incubated and the colonies are counted and expressed as colony forming units (cfu/m^3).

The air sampler was located approximately 100 cm away from the patient's bed (at the height of 91 cm). The air samples were collected for a period of 10 minutes. After each sampling, the culture plates were immediately transferred to the laboratory and incubated at 37 °C for 24–48 h. The number of grown colonies on each plate was recorded and the concentration of the airborne bacteria and fungi were calculated following the process of culturing in certain air volume (m^3). The results were expressed as colony-forming units per volume of sampled air. Finally, the mean levels of airborne bacteria and fungi in the haemodialysis centre were compared with the European Union Good Manufacturing Practices Guidelines (≤ 1 cfu/m^3 in class A rooms and ≤ 100 cfu/m^3 in class C rooms).[11]

Swabs are taken from bed, dialysis machine, dressing trolley, cardiac table, nursing counter of the dialysis Unit. After each sampling, swabs were immediately transferred to the laboratory and culture was done on Blood agar and MacConkey Agar culture plates and incubated at 37 °C for 24hours. Sterile precautions were taken while processing the samples. Identification of isolates from positive culture was done as per standard tests for identification, by Gram staining, motility and biochemical tests like catalase, coagulase, indole, methyl red, Voges-Proskauer, citrate, urease, phenyl pyruvic acid test and oxidase test. Antibiotic resistance testing of isolates was performed by modified Kirby Bauer's disc diffusion method on Mueller Hinton agar as per CLSI 2018 and EUCAST guidelines. All the culture media, biochemical media and antibiotic discs used were obtained from Hi Media.

These procedures were repeated prefogging and post fogging so as to evaluate the complete microbiological surveillance. The fogging was done by Microgen's "D-125", is recommended for use as a non porous hard surface disinfectant in hospitals and other healthcare facilities, every month and the samples were processed n the department of Microbiology of the institute.

2.2. Ethics

All applicable institutional guidelines for the study were followed. It was entirely an observational study. This retrospective study was approved by Institutional ethical committee.

3. Result

Total of 42 Air culture (21 pre and 21 postfogging) and 588 swab culture (294 pre and 294 post fogging) samples were received in the microbiology department between a period of 21 months (from April 2018 to December 2019) from the dialysis unit of the hospital. The mean bacterial and fungal load were evaluated and calculated.

Prefogging results (Table 1) were within the normal limits and the load was futher reduced postfogging (Table 2), according to standard guidelines. Aerobic culture and antibiotic resistance pattern of surface swab cultures were done, out of which 11 (32.34%) prefogging swab culture samples, showed single growth of gram positive bacteria that were reduced to no growth post fogging.

3.1. Air culture

Table 1: The mean bacterial and fungal load - pre fogging, from the dialysis unit of the hospital

Pre-fogging Site	Mean bacterial cfu/m^3	Mean fungal load cfu/m3
Haemodialysis unit I	43.5 cfu/m^3	1.42 cfu/m^3
Haemodialysis unit II	43.85 cfu/m^3	1.14 cfu/m^3
Isolation ward I	12.85 cfu/m^3	0.28 cfu/m^3
Isolation ward II	16.28 cfu/m^3	1.57 cfu/m^3
Peritoneal dialysis Unit	44.5 cfu/m^3	1.34 cfu/m^3

According to the European Union Good Manufacturing Practices guidelines, Haemodialysis centres are placed in the class C of air surveillance standards (≤ 100 CFU/m^3).[11]

According to the European Union Good Manufacturing Practices guidelines, Haemodialysis centres are placed in

Table 2: The mean bacterial and fungal load - post fogging was from the dialysis unit of the hospital

Post-Fogging Site	Mean bacterial cfu/m^3	Mean fungal load cfu/m^3
Haemodialysis unit I	12.41cfu/m^3	1.08 cfu/m^3
Haemodialysis unit II	7.58 cfu/dm^2	0.5 cfu/m^3
Isolation ward I	10.41 cfu/dm^2	0.25 cfu/m^3
Isolation ward II	2 cfu/dm^2	0.25 cfu/m^3
Peritoneal dialysis Unit	13.5 cfu/m^3	0.5 cfu/m^3

the class C of air surveillance standards (≤ 100 CFU/m^3).[11]

3.2. Standards & guidelines

As per USP chapter <1116> microbial limits for sterile products are as follows:-

Table 3:

Class	CFU/m^3 air
10,000	<20
100,000	<100

1. Class 10,000:-

Class 100,000:- particle count not to exceed a total or 100,000 particle per cubic foot of a size 0.5μ and larger or 700 particle per cubic foot of a size 5.0μ and larger.

3.3. Bacterial load from surface

The mean aerobic colony count (ACC) from surfaces in the dailysis unit were under acceptable limits, at <5 cfu/cm^2 except from cardiac table and dressing trolley in haemodailysis unit I which showed the growth of Methicillin Resistant Coagulase Negative Staphylococci (11 cfu/cm^2) and Methicillin Sensitive Coagulase Negative Staphylococci (13 cfu/cm^2) respectively in pre-fogging samples. That also showed no growth post-fogging. No bacteria were isolated from the dialysis unit post fogging.

4. Discussion

Different studies had reported that air and hand contact surfaces of the healthcare service units are contaminated by different pathogens which might serve as source of infections. This study was carried out to gain an insight into the distribution, frequency, bacterial load, and antimicrobial susceptibility profile of pathogens at the setting of dialysis unit of, one of the busiest hospitals in North India.

The mean bacterial and fungal load pre and post fogging was evaluated for a period of 21 months (from April 2018 to December 2019) in the dialysis unit of the hospital.

According to the European Union Good Manufacturing Practices guidelines, Haemodialysis centres are placed in the class C of air surveillance standards (≤ 100 CFU/m^3).[11] In the present study, the total mean (±SD) of airborne bacterial colony count in the haemodialysis centre was within the normal limits post fogging which indicates suitable air conditions in the haemodialysis centre. The results of the total count of bacteria in the air and the pattern of isolated bacteria were consistent with other studies conducted in health centres and other wards such as intensive care units.[12,13]

The aerobic surface swab culture results revealed optimal limits prefogging except from cardiac table and dressing trolley in haemodailysis unit I which showed the growth of Methicillin Resistant Coagulase Negative Staphylococci (11 cfu/cm^2) and Methicillin Sensitive Coagulase Negative Staphylococci (13 cfu/cm^2) respectively two times in the period of evaluation, which was reduced to no growth post fogging. All other surfaces showed no growth. This finding is relatively lower than other similar studies done in Ethiopia and abroad in Nigeria that reported bacterial growth at 52.9% and 65.7%, respectively.[14,15] In the present study, all of the isolates were gram positive which is in line with previous studies done in Ayder Hospital, Ethiopia, that reported 87.3%.[16] In contrast, lower distribution of gram positives at 43.1% was reported in Hawassa, Ethiopia.[17] The air bioload and aerobic surface swab culture results in the study revealed optimal limits, this shows that surface and aerial disinfection is proper in the dialysis unit as patients undergoing the haemodialysis treatment are at a greater risk of acquiring systemic infections.

5. Conclusion

Dialysis Unit is an important part of the hospital to have optimum conditions for the dialysis of critical patients. Patients undergoing the haemodialysis treatment are at a greater risk of acquiring infections. Therefore, periodic surveillance programs for microbiological qualification in haemodialysis centres can also lead to a better planning for disinfection of dialysis units.

6. Source of Funding

None.

7. Conflict of Interest

None.

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