

ORIGINAL ARTICLE

MICROBIAL COLONIZATION PROFILE OF RESPIRATORY DEVICES

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ABSTRACT

Background: The respiratory care equipment's which include nebulizers, humidifiers, and ventilators may have been identified as the potential vehicle which may cause major nosocomial infections if they are colonized by different bacteria. This study was conducted to know presence of **microbial flora in** inhalation therapy equipment, type of organisms.

Methodology: The study included 60 samples out of which 30 samples were taken from nebulizers, and 30 samples were taken from humidifier chambers in use. Rinse sampling method using 10-20 ml sterile BHI broth was performed. Quantitative culture was performed using colony counting agar spread plate method.

Result: 51.6% samples showed significant bacterial growth. Out of these 14 samples were of nebulizers and 17 samples of humidifier chambers. 90.33 % bacterial isolates were gram negative bacilli and 9.66 % were gram positive cocci. Following gram negative bacilli were isolated: Pseudomonas (41.93 %), B.cepacia (16.13%), Klebsiella species (12.9%), Acinetobacter species (12.9%) and Polymicrobial flora (6.45%).

Conclusion: Our study indicates a potential risk of nosocomial infection due to microbial colonization of various respiratory devices.

Keywords: Humidifiers Ventilators, Microbial colonization, Disinfection

INTRODUCTION

Respiratory care equipments which include humidifiers and nebulizers have been identified as potential vehicles causing major nosocomial respiratory infections if they are colonized by fungi or bacteria.¹⁻³ Contaminated respiratory care equipments may lead to nosocomial infections via 2 routes; firstly: Equipment may serve as a reservoir for microorganisms, especially gram-negative bacilli. The fluid containing devices such as nebulizers and humidifiers may become heavily contaminated by bacteria and fungi which may be capable of multiplying in water. The pathogens may then spread to the patients by aerosolization in the room. Secondly, the contaminated equipment may lead to a direct instillation or delivery of microorganisms to the airways, if the equipment is directly linked to a ventilator system or if contaminated medication is instilled or aerosolized. Many types of equipment such as oxygen masks and nebulizer chambers may be transferred from patient to patient several times daily but they may be seldom cleaned daily.⁴⁻⁶ Autopsy material at Parkland Memorial Hospital from the years 1952, 1957, and 1963 was reviewed to determine the frequency of necrotizing pneumonia. These years were selected to represent a period before the widespread use of present

inhalation therapy techniques, a period preceding the introduction of prolonged nebulization treatments, and the present period of widespread use of inhalation therapy. The frequency of gram-negative necrotizing bacillary Pneumonia in 1952 was 0.8%, in 1957 was 1.8%, but by 1963 had risen to 8.0%. The association between the increasing incidence of gram-negative necrotizing bacillary pneumonia and widespread use of inhalation therapy coupled with apparent lack of association with other predisposing factors suggested the potential role of inhalation therapy in nosocomial pulmonary infection.⁷ The infection control activities should emphasize the establishment of appropriate preventive guidelines and policies and the continuing education of health care workers to maintain an optimal compliance with the preventive practices.^{8,9}

With this in mind the study was planned with aim to determine the rate of bacterial colonization in the nebulizers, humidifier chambers in our hospital.

METHODOLOGY

All the nebulizers & humidifiers, in use in the Dept. of Medicine & Pediatrics were taken in the study (Nebulizers: 30 Humidifiers-30)

After getting permission from Institutional Ethics committee, Rinse sampling method was used for sampling nebulizer reservoirs & humidifiers.¹⁰

10-20 ml of sterile BHI broth was placed in the bottle or tubing, and both ends were sealed appropriately. Bottle or tubing was vigorously shaken after it was sealed, end to end approximately 50 times. Rinse fluid was decanted in a sterile container & transported immediately for bacterial culture

Culture methods for rinse fluids: Quantitative culture was performed using agar spread plate method. Two Serial 10-fold dilutions of the rinse fluid were made in sterile non bacteriostatic saline. 0.1ml of each dilution was pipetted out onto a standard agar plate surface. Separate bent sterile glass spreader was used to distribute the inoculums on each surface. Plates were incubated under conditions and for periods of time sufficient to recover implicated microbial populations. Plates were examined for significant growth (more than 10³ CFU.)

This cross sectional study was conducted from May to September 2014.

Inclusion Criteria: All the Respiratory devices (Nebulizers/Humidifiers) which were currently used in wards & ICU of Lata Mangeshkar Hospital, Dighodh were taken into the study.

Exclusion Criteria: The devices not in use were not taken into this study.

RESULTS

Thirty one out of 60 Samples showed significant bacterial growth. Out of these 14 samples were from nebulizers and 17 samples from humidifier chambers. 38.7% samples from I.C.U, 51.6% samples from Wards, 9.67% samples from OPD showed significant bacterial colonization.

Table 1: Culture Positivity in various samples

Sample site	Positive for culture (> 10 ³ CFU/ml)	Negative for culture
Nebulizers	14	16
Humidifiers	17	13
Total	31	29

Out of these bacterial isolates 90.33 % were gram negative bacilli and 9.66 % were gram positive cocci. Out of 90.32% gram negative bacilli, maximum (41.93%) were Pseudomonas, 12.90% were Klebsiella, 12.9% were Acinetobacter, 16.12% were Burkholderia cepacia Polymicrobial growth (more than one organism) was seen in 6.45% samples.

Table 2: Organism isolated (n=31)

Species	Nebulizers (n=14)	Humidifiers (n=17)	Total (%)
Pseudomonas	7	6	13 (41.9)
Klebsiella	2	2	4 (12.9)
Burkholderia Cepacia	1	4	5 (16.1)
Acinetobacter	1	3	4 (12.9)
Coagulase Negative Staphylococcus	1	0	1(3.2)
Staphy aureus	1	0	1(3.2)
Poly microbial	0	2	2 (6.5)

Table 3: Split up of Polymicrobial Flora isolated

Polymicrobial-1	E.Coli+ Pseudomonas
Polymicrobial-2	Klebsiella + Staphylococcus aureus

DISCUSSION

Respiratory infections are the commonest among nosocomial infections. Nosocomial pneumonia is the second most common nosocomial infection worldwide and the most common infection in intensive care units (ICUs). In the United States, The Center for Disease Control and prevention (CDC) roughly estimated 1.7 million hospital-associated infections from all types of microorganisms which included bacteria, fungi and viruses, which contributed to 99,000 deaths per year.¹¹ Most nosocomial infections in hospitals worldwide are linked to some human activities near or inside the hospitals, to available water supply, contaminated air and medical devices or equipment used in the health care delivery. In this study, a Nebulisers & Humidifiers, which are commonly used respiratory devices were screened to determine rate of colonization & type of bacteria present. The presence of organisms on the medical devices highlights the flaws on the cleaning and disinfection processes of medical equipment.^{12, 13, 14}

Nebulizers create aerosols of minute droplets that penetrate deeply into the narrowest airways and thus present a significant problem. This is especially so for small volume medication nebulizers.¹⁵ In our study we studied 30 nebulizers which were in use in various sections of our hospital. Fifteen samples were taken from nebulizers in I.C.U, 7 samples were taken from wards, 8 samples were taken from OPD Nebulizers. Out of these thirty nebulizers we found a significant growth of bacteria in fourteen nebulizers. Nebulizers used to deliver medication easily become contaminated. They should be washed with detergent and dried every time they are used. Mouthpieces should be Changed every 24 hours.¹⁶ Humidifiers: Humidification of the circuit is essential to prevent dehydration of the airways. Humidifiers do not produce aerosols so if the water in the reservoir becomes contaminated, the bacteria are less likely to be inhaled. However, water vapor tends to condense in

the tubing. The condensate may become heavily contaminated and can drain into the trachea, increasing the risk of infection. Humidifiers should be filled with sterile water and decontaminated every 48 hours.¹¹ In the present study 30 humidifiers were studied which were in use in various sections of hospital out of which 17 samples were taken from humidifiers in I.C.U, 13 samples were taken from humidifiers in wards,. Out of these significant growth of bacteria was seen in 17 humidifiers. In Present study the positivity rate for bacterial colonization in nebulizers and humidifiers was 50% and 56.66% respectively. Similar study was carried out by Savita Jadhav et al, in her study the positivity rate for bacterial colonization in nebulizers and humidifiers was 47.5% & 78.26% respectively.¹⁷

We found that predominantly gram negative organisms were present in nebulizers and humidifiers (90.33 %). Similar studies have showed varying degree of colonisation but with preponderance of gram negative bacteria. Study by Savita Jadhav et al ¹⁷ showed 68.85% gram negative bacteria & 31.14% gram positive bacteria The most common organism in present study was *Pseudomonas aeruginosa*, 13(41.93%)& *B.cepacia*, 5 (16.12%) followed by *Klebsiella*, 4 (12.90%)(Table-2) Most common bacterial isolate in the study of Savita Jadhav et al was *Pseudomonas* (39.53%) followed by *Acinetobacter* (13.9%) and *Klebsiella*(9.52%). Both the studies indicate approximately similar bacterial isolation, with predominance of *Pseudomonas* species. Although studies of infectivity of aerosols have shown that inhalation therapy equipment frequently generates significant bacterial aerosols but we need to evaluate the potential pathogenicity of these aerosols which are dependent on various factors like Particle size of aerosols & Minimum infectious dose

CONCLUSION

Our study indicates a potential risk of nosocomial infection due to microbial colonization of various respiratory devices. The nebulizers and humidifier chambers need to be cleaned more frequently with disinfectants, to control nosocomial infections. Proper cleaning and sterilization or a high level disinfection of the reusable equipment is essential, to prevent the infections which are associated with the respiratory therapies such as oxygen therapy, nebulization, etc. Devices or parts of devices need to be rinsed with water after they have been chemically disinfected. The implementation of new and regular hygiene measures for the maintenance of such equipments is desirable.

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