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HERE, THERE AND EVERYWHERE: A HOSPITAL-BASED STUDY ON NOSOCOMIAL AND ENVIRONMENTAL NON-FERMENTERS

Microbiology

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ABSTRACT

Aim: To assess the prevalence of non-fermenting gram negative bacilli(NFGNB) as nosocomial pathogens and environmental contaminants.
Material and Methods: Nonfermenting gram negative bacilli were isolated from relevant patient samples and high-touch surfaces in the hospital environment. They were identified and their antibiotic susceptibility testing was done using conventional and automated methods.
Result: The prevalence of nonfermenters as hospital acquired pathogens and as environmental contaminants was 25.8% and 16.3% respectively. All clinical isolates of *Acinetobacter baumanii* cplx and *Pseudomonas aeruginosa* were multidrug resistant. Cluster analysis of clinical isolates show similar antibiotic susceptibility profile indicating an ongoing cross-transmission in the hospital.

KEYWORDS

non-fermenters, nosocomial, ubiquitous, hospital-based

INTRODUCTION

Non-fermenters are a heterogeneous group of gram-negative bacilli. They are aerobic, non-sporing; either not using carbohydrates as an energy source or degrading them through metabolic pathways other than fermentation. They comprise a multitude of bacterial species belonging to different genera and have various features. However they have a commonality: they are ubiquitous, meaning they are widespread in the environment. Non-fermenters are present in elemental components of nature like soil, water, and decaying vegetation.[1]

All this led them to be often disregarded as contaminants and not pathogens. However several non-fermenters have emerged as significant multidrug pathogens.[2] Their omnipresence has also extended to the hospital environment. The combination of the above two factors has made them ideal nosocomial pathogens.

Though routine environmental surveillance is not recommended, acquisition of such multidrug-resistant non-fermenters is a continuous phenomenon, one that is less studied and often ignored when exploring infection control protocols. Therefore this study was undertaken to identify the prevalence of non fermenters as nosocomial pathogens and environmental contaminants and to find out the correlation between them.

OBJECTIVES

1. To study and identify nosocomial infections.
2. To isolate and identify non-fermenting gram-negative bacilli responsible for nosocomial infections.
3. To isolate and identify non-fermenters present in the hospital environment.
4. To study and compare the antibiogram of both.

MATERIALS AND METHODS

Type of Study: Descriptive, observational, cross-sectional, tertiary care-based study.

Study duration: 1 year (January 2019-December 2019)

INCLUSION CRITERIA:
1. Patients who consented to the study.
2. Patients admitted for more than 48 hours in the hospital.
3. Patients who were more than 14 years of age

EXCLUSION CRITERIA:
Patients who did not consent to the study.

Collection of clinical samples: Samples were collected from various sites using sterile, aseptic procedures.

Collection of environmental samples: Swab samples from various high-touch areas of the hospital environment were collected. The following items and areas were sampled; bed rails, bedside tables, food tables, nurses' tables, chairs, doors, windows, door handles, floor, basins, taps, corrugated pipes, nurses' files, and cabinets.

Processing Of Samples:
1. After transportation of both types of samples (clinical and environmental) to the bacteriology laboratory, the samples were inoculated in nutrient agar, MacConkey, and blood agar.
2. The isolated bacteria were identified by using standard laboratory techniques and VITEK 2D.
3. Antibiogram of both clinical and environmental bacterial isolates was performed by the Kirby Bauer disc diffusion method according to CLSI guidelines. VITEK 2D was also used for antibiotic susceptibility testing.
4. Non-fermenters isolated from both clinical and environmental samples were taken into account and their antibiogram was compared.

Data Analysis: All data was initially entered into MS Excel. Graph Pad Prism 8.0 was used for statistical analysis.

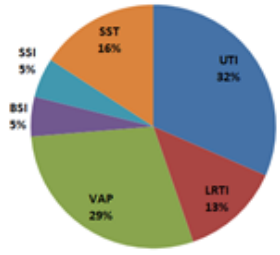
RESULTS

A total of 2405 patients were diagnosed with nosocomial infections according to the CDC-NHSN Criteria.[3] Non-fermenting gram-negative bacilli were isolated from 38 patients out of 147 patients diagnosed with nosocomial infections during the study period. The prevalence of non-fermenters as hospital-acquired pathogens was thus found to be 25.8%.

There was a preponderance of males (71%) over females (29%). The maximum number of nonfermenting gram-negative bacilli was isolated in the age groups 41-50 years (26%) and 51-60 years (26%).

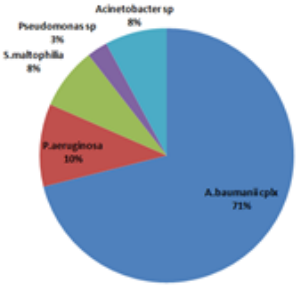
The isolation of nonfermenting gram-negative bacilli was most frequent among patients affected with catheter-associated urinary tract infections (31%), followed by ventilator-associated pneumonia (29%).

INFECTION	NUMBER(n)
Urinary Tract Infections(UTI)	12
Lower Respiratory Tract Infection(LRTI)	6
Ventilator Associated Pneumonia(VAP)	11
Surgical Site Infection(SSI)	2
Skin And Soft Tissue Infection(SST)	6
Bloodstream Infection(BSI)	1



Nonfermenters were more prevalent in the critical care unit (53%) than in general wards (47%).

The most predominant organism isolated was *Acinetobacter baumanii cplx* (71%, n=27) followed by *Pseudomonas aeruginosa* (10%, n=4), *Stenotrophomonas maltophilia*(8%,n=3) and *Acinetobacter lwoffi* (8%,n=3)



Analysis of Environmental Samples

200 samples were collected from various high-touch areas in the hospital.134 samples showed growth of which, nonfermenting gram-negative bacilli were isolated from 22 samples. Thus the prevalence of NFGNB in the hospital environment was 16.4%.

The maximum number of non-fermenters were isolated from towels (n=3), basins (n=3), and food tables (n=3).

The predominant NFGNB isolates from the environment were *Acinetobacter baumanii complex* (n=7), *Acinetobacter lwoffi* (n=7), and *Pseudomonas aeruginosa* (n=7).

Antibiogram Analysis

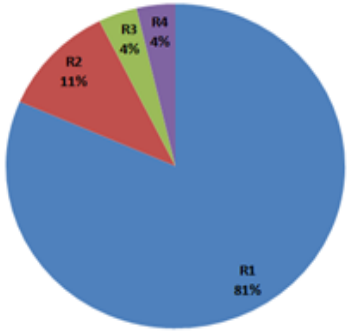
All clinical isolates of *Acinetobacter baumanii cplx* and *Pseudomonas aeurginosa* were multidrug-resistant (100%).

Since *Acinetobacter baumanii cplx* was the most frequently isolated NFGNB, cluster analysis of the isolates based on their antibiotic sensitivity pattern was performed.

Based on their culture sensitivity patterns, the following common sensitivity patterns were found prevalent in *Acinetobacter baumanii cplx*(71%) obtained from patient samples.

MDR PHENOTYPE	COMBINATION NUMBER	N	%
ak-tg-cl	R1	22	81
tg-cl	R2	3	11
ak-cl-cfs-cot	R3	1	4
pb-cl	R4	1	4

(ak-amikacin,tg-tigecycline,cl-colistin,cot-cotrimoxazole,pb-polymixin b,cfs-cefoperazone/sulbactam)



Among the environmental isolates,6 isolates were found to be multidrug-resistant(27%).1 isolate of *Acinetobacter baumanii complex* had a similar sensitivity pattern to the clinical isolates(MDR phenotype R1). It should be further noted that the isolate was obtained from a hospital basin.

DISCUSSION

NFGNB reportedly accounts for 15% of all clinical isolates.[4] The turn of the decade has established them as significant hospital-acquired pathogens and not contaminants due to the widespread and indiscriminate use of antibiotics.

In our study, 25.8% of clinical samples and 16.3% of environmental samples were constituted by non fermenters. The isolation rate was higher than other reports due to the study sample being restricted to nosocomial infections.

As far as the demographic details are concerned, there is a predominance of males (71%) over females (29%). This finding is similar to the reports by Chawla et al.[5]

The maximum number of NFGNB was obtained from the critical care unit (53%) with an overall preponderance in patients with catheter-associated urinary tract infection (31%), followed by ventilator-associated pneumonia (29%). This corroborates with several other studies where non-fermenters are the major culprits in critically ill and immunocompromised patients.[6-7]

According to the studies conducted by Perween et al (2014),[8] Agarwal et al (2017),[7] a bulk of the NFGNB contributing to the infections *were Acinetobacter baumanii cplx* and *Pseudomonas aeruginosa*.In a Mexican study summarized by Luna et al gram-negative pathogens,

especially *Acinetobacter baumanii cplx* dominated over other pathogens especially where critical care set-ups were concerned.[9] All this corroborates with our study where *Acinetobacter baumanii cplx* and *Pseudomonas aeruginosa* predominate.

Various studies have shown *Pseudomonas aeruginosa* and *Acinetobacter baumanii* to be strongly associated with environmental contamination.[10-11] Outbreaks of *A.baumanii cplx* have been associated with contaminated inanimate fomite.[12-13] Our study found *A.baumanii cplx*, *P.aeruginosa* as the most frequent environmental contaminants (n=7).This is similar to the findings of Mohapatra et al.[14]

The cluster analysis of the clinical samples showed 81% of the *A.baumanii* cplx isolates having a similar sensitivity pattern. This indicates ongoing cross-transmission within the hospital.1 isolate of *A.baumanii complex* obtained from a basin had a similar sensitivity pattern as well. This proves to be a revelation as the hospital plumbing system may be a major source of contamination in the hospital environment.

In various studies, it was seen that handwashing sinks are a major niche for the transmission of multidrug-resistant organisms.[15-17]

CONCLUSION

The prevalence of multidrug-resistant non fermenters foretells an ominous future as far as infection control is concerned. The hospital environment continues to be a rich but underrated source of deadly pathogens. Antibiogram based cluster analysis may be an inexpensive means to assess outbreaks in places lacking the sophisticated machinery of bacterial typing.

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Conflicts Of Interest: None

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