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Research Article

Increasing incidence of multidrug resistant Pseudomonas aeruginosa in inpatients of a tertiary care hospital

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ABSTRACT

Background: Pseudomonas aeruginosa is an important pathogen isolated from various clinical infections. The occurrence of multidrug-resistant (MDR) Pseudomonas aeruginosa strains is increasing worldwide and limiting our therapeutic options resulting in high mortality. We aim to study the incidence of multidrug resistant Pseudomonas aeruginosa in inpatients from various departments along with rate of nosocomial infections.
Methods: A cross sectional study from January 1, 2013 to December 31, 2013. A total of 167 Pseudomonas aeruginosa were isolated from 764 clinical specimens. The isolates were identified by standard microbiological techniques. The antibiotic susceptibility was done by Kirby Bauer method.
Results: The highest number of isolates were from pulmonary samples n=90 (53.89%) followed by pus n=48 (28.74%). Overall, 39 (23.36%) isolates were nosocomial. The nosocomial isolates were mainly isolated from department of surgery, orthopaedics, obstetrics & gynaecology followed by others. Among 167 isolates screened, 53 (31.73%) were found to be MDR (resistant to ≥3 classes of antipseudomonal agents). The resistance was most against cephalosporins [Cefepime (65.26%), cefotaxime (60.47%)], fluoroquinolones [Ciprofloxacin (46.1%), levofloxacin (31.87%)] aminoglycosides [Amikacin (37.72%), gentamicin (31.13%)] followed by ureidopenicillins and carbepenems. About 56.75% isolates were suspected Metallo β lactamases producers.
Conclusion: The study suggests that the incidence of nosocomial infection by multidrug resistant Pseudomonas aeruginosa is increasing globally especially the Metallo Beta lactamases producing strains. So there is a continuous need of conduction of surveillance programmes to formulate rational treatment strategies to combat this emerging challenge.

Keywords: Pseudomonas, Incidence, Nosocomial, Antibiotic, Resistance

INTRODUCTION

Pseudomonas aeruginosa is one of the common bacterial pathogen isolated from various clinical samples. It causes a wide range of infections including bacteraemia, pneumonia, meningitis, urinary tract and wound infections. The earlier studies point that it is a leading cause of nosocomial infections especially in burn patients, respiratory diseases, patients undergone surgery and catherized patients. The incidence is more in developing countries. In recent years, there is significant increase in the prevalence of multidrug resistance in P. aeruginosa (MDRPA) has been noticed, which is related to high morbidity and mortality.[1,2] The rise in incidence of multi drug resistant P. aeruginosa which has limited the therapeutic option is due to its predilection to acquire

resistance determinants to a wide range of antibacterial agents. The common resistant mechanism is production of β lactamases, including penicillinases, cephalosporinases and carbapenemases.[3]

Consequently the increase in resistance to antipseudomonal agents poses a great hindrance in formulating the treatment strategies to combat the deadly infections. The objective of this study is to determine the prevalence of MDRPA, rate of nosocomial infections in different departments and resistance pattern of isolates.

METHODS

The study was carried out from January 1, 2013 to December 31, 2013 in a tertiary care teaching hospital in U.P., India. Total 764 clinical samples from inpatients of various departments were received in Department of Microbiology for culture and sensitivity.

Inclusion criteria for the patients

Patients admitted to different departments of the hospital, were included in this study.

Exclusion criteria for the patients

Patients coming as outpatient to emergency were not included.

Data collection

The patient's clinical data (including age, sex, department, specimen type and clinical diagnosis) were collected.

Sample processing

The various clinical samples like urine, pus, sputum, blood, vaginal swab and body fluids etc. of the admitted patients were collected aseptically. The culture was done using blood agar, MacConkey agar & nutrient agar (HIMEDIA, Mumbai). The identification of the isolated colonies was done by standard microbiological methods.[4]

Antibiotic susceptibility testing

AST were done by Kirby Bauer method[5] using various antibiotic discs (HIMEDIA, Mumbai) including imipenem (IPM), meropenem (MRP), ampicillin-sublactam (APS), piperacillin-tazobactam (PIT), amikacin (AK), gentamicin (GEN), ciprofloxacin (CIP), levofloxacin (LE), cefotaxime (CTX), cefepime (CPM).

Multidrug resistant Pseudomonas aeruginosa (MDRPA)

It is defined as those resistant to three or more classes of antipseudomonal agents (i.e., penicillins/cephalosporins, carbapenems, fluoroquinolones, and aminoglycosides).[6]

Nosocomial infection

The causative organism is isolated after 48 hours of admission to the hospital.[7]

Screening of metallo β lactamases producing Pseudomonas aeruginosa

Imipenem (IMP)-EDTA combined disc test

The IMP-EDTA combined disk test was performed as described by Yong et al.[8]

Test organisms were inoculated on to plates with Mueller Hinton agar as recommended by the CLSI. Two 10 µg imipenem disks (Himedia, Mumbai) were placed on the plate, and appropriate amounts of 10 µL of EDTA solution were added to one of them. The inhibition zones of the imipenem and imipenem-EDTA disks were compared after 16 to 18 hours of incubation in 35°C. In the combined disc test, if the increase in inhibition zone with the imipenem and EDTA disc was ≥7 mm than the imipenem disc alone, it was considered as MBL positive.[8]

Statistical analysis

Microsoft office 2007 was used for data tabulation and analysis. Proportions and percentages were used as statistical measures.

RESULTS

A total of 167 Pseudomonas aeruginosa isolates were obtained from 764 clinical specimens (Table 1) from all patients hospitalized in wards of medicine, T.B & chest, surgery, paediatrics, orthopaedic, obstetrics and gynaecology and ENT. The maximum isolates were from patients aging 21-40 years and in males n=106 (63.47%) as depicted in Figure 1.

Table 1: Number of Pseudomonas aeruginosa isolated in different clinical specimens.

Samples	Number of samples	Number of samples with Pseudomonas aeruginosa
Pulmonary samples*	256 (33.5%)	90 (53.89%)
Pus	196 (25.65%)	48 (28.74%)
Urine	172 (22.51%)	18 (10.77%)
Blood	62 (8.11%)	04 (2.39%)
Body fluids	40 (5.23%)	04 (2.18%)
Throat swabs	24 (3.14%)	01 (0.59%)
Vaginal/urethral swab	07 (0.91 %)	01 (0.59%)
Aural swabs	07 (0.91 %)	01 (0.59%)
Total	764 (100%)	167 (100%)

*Pulmonary samples: sputum, BAL, pleural fluid.

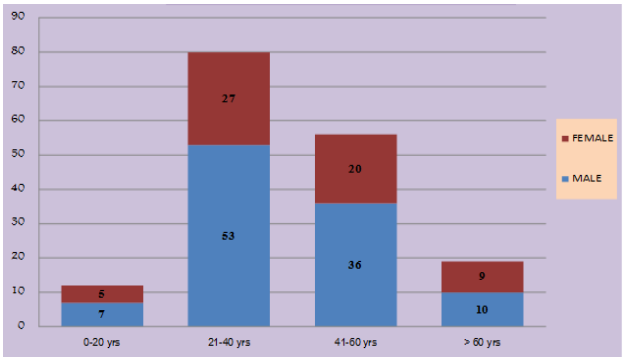

Figure 1: Age & sex distribution.

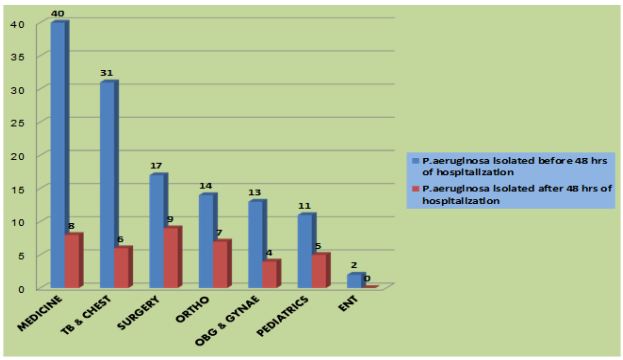

Figure 2: Distribution of hospital acquired and community acquired amongst the inpatients.

Table 2: Resistance pattern of the isolates against the antipseudomonal drugs and percentage of suspected cases of metallo β lactamases producers.

Antipseudomonal agents	Total strain tested	Resistance (%)	Suspected cases of metallo β lactamases producing P. aeruginosa
Ureidopenicillin			
Pipercillin/tazobactam (PIT)	167	54 (32.33)	
Ampicillin-sublactam (CFS)	161	49 (30.43)	
Cephalosporins			
Cefotaxime (CTX)	167	101 (60.47)	
Cefepime (CPM)	167	109 (65.26)	
Fluoroquinolones			
Ciprofloxacin (CIP)	167	77 (46.1)	
Levofloxacin (LE)	160	51 (31.87)	
Aminoglycosides			
Amikacin (AK)	167	63 (37.72)	
Gentamicin (GEN)	167	52 (31.13)	
Carbepenems			
Imipenem (IPM)	167	37 (22.15)	21 (56.75%)
Meropenem (MRP)	151	30 (19.86)	
Note: Out of 167 strains 53 (31.73%) strains were resistant to 3 or more classes of antipseudomonal agents			

The highest incidence of nosocomial infection was observed in department of surgery n=9 (34.62%) followed by department of obstetrics & gynaecology n=4 (33.53%) and department of orthopaedics n=7 (33.33%) as shown in Figure 2. The highest resistance was seen towards cephalosporins [Cefotaxime (CTX) 60.47% & cefepime (CPM) 65.26%] as shown in Table 2.

P. aeruginosa was most susceptible to carbepenems [Meropenem (MRP) 80.14 % imipenem (IPM) 77.85 %]. We found about 31.73% of MDRPA and 56.75% suspected cases of metallo β lactamase P. aeruginosa by imipenem (IMP)-EDTA combined disc screening test as shown in Figure 3.

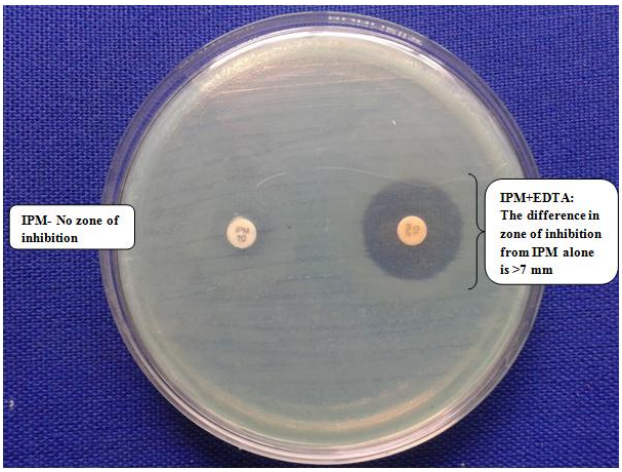

Figure 3: Showing metallo β lactamases producing Pseudomonas aeruginosa by IPM & IPM-EDTA screening test.

DISCUSSION

The increasing of infections caused by multidrug resistant bacteria has now become a major threat in medical world. Amongst them the MDRPA is now becoming a common cause of nosocomial infection.

In this study, we assessed the increasing incidence of MDRPA in the inpatients of various departments in a tertiary hospital. In our study the most number of P. aeruginosa isolated was from pulmonary samples n=90 (53.89%) followed by pus n=48 (28.74%) and urine n=18 (10.77%). These results are in line with the previous studies.[9,10] The isolation rate from different clinical samples varies according to the condition and the specimen.

A high rate of P. aeruginosa has been isolated from the age group 21-40 years which is supported by a previous study.[11] This may be due to maximum occupational exposure to the organism. The prevalence in male (63.47%) was more than the females (36.53%) in our study. A previous study from Nigeria shows prevalence of 52.8% in males and 47.2% in female.[12]

This study shows that among all the isolates of P. aeruginosa the rate of nosocomial isolates was 23.36%. This is slightly lower than a study by Bergmans et al. who reported 50% of all cases of P. aeruginosa infection were nosocomial.[13] The variation in the rate of nosocomial infection varies from hospital to hospital which can be due to the length of the hospital stay, adherence to the aseptic precautions, invasive procedures, segregation of the patients etc. We found the most number of nosocomial infections by P. aeruginosa was from department of surgery (34.62%) followed by department of gynaecology (33.53%), and Department of orthopaedics (33.33%). These data are in consistent with some past studies.[14] This can be due to the highest exposure of the patient to the invasive procedures and the hospital stay of the patients in these departments is more as compared to others. Another factor can be the non-adherence to the safety measures like hand washing.

Nowadays the incidence of MDRPA is escalating and one of the newest concerns is the emergence of metallo β lactamase producing P. aeruginosa. In the present study, we found that the isolates were resistant to cephalosporins (Cefotaxime 60.47%, cefepime 65.26%) and fluoroquinolones (Ciprofloxacin 46.1%). A 10 year survey has reported the increasing trend of cefepime resistance as (16 to 25%) and Ciprofloxacin as (15 to 32%).[15] While a 3 year study from India reports Ciprofloxacin resistance of 63.1%.[11]

Carbepenems such as the imipenems and meropenem are often used as last choice for treatment of infection by Pseudomonas. Currently the resistance towards this group of drugs is increasing. We observed the resistance of 22.15% for imipenems and 19.86% for meropenems. This result is in concordance with a ten year survey report.[15] Various studies have reported the resistance to imipenem of upto 31.6%.[16] This infer the increasing trend of drug resistance in current scenario which can be due to blind use of broad spectrum antibiotics and the unique feature of P. aeruginosa to acquire resistance due to low permeability of the cell wall, the production of inducible cephalosporinases, an active efflux and a poor affinity to the target sites.[17]

Further we screened the isolates resistant to carbepenems by imipenem (IMP)-EDTA combined disc method. WE found 56.75% suspected cases of metallo β lactamase producing P. aeruginosa. According to several studies MBL production in P. aeruginosa ranged from 7% to 65%.[18-22]

The ureidopenicillin group represented by piperacillin-tazobactam showed a relatively lower resistance of 32.33% in our study. Amongst the aminoglycosides, amikacin and gentamicin showed resistance of 37.72% & 31.13% respectively. The rate of MDR P. aeruginosa is accelerating in the world especially in developing countries causing a life threatening situation. We found 31.73% strains of P. aeruginosa were multidrug resistant which is quite equivocal to the results shown by Flamm et al. (29.25%).[23]

CONCLUSION

As the prevalence rate of multidrug resistance continues to rise and spread worldwide, it is becoming a serious issue in hospital settings leading to higher rate of nosocomial infections. There is increasing trend of antibiotic resistance to the drugs which were highly sensitive. Periodic surveillance of the sensitivity pattern should be carried over time to time, to detect the resistance trends. Also, a judicious strategy on the restricted and prudent use of antipseudomonal agents is immediately required which would combat the morbidity & mortality by these strains.

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Conflict of interest: None declared
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