"The Rising Threat of Drug Resistant in Pseudomonas (P. Aeruginosa) in Patients Attending a Tertiary Care Hospital, Kanpur."

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Abstract:

Introduction: The potentiality of Pseudomonas spp. to produce variety of drug resistance mechanism has led to evolution of drug resistant phenotypes with its ability to rapidly develop resistant to multiple cases of antibiotics. Although the impact of resistance mechanisms on mobile genetic elements is always a concern, the most different change we face with pseudomonas is its ability to rapidly develop resistance driving challenge for clinicians in the treatment of severe patients.

Aim: To determine the rising threat of Drug resistant in Pseudomonas (P. aeruginosa) inpatients attending a tertiary care hospital Kanpur.

Materials and Methods: The study was carried out in the Dept. of Microbiology RMCH &RC for a period of 6 months from Jan 2021 to June 2021. A total of 27 isolates of P. aeruginosawere isolated from 302 clinical samples of patients attending a tertiary care centre. Antimicrobial Susceptibility Testing (AST) was performed for all isolates by standard KirbyBauer disc diffusion method on Mueller Hinton Agar (MHA) according to the CLSI guidelines. Phenotypic profiling of Extended Spectrum b-Lactamase (ESBL) and Metallo b-Lactamase (MBL) was performed by disc potentiation test Imipenemase (IMP). The obtained results were statistically analysed.

Result: Out of 302 total clinical samples, 27 isolates were P. aeruginosawith the incidence rate of 8.94%.Males were more as compared to Females with (62.96%) and(37.03%) respectively. The maximum age group was seen in 21-40 age group 33.33%.Among 27 patients IPD patients were (89%) and OPD with (11%). Pus samples was the most common sample isolated (66.66%). Out of 27 isolates 11(40.74%) were ESBL producers and 6 (22.2%) and were MBL producers. Among 27 Pseudomonas isolates, 11 (40%) were MDR phenotypes, 2 (7.4%) were XDR phenotypes and there were no PDR phenotypes isolated in present study as all isolates were 100% sensitive to Colistin and Polymyxin B.

Conclusion: Strict antibiotic policies and regular surveillance programme for antimicrobial resistance should be tailored to fend off the emergence of drug resistant P. aeruginosa. Colistin and Polymyxin B still shows high sensitivity against MDR P. aeruginosa and XDR P. aeruginosa phenotypes. Early detection of b-lactamases should be performed regularly for all clinical isolates of Pseudomonas aeruginosa toguide antibiotic selection and for the better management of serious infection...

Keywords: Drug AST, ESBL, MBL MDR, Pseudomonas aeruginosa

Introduction

Pseudomonas is a rod-shaped, aerobic, Gram-negative bacterium belonging to the family Pseudomonadaceae [1]. Pseudomonas aeruginosa easily adapts to the environment inhabits and can also colonize and invade a human host to cause serious infections [2, 3]. P. aeruginosa isolates that cause infections are thought to express various virulence factors. This pathogen is one of the most common causes of pneumonia [4, 5].

Risk factors for the development of infections caused by Pseudomonas include neutropenia, cystic fibrosis, severe burns, and foreign device installations [2, 3]. The general human population is refractory against infections caused by Pseudomonas species, but Pseudomonas species are physiologically highly flexible and able to act as opportunistic pathogens in humans with weakened immune systems [6]. P. aeruginosa causes life-threatening community-acquired pneumonia, nosocomial infections such as pneumonia, urinary tract infections, and bacteremia; and chronic lung infections in patients with cystic fibrosis [7]. microbiological cause of a case of pneumonia is especially important for preservation of the sensitivity of bacteria to antibiotics and for regulation of drug therapy [7] Pneumonia due to Pseudomonas can be transmitted in hospitals by nursing staff, medical equipment, sinks, disinfectants, and food. Pseudomonas infections are a serious problem in hospitals for two reasons. First, patients who are critically ill can die from pneumonia caused by Pseudomonas. Second, the elimination of P. aeruginosa in patients with infections is very difficult because of its resistance to a variety of antibiotics [7]. P. aeruginosa currently shows resistance to the following antibiotics: penicillin G; aminopenicillin, including those combined with beta-

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lactamase inhibitors; first and second generation cephalosporins; piperacillin; piperacillin and tazobactam; cefepime; ceftazidime; aminoglycosides; the quinolones; and the carbapenems; as well as colistin and fosfomycin [8]. Therefore, distinguishing the trends in resistance of P. aeruginosa becomes important for choosing the right antibiotic because P. aeruginosa is the fourth most common cause of pneumonia [9].

Material and Methods

The study was carried out in the Dept. of Microbiology RMCH &RC for a period of 6 months from Jan 2021 to June 2021. A total of 27 isolates of P. aeruginosa were isolated from 302 clinical samples of patients attending a tertiary care centre. Bacterial colonies on MacConkey agar plates showed non lactose fermenting pale colour colonies and were oxidase test positive. Whereas on nutrient agar, showing greenish colouration due to production of pyoverdine pigment and oxidase positive. Antimicrobial Susceptibility Testing (AST) was performed for all isolates by standard KirbyBauer disc diffusion method on Mueller Hinton Agar (MHA) according to the CLSI guidelines [10]. Phenotypic profiling of Extended Spectrum b-Lactamase (ESBL) and Metallo b-Lactamase (MBL) was performed by disc potentiation test Imipenemase (IMP). The obtained results were statistically analysed.

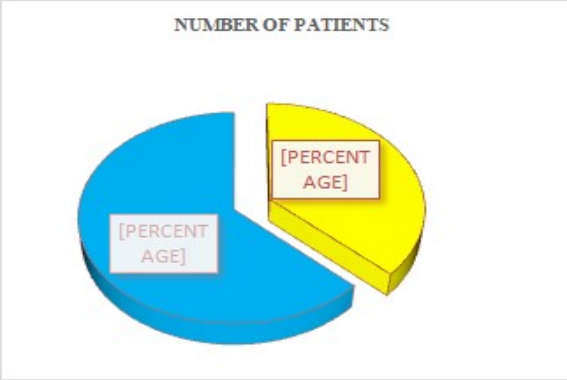
Sample Size: Out of 302 total human clinical samples, 27 isolates were P. aeruginosa with the incidence rate of 8.94%that the real value is within + 5% of the surveyed value. The population has taken 50%. Sample size was calculated using Calculator.net. Samples collected from OPD, IPD, ICU, HDU, Wards. Patient's ongoing antibiotic therapy for the last 15 days.

Results

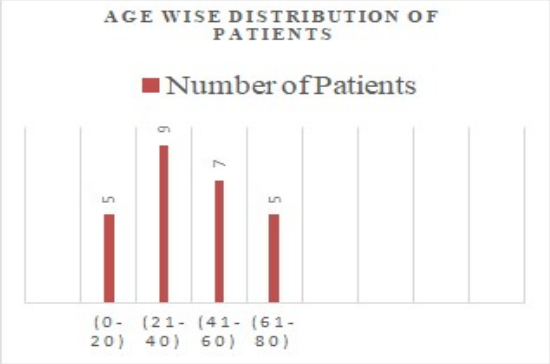
Out of 302 total clinical samples, 27 isolates were P. aeruginosa with the incidence rate of 8.94%. Males were more as compared to Females with (62.96%) and (37.03%) respectively. The maximum age group was seen in 21-40 age group 33.33%. Among 27 patients IPD patients were (89%) and OPD with (11%). Pus samples was the most common sample isolated (66.66%). Out of 27 isolates 11(40.74%) were ESBL producers and 6 (22.2%) and were MBL producers. Among 27 Pseudomonas isolates, 11 (40%) were MDR phenotypes, 2 (7.4%) were XDR phenotypes and there were no PDR phenotypes isolated in present study as all isolates were 100% sensitive to Colistin and Polymyxin B.

Table1: Distribution to the type of isolates.

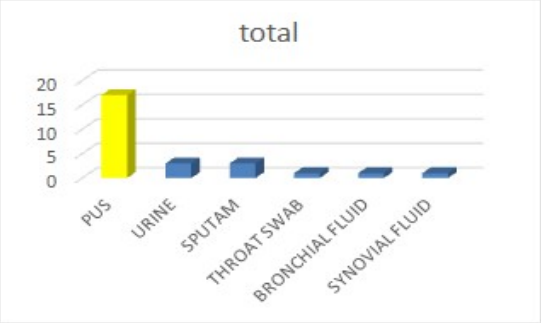
S. No	Type of isolate	No .of isolates	Percentage
1.	Clinical sample	302	91%
2.	pseudomonas	27	8.9%



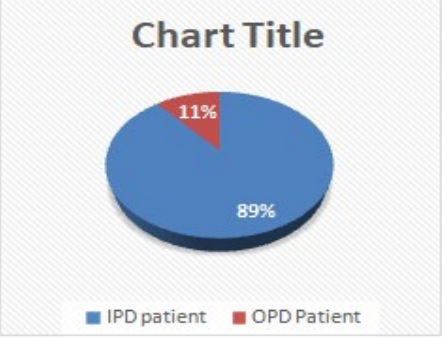
[Graph - 1]: Gender wise distribution of bacteria isolated in our study.



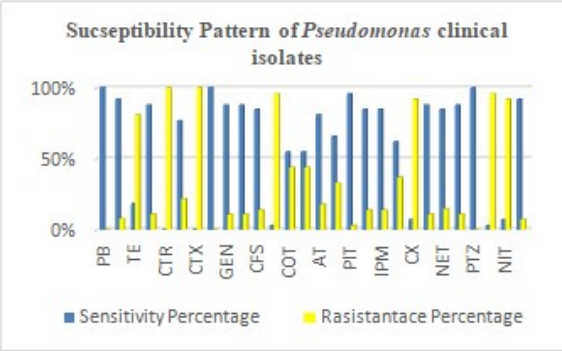
[Graph - 2]: Age wise distribution of patients



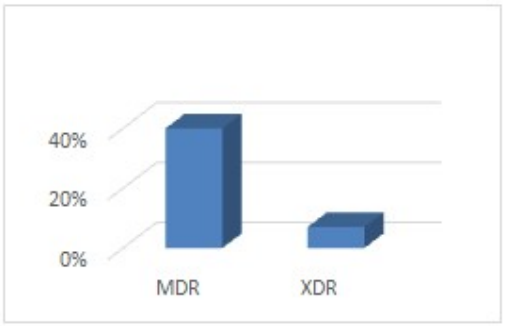
[Graph - 3]: Sample wise distribution of the isolates



[Graph - 4]: Distribution of Pseudomonas from different words.



[Graph -5]: AST profile for various antibiotics with respect to pseudomonas.



[Graph - 6]: Representation of MDR and XDR.

Discussion

Emergence of MDR, XDR phenotypes in P. aeruginosa has become a serious threat in recent years and the treatment of these phenotypes is very challenging task for the clinicians.[11,12,13]. The incidence of pseudomonas in our study is 8.94% which is similar to the study done by other author Majdi N. AI- Hasan el al [14]. The seroprevalence rate of MDR and XDR P. aeruginosa in present study was 40% and 7.4%, respectively. For MDR P. aeruginosa isolates, the drug of choice is carbapenemsbut due to increasing resistance towards carbapenems is now a serious threat. In the present study, the resistance pattern for Imipenem and Meropenem was lowest as 15% and 14%, respectively. However, Bhatt P et al., reported the resistance pattern of 61% and 54%, respectively for MDR P. aeruginosa isolates [15]

Table no. 2: Comparison of MDR with other studies.

S.No	Study	Year	XDR (prevalence)
1	Dash M et al.,[15]	2014	35%
2	Gill JS et al.,[11]	2016	2.50%
3	Shivendra dutt Shukla et al.,[18]	2021	7%
4	Present study	2022	7.40%

Table no.3: Comparison of XDR with other studies.

S.No	Study	Year	MDR (Prevalence)
1	Dash M et al.,[16]	2014	84.70%
2	Singh NP et al.,[17]	2017	15.20%
3	Shivendra dutt Shukla et al.,[18]	2021	52%
4	Present study	2022	40%

The seroprevalence rate of MDR and XDR *P. aeruginosa* in present study was 40% and 7.4%, respectively. For MDR *P. aeruginosa* isolates, the drug of choice is carbapenemsbut due to increasing resistance towards carbapenems is now a serious threat. In the present study, the resistance pattern for Impanel and Meropenem was lowest as 15% and 14%, respectively. However, Bhatt P et al., reported the resistance pattern of 61% and 54%, respectively for MDR *P. aeruginosa* isolates [15]

The Present study shows MDR strains to be 40% which is in support with the study performed by Dash M et al.,[16] and Shivendra dutt Shukla et al.,[18]and in contrast with the study carried out in year 2017 by Singh NP et al,.

The Present study shows XDR strains to be 7.4% which is higher than carried out in year 2014 by Dash M et al, and lower than carried out in year 2016 by Gill JS et al,[11] and similar to the study and in accordance with the study in year 2021 by Shivendra dutt Shukla et al.[17] The Present study shows MDR strains to be 63% for male and 37% for female in age group 21-40 which is higher than carried out in year 2010 by Desirre Caselli et al 67%for male and 33% for female.

Conclusion

Strict antibiotic policies and regular surveillance programme for antimicrobial resistance should be tailored to fend off the emergence of drug resistant P. aeruginosa. Colistin and Polymyxin B still shows high sensitivity against MDR P. aeruginosa and XDR P. aeruginosa phenotypes. Early detection of b-lactamases should be performed regularly for all clinical isolates of Pseudomonas aeruginosa to guide antibiotic selection and for the better management of serious infection.

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