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Original Research Article

Antibiotic Susceptibility Pattern of *Pseudomonas Aeruginosa* Isolated From Various Clinical Samples at a Tertiary Care Centre

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ABSTRACT

Pseudomonas aeruginosa is inherently resistant to many antimicrobial agents owing to impermeability, multi-drug efflux and a chromosomal AmpC β-lactamase. So, the current study was undertaken to determine the antibiotic susceptibility pattern of pseudomonas aeruginosa isolated from various clinical samples. The study was conducted over a period of one year, January 2013 to December 2013.Total 3175 samples were studied. The various clinical samples included in the study were pus exudates from various body lesions, body fluids etc. All samples were inoculated on 5% blood agar and MacConkey agar and incubated for 24-48 hours at 37^0C. From the growth on these media, identification of Pseudomonas aeruginosa was done. All confirmed isolates were subjected to antibiotic susceptibility test by the Kirby-Bauer disc diffusion method as suggested by CLSI guidelines using the following antibiotic discs. Amikacin, Ceftazidime, Ciprofloxacin, Gentamicin, Imipenem, Piperacillin, Tobramycin. Of the 3175 clinical samples studied, Pseudomonas aeruginosa were isolated in 292 samples. Maximum number of Pseudomonas isolates was found in pus [14.11%]. In our study, the isolates were susceptible to Imipenem by 98.97 % followed by Amikacin 88.01% and then Tobramycin 78.47%. The minimum susceptibility or the maximum resistance by Pseudomonas isolates in our study was shown to Ceftazidime [33.90 %]. Imipenem was the only anti-pseudomonal drug against which all isolates of *P. aeruginosa* were almost fully sensitive. We suggest a more restricted and a more rational use of this drug in this hospital setting. Regular anti-microbial susceptibility monitoring is essential for local, regional and national level isolates.

Key words: Antibiotic Susceptibility, *Pseudomonas aeruginosa*

INTRODUCTION

The worldwide emergence of multi-drug resistant bacterial strains in hospitals and community continues to be a problem of due scientific concern, especially infections caused by *Pseudomonas* species and *Pseudomonas aeruginosa* in particular. [1]

Multiple antibiotic resistance in bacterial populations is a pervasive and growing clinical problem, which is recognized as a threat to public health. Hence, there is a need to conduct area-specific monitoring studies to profile different pathogens responsible for specific infections and their resistance patterns, so as

to generate data that would help clinicians to choose the correct empirical treatment. [2]

Pseudomonas aeruginosa is inherently resistant to many antimicrobial agents owing to impermeability, multi-drug efflux and a chromosomal AmpC β-lactamase. [3]

The most common resistance mechanism against various β-lactam drugs is the selection of mutations leading to the hyper production of chromosomal *AmpC*. The derepressed mutants can be selected in clinical settings expressing resistant phenotype. [4]

It has the unique ability to infect all body systems. It almost exclusively infects hospitalized patients with lowered host resistance and is the most frequent pathogen isolated from nosocomial infections in the ICU. [5]

In India the prevalence of MBLs range from 7.5% to 71%, but there are very few documented reports. [6]

So, the current study was undertaken to determine the antibiotic susceptibility pattern of Pseudomonas aeruginosa isolated from various clinical samples.

MATERIALS AND METHODS

The study was conducted over a period of one year, January 2013 to December 2013.

Total 3175 samples were studied. The various clinical samples included in the study were pus exudates from various body lesions, sputum, urine, blood, various body fluids other than blood like pleural fluid, ascitic fluid, CSF etc.

All samples were inoculated on 5% blood agar and MacConkey agar and incubated for 24-48 hours at 37^0C. From the growth on these media, identification of Pseudomonas aeruginosa was done following the guidelines given in manual of clinical microbiology. [7]

All confirmed isolates were subjected to antibiotic susceptibility test by the Kirby-Bauer disc diffusion method as suggested by CLSI guidelines using the following antibiotic discs [Hi-Media]-

AK- Amikacin [30mcg/disc], CAZ- Ceftazidime [30 mcg/disc], CIP- Ciprofloxacin[5 mcg/disc], GEN- Gentamicin [10 mcg/disc], IPM- Imipenem [10 mcg/disc], PI- Piperacillin [100 mcg/disc], TOB- Tobramycin [10 mcg/disc].

OBSERVATIONS

Table No. 1: Pseudomonas isolated from various clinical samples

Total number of samples	Number of Pseudomonas isolates [% in bracket]
Pus [907]	128 [14.11]
Sputum [881]	62 [7.03]
Urine [467]	34 [7.28]
Blood [279]	16 [5.73]
Body fluids other than blood [431]	48 [11.13]
CSF [210]	4 [1.90]
Total- 3175	292 [9.19]

Of the 3175 clinical samples studied, Pseudomonas aeruginosa were isolated in 292 samples. Maximum number of Pseudomonas isolates were found in pus [14.11%], followed by body fluids [11.13%].

Out of total Pseudomonas isolates, 181 isolates were obtained from male patients and rest of the isolates from females.

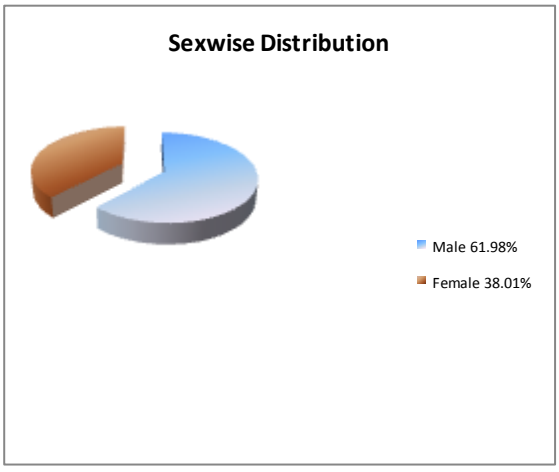

Fig. No. 1: Sex wise distribution of the Pseudomonas isolates

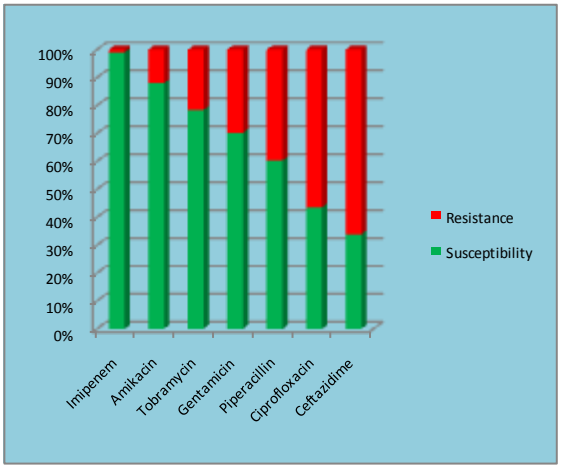

Fig. No.2: Bar diagram showing the percentage of susceptibility and resistance to the various anti pseudomonal drugs

Table No.2: The antibiotic susceptibility of the Pseudomonas isolates from Pus (64) specimens

Antibiotic	Sensitive	Sensitivity in %	Resistance	Resistance in %
Amikacin	52	81.25	12	18.75
Ceftazidime	20	31.25	44	68.75
Ciprofloxacin	30	46.87	34	53.12
Gentamicin	47	73.43	17	26.56
Imipenem	64	100.00	0	0.00
Piperacillin	45	70.31	19	29.68
Tobramycin	59	92.18	5	7.81

Table No.3: The antibiotic susceptibility of the Pseudomonas isolates from Swab [64] specimens-

Antibiotic	Sensitive	Sensitivity in %	Resistance	Resistance in %
Amikacin	58	90.62	6	9.37
Ceftazidime	18	28.12	46	71.87
Ciprofloxacin	20	31.25	44	68.75
Gentamicin	32	50.00	32	50.00
Imipenem	64	100.00	00	0.00
Piperacillin	40	62.5	24	37.5
Tobramycin	48	75.00	16	25.00

Table No. 4: The antibiotic susceptibility of the Pseudomonas isolates from Sputum [62] specimens-

Antibiotic	Sensitive	Sensitivity in %	Resistance	Resistance in %
Amikacin	60	96.77	2	3.12
Ceftazidime	33	53.22	29	46.77
Ciprofloxacin	25	40.32	37	59.67
Gentamicin	58	93.54	4	6.45
Imipenem	61	98.38	1	1.61
Piperacillin	47	75.80	15	24.19
Tobramycin	55	88.70	7	11.29

Table No. 5: The antibiotic susceptibility of the Pseudomonas isolates from various body fluids [48] specimens

Antibiotic	Sensitive	Sensitivity in %	Resistance	Resistance in %
Amikacin	42	87.5	6	12.5
Ceftazidime	16	33.33	32	66.67
Ciprofloxacin	20	41.66	28	58.33
Gentamicin	30	62.5	18	37.5
Imipenem	46	95.83	2	4.16
Piperacillin	22	45.83	26	54.16
Tobramycin	37	77.08	11	22.91

Table No.6: The antibiotic susceptibility of the Pseudomonas isolates from urine [34] specimens-

Antibiotic	Sensitive	Sensitivity in %	Resistance	Resistance in %
Amikacin	30	88.23	4	11.76
Ceftazidime	8	23.52	26	76.47
Ciprofloxacin	20	58.82	14	41.17
Gentamicin	19	55.88	15	44.11
Imipenem	34	100.00	0	0.00
Piperacillin	18	52.94	16	47.05
Tobramycin	18	52.94	16	47.05

Table No.7: The antibiotic susceptibility of the Pseudomonas isolates from blood [16] specimens-

Antibiotic	Sensitive	Sensitivity in %	Resistance	Resistance in %
Amikacin	14	87.5	2	12.5
Ceftazidime	4	25	12	75
Ciprofloxacin	10	62.5	6	37.5
Gentamicin	16	100.00	0	0.00
Imipenem	16	100.00	0	0.00
Piperacillin	4	25.00	12	75.00
Tobramycin	12	75.00	4	25.00

Table No. 8: The antibiotic susceptibility of the pseudomonas isolates from CSF [4] specimens -

Antibiotic	Sensitive	Sensitivity in %	Resistance	Resistance in %
Amikacin	1	25.00	3	75.00
Ceftazidime	0	0.00	4	100.00
Ciprofloxacin	2	50.00	2	50.00
Gentamicin	3	75.00	1	25.00
Imipenem	4	100.00	0	0.00
Piperacillin	0	0.00	4	100.00
Tobramycin	0	0.00	4	100.00

RESULTS AND DISCUSSION

Out of 3175 clinical samples of various natures, Pseudomonas species were isolated in 292 samples i.e. 9.19 %.Whereas the previous one year study at the same institute recorded 157 pseudomonas aeruginosa isolates from 1742 specimens. From this it can be inferred that Pseudomonas aeruginosa is undoubtedly an important nosocomial pathogen. However the percentage of Pseudomonas aeruginosa found in our study is somewhat lower than that from the study by Viren A. Javiya [2] and others which was 20.28%, and from S Shenoy [5] and others which was 31.52%.

Maximum numbers of Pseudomonas were isolated from Pus [14.11%] followed by Body fluids [11.13%] and urine [7.28%]

The following table compares the sample wise isolation of Pseudomonas aeruginosa in previous and present study at our institute.

Table No.9: The comparison of sample wise isolation of Pseudomonas aeruginosa in previous and present study at this institute

Specimens(n)	Pseudomonas aeruginosa (%)	
	Previous study	Present study
Pus	11.32%	14.11%
Sputum	7.92%	7.03%
Urine	4.13%	7.28%
Others	3.13%	7.39%
Total	9.01%	9.19%

In the study by S Shenoy [5] and others, Pus was the specimen from which Pseudomonas was isolated in maximum numbers, followed by Urine. Whereas maximum Pseudomonas isolates were from urine samples in the study by Viren A Javiya. [2] Vijaya Chaudhari et al [8] mentioned that pus samples (35.3%) showed highest culture positivity followed by sputum (20.8%) and urine (13%).

Antibiotic Sensitivity Pattern

In our study, the isolates were susceptible to Imipenem by 98.97 % followed by Amikacin 88.01% and then Tobramycin 78.47%. Following is the table comparing the antibiotic sensitivity patterns observed in the previous and present study at our institute.

Table No.10: The comparison of the antibiotic sensitivity patterns observed in the previous and present study at this institute

Antibiotic	Sensiivity pattern (susceptibility in %)	
	Previous study	Present study
Ceftazidime	33%	33.90%
Amikacin	67%	88.01%
Imipenem	89%	98.97%

However, only 33.37% sensitivity was observed in the study by Tamil Selvi Sivanmalappan [9] and others.

It's noteworthy that this study was restricted for the isolates from diabetic foot ulcers only.

In the study by Anurag Payasi et al [10] the susceptibility of Pseudomonas aeruginosa to Imepenem was 66.7%

Our findings about Imipenem are comparable with the study by S Shenoy [5] and others [100%] and Viren A Javiya [2] and others [78.57%]

The minimum susceptibility or the maximum resistance by Pseudomonas isolates in our study was shown to Ceftazidime [33.90 %]

This is somewhat lower than that observed in other studies, by Anurag Payasi et al [10] (44.8%), Viren A Javiya [2] and others [67.86%], by S Shenoy [5] and others [57.08%]

The susceptibility pattern for the drugs Amikacin and Ceftazidime was 67% and 33% in the previous study. This observation is also consistent in the present study [88.1% and 33.9%].

Most infections with Pseudomonas species occur in compromised hosts. The pathogenicity of these organisms is based on its ability to produce a variety of toxins and proteases and also on its ability to resist phagocytosis. [11]

In addition to its planktonic lifestyle, *P. aeruginosa* forms dense biofilms. MICs and minimal bactericidal concentrations can be 100 to 1,000 times greater in these biofilms than for the equivalent planktonic population. [12]

Development of resistance by Pseudomonas species is seen among α-carboxy- and amino-penicillins, third- and fourth-generation cephalosporins, mono-bactams, carbapenems, aminoglycosides and fluoroquinolones. Resistance to each of these drug classes can arise by various mutations causing up regulation of efflux or down regulation of permeability or, in the case of aminopenicillins and cephalosporins, via hyper production of the chromosomal AmpC β-lactamase. [13]

Increasing resistance to different anti-pseudomonal drugs particularly among hospital strains has been reported world-wide and this is a serious therapeutic problem in the management of disease due to these organisms. [14]

CONCLUSION

Results of the present study have demonstrated the occurrence of resistance to various antipseudomonal agents among the *P. aeruginosa* isolates. Imipenem was the only anti-pseudomonal drug against which all isolates of *P. aeruginosa* were almost fully sensitive. We suggest a more restricted and a more rational use of this drug in this hospital setting. Amikacin, Tobramycin and Gentamicin could be the preferred drugs for optimal management of infections caused by *P. aeruginosa*. Regular anti-microbial susceptibility monitoring is essential for local, regional and national level isolates. This would help and guide the physicians in prescribing the right combinations of anti-microbials to limit and prevent the emergence of multi-drug resistant strains of *P. aeruginosa*.

REFERENCES

1. Shaikh S. et al., Prevalence of multidrug resistant and ESBL producing Pseudomonas aeruginosa in a tertiary care hospital, Saudi journal of biological sciences. 2014.06.001
2. Javiya V A et al. Antibiotic susceptibility patterns of Pseudomonas aeruginosa at a tertiary care hospital in Gujarat, India. Indian J Pharmacol, oct 2008, 40(5): 230-234.
3. Henwood C J et al. Antimicrobial susceptibility of Pseudomonas aeruginosa: results of a UK survey and evaluation of the British Society for Antimicrobial Chemotherapy disc susceptibility test Journal of Antimicrobial Chemotherapy.Vol 47(06): 789-799.
4. Upadhyay S et al. Co-existence of Pseudomonas-derived cephalosporinase among plasmid encoded CMY-2 harboring isolates of Pseudomonas aeruginosa in north India. IJMM. 2013 31(03): 257-260.
5. Shenoy S et al. Antibiotic sensitivity patterns of Pseudomonas aeruginosa strains isolated from various clinical specimens. Indianjmedsciences. 2002 56(09): 427-430.
6. Kumar S H, Day AS et al. Prevalence and risk factors of metallo β-lactamase producing *Pseudomonas aeruginosa* and *Acinetobacter species* in burns and surgical wards in a tertiary care hospital. Journal of laboratory physicians. 2012 4(01): 39-42.
7. Gillgan PH, Pseudomonas aeruginosa and burkholderia, In Murray PR, Baron EJ, Pfaler AA et al, eds. Manual of clinical Microbiology, American Society of Microbiology, 1995. 6th sub ed. Pp 509-19,.
8. Chaudhary V et al. Antibiotic resistance patterns of Pseudomonas aeruginosa in a tertiary care hospital in central India. International journal of Medical science and public health. 2013 2(02): 386-389.
9. Tamil S S et al. Antimicrobial Susceptibility Patterns of Pseudomonas aeruginosa from Diabetes Patients with Foot Ucers. International Journal of Microbiology. 2011 article id 605195, 4 pages.
10. Payasi A , Chaudhary M,. Rising Antimicrobial Resistance of Pseudomonas aeruginosa Isolated from Clinical Specimens in India. Journal of Proteomics and bioinformatics. 2013 6: 005-009.
11. Baltimore R. S., "Pseudomonas," in Nelson Textbook of Pediatrics, pp. 862–864.
12. Dominic Hill et al, Antibiotic Susceptibilities of Pseudomonas aeruginosa Isolates Derived from

Patients with Cystic Fibrosis under Aerobic, Anaerobic, and Biofilm Conditions, J. Clin. Microbiol. October 2005 vol. 43 no. 10 5085-5090.
13. Livermore, D. M. & Yang. Y. J. (1987). β-Lactamase lability and inducer power of newer β-lactam antibiotics in relation to their activity against β-lactamase-inducibility mutants of Pseudomonas aeruginosa. Journal of Infectious Diseases 155, 775–82.
14. Chander et al. Antimicrobial susceptibility patterns of pseudomonas aeruginosa clinical isolates at a tertiary care hospital in Kathmandu, Nepal. Asian journal of pharmaceutical and clinical research, Vol 6, Suppl 3, 2013.

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