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Hospital Antibiogram - As an aid in selecting empiric antibiotic therapy

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Abstract

Background: An antibiogram is an overall profile of antimicrobial susceptibility testing results of specific microorganisms to a different group of antimicrobial drugs. Antibiograms are often used by clinicians to assess local susceptibility rates, as a tool in selecting empiric antibiotic therapy and in monitoring resistance patterns over time within an institution. This study determined the antibiogram of bacterial isolates from different clinical samples.

Methods: Clinical specimens such as swab from wound, urine, sputum, blood and throat swab were sampled following standard operating procedures. Antimicrobial susceptibility test was performed according to CLSI guidelines.

Results: Overall, 95(24%) samples were culture positive during the period of July, 2020 to September, 2021. Off the 95 culture positive isolates, Staphylococcus aureus 29 (31%), Pseudomonas aeruginosa 20 (21%), Klebsiellae 17 (18%), Eshcerchia coli (E. coli) 16(17%) and other bacteria 13 (13.6%). Among 29 Staphylococcus aureus, 75% isolates were resistant to fluroquinolones, penicillin and 37% isolates were resistant to tetracyclin and 48% MRSA. Out of 20 Pseudomonas aeruginosa, 40% isolates were resistant to aminoglycosides, fluroquinolones, ceftazidime and piperacillin tazobactum E. coli and Klebsiellae isolates showed 95% resistant against the first- and second-generation cephalosporin's, whereas fluroquinolones, Aztreonam, ceftazidime, co-trimoxizole showed 58% resistant and aminoglycosides, piperacillin tazobactum showed 31% resistant.

Conclusion: Most of the identified bacteria were resistant to the routinely used antibiotics and multidrug-resistant isolates are increasing day by day. Therefore, it is recommended to have strict antibiotics utilization policies within the hospital and to support clinicians on rational choice of antibiotic therapy.

Keywords: Bacterial isolates, Hospital Antibiogram, CLSI, Empiric antibiotic therapy.

Introduction

The hospital antibiogram is a periodic summary of antimicrobial susceptibilities of local bacterial isolates submitted to the hospital's clinical microbiology laboratory. Antibiograms are often used by clinicians to assess local susceptibility rates, as an aid in selecting empiric antibiotic therapy, and in monitoring resistance trends over time within an institution. Antibiograms can also use to compare susceptibility rates across institutions and track resistance trends.[1]

It is crucial to monitor emerging trends in resistance at the local level to support clinical decision making, infection-control interventions, and antimicrobial-resistance containment strategies. Monitoring of antimicrobial resistance trends is commonly performed in health care facilities using an annual summary of susceptibility rates, known as a cumulative antibiogram report.[2]

The clinical microbiologist plays an important role in making of the antibiogram. The foremost thing is the accurate daily reporting of bacterial cultures with antibiotic sensitivity test as per standard CLSI guidelines.[3] It is a good practice to detect certain multidrug resistant organisms like Methicillin Resistant Staphylococcus aureus (MRSA), Extended Spectrum β-lactamases (ESBLs), Vancomycin Resistant Entericocci (VRE), etc., and include a remark on the implications of such reporting in the results and advice appropriate therapy and infection control precautions. Then there is the need for accumulate the antibiogram data for over a period of time viz., quarterly, half yearly or annually.[3] Finally, the microbiologist plays a role in the formulation of the hospital antibiotic policy, translating the cumulative antibiogram into practical applications.

Material & Methods

A prospective cross-sectional study was done between July, 2020 to September, 2021 in Shantabaa Medical College & General Hospital, Amreli, Gujarat. Clinical specimens such as swab from wound, urine, sputum, blood and throat swab were sampled following standard operating procedures. Depending on the source of the specimen, each sample was plated on Blood agar, MacConkey's agar, CLED agar, Nutrient agar and Chocolate. All the inoculated plates were incubated aerobically at 37^0C for 24-48 hrs. Bacterial isolates were identified by standard phenotypic microbiological methods.

Antimicrobial susceptibility test

Susceptibility of bacterial isolates to different antibiotics was analyzed by Kirby–Bauer disk diffusion susceptibility testing on Muller Hinton Agar (MHA). All the identified bacterial isolates were checked for susceptibility to Ampicillin (10 μg), Penicillin (10 μg), Cefoxitin (30 μg),Ttetracycline (30 μg), Nitrofurantoin (300 μg), Chloramphenicol (30 μg), Gentamicin (10 μg), Tobramycin(10 μg), Amikacin (30 μg), Ampicillin /Sulbactam(10/10 μg), Piperacillin/tazobactam (100/10 μg), Ciprofloxacin (5 μg), Levofloxacin (5 μg), Cotrimoxazole (25 μg), Trimethoprim (5 μg), Vancomycin (30 μg), Norfloxacin (10 μg), Fosfomycin

(200 µg), Azithromycin (15 µg), Clindamycin (2 µg), Linezolid (30 µg), Cefepime (30 µg), Cefotaxime (30 µg), Aztreonam (30 µg), Imipenem (10 µg) and Meropenem (10 µg).

The choice of antibiotic agents is based on the commonly available drugs and drugs which are frequently prescribed by physicians. Resistance data were interpreted according to zone sizes from the Clinical and Laboratory Standards Institute (CLSI) guideline. American Type Culture Collection (ATCC) standard reference strains (E. coli ATCC-25922 and S. aureus ATCC-25923) were used to verify the performance of the culture media and antibiotics.[4]

Results & Discussion

Overall, 95(24%) samples were culture positive during the period of July, 2020 to September, 2021. Off the 95 culture positive isolates, Staphylococcus aureus 29 (31%), Pseudomonas aeruginosa 20 (21%), Klebsiellae 17 (18%), Eshcerchia coli (E. coli) 16(17%) and other bacteria 13 (13.6%) [Chart 1]. Our finding correlates with Bessa et al., [5] who reported Staphylococcus aureus (S. aureus) was the dominant bacterial species from the wound followed by Pseudomonas aeruginosa, Proteus mirabilis and E. coli. According to Dryden [6] S. aureus and MRSA are major causes of soft tissue infection in hospitalized patients.

Among 29 Staphylococcus aureus, 75% isolates were resistant to fluroquinolones, penicillin and 37% isolates were resistant to tetracyclin. Overall, 48% of Staphylococcus aureus were cefoxitin resistant and they were reported as Methicillin resistant staphylococcus aureus (MRSA). Our finding were correlated with the finding of Trojan et al. [7-9], that S. aureus was highly susceptible to Vancomycin and Linezolid and it showed resistance to ampicillin, amoxyclav, ciprofloxacin and azithromycin. Out of 20 Pseudomonas aeruginosa, 40% isolates were resistant to aminoglycosides, fluroquinolones, ceftazidime and piperacillin tazobactum E. coli and Klebsiellae isolates showed 95% resistant against the first- and second-generation cephalosporin’s, whereas fluroquinolones, Aztreonam, ceftazidime, co-trimoxizole showed 58% resistant and aminoglycosides, piperacillin tazobactum showed 31% resistant. Acinetobacter exhibited 100% resistant against fluoroquinolones, ceftriaxone and ceftazidime.

[Table 1 and Table 2] Our data analysis regarding the susceptibility patterns of antimicrobials confirms or contradict the findings of previous studies. For example, Acinetobacter and Pseudomonas were most susceptible to amikacin in a study conducted by Riyadh [10-11], in our study also aminoglycosides were showed sensitive. Whereas study conducted by Gill M.K. et.al.,[12] observed a high level resistant to the fluoroquinolones and aminoglycosides. In their study Ciprofloxacin was found resistant in 96% whereas Amikacin resistance was 85% and Gentamicin 89% respectively. The resistant to fluroquinolones could be due to mutations in the chromosomal genes encoding DNA gyrase of the bacteria or due to efflux of the drug.[13]

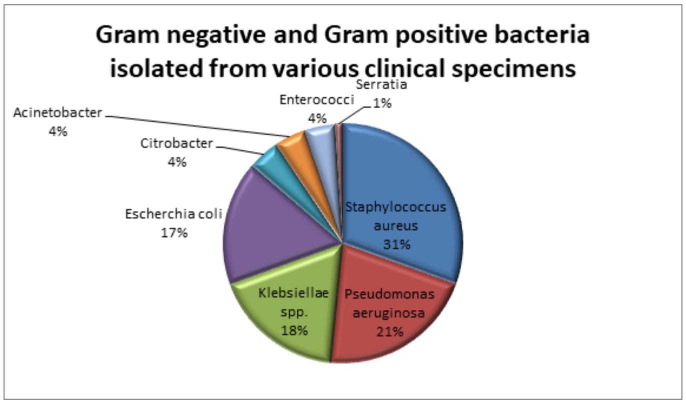
Table 1: Antibiogram of Gram-negative bacteria

Organism (No. of isolates = n)	The following antibiotics showing Resistance (R) against the number of isolates																					
	GENTAMI	TOBRAMY	AMIKACIN	AMPICILLI	PIPERACIL	CEFUROXI	CEFIPIME	CEFOXITI	CEFTRIOX	CIPROFLO	LEVOFLO	IMIPENEM	COTRIMO	AZTREON	CEFTAZA	CHLORAM	TETRACY	CEFAZOLI	FOSFOMY	NITROFUR	AMPICILLI	MINOCYC
Pseudomonas aeruginosa (n=20)	7	7	6	-	7	-	7	-	-	9	7	1	-	5	8	-	-	-	-	-	-	-
Escherichia coli (n=16)	7	7	5	11	5	16	11	10	15	11	11	0	8	11	14	5	16	6	1	-	16	-
Klebsiellae spp. (n=17)	7	6	4	9	5	16	10	11	15	10	9	3	10	10	14	7	16	7	-	-	-	-
Citrobacter (n=4)	1	1	1	-	-	1	2	1	3	1	1	-	3	3	3	-	2	1	-	-	2	-
Acinetobacter (n=4)	-	-	0	2	-	1	1	1	4	3	3	-	2	1	4	-	1	-	-	-	1	1
Serratia (n=1)	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	1	1	-	-	-	1	-

Table 2: Antibiogram of Gram-Positive bacteria

Organism (No. of isolates = n)	The following antibiotics showing Resistance (R) against the number of isolates															
	GENTAMICIN	AMPICILLIN/ SULBACTUM	CLINDAMYCI	CEFOXITIN	CIPROFLOXA	LEVOFLOXA	COTRIMOXIZ	LINEZOLID	PENICILLIN	CHLORAMPJ	TETRACYCLI	CEFAZOLIN	FOSFOMYCIN	NITROFURON	AMPICILLIN	MINOCYCLIN
Staphylococcus aureus (n=29)	10	-	6	14	22	23	11	-	23	3	10	-	-	-	23	-
Enterococci (n=4)	0	0	-	0	1	1	0	0	0	0	1	0	0	1	2	0

Chart 1: Gram negative and Gram-positive bacteria isolated from various clinical specimens



Conclusion

Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella spp. and E. coli were the prominent isolates from different clinical specimens. Most of the isolates were resistant to ampicillin, amoxyclav, tetracycline, fluroquinoles and cotrimoxazole. These notorious organisms always change their sensitivity pattern by their different drug resistant mechanisms and overuse/misuse of antibiotics. Therefore, systematic collection and analysis of routine clinical laboratory data is important in assessing the antimicrobial resistance burden. Nationwide surveillance is urgently needed to provide policy makers, antimicrobial stewardship committees, infection preventionists, microbiologists and epidemiologists with essential information to guide proper action plans.

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