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IP International Journal of Medical Microbiology and Tropical Diseases

Journal homepage: https://www.ijmmtd.org/

Short Communication

Detection of drug-resistant phenotypes among gram-negative bacterial isolates using Vitek 2 Advanced expert system (AES)

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ARTICLE INFO

Article history:
Received 27-06-2024
Accepted 12-07-2024
Available online 27-09-2024

Keywords:
Antimicrobial resistance
Vitek 2 advanced expert system (AES)
Drug resistance
Carbapenemases

ABSTRACT

Antimicrobial resistance (AMR) represents one of the most crucial public health threats worldwide. Hence, rapid detection of resistance patterns is of paramount importance. Vitek 2 AES (advanced expert system) can generate rapid and accurate AST reports, which can aid in starting the pathogen-directed treatment on time. We have analyzed the utility of Vitek AES in reporting various resistance patterns among gram-negative bacterial clinical isolates. About fifty multi-drug-resistant gram-negative bacterial isolates were subjected to AST testing by VITEK N407 card. The micro broth dilution method was used to estimate colistin minimum inhibitory concentration. The resistant phenotypes reported as per Vitek AES were documented and analyzed. Vitek AES grouped the resistance mechanisms into carbapenamase (58%), carbapenamase with AmpC (10%), carbapenamase with ESBL (12%), carbapenamase±ESBL (14%) and ESBL (6%). This study highlights using Vitek 2 AES as a rapid tool for reporting antimicrobial susceptibility and drug-resistant phenotypes.

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1. Introduction

Antimicrobial resistance has emerged as an essential public health problem worldwide in recent decades.[1] Globally, the highest antibiotic consumption is recorded from the BRICS countries, i.e., Brazil, Russia, India, China, and South Africa. As per the Global Antibiotic Consumption Report 2010, the two last-resort classes of antimicrobial agents, carbapenems (45%) and polymixins (13%), were consumed the most.[2] This is due to the unregulated use of antibiotics in all the sectors, lack of stewardship practices, poor sanitation, and hygiene.[3] Prompt initiation of broad-spectrum antibiotic treatment is recommended for all patients with suspected sepsis to minimize the risk of complications and adverse outcomes. Sepsis is mainly caused by gram-negative bacteria (GNB) like Carbapenem-resistant Enterobacterales (CRE), *Pseudomonas aeruginosa*, and *Acinetobacter baumannii*, which cause significant morbidity and mortality.[4] Hence, rapid and accurate identification of etiological agents, as well as detection of resistance patterns, has paramount importance. Automated antimicrobial susceptibility testing (AST) devices such as Vitek 2 AES (advanced expert system) can be used to generate AST reports, and AES incorporates extensive information to recognize certain drug resistance patterns as indicative of specific resistance phenotypes of bacteria. AES software of the Vitek 2 system analyses the minimum inhibitory concentration (MIC) data against a database of phenotypes and infers the resistance phenotype while generating the results.[5] In this study, we have analyzed the utility of Vitek 2 AES in reporting various resistance patterns among gram-negative bacterial clinical

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https://doi.org/10.18231/j.ijmmtd.2024.049
2581-4753/© 2024 Author(s), Published by Innovative Publication.

isolates.

2. Materials and Methods

A prospective cross-sectional study was conducted using fifty multi-drug-resistant (MDR) gram-negative bacterial clinical isolates. The study was carried out for three months, from February 2023 to April 2023. All archived bacterial isolates were subcultured and reidentified using standard protocols.[6] Antimicrobial susceptibility testing was performed by using VITEK critical care card N407 as per Vitek 2 compact – Instrument User Manual.[7] The micro broth dilution method (MBD) [commercially available Micropro BMD KIT] was used to estimate colistin minimum inhibitory concentration (MIC). MICs for colistin were interpreted as per Clinical and Laboratory Standards Institute (CLSI) 2023 guidelines.[8] The resistant phenotypes reported as per Vitek 2 AES were documented and analyzed.

3. Results

Amongst the fifty MDR gram-negative bacterial isolates, the majority were from wound swabs (38%), followed by tissue (36%), blood (22%), catheter tip (2%), and ear swabs (2%). The majority of MDR isolates used for Vitek testing were *Acinetobacter baumannii* (n=29, 58%), followed by Klebsiella pneumoniae (n=10, 20%), *Pseudomonas aeruginosa* (n=6, 12%), and Escherichia coli (n=5, 10%). Isolates were found to be resistant to cephalosporins (cefoxitin 24%, ceftizoxime 20%, cefepime 42%), beta lactam-beta lactamase inhibitors (ceftazidime-avibactam 26%, ceftalazone tazobactam 42%) and meropenem 90%. Colistin MIC value tested by micro broth dilution was in the range of intermediate susceptibility for all the isolates. Advanced expert system analysis (AES) grouped the resistance mechanisms into Carbapenemase (n=29, 58%), Carbapenemase with AmpC (n=5, 10%), Carbapenemase with ESBL (n=6, 12%), Carbapenemase±ESBL (n=7, 14%) and ESBL (n=3,6%) (Figure 1).

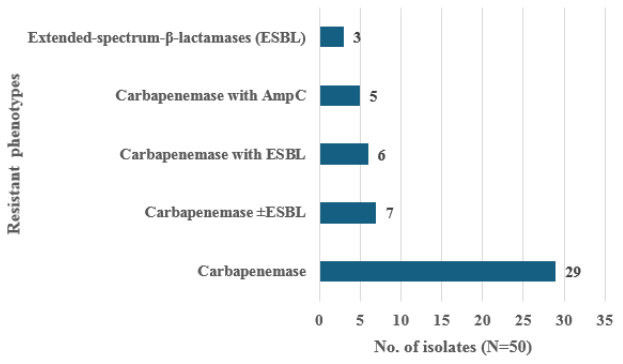

Figure 1: Distribution of resistant phenotypes among the MDR gram-negative bacterial isolates (n=50)

4. Discussion

Increased antibiotic resistance among the gram-negative bacteria has become a significant concern worldwide. Most MDR gram-negative isolates in our study were from skin and soft tissue infections. Based on the Vitek 2 AES findings, the resistance mechanisms in the fermenters and non-fermenters were grouped into Carbapenemase, Carbapenemase with AmpC, Carbapenemase with ESBL, Carbapenemase±ESBL and ESBL (extended-spectrum-β-lactamases). Amongst them, the highest carbapenemase producers were *Acinetobacter baumannii*, followed by Klebsiella pneumoniae. On the contrary, Kabanangi et al. showed that *Pseudomonas aeruginosa* was the highest producer of Carbapenemase.[9] The Vitek 2 AES validates the AST report by cross-checking the MIC distribution of each bacterial isolate to an antimicrobial agent against a database of phenotypes to infer resistance mechanisms.[5,10] This system also provides confidence for the reports by labeling them as consistent, consistent with correction, or inconsistent if MIC data does not match the resistant phenotype.

5. Conclusion

The emergence of MDR gram-negative bacteria is a grave threat and burden on the healthcare system. It necessitates adopting new approaches and stringent antimicrobial stewardship practices to curb antimicrobial resistance. The findings from this study highlight the utility of Vitek 2 AES as a rapid tool for reporting antimicrobial susceptibility and resistant phenotypes of bacterial isolates. This tool can significantly aid microbiologists and clinicians in making informed decisions about treating patients infected with multi-drug-resistant isolates.

6. Conflict of Interest

None.

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Cite this article: Dinakaran S, Venu A, Sundararajan P, Chandrakesan SD, Nair S, Bhat S. Detection of drug-resistant phenotypes among gram-negative bacterial isolates using Vitek 2 Advanced expert system (AES). *IP Int J Med Microbiol Trop Dis* 2024;10(3):289-291.