Original Article

Comparison of bacterial culture and their antibiotic sensitivity pattern in conventional and automated system (VITEK 2)

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Abstract

Introduction: In the fight against healthcare challenges like Multi Drug Resistant Organism, microbial identification testing with antibiotic sensitivity pattern is a key step for providing information necessary for targeted clinical responses and better patient care outcomes. Nowadays it is very important to identify organism and to give antibiotic sensitivity pattern rapidly and accurately. In this study we are going to compare the results of conventional and automated method (VITEK 2) for bacterial identification. The VITEK 2 system is automated and convenient instrument for identification of bacteria and for antibiotic susceptibility testing, which gives results rapidly within 5-8 hours, compared to conventional manual method which takes 24-48 hours.

Material and methods: In this study total of 55 samples (including Blood, Urine, Pus, Body fluids) received from various departments (ICU, General Medicine, General surgery, Pediatrics, Orthopedics) were evaluated by use of identification test with VITEK 2 system (BioMerieux) and results were compared with Conventional manual method (routine culture on Blood Agar Plate, MacConkey Agar and biochemical reactions).The antibiotic sensitivity pattern were tested with VITEK 2 ID (GPC-AST N281 and GNB-AST P628) and compared with results of conventional disc diffusion method.

Results: Out of 55 samples,18 (32.7%) isolates were Gram Positive Cocci (Coagulase negative staphylococcus spp, Streptococcus spp, Enterococcus spp) and 37 (67.2%) isolates were Gram negative Bacilli (Escherichia coli, Klebsiella pneumoniae, Pseudomonas spp, Acinetobacter spp, Salmonella spp). It was found that VITEK has identified up to species level and no strain has been misidentified. Out of 55 strains, the rate of antibiotic susceptibility pattern to 50 organisms, had an overall correct rate of 90.9%. Three (5.44%) of the strain exhibited resistant with manual and susceptible with VITEK. Two (3.63%) of the strain showed minor error.

Conclusion: The VITEK 2 system had an overall reliable performance and identified up to species level. However the identification results took only 5-8 hours which is much faster than conventional identification results, as the latter are usually reported 2 days after receiving sample. This automated method allows rapid and appropriate antimicrobial treatment for patients, almost 1 or 2 days earlier than the conventional method. Thus, VITEK 2 SYSTEM, reduces the usual time

taken for laboratories to process the culture samples, decrease the turnaround time and thus provide better patient management.

Keywords: *Multi Drug Resistant Organism, conventional manual method, VITEK 2 ID (GPC-AST N281 and GNB-AST P628), disc diffusion method.*

Introduction

The bacterial identification (ID) and antimicrobial susceptibility testing (AST) are done to guide antibiotic therapy and drug resistance pattern[1]. Rapid and accurate bacterial identification and susceptibility testing improve patient outcome, decreases emergence of resistance, reducing both morbidity and mortality and the danger of spread of infection[2]. There is a need to provide rapid, efficient and accurate system for bacterial identification and antimicrobial susceptibility testing of pathogens[3], in order to shorten the hospital stay of the patients and lower mortality and morbidity rate, as well as provide financial benefits by reducing healthcare costs[4].

Compared with conventional methods that requires 24-48 hours, the automated method can make rapid same-day reporting possible and thus permit better patient management[5]. For this reason, microbiologists have tried for many years to reduce the turnaround time of bacterial ID and susceptibility testing[6]. At the beginning, microscopic, chemical, and new automated methods provided rapid and cost effective alternatives to standard culture techniques, Recently, a real-time PCR method and matrix assisted laser desorption/ ionization time-of-flight mass- spectrometry (MALDI‑TOF MS) have been described for the direct ID of bacterial species[7].

The objective of this study was to evaluate the sensitivity of the VITEK® 2 system, a system that automatically performs the processes required for microorganism identification and for the determination of antimicrobial susceptibility and compared with conventional manual method[8].

Materials and Methods:

The study was carried out in Microbiology department at Sree Balaji Medical College and Hospital, Chennai over duration of five months from November 2019 to April 2020. In this study total of 55 samples (including Blood, Urine, Pus, Body fluids) received from various departments (ICU, General Medicine, General surgery, Pediatrics, Orthopedics) were evaluated using identification test with VITEK 2 COMPACT system (BioMerieux) and results were compared with conventional manual method.

Samples received (other than blood) were routinely subjected to culture on nutrient agar, blood agar, MacConkey agar and incubated at 37^{o}C overnight. In case of Blood, sample inoculated bottles were loaded into the BacT/Alert Microbial Detection System. Blood culture bottles that showed positive were taken out and sub cultured on nutrient agar, blood agar and MacConkey agar and incubated at 37°C overnight. The colonies isolated as pathogen were processed by manual method and VITEK 2 COMPACT SYSTEM for comparison.

Manual identification of the bacterial culture was done by Culture Smear Gram staining, routine standard biochemical tests. Cultures susceptible to various antibiotics

were tested by Kirby Bauer disc diffusion method. After subculturing on blood and MacConkey agar, the isolates were inoculated into the following specific identification cards of the automated VITEK 2 system using the standard protocol: Gram positive cocci (GP), Gram negative bacilli (GN), and the antibiotic sensitivity pattern were tested with VITEK 2 ID (GPC-AST N281 and GNB-AST P628) and the results were compared.

Results:

Out of 55 samples received, majority of the samples were from ICU (35 samples - 63.67%) followed by General medicine (8 samples-14.54%), General surgery (4 samples-7.27%), Pediatrics (4 samples-7.27%), orthopedics (2 samples-3.63%) OBG (1sample-1.81%), Causality (1sample- 1.81%) (Fig 1).Predominantly sample received was blood (39 samples-70.90%).

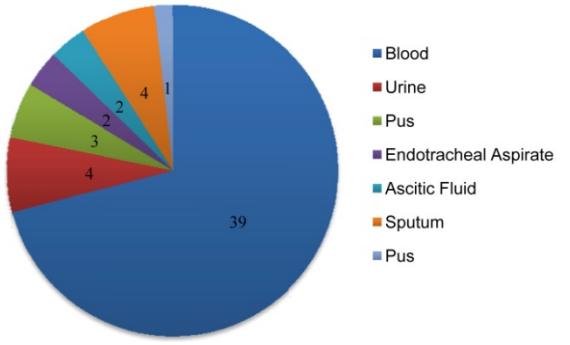

Fig-2: Comparison of number of samples received.

Out of 55 samples, 18 (32.7%) isolates were Gram Positive Cocci (Coagulase negative staphylococcus spp, Streptococcus spp, Enterococcus spp) and 37 (67.2%) isolates were Gram negative Bacilli (*Escherichia coli, Klebsiella pneumoniae, Pseudomonas* spp, *Acinetobacter* spp, *Salmonella* spp). Predomin ant isolates were *E.Coli* 15 (27.29%), followed by Coagulase Negative *Staphylococcus* species -14 (25.45%), *Acinetobacter* species-10 (18.18%), Pseudomonas species -7 (12.74%), *Klebsiella pneumoniae* – 3 (5.45%), *Streptococcus species* -3 (5.45%), *Salmonella* species -2 (3.63%), *Enterococcus* species -1 (1.81%).

Table 1: Bacterial isolates identified by conventional manual method and VITEK 2 SYSTEM and their concordant and discordant level.

No. of Organism	Manual	VITEK	Concordant	DisConcordant
15	*Escherichia coli*	*Escherichia coli*	15(100%)	0
3	*Klebsiella pneumoniae*	*Klebsiella pneumoniae*	3(100%)	0
7	*Pseudomonas Aeruginosa*	*Pseudomonas Aeruginosa*	7(100%)	0
10	*Acinetobacter species*	*a)Acinetobacter bowmanii*	6+4=10 (100%)	0
		b)Acinetobacter lwofii		
2	*Salmonella typhi*	*Salmonella typhi*	2(100%)	0
14	Coagulase Negative *Staphylococcus* species	a)Staphylococcus Hominis	7+3+1+1+2=14 (100%)	0
		b)*Staphylococcus Haemolyticus*		
		c)*Staphylococcus lentus*		
		d)*Staphylococcus cohini*		
		e)*Staphylococcus epidermidis*		
1	Enterococcus species	*Enterococcus faecalis*	1(100%)	0
3	Streptococcus pneumonia	*Streptococcus pneumoniae*	3(100%)	0

The results of VITEK 2 SYSTEM and manual method were compared, **VITEK has identified up to species level and no strains were mis-identified** (TABLE-1). The rate of antibiotic susceptibility to 50

organisms, had an overall correct rate of 90.9%. Three (5.44%) of the strain gave resistant with manual and susceptible with VITEK. Two (3.63%) of the strain showed minor error (Table 2).

Table 2: Shows discrepancy in the antibiotic sensitivity pattern of organisms between Manual and VITEK 2 (for 5 of the isolates which showed difference).

Microorganism	Antibiotic	Sensitivity pattern with manual	Sensitivity pattern with Vitek
Enterococcus fecalis	Ciprofloxacin	R	S
Pseudomonas aeruginosa	Amikacin	S	I
Escherichia coli	Imipenem	R	S
Acinetobacter baumanii	Tigecycline	S	I
Acinetobacter lwoffi	Meropenem	S	I

S-Sensitive, I-Intermediate, R-Resistant.

Discussion:

In morbid infections the key problems are rapid and precise identification of the pathogen involved. Rapid detection of bacterial isolates and antibiotic sensitivity testing ameliorate therapeutic options and outcome, reduces the emergence of antimicrobial resistance and decreases costs of treatment 1. The VITEK 2 system uses colorimetric reading of the new GP and GN cards, fully automated incubation and interpretation with minimal supplemental testings required. The results provided by the colorimetric VITEK 2 is considered to be accurate due to the improvement and the extension of the database 2.

In our study there is 100% concordance with the identification of organisms by conventional and VITEK system and 90.9% of concordance rate for antimicrobial susceptibility test, these results are comparable with study conducted by Nayeem-u-din Wani et al in which minimal discrepancy were seen with manual and VITEK of 91.1% in Gram Negative Bacteria 1.

In a study conducted by Fre´de´ric Wallet et al (2005) showed 249 gram-positive strains tested with both the IDGPC and GP cards and the 331 gram-negative strains tested with both the ID-GNB and GN cards, 218 (87.5%), 235 (94.4%), 295 (89.1%), and 321 (97%) were correctly identified (to the genus or species level), respectively[2]. Neelima Angaali (2018) conducted a study to test the ability of VITEK to detect directly from Urine sample which showed 80.7% correlation of organism isolation with the standard technique[8].

Conclusion:

In the current situation the need for the rapid identification of the microorganism is very vital to initiate the early treatment procedure. For the rapid identification of microorganism, the VITEK2 system had an overall reliable performance and identified up to species level. However the advantage of VITEK over manual method is identification and the sensitivity pattern and MIC of the organism took only 5-8 hours as the later are usually reported 2 days after receiving the samples. This rapid method allows proper antimicrobial treatments almost 1 or 2 days earlier than the conventional method. Thus, this method decreases the turn around time for laboratory and thus provide better patient management.

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