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Controlled Clinical Comparison of VersaTREK® versus BacT/ALERT® Blood Culture Systems

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REVISED ABSTRACT

Objectives: To assess the relative yield of bacteria and yeasts isolated from the blood of adult patients with suspected sepsis, we compared the new VersaTREK® (TREK Diagnostic Systems, Cleveland, Ohio, USA) automated continuously monitoring blood culture system to the BacT/ALERT® 3D system (bioMérieux, Inc, Durham, North Carolina, USA).
Methods: Identical protocols were followed for both systems. Paired aerobic and anaerobic VersaTREK® (VTI) media were compared with standard aerobic and anaerobic BacT/ALERT® 3D (3D) media; each of the 4 culture bottles was filled with 6-9 mL of blood. All bottles flagged positive by the instruments were subcultured to determine both true- (growth) and false- (no growth) positive cultures. Additionally, to assess false-negative bottles, terminal subcultures were done on all negative companion bottles to true-positive bottles. All isolates were identified by standard methods.
Results: All 4 bottles were adequately filled in 5,389 (79%) of the 6,786 4-bottle sets obtained. Of 413 clinically significant (based on previously published criteria) isolates detected in one or both blood culture systems, there was no overall difference in recovery of microorganisms; however, streptococci and enterococci (P<0.05) were detected more frequently with VTI. Of 233 clinically significant positive cultures detected in the aerobic bottles of both systems within 72 hours, growth was detected sooner in the VTI (mean of 14.9h) versus the 3D (17.9h) system. The reverse was seen in 181 comparisons with the anaerobic bottles: VTI (mean of 21.9h) and 3D (15.7h). Both systems were comparable (P = NS) in detecting the 179 unimicrobial episodes of bacteremia seen: 137 (77%) were detected in both systems, 23 (13%) only in VTI and 19 (11%) only in 3D. False-positive rates for aerobic and anaerobic bottles, respectively, were 1.6% and 1.0% for VTI and 0.7% and 0.8% for 3D. The number of false-negative aerobic bottles found were 3 with VTI and 4 with 3D, whereas the corresponding numbers for anaerobic bottles were 3 with VTI and 23 with 3D.
Conclusion: We conclude that the VTI and 3D systems are comparable for detection of bloodstream infections with bacteria or yeasts.

BACKGROUND

VersaTREK® (TREK Diagnostic Systems, Cleveland, Ohio, USA) and BacT/ALERT® (bioMerieux, Durham, North Carolina, USA) are common blood culture systems used in the United States. The VersaTREK system (VTI) provides increased volume of broth and a pressure sensor to detect gas production and consumption, whereas the BacT/ALERT® (3D) uses a colorimetric sensor for CO_2 detection. The net result of these differences in VTI has not been evaluated in a controlled clinical trial. We, therefore, compared the two systems for detection of bacteremia and fungemia from the blood of adult patients with suspected sepsis.

MATERIALS AND METHODS

1 This study was started in November 2003 and was completed in August 2004.
2. 30 mL of blood was collected from adult patients with suspected bacteremia or fungemia at Duke University Medical Center and 7.5 mL were distributed into both an aerobic (SA) and anaerobic (SN) 3D standard bottle (40 mL broth/bottle) and an aerobic (REDOX 1) and anaerobic (REDOX 2) VTI bottle (80 mL broth per bottle) (Figure).
3. Each bottle was measured upon receipt to determine if 6-9 mL of blood was inoculated into each bottle. Only adequately filled bottles were included in the analysis.
4. Bottles from each culture set were placed in the respective 3D or VTI instruments and incubated for 5 days or until they signaled positive. Negative companion bottles from positive sets were subcultured at the end of the 5-day protocol.
5. Statistical analysis of results was done with the modified chi-square test described by McNemar.
6. Each positive culture was reviewed by an infectious diseases physician and coded as a true positive, a contaminant, or an isolate of unknown clinical importance.
7. Bacteremic and fungemic episodes were defined by growth of a clinically important blood culture isolate without recovery of a different microorganism during the subsequent seven-day period. If a different clinically important microorganism was recovered within 72 hours, the two isolates were considered a polymicrobial episode (not included in the analysis). If a different microorganism was recovered after 72 hours, the second isolate was considered a new episode.

Figure. BacT/ALERT® vs VersaTREK®

BacT/ALERT® VersaTREK®

Table 1A. Comparative yield of clinically important isolates in VersaTREK® versus BacT/ALERT® 3D blood culture systems.

	No. detected by:			
Microorganisms	Both systems	VTI only	3D only	P
Staphylococcus aureus	43	13	5	NS
Coagulase-negative staphylococci	36	5	9	NS
Streptococcus and *Enterococcus* spp.	60	16	6	<0.05
Enterobacteriaceae	95	17	15	NS
Other gram-negative bacteria	20	3	6	NS
Anaerobic bacteria	11	10	3	NS
Yeasts	23	8	9	NS
All microorganisms	288	72	53	NS

Table 1B. Comparative yield of clinically important isolates in VersaTREK® versus BacT/ALERT® 3D blood culture systems for patients on antimicrobial therapy.

	No. detected by:			
Microorganisms	Both systems	VTI only	3D only	P
Staphylococcus aureus	6	5	4	NS
Coagulase-negative staphylococci	7	3	1	NS
Streptococcus and *Enterococcus* spp.	9	5	0	NS
Enterobacteriaceae	15	8	4	NS
Other gram-negative bacteria	7	1	0	NS
Anaerobic bacteria	1	0	0	NS
Yeasts	6	3	1	NS
All microorganisms	51	25	10	<0.025

Table 2. Comparative yield of clinically important episodes in VersaTREK® versus BacT/ALERT® 3D blood culture systems.

	No. detected by:			
Microorganisms	Both systems	VTI only	3D only	P
Staphylococcus aureus	27	2	1	NS
Coagulase-negative staphylococci	19	0	1	NS
Streptococcus and *Enterococcus* spp.	20	3	1	NS
Enterobacteriaceae	45	4	6	NS
Other gram-negative bacteria	6	3	4	NS
Anaerobic bacteria	6	5	3	NS
Yeasts	14	6	3	NS
All microorganisms	137	23	19	NS

Table 3. Comparative time to positivity (detected within 72 hours) in VersaTREK® versus BacT/ALERT® 3D blood culture systems.

	Mean time (hours)					
	Aerobic			Anaerobic		
Microorganisms	No.	VTI	3D	No.	VTI	3D
Staphylococcus aureus	40	13.4	17.3	31	30.0	16.0
Coagulase-negative staphylococci	29	18.6	22.4	19	30.9	16.5
Streptococcus and *Enterococcus* spp.	46	13.6	16.2	46	18.8	15.1
Enterobacteriaceae	78	11.6	13.4	70	17.7	15.1
Other gram-negative bacteria	20	15.5	18.5	2	26.6	14.0
Anaerobic bacteria	0	0	0	9	17.7	23.1
Yeasts	20	27.6	33.6	3	28.3	13.2
All microorganisms	233	14.9	17.9	180	21.9	15.7

RESULTS

1. A total of 7,762 blood culture sets were received, including 5,389 (69%) with an adequate volume of blood in all four bottles.
2. 413 clinically significant isolates from 1,752 patients were detected in one or both blood culture systems (Table 1A).
3. Both systems were comparable for isolation of microorganisms except for, *Streptococcus* and *Enterococcus* spp. which were detected significantly more frequently in VTI (Table 1A). VTI yielded more microorganisms in the presence of antimicrobial therapy than did 3D (Table 1B).
4. There were no significant differences between the two systems by episode analysis (Table 2).
5. When clinically important microorganisms were recovered from both aerobic bottles, the mean time to detection was shorter in VTI (14.9 hours) than in 3D (17.9 hours) (Table 3). With anaerobic bottles, however, detection times were longer for VTI bottles (21.9 hours) versus 3D bottles (15.7 hours).
6. Of the 6,786 blood culture sets containing all 4 adequately filled bottles, there were 81 (1.2%) false-positive bottles in REDOX 1, 40 (0.6%) in REDOX 2, 33 (0.5%) in SA, and 41 (0.6%) in SN.
7. There were 3 false-negative REDOX 1 bottles when companion bottle(s) were positive as compared with 7 REDOX 2, 4 SA, and 23 SN bottles. Nineteen of the 23 false-negative SN bottles were with strict aerobes, including *Pseudomonas* spp., *Stenotrophomonas* spp., and yeasts.
8. Contaminants were isolated with equal frequency from VTI sets and 3D sets (49 from both, 56 from VTI only and, 43 from 3D only; P=NS).

CONCLUSIONS

1. The overall performance of the VTI blood culture system was similar to the 3D blood culture system for detection of clinically significant microorganisms from adult patients with suspected bacteremia or fungemia.
2. There was no significant difference in detection of bacteremic or fungemic episodes between the two systems.
3. When both bottles were positive within 72h, the overall time to detection was shorter in VTI aerobic by 3.0 hours and shorter in 3D anaerobic by 6.2 hours.
4. The aerobic VTI bottle had the highest false-positive rate.
5. The VTI system detected more isolates from patients on antimicrobial therapy. This may be due to the higher dilution provided by the VTI system.