JOURNAL OF CLINICAL MICROBIOLOGY, May 2009, p. 1609–1610 Vol. 47, No. 5
0095-1137/09/$08.00+0 doi:10.1128/JCM.00351-09

# Letters to the Editor

## Identification of Methicillin-Resistant or Methicillin-Susceptible *Staphylococcus aureus* in Blood Cultures and Wound Swabs by GeneXpert[▽]

Until a decade ago, clinicians could use epidemiological clues to select empirical therapy for methicillin-susceptible *Staphylococcus aureus* (MSSA) or methicillin-resistant *S. aureus* (MRSA) (5). The emergence of MRSA as a community pathogen and the documentation of the inferiority of non-beta-lactam antibiotics in treating MSSA bacteremia greatly complicate initial antibiotic choice (2–4, 7, 8, 9). Early identification and determination of antibiotic susceptibility might help focus initial antibiotic therapy. We compared a multiplex PCR that identifies MSSA and MRSA to standard microbiologic techniques for evaluating the results of blood cultures (BCs) and wound swab (WS) cultures.

Blood was cultured in BacT/Alert, and drug susceptibility was determined with a Vitek 2 system (both from BioMerieux, Durham, NC). For BCs judged to contain gram-positive cocci in clusters (GPCCl), 1-ml aliquots were centrifuged (2 min at 3,000 rpm) to remove charcoal, and the supernatant was studied in a GeneXpert system (Cepheid, Sunnyvale, CA). WS samples were streaked to standard media (blood, chocolate, McConkey, and colistin-nalidixic acid) and then studied in the GeneXpert system within 48 h of collection. GeneXpert real-time PCR detects proprietary sequences of the *S. aureus* protein A gene, the staphylococcal cassette chromosome, and the methicillin resistance element (1).

Of 223 blood samples, 68 yielded *S. aureus* by culture, 47 with MRSA and 21 with MSSA. PCR correctly identified 67/68 (98.5%) *S. aureus* isolates (Tables 1 and 2), including 46/47 (97.9%) MRSA and 21/21 (100%) MSSA isolates. No BC (155/155; 100%) that contained GPCCl without *S. aureus* contained *S. aureus* by PCR.

Of 321 WS samples, 106 yielded MRSA and 51 MSSA by culture. PCR identified 104/106 (98.1%) MRSA isolates correctly but misidentified 2 MRSA isolates as MSSA (Table 1). Of 51 MSSA isolates, 47 (92.2%) were identified correctly, 3 incorrectly as MRSA, and 1 incorrectly as no *S. aureus* by PCR.

TABLE 1. Detection of organisms by culture or PCR

| Sample | Organism identified by standard culture (no. of samples) | No. of samples in which indicated organism detected by PCR | | |
|---|---|---|---|---|
| | | MRSA | MSSA | No *S. aureus* |
| BC | MRSA (47) | 46 | 1 | 0 |
| | MSSA (21) | 0 | 21 | 0 |
| | No *S. aureus* (155) | 0 | 0 | 155 |
| WS | MRSA (106) | 104 | 2 | 0 |
| | MSSA (51) | 3 | 47 | 1 |
| | No *S. aureus* (164) | 13 | 18 | 133 |
| | No *S. aureus* after adjustment for prior antibiotics and no growth (141)[a] | 4 | 4 | 133 |

[a] See text.

TABLE 2. PCR sensitivity, specificity, PVs, and effect of concomitant antibiotic use

| Sample, organism detected | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) |
|---|---|---|---|---|
| BC | | | | |
| MRSA | 97.9 | 100 | 100 | 99.4 |
| MSSA | 100 | 99.5 | 95.5 | 100 |
| No *S. aureus* | 100 | 100 | 100 | 100 |
| WS before adjustment for prior antibiotics and no growth by culture[a] | | | | |
| MRSA | 98.1 | 92.6 | 86.7 | 99.0 |
| MSSA | 92.2 | 92.6 | 70.1 | 98.4 |
| Wound swab after adjustment for prior antibiotics and no growth by culture[a] | | | | |
| MRSA | 98.1 | 96.4 | 93.7 | 98.9 |
| MSSA | 92.2 | 97.6 | 88.7 | 98.4 |

[a] See text.

PCR was positive for *S. aureus* in 31 of 164 samples that did not contain *S. aureus* by culture; however, 20 of these 31 were from patients who had received antistaphylococcal antibiotics, and 3 yielded no growth, suggesting inadequate sampling (Tables 1 and 2).

The results of this study show that, once GPCCl have been identified in BCs, PCR technology has high sensitivity, specificity, positive predictive value (PPV), and negative PV (NPV) for correctly identifying MRSA and MSSA. In some cases, appropriate therapy for *S. aureus* bacteremia could be selected 48 h sooner than with conventional reporting.

For WS samples, however, the results show greater variability. Sensitivity exceeded 98% for MRSA but was lower (92%) for MSSA. The NPV for these two organisms was still high (≥98.4%). Early identification of MRSA would indicate a need for appropriate therapy, and the finding of no *S. aureus* by PCR strongly suggests the true absence of this pathogen. If culture is regarded as definitive ("gold standard"), PCR provides numerous false positives. Recent studies, however, suggest that *S. aureus* may go undetected in 15 to 20% of WS samples unless selective media are used (6, 10). We found that many patients with negative culture and positive PCR results were taking antistaphylococcal antibiotics. Thus, it is unclear from the present study whether our finding of *S. aureus* by PCR and its absence by conventional culture represents a false-positive or a true-positive finding.

We acknowledge the support of Cepheid, Inc., for the provision of materials for use in this study.

## REFERENCES


1. **Cepheid.** 2008. Xpert MRSA/SA blood culture: instruction manual. Cepheid, Sunnyvale, CA.
2. **Chang, F. Y., J. E. Peacock, Jr., D. M. Musher, P. Triplett, B. B. MacDonald, J. M. Mylotte, A. O'Donnell, M. M. Wagener, and V. L. Yu.** 2003. Staphylococcus aureus bacteremia: recurrence and the impact of antibiotic treatment in a prospective multicenter study. Medicine (Baltimore) **82:**333–339.
3. **Fridkin, S. K., J. C. Hageman, M. Morrison, L. T. Sanza, K. Como-Sabetti, J. A. Jernigan, K. Harriman, L. H. Harrison, R. Lynfield, and M. M. Farley.** 2005. Methicillin-resistant Staphylococcus aureus disease in three communities. N. Engl. J. Med. **352:**1436–1444.
4. **Gonzalez, C., M. Rubio, J. Romero-Vivas, M. Gonzalez, and J. J. Picazo.** 1999. Bacteremic pneumonia due to Staphylococcus aureus: a comparison of disease caused by methicillin-resistant and methicillin-susceptible organisms. Clin. Infect. Dis. **29:**1171–1177.
5. **Hryniewicz, W.** 1999. Epidemiology of MRSA. Infection **27**(Suppl. 2)**:**S13–S16.
6. **Mahlen, S. D., A. T. Harrington, and J. E. Clarridge III.** 2008. Validation and use of Bio-Rad MRSA*Select* screening agar for rapid identification of MRSA directly from clinical specimens, abstr. D1133. Abstr. 48th Intersci. Conf. Antimicrob. Agents Chemother., Washington, DC.
7. **Miller, L. G., F. Perdreau-Remington, G. Rieg, S. Mehdi, J. Perlroth, A. S. Bayer, A. W. Tang, T. O. Phung, and B. Spellberg.** 2005. Necrotizing fasciitis caused by community-associated methicillin-resistant Staphylococcus aureus in Los Angeles. N. Engl. J. Med. **352:**1445–1453.
8. **Shopsin, B., B. Mathema, J. Martinez, E. Ha, M. L. Campo, A. Fierman, K. Krasinski, J. Kornblum, P. Alcabes, M. Waddington, M. Riehman, and B. N. Kreiswirth.** 2000. Prevalence of methicillin-resistant and methicillin-susceptible Staphylococcus aureus in the community. J. Infect. Dis. **182:**359–362.
9. **Stryjewski, M. E., L. A. Szczech, D. K. Benjamin, Jr., J. K. Inrig, Z. A. Kanafani, J. J. Engemann, V. H. Chu, M. J. Joyce, L. B. Reller, G. R. Corey, and V. G. Fowler, Jr.** 2007. Use of vancomycin or first-generation cephalosporins for the treatment of hemodialysis-dependent patients with methicillin-susceptible Staphylococcus aureus bacteremia. Clin. Infect. Dis. **44:**190–196.
10. **Wendt, C., J. M. Boyce, K. C. Chapin, R. Dickenson, U. Eigner, N. L. Havill, S. Schuett, and A. M. Fahr.** 2008. Evaluation of a new selective medium (BBL CHROMagar MRSA II*) for the detection of methicillin-resistant *Staphylococcus aureus* (MRSA) from different specimens, abstr. D1135. Abstr. 48th Intersci. Conf. Antimicrob. Agents Chemother., Washington, DC.



**M. Parta***
*Medical Service (Infectious Disease Section)*
*Michael E. DeBakey Veterans Affairs Medical Center*
*2002 Holcombe Blvd., Rm. 4B370*
*Houston, Texas 77030*

**M. Goebel**
**M. Matloobi**
*Medical Service (Infectious Disease Section)*
*Michael E. DeBakey Veterans Affairs Medical Center*
*Houston, Texas*

**C. Stager**
*Department of Pathology*
*Baylor College of Medicine*
*Houston, Texas 77030*

**D. M. Musher**
*Medical Service (Infectious Disease Section)*
*Michael E. DeBakey Veterans Affairs Medical Center*
*Houston, Texas*

*Phone: (713) 794-7384
Fax: (713) 794-7045
E-mail: parta@bcm.edu


▽ Published ahead of print on 4 March 2009.