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Clinical Impact of Rapid Antimicrobial Susceptibility Testing of Blood Culture Isolates

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The results of a rapid, direct blood culture disk susceptibility test indicated that antimicrobial chemotherapy should be changed in 48 of 173 patients with bacteremia. In 32 patients (66.6%), the indicated change was made approximately 24 h sooner than if conventional, nonrapid susceptibility tests had been used to guide therapy.

It is generally assumed that, if the results of clinical microbiological analyses are to contribute in a meaningful way to the diagnosis, management, and prognosis of patients with infectious diseases, they must be made available to the clinician in a clinically relevant time frame. In some instances, the clinical utility of information provided by the diagnostic microbiology laboratory is significantly diminished by the length of time it takes to generate that information. Recognizing this, efforts have been made to devise analytical procedures which make results available more quickly. Examples of rapid techniques include radiometric detection of positive blood cultures, immunochemical methods for detecting microbes or their antigens directly in clinical specimens, rapid automated and nonautomated identification and susceptibility procedures, and rapid automated methods for estimating the quantity of microorganisms in fluid specimens such as urine.

We recently described a direct disk diffusion susceptibility test which permitted accurate determination of the antimicrobial susceptibilities of blood culture isolates within 16 to 20 h of the time in which a blood culture was first detected as being positive, or approximately 24 h more quickly than conventional methods (1). The accuracy of this method (96.8%) was equivalent to the accuracy of standardized disk diffusion susceptibility procedures. The intent of the present study was to determine how rapid disk susceptibility testing influenced antimicrobial chemotherapy.

The medical records of 204 unique patients with positive blood cultures at the University of Oregon Health Sciences Center were examined retrospectively over a 2-year period to determine whether antimicrobial chemotherapy was altered based on the results of the direct blood culture susceptibility test. Of this group, 173 patients had blood cultures which yielded a single clinically significant organism and were receiving at least one antimicrobial agent empirically at the time the direct susceptibility test was performed. The results of direct blood culture susceptibility tests were, in all cases, immediately provided by a medical technologist directly to the patient's primary physician via a telephone call. In addition, a written report was issued containing all direct susceptibility test results. This information was thus available within 24 h of the time in which a blood culture was detected as positive. Advice regarding antibiotic efficacy and toxicity was not provided. The reliability of the direct blood culture susceptibility test was well known to those clinicians receiving this information, as this test and the reporting system described above had been in effect for approximately 6 years before the initiation of this study. The medical staff had no knowledge of this investigation.

Two indications for altering antimicrobial chemotherapy on the basis of the results of the direct susceptibility test were defined. (i) The organism recovered from the patient's blood culture was found to be more susceptible to an antibiotic(s) other than what the patient was receiving. For example, in a patient with a gram-negative bacillus bacteremia who was receiving gentamicin, the organism was found to be susceptible to tobramycin but resistant to gentamicin by the direct test. (ii) The results of the direct test indicated that an antibiotic(s) which was less toxic than the agent(s) the patient was receiving possessed comparable activity against the blood culture isolate. In those instances where the indication for changing antibiotics fell into both categories (i.e., an antibiotic(s) was both more active and less toxic), for the purposes of data

analysis, the event was included in the former category since greater susceptibility was considered a more compelling reason than less toxicity for changing therapy.

Antibiotic therapy was considered as having been altered owing to the results of the direct susceptibility test only when a change was made within 24 h of completion of the test and when that change was consistent with the substitution indicated by the direct test. All results were confirmed with a standardized disk susceptibility test. This information was available approximately 24 h after the results of the direct test.

In 31 instances (17.9% of 173 patients), change to a more active antibiotic(s) was indicated on the basis of the results of the direct test. Antibiotic therapy was altered in 24 of these patients (77.4%) within 24 h of the availability of the direct test results. In two additional patients, antibiotic therapy was changed to a more active antibiotic after receipt of the results of the standardized disk susceptibility test. In no case was antibiotic therapy changed, on the basis of the results of the direct test, to an agent with activity comparable to that of the agent that the patient was receiving, unless decreased toxicity could be achieved.

Change to a less toxic antibiotic(s) was indicated in 17 (9.8%) of the 173 patients. This change was made in 8 (47.1%) instances within 24 h of receipt of the direct susceptibility test information. In four patients, change to a less toxic antibiotic was made only after the standardized test had been performed and the results had been reported.

Collectively, the results of the direct susceptibility test indicated that a change to a more active or less toxic antibiotic(s) was indicated in 48 (27.2%) of 173 patients with positive blood cultures. In 32 cases (66.7%), a change was made within 24 h of receipt of the direct test results. In no instance did the results of the direct test lead to an inappropriate change in therapy as indicated by the results of the standardized test.

It is difficult to determine whether the results of the direct test were solely responsible for all changes in antibiotic therapy made within the 24-h period after completion of the direct test. Other factors, such as the availability of organism identification, subsequent positive blood cultures, and the clinical status of patients, cannot be excluded as factors which influenced alterations in antibiotic therapy. It is believed, however, that most changes were indeed made on the basis of the results of the direct susceptibility test since changes were not included in the foregoing data analysis unless the substitutions made were those indicated by the direct susceptibility test. Furthermore, in only six cases were changes indicated by the direct test made only after receipt of the results of standardized test 24 h later.

Several direct blood culture susceptibility test procedures have been described which provide accurate information approximately 24 h sooner than standardized tests (1–4). The results of the present study suggest that the information provided by such direct tests can significantly influence empirical antimicrobial chemotherapy of patients with positive blood cultures. In 32 (18.5%) of 173 patients, antibiotic therapy was altered approximately 24 h sooner than would have been possible if only standardized susceptibility tests had been performed. If the use of more-efficacious and less-toxic antibiotics is considered desirable in patients with bacteremia, then it can be inferred from this study that rapid direct susceptibility testing of blood culture isolates can have a positive clinical impact on patient care. It also seems reasonable that new technologies which shorten even further the length of time necessary to provide susceptibility information on blood culture isolates could potentially have an even greater clinical impact. The results of this study should not be construed as being applicable to rapid identification techniques or to rapid susceptibility testing of organisms recovered from specimens other than blood. The clinical significance of such methodologies awaits further investigation. Finally, it should be noted that, among the patients with bacteremia examined in this study, empirical antibiotic therapy was usually appropriate. In 72.8% of 173 patients, no change in therapy was indicated by either direct or standardized susceptibility testing.

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