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Validity of Cultures of Fluid Collected through Drainage Catheters versus Those Obtained by Direct Aspiration

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To examine the validity of cultures of fluid collected through drainage catheters, we reviewed retrospectively fluid specimens that had been collected through catheters in place for at least 2 days. These specimens were taken from patients at a large tertiary-care hospital. A total of 974 specimens representing 620 patient episodes were received. For 554 (89%) episodes there was no reliable imaging evidence for localized infection, rendering the results uninterpretable. The remaining 66 (11%) episodes were followed within 2 days by radiologically guided or open aspiration of one or more fluid collections (predominantly in the abdomen or pelvis) near the drainage catheter, allowing comparison of culture results of 59 direct aspirates with those of prior catheter drainage. In 33 (56%) of these 59 cases, matched culture results were equivalent for therapeutic decision making. However, relying on results of catheter drainage cultures would have led to inadequate antimicrobial therapy in 13 (22%) cases, to excessive therapy in 11 (19%) cases, and to both in 2 cases (3%). We conclude that radiological imaging should be standard practice in the assessment of deep-tissue infections in patients with drainage catheters, and that direct aspiration of potentially infected fluid collections is the most reliable method of obtaining specimens for culture that should be used to guide therapy.

Although one-step needle aspiration and lavage is increasingly used for diagnosis and treatment of abdominal and pelvic abscesses (5), percutaneous catheters often are inserted with radiological guidance into those abnormal collections of body fluid that require continuous drainage. They are also placed manually during many surgical procedures to prevent accumulation of exudate and blood at the operative site. Over the days to weeks that these catheters remain in place, drainage fluid may be submitted for culture, especially when symptoms and signs suggest infection. Culture of such fluid is potentially misleading, however, when the fluid becomes contaminated within the catheter or collection apparatus, or when the fluid does not originate from a site of clinically important infection. To further examine the validity of cultures of fluid collected through drainage catheters, we initially looked at the clinical circumstances under which specimens from drainage catheters were submitted for culture, then compared the culture results for fluid collected through a preexisting drainage catheter with those for direct aspiration, and finally assessed the potential therapeutic consequences of these comparisons.

(A report of this work was presented at the 98th General Meeting of the American Society for Microbiology, May 1998.)

MATERIALS AND METHODS

Using a computerized database, we reviewed retrospectively all fluid specimens labeled with "JP" (Jackson-Pratt) as the source which were submitted for bacterial culture from patients at a large tertiary-care hospital between January 1992 and December 1997. Although clinical staff at this hospital commonly label all drainage catheters "JP," a variety of drainage catheter types and brands were used. Only specimens collected through catheters placed at least 2 days earlier were studied. Individual specimens were grouped by episode, defined as a period of time during which any number of catheter drainage specimens from the same patient were submitted to the clinical microbiology laboratory for culture with no more than 1 day between consecutive specimens.

First, we examined the radiological records for each episode. Then, for those patients from whom a direct, open, or image-guided specimen was collected within 2 days after collection of the specimen from the preexisting drainage catheter, we compared the results of bacterial culture from matched specimens, reviewed the corresponding computed tomography (CT) or ultrasound (US) films, and examined the clinical records.

For each culture result of direct aspirate or catheter drainage fluid, an infectious-disease physician who had not been directly involved with the patient's care noted retrospectively one or a combination of antimicrobial agents that would have been reasonable therapy, in combination with drainage, for the microorganisms present. A combined beta-lactam and beta-lactamase-inhibiting agent with broad-spectrum aerobic and anaerobic activity frequently was selected. Individual samples were assessed according to the relative quantity of microorganisms on Gram stain microscopy and culture, the reputation of each isolate as a pathogen, and antimicrobial susceptibility results, when available. For example, yeasts were judged to require treatment only when detected by both Gram stain microscopy and culture. Actual antimicrobial use by the patients' physicians was not examined.

Assuming culture of directly aspirated fluid to be the "gold standard," the potential consequences of selecting antimicrobial therapy based on the results of prior catheter drainage fluid culture were assessed: therapeutically equivalent drainage catheter results were defined as correct, and discrepant drainage catheter results were defined as excessive (if the result could have led to unnecessary antimicrobial therapy) or inadequate (if the result could have led to insufficient antimicrobial therapy). A radiologist, unaware of the results of fluid cultures, determined each direct image-guided aspirate to be either from the same site as the tip of the preexisting drainage catheter or from a site remote from the catheter tip.

Each image-guided direct aspiration was performed using an 18-gauge needle, aseptic technique, and single-use, sterile equipment. In the clinical microbiology laboratory, catheter drainage and aspirate fluids were examined microscopically after Gram staining and were cultured on the following media: Trypticase soy agar with 5% sheep blood, Columbia colistin-nalidixic acid agar with 5% sheep blood, MacConkey II agar, anaerobic brucella blood agar, and anaerobic laked blood agar with kanamycin and vancomycin (BD Biosciences, Sparks, Md.).

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TABLE 1. Relationship between potential therapeutic consequences of culture of drainage catheter fluid and proximity of subsequent direct aspirate to preexisting drainage catheter tip

Potential therapeutic consequence	No. of patients with indicated proximity of direct aspirate(s) to drainage catheter tip(s)		
	Same site	Unclear	Remote site
Correct therapy	12	2	19
Incorrect therapy			
Excessive	3	1	7
Inadequate	4	1	8
Both	2	0	0
Total	21	4	34

RESULTS

A total of 974 specimens representing 620 episodes were received during the study period. For 311 (50%) episodes, no CT or US imaging of the corresponding body region was done within 2 days before or after submission of the specimen. For 243 episodes, CT or US showed no, small, or diminishing collections not warranting aspiration. The remaining 66 (11%) fluid collections were followed within 2 days by direct aspiration or drainage of one or more fluid collections, thereby allowing comparison of culture results of 59 direct (55 radiologically guided, 4 open) aspirates with those of prior catheter drainage.

For 57 (97%) of these 59 patients, the catheters through which the initial fluid sample was collected drained an intra-abdominal site; 1 of the remaining 2 patients had a catheter draining the pericardial space, and the other's catheter drained the cavity of a removed cardiac pacemaker. For 47 drainage catheters whose exact date of insertion could be determined, the median duration of placement prior to initial fluid collection was 11 days (range, 3 days to 11 weeks). On the day of initial collection of fluid from the drainage catheter or the previous day, 50 of 58 patients (86%) had a temperature of ≥38.3°C, and 46 of 51 patients (90%) had more than 50 ml of fluid draining from any one drainage catheter present (not necessarily the catheter from which the index sample was collected). Catheter drainage fluid submitted for culture was described as brown, green, cloudy, purulent, or bloody for 49 of 53 (92%) patients for whom information was available.

Overall, culture of directly aspirated fluid was positive in 46 (78%) patients. Cultures of catheter drainage and aspirate fluids gave comparable results with regard to therapeutic decision making for 33 patients (Table 1). Discrepant results between catheter drainage and aspirate fluid cultures that could have led to incorrect therapy were seen for 26 patients; in only 4 (15%) cases could these differences be attributed to changes in antibiotic therapy between sampling times or to the selection of the media and atmosphere for incubation. Potentially misleading results from catheter-collected specimens were equally frequent when the drainage catheter tip apparently lay in the same fluid collection that subsequently was sampled (9 [43%] of 21 cases) as when the tip apparently lay in a site remote from the collection that subsequently was sampled (15 [44%] of 34 cases). The median duration of drainage catheter placement before the initial specimen was collected was 12 days (range, 3 days to 11 weeks; interquartile range, 7 to 14 days) for patients with therapeutically equivalent culture results and 10 days (range, 3 to 19 days; interquartile range, 7 to 12 days) for patients with discrepant culture results; the median values for these two groups were not significantly different ($P = 0.106$ by two-sided randomization test).

DISCUSSION

Although Jackson and Pratt proposed in 1971 that fluid collected through a drainage catheter into a closed reservoir could be "sent to the laboratory for bacteriological culture without fear of contamination from the external environment," no data were presented to support this conclusion (1). Subsequently, several authors have examined prospectively the correlation between surveillance cultures of fluid collected through drainage catheters and cultures of samples from clinically infected sites (2–4, 6). In each study, the predictive value of positive culture from the catheter drainage fluid for subsequent infection was poor; sensitivity varied but was as low as zero (3). No study included more than six patients with documented infection. In contrast, we examined the accuracy of culture of catheter drainage fluid in actual clinical practice and included a larger number of patients with true infection ($n = 46$). We found that most (89%) catheter drainage specimens were submitted without accompanying reliable CT or US evidence for localized infection, thereby rendering the culture result uninterpretable. Furthermore, when a fluid collection of potential significance was radiologically confirmed, culture of the fluid collected through preexisting drainage catheters yielded discrepant results in nearly half the cases, even in those cases in which the catheter tip apparently lay in the same collection that subsequently was sampled. Therefore, whether a significant collection is present or absent, the results of catheter drainage fluid cultures are potentially misleading for therapeutic decision making. There was no evidence that sampling drainage fluid from catheters in place for a shorter time (but more than 2 days) was more accurate than sampling from catheters in place for longer times.

Our findings support the recommendation that radiological imaging should be standard practice in the assessment of deep-tissue infections in patients with drainage catheters, and that direct aspiration of potentially infected fluid collections is the most reliable method of obtaining specimens for culture that should be used to guide therapy, whether as part of a one-step aspiration procedure in the assessment of a new collection or as part of a reevaluation of a collection with a preexisting drainage catheter. To educate those responsible for the care of patients with drainage catheters at this medical center, we wrote a letter to the appropriate clinicians in selected divisions of the Departments of Surgery, Medicine, Obstetrics and Gynecology, and Pediatrics summarizing these findings and recommendations. In addition, the following interpretative comment was added to the results of all bacterial cultures of body fluids from the abdomen or pelvis that were collected through a drainage catheter:

> Bacterial cultures of fluid collected through drainage catheters ("JP" drains") in place for more than two days yield inaccurate results with potentially misleading therapeutic consequences in nearly half of cases compared with fluid col-

lected by direct image-guided or open aspiration. If questions, please consult the Medical Microbiology Fellow or Infectious Diseases Service.

Using these measures, we aim to eventually eliminate submission for culture of fluid samples collected through preexisting drainage catheters at our hospital.

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