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# Value of Needle Aspiration in Bacteriologic Diagnosis of Cellulitis in Adults

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**We prospectively studied 30 adult patients with cellulitis, including many who were hospitalized with significant underlying medical problems. Needle aspiration of both central and leading edge areas of their lesions was performed in an attempt to establish a bacteriologic diagnosis. Potential pathogens were isolated by this technique in only 10% of the patients. Neither site of aspiration was clearly superior in terms of culture yield. Because aspirate Gram stains and cultures so rarely provided useful bacteriologic information, they were seldom helpful in guiding antibiotic selection or in influencing the outcome of treatment in most patients. However, clinical information, as well as results of primary lesion cultures when obtainable, may be used to successfully select therapy in most cases of adult cellulitis. On the basis of our results, needle aspiration may not be justified as a routine diagnostic procedure for all adults with cellulitis, though it may still be useful in selected patients.**

Cellulitis is an acute spreading infection of the skin and subcutaneous tissues characterized by local findings of tenderness, erythema, increased warmth, swelling, and regional adenopathy. Attempts to establish a precise bacteriologic diagnosis in most cases of cellulitis in adults are usually unrewarding, and therapy tends to be empiric. Uman and Kunin (12) as well as Goetz et al. (5) showed that cultures of material obtained from needle aspiration of areas of soft tissue infection or cellulitis could be successful in isolating a pathogen in a small number of selected patients. Citing these reports, textbooks of infectious diseases often advocate needle aspiration for culture in the general management of cellulitis. However, when we undertook this study, no prospective evaluation of cellulitis could be found to document how often needle aspiration actually establishes a bacteriologic diagnosis in adults. Since then, a study in adults by Hook et al. (7) reported that only 10% of aspirate cultures are positive. No study has yet, however, prospectively evaluated the best area to culture (center or leading edge of cellulitis) or how often the procedure significantly influences outcome of therapy. We designed and undertook our prospective study to address these issues.

## MATERIALS AND METHODS

**Patient selection.** Thirty adult patients, 16 years of age or older, with a clinical diagnosis of cellulitis were prospectively entered in the study. Patients either admitted to Montefiore Hospital or evaluated as outpatients in the emergency department were accepted. Cellulitis was defined as an acute, spreading inflammation of the skin and subcutaneous tissues, characterized by three or more of the following clinical findings: tenderness, erythema, swelling, or increased warmth. Patients were excluded if the inflammation was associated with an intravenous catheter or obvious phlebitis. Patients on prior antibiotic therapy were also excluded unless the cellulitis had obviously progressed while the patient was on therapy or if it first developed while the patient was on antibiotics used to treat another infection. Informed consent was obtained to perform needle aspiration.

**Needle aspiration technique.** All needle aspirations were performed by the same investigator (P.N.) using identical technique and materials in each case. Aspiration was done at two sites: at a central area of the lesion, generally at an area of maximal inflammation, or of fluctuance if present; and at the leading edge of erythema or inflammation. Each aspirate site was cleansed with povidone-iodine solution, the excess was then removed with 70% isopropyl alcohol, and the area was allowed to air dry. A 21-gauge needle attached to a 10-ml plastic syringe was used for aspiration. If initial aspiration attempts failed to produce any visible material, the needle was left in place and the original syringe was replaced with one containing 0.5 ml of nonbacteriostatic normal saline. The saline was then injected subcutaneously and promptly reaspirated.

**Primary lesion and blood culturing techniques.** A primary lesion was defined as any wound or skin condition contiguous with the area of cellulitis, causing a break in the skin and thus representing a potential site of origin for the infection. Cultures were obtained from deep areas of primary lesions with sterile culture swabs and transport media, without prior skin preparation. Blood cultures were collected from patients by standard, sterile technique.

**Microbiological culture technique.** Aspirated material was promptly carried to the microbiology laboratory in the capped needle and syringe used for collection, where it was immediately inoculated onto culture media. When necessary to obtain enough material to inoculate all plates, a few drops of tryptic soy broth were first aspirated into the syringe through the original needle. For aerobic culturing, 5% sheep blood, MacConkey, colistin-nalidixic acid, and chocolate agars were used. Anaerobic cultures were done with 5% sheep blood, phenylethyl alcohol, and kanamycin-vancomycin-laked blood agars and by inoculating thioglycolate broth medium after drawing the broth through the original needle

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TABLE 1. Characteristics of the 30 study patients with cellulitis

| Underlying disease | No. (%) | Primary lesions | No. (%) | Characteristics of cellulitis | No. (%) |
|---|---|---|---|---|---|
| None identified | 12 (40) | None identified | 5 (17) | Pain or tenderness | 29 (97) |
| Diabetes | 7 (23) | Fungal skin infection | 11 (37) | Erythema | 29 (97) |
| Venous insufficiency | 3 (10) | Cutaneous ulceration | 6 (20) | Swelling | 27 (90) |
| Alcoholism | 2 (7) | Traumatic wounds (blunt trauma, lacerations, abrasions) | 5 (17) | Increased warmth | 28 (93) |
| Bone marrow transplantation | 1 (3) | | | Fluctuance | 2 (7) |
| Multiple myeloma | 1 (3) | Callus | 1 (3) | Regional adenopathy | 8 (27) |
| Systemic lupus erythematosus (on steroids) | 1 (3) | Psoriatic lesions | 1 (3) | Temperature ≥100°F (37.7°C) | 17 (57) |
| | | Skin pustules | 1 (3) | White blood count ≥10,000/mm$^3$ | 15 (50) |
| Liver disease, ascites (patient with abdominal cellulitis) | 1 (3) | | | | |
| Extensive psoriasis | 1 (3) | | | | |
| Congenital sensory neuropathy (with recurrent trauma) | 1 (3) | | | | |

and using it to rinse the collection syringe. Gram stains prepared from each specimen were interpreted by one of us (P.N.). Standard microbiological techniques were used to identify isolated organisms (9).

## RESULTS

**Study population.** The general characteristics of the 30 study patients with cellulitis are summarized in Table 1. The mean patient age was 54 years, with a range of 16 to 92 years. Male patients outnumbered females by nearly two to one. Of the 30 patients, 18 had significant underlying diseases that could have been predisposing factors in their acquisition of cellulitis. All but two of the patients were hospitalized. Cellulitis occurred in the lower extremity in nearly all (26 of 30) cases and was present for an average of 2.6 days before the time of culture (range, 1 to 10 days). A primary lesion could be identified in the majority of patients (25 to 30). These lesions were most often fungal skin infections, followed by cutaneous ulcerations and traumatic wounds. Clinical findings of pain or tenderness, erythema, swelling, and increased warmth were present in nearly all patients. Fluctuance and regional adenopathy were seen much less frequently. Fever (temperature, ≥100°F [37.7° C]) and elevated leukocyte counts (≥10,000/mm$^3$) were not consistent findings, being seen in only 57 and 50% of the patients, respectively.

**Microbiological results.** The findings in all patients having positive cultures of material obtained from needle aspiration, primary lesion, and blood sources are summarized in Table 2. Potential pathogens were isolated by needle aspiration in 10% of patients (3 of 30), when results of both aspirate sites are included. Cultures were positive in 75% of patients (6 of 8) in whom primary lesions were cultured and in 4% of patients (1 of 26) having one or more blood cultures drawn.

Gram stains of aspirated material from both central area and leading edge sites revealed polymorphonuclear leukocytes in about one-half of the smears, but potential pathogens were never identified.

Of the 60 total aspirations performed (30 central areas and 30 leading edge areas), only 5 (8%) isolated potential pathogens. Presumed contaminants were isolated in one case only, in which *Corynebacterium* species and coagulase-negative staphylococci were isolated separately from the thioglycolate broth cultures of the central and leading edge aspirates, respectively. Of 30 central area cultures, 3 yielded potential pathogens, compared with 2 of 30 leading edge cultures.

The organisms isolated from the three cases having positive aspiration cultures warrant further comment. *Citrobacter diversus* was isolated from both central area and leading edge cultures of patient 2, who had systemic lupus erythematosus and was receiving moderate doses of steroids. The organism was also cultured from a cutaneous ulcer, felt to represent a primary lesion in this patient. *Morganella morganii* was also isolated from both blood and primary lesion cultures of this same patient. In patient 5, a diabetic with a history of a cat scratch, *Pasteurella multocida* was isolated from the central area aspirate. No material for culture could be obtained from the primary lesion in this patient. In the third case (patient 7), coagulase-negative staphylococci were isolated from both aspirated sites of cellulitis, as well as from the primary lesion (a traumatic abrasion). Although this organism could represent a skin contaminant, it was presumed to be pathogenic because of its isolation from all three sites.

**Response to treatment.** The final choice of antibiotic therapy was left to the patient's primary physician. In 21 cases (including patients 1, 5, and 7), a single antibiotic with activity against staphylococci and streptococci was used (i.e., cefalexin, cefazolin, dicloxacillin, nafcillin, or vancomycin). Additional coverage employing a broader-spectrum antibiotic or a combination of antibiotics was used in nine patients who tended to be immunocompromised, more acutely ill on presentation, or to have significant underlying diseases (including patients 2, 3, 4, and 6). Combination therapy was most often an aminoglycoside combined with an antibiotic having antistaphylococcal or anaerobic activity.

Of the 30 patients, 25 improved with initial antibiotic therapy (including patients 2, 3, 5, and 7). An additional three patients also improved, but had early surgical drainage and debridement of infected areas, along with antibiotics (including patient 1). Only two patients worsened on initial therapy. Both were diabetics with severe vascular insufficiency who required surgical debridement (patients 4 and 6).

## DISCUSSION

In our study, needle aspiration of cellulitis provided a bacteriologic diagnosis in only 10% of adults. This yield is particularly low when considering that the study population included many acutely ill, hospitalized patients with significant underlying medical problems. Further, the study was performed in a prospective fashion, with a single investigator doing all aspirations, thereby controlling for technique and rapid inoculation of culture media. Because so few needle

TABLE 2. Summary of significant bacteriologic findings in study patients having positive cultures

| Patient | Age (yr) | Sex[a] | Underlying disease | Site | Primary lesion | Organism(s) isolated from primary lesion | Organism isolated from needle aspirate[b] | Organism isolated from blood |
|---|---|---|---|---|---|---|---|---|
| 1 | 71 | M | Venous insufficiency | Lower extremity | Traumatic laceration | Alpha-hemolytic streptococci, group D streptococci, coagulase-negative staphylococci, *Micrococcus* sp., *Klebsiella pneumoniae*, *Clostridium perfringens*, *Peptococcus* sp. | CA and LE, none | None |
| 2 | 29 | F | Systemic lupus erythematosus (on prednisone 40 mg q d) | Lower extremity | Heel ulceration | Group D streptococcus, coagulase-negative staphylococci, *C. diversus*, *M. morganii* | CA and LE, *C. diversus* | *M. morganii* |
| 3 | 76 | M | None | Lower extremity | Callus of foot | *M. morganii* | CA and LE, none | None |
| 4 | 81 | M | Diabetes | Lower extremity | Ulceration | Group D streptococcus, *Proteus mirabilis*, *Citrobacter freundii*, *Klebsiella oxytoca* | CA and LE, none | None |
| 5 | 32 | M | Diabetes | Upper extremity | Laceration from cat | Not obtained | CA, *Pasteurella multocida*; LE, none | None |
| 6 | 63 | M | Diabetes | Lower extremity | Ulceration | Group B streptococcus, *S. aureus*, *Pseudomonas aeruginosa*, *Acinetobacter anitratum*, *Peptococcus* sp. | CA and LE, none | None |
| 7 | 23 | F | None | Lower extremity | Traumatic abrasion | Coagulase-negative staphylococcus | CA and LE, coagulase-negative staphylococcus | Not obtained |

[a] M, Male; F, female.
[b] CA, Central area of cellulitis; LE, leading edge of cellulitis.

aspirate cultures isolated pathogens, we were unable to determine whether there is any significant difference in culture yield when comparing aspirates obtained from the central area versus those from the leading edge of cellulitis. All that may be concluded is that it is possible to infrequently isolate bacteria from both areas and that neither is clearly superior. Potential pathogens were never identified on Gram stains of material aspirated from our patients with cellulitis; therefore, the smears were not useful in suggesting an early bacteriologic diagnosis or in guiding initial antibiotic therapy. Neither were aspirate culture results helpful in directing subsequent therapy, because they were so seldom positive.

Group A streptococci and *Staphylococcus aureus* are reported to be the most frequent causative agents of cellulitis in adults. However, many other organisms have been isolated from patients with cellulitis, including various members of the family *Enterobacteriaceae*, *Pseudomonas aeruginosa*, *Streptococcus pneumoniae*, *Pasteurella multocida*, and *Haemophilus influenzae*, to name only a few (3, 5, 10, 11, 13). Because of the numerous potential bacterial causes of cellulitis, a rapid, simple diagnostic procedure to establish the etiologic agent would be helpful in directing specific therapy of individual patients. The technique of needle aspiration has been advocated as such a procedure, but with virtually no prospective data to document its usefulness in adult patients. Two prospective studies of needle aspiration in children with cellulitis have reported positive cultures in 48 and 60% of cases, respectively (1, 2). Two retrospective studies which have included adults, however, reported that only 5 to 6% of needle aspirate cultures yielded pathogens (4, 6), suggesting that the procedure has a far lower yield in adults than in children. The only other prospective study of adults with cellulitis recently reported that 10% of cultures obtained by needle aspiration were positive (7). The results of these few earlier studies and of our own prospective investigation indicate that the microbiological diagnosis of cellulitis in individual adult patients remains a difficult problem and that needle aspiration is most often unrewarding.

Despite the lack of bacteriologic information from needle aspiration or blood cultures, however, our study does show that treatment of cellulitis in adults will generally be successful when guided only by information gained from the clinical history and examination and from culture results of primary lesions when present. Staphylococci and streptococci are the most common causes of cellulitis, and indeed most of the adults in our study population responded to specific antibiotic therapy covering these pathogens. However, since *C. diversus*, *M. morganii*, and *Pasteurella multocida* were also isolated from our patients, our findings do emphasize that in compromised hosts and in certain clinical settings, more unusual organisms may cause cellulitis and should be anticipated in selecting initial antibiotic coverage. The isolation of *Pasteurella multocida* from the patient with a cat scratch illustrates how clinical history can guide therapy (3). Primary lesion culture results are often valuable in selecting antibiotic therapy for patients with cellulitis. In two of the three study patients in whom needle aspirate cultures isolated an organism, the same organism was found in cultures of their primary lesions. When cellulitis occurs secondary to cutaneous ulcerations or lacerations, particularly in diabetics or compromised hosts, cultures of these primary lesions often yield multiple organisms, including gram-positive and gram-negative aerobes, as well as anaerobes. Many of these organisms are normal skin flora, and when multiple organisms are isolated in an individual patient, not all are necessarily pathogenic. However, in such clinical settings, initial

antibiotic therapy probably should include coverage for all of these potential pathogens.

In conclusion, in evaluating adults with cutaneous cellulitis, our prospective study demonstrates that needle aspiration successfully establishes a specific bacteriologic diagnosis in only a small percentage of cases. For most patients, the procedure will not be helpful in directing either initial or subsequent antibiotic therapy or in significantly influencing outcome of treatment. Given our results, one might question whether this procedure ought to be advocated as a routine diagnostic study. On the one hand, most of the patients we studied responded to therapy guided only by clinical history or by cultures of primary lesions. Therefore, because of its low sensitivity, it could be argued that needle aspiration is not justified in all patients. On the other hand, the procedure is simple, safe, and relatively inexpensive and a few rather unusual organisms were isolated from our study population. Aspiration may still be useful in selected instances, such as in compromised hosts, in clinical situations in which more unusual organisms are suspected, or whenever toxicity from empiric or multiple antibiotics is a concern. An alternative diagnostic approach, which also warrants further investigation, is skin biopsy of such lesions for culture. Two studies of different biopsy techniques have reported higher yields of positive cultures in cellulitis than those obtained with simple needle aspiration (7, 8).

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