Yale Studies of Patient Care

II. The Use of Urine Culture in the Management of Urinary Tract Infections

C. LYNN MORROW, WALTER J. HIERHOLZER, JR., AND RICHARD V. LEE

Departments of Internal Medicine and Epidemiology and Public Health, Yale University School of Medicine, New Haven, Connecticut 06510

Received February 3, 1976

Urinary tract infection (UTI) is a common medical problem. The diagnosis and management of urinary tract infections is an important and frequent clinical task. Symptoms and routine urine analysis are not consistent or reliable indicators of UTI; a quantitative culture of the urine is necessary for a definitive diagnosis (1-3). Because symptoms and urine analysis are of questionable value in documenting persistence of infection, a follow-up quantitative urine culture is necessary to demonstrate the effectiveness of antimicrobial therapy (1-5). The purpose of this study was to investigate how the results of quantitative urine cultures were used in the management of patients with UTI, symptoms of UTI, or conditions that predispose to UTI.

METHODS

Adult patients using the outpatient facilities of the Department of Internal Medicine at the Yale-New Haven Hospital, including the Emergency Room, Extended Emergency Room (Walk-in Clinic) and general medical clinics, were studied. These three areas combined have 40,000-45,000 patient visits per year and are staffed primarily by medical house officers in the second year of postgraduate training. Other staff caring for patients in these areas include two nurse practitioners, one physician's associate, supervising faculty from the full-time and voluntary staff, and numerous medical students.

The results of all urine cultures done by the medical staff in the Emergency Room, Extended Emergency Room, and general medical clinics during 3 consecutive months were reviewed. A positive culture was defined as having $>10^5$ organisms/ml for females and $>10^4$ organisms/ml for males; borderline culture was defined as having $10^4$ organisms/ml for females and $10^3$ organisms/ml for males; and negative culture was defined as having $<10^4$ organisms/ml for females and $<10^3$ organisms/ml for males.

The charts of all patients having a positive or borderline urine culture were reviewed. A random sample, equal in size to the number of patients with positive cultures, was selected from all patients with negative cultures. The charts of this sample of patients with negative cultures were reviewed. The distribution of age and sex in the random sample of patients with negative cultures was similar to the group of patients with positive or borderline cultures.

1Reprint requests should be sent to: Richard V. Lee, M.D., Buffalo Veterans Administration Hospital, 3495 Bailey Avenue, Buffalo, New York 14215.
The information collected from each chart included the presence of symptoms, predisposing conditions or risk factors, antibiotic therapy prescribed, appropriateness of the antibiotic according to antibiotic sensitivity testing, notation in the chart that a follow-up visit should be made, and record of a follow-up visit.

Clinical findings were divided into three categories: (i) Suggestive findings: dysuria, frequency, urgency, hematuria, pyuria, fever, flank or back pain, or a combination of these. (ii) Flank or back pain only. (iii) No symptoms or findings.

Patients were classified as “high risk” if they had a history of previous UTI, renal stone, diabetes mellitus, hypertension, or any previous urethral catheterization. Patients giving negative responses to the appropriate questions or patients with no mention of any of these conditions on at least four previous hospital visits were excluded from the high risk category. Patients with charts containing insufficient information about these conditions were classified as unknown.

Plans for follow-up care, written in the chart, were classified as: (a) Absent; (b) present, patient asked to return for follow-up outpatient visit; (c) phone contact suggested; (d) patient referred elsewhere; (e) patient admitted.

Patients were classified as regular users of the hospital if they had at least two visits per year.

Other information recorded included method of payment (private insurance, Medicare/Medicaid, welfare, self-pay) and area of residence.

Correlation and statistical analyses of the data were done using an IBM 370 Series computer.

RESULTS

Clinical Characteristics and Culture Results

There was a total of 15,391 patient visits to the Emergency Room, Extended Emergency Room, and general medical clinics during the 3-month study period. Six hundred thirty-eight urine cultures were ordered. Of these, 105 (16%) were positive, 33 (5.2%) were borderline, and 500 (78.3%) were negative. Medical records were not available for 18 patients with positive cultures and 7 patients with borderline cultures. The final study group of 200 consisted of 87 patients with positive urine cultures, 26 patients with borderline urine cultures, and 87 randomly selected patients with negative urine cultures.

One hundred fifteen patients were judged to have risk factors, and 40 patients to have no risk factors. The remaining 45 patients’ charts had insufficient information to judge risk. Suggestive clinical findings for UTI were present in 112 patients; 48 patients had only flank pain or back pain; 35 patients had no clinical findings or symptoms. The combination of risk factors and major clinical findings was present in 71 patients.

The clinical history and clinical findings were unreliable indicators of infection. Only 51% of patients with a suggestive clinical finding had a positive culture. Of those patients at a high risk for UTI, only 50% had a positive culture. High risk plus a major clinical finding similarly were not closely correlated with a positive culture: 59% of patients with this combination had positive urine cultures. Conversely, 31% of patients with no major clinical findings for UTI had positive cultures, and 37% of patients judged not to be at risk had a positive urine culture.

Antimicrobial Treatment

Fifty percent of all 200 patients received antimicrobial therapy. Antimicrobial therapy was prescribed before the result of the urine culture was known for 75% of
patients with positive urine cultures and for 25% of patients with negative urine cultures. When patients had a suggestive clinical finding for UTI, 68% were given an antimicrobial drug. Only 19% of patients with no suggestive clinical findings for UTI and 35% of patients with only flank or back pain were given antimicrobial drugs (Table 1). These differences were statistically significant ($p < 0.0005$). On the other hand, a history of predisposing conditions or risk factors appeared to have no effect on the use of antibiotics (Table 2).

**Follow-up Management**

Eighty-four of the 200 patients returned for a follow-up visit; however, only 23 of 87 patients with positive initial urine cultures returned to the clinic for a follow-up visit. Twelve others were admitted or referred to other follow-up. The flow diagrams (Figs. 1 and 2) illustrate the management course of the patients with positive and negative cultures. The patients with borderline cultures were not included in these results. Because only 5% of patients with borderline urine cultures develop positive cultures on repeat testing (2), we felt that this group could be eliminated when contrasting the management of patients with positive urine cultures with patients having negative urine cultures.

Of the 65 patients with positive initial urine cultures treated on the initial visit, 6 were referred or admitted, 17 returned for follow-up visits, and 42 did not return for follow-up care or culture. Eight of these 42 patients not returning had been placed on the wrong drug according to antibiotic sensitivity testing. One of the 17 returnees was started on an inappropriate antimicrobial but was not switched to a more suitable drug on the return visit.

Of the 22 patients with positive initial cultures receiving no antibiotics on the initial

---

**TABLE 1**

| Clinical findings | Patients given antibiotics | Patients not given antibiotics |
|-------------------|---------------------------|-------------------------------|
| None              | 4 (11%)                   | 31 (89%)                      |
| Suggestive        | 76 (68%)                  | 36 (32%)                      |
| Pain              | 17 (35%)                  | 31 (65%)                      |
| Other or unknown  | 1                         | 4                             |
| Total             | 98                        | 102                           |

* $p < 0.0005$.

---

**TABLE 2**

| High risk | Patients given antibiotics | Patients not given antibiotics |
|-----------|---------------------------|-------------------------------|
| No        | 20 (50%)                  | 20 (50%)*                     |
| Yes       | 59 (51%)                  | 56 (49%)*                     |
| Unknown   | 19                        | 26                            |
| Total     | 98                        | 102                           |

* $p > 0.1$
visit, 6 were referred or admitted and 10 others did not return to clinic. Of the 6 that did return, 4 received no antibiotics on the return visit.

There was no correlation between a positive initial urine culture and a follow-up clinic visit. Of the 75 patients with positive initial urine cultures who were not referred or admitted, 52 or 70% did not return to the clinic for follow-up of the positive culture. Similarly, symptoms did not correlate with better follow-up: Only 39% of patients with a suggestive clinical finding of UTI made follow-up visits, whereas 59% of patients with no urinary symptoms and 52% of patients with only flank or back pain returned. Only 34% of patients given an antimicrobial drug returned for follow-up clinic visits; whereas 47% of patients not given an antibiotic returned \((p = 0.05)\). No correlations could be made between follow-up rate and area of residence, method of treatment, or regular vs new users of the outpatient department.

Fifty patient records contained no notation about follow-up care. Only 14% of these patients returned to the hospital for follow-up care. Ninety-nine patient records had a written recommendation for follow-up care. Fifty-two percent of these patients returned. The difference in rate of return is statistically significant \((p < 0.0005)\).

**DISCUSSION**

The results of this retrospective study indicate that the evaluation and management of patients with suspected urinary tract infections in a busy teaching

FIG. 1. Management of patients with positive urine cultures.

FIG. 2. Management of patients with negative urine cultures.
hospital outpatient department often proceed with little attention to the results of the urine culture. Physicians prescribed antibiotics to 50% of 174 patients before the results of the urine culture were known. Because we used the urine culture as the focus of the study, we have no information about patients who may have been treated for UTI without benefit of urine culture.

The patient’s symptoms and clinical findings (fever, pyuria, hematuria, etc.) were important determinants for antibiotic treatment despite evidence from this study and others (6–10) that symptoms and routine urine analysis without urine culture are not reliable indicators of genuine UTI. The presence of predisposing conditions such as diabetes or hypertension seemed not to affect the physicians prescribing for UTI. Despite this evidence, physicians prescribed antibiotics for 75% of patients later shown to have a positive culture and only 25% of patients later shown to have a negative culture. This degree of accuracy is impressive, if imperfect, and implies that many more factors than studied here contribute to the physician’s management decisions for the individual patient with possible UTI. The use of the examination of the gram-stained urine sediment is an accepted additional method for judging the presence of urinary tract infection. The use of this method may have provided additional guidance to the physician in the use of antibiotics. Documentation of such use is rarely available in the medical record and could not be found in the present review.

It is clear that the results of the urine culture had little if anything to do with the physician’s decision to start antimicrobial treatment. Not only were the majority of patients started on antibiotics before the culture result was known, but two-thirds of the patients with positive cultures untreated at the initial visit were not given antibiotics when they returned for follow-up visits when the results of the urine culture were available. Although there is disagreement about the necessity of waiting for culture results before starting antibiotic therapy, there is general agreement that a follow-up urine culture is necessary to determine the efficacy of treatment (1–5). The results of our study indicate that the urine culture was apparently not used to determine which patients should receive follow-up care. As with decisions about starting antibiotic therapy, decisions about follow-up care were often made before the results of the urine culture were known. Although what the patient was told was unknown, when the physician’s notes contained a recommendation for follow-up, the patient was more likely to return for follow-up care and culture. Indeed, the physician’s written note recommending follow-up was the only variable, of those studied, positively correlated with follow-up care.

The return rate for the entire study population was 40%, but only 30% of the patients with a positive urine culture returned for follow-up care. Similarly, patients with suggestive clinical findings for UTI had a lower return rate than the overall population. Patients started on antibiotics on the initial visit were less likely to return than those not started on antibiotics. We had expected that patients treated for symptoms and genuine urinary tract infection would be more likely to continue medical care than patients not so afflicted and not given medication. Our observations indicate that successful management of patients with UTI or possible UTI is affected less by the clinical, microbiologic, or therapeutic aspects of the individual case and more by the doctor’s instructions to the patient. We suspect that patients with symptomatic UTI, unless carefully instructed otherwise, will assume incorrectly that disappearance of symptoms and pills signals completion of successful therapy and cure, thus neglecting to return for follow-up care.

Several factors contribute to the haphazard use of urine culture results in managing patients with UTI or possible UTI. Because there is a 24-48-hr wait for
culture results and because most of the treating physicians are not present in the outpatient department regularly each day, the physicians treat empirically. Similarly, because the culture results are not conveyed to the treating physician as soon as they are available, appropriate changes in therapy or follow-up management are not made. Furthermore, some of the laboratory result papers are misfiled, non-filed, or lost before the treating physician sees them. It is possible for a patient’s record not to contain important laboratory data when he or she returns for follow-up care.

This study indicates that, for a variety of reasons, the management of adult patients with UTI or possible UTI at a teaching hospital outpatient department often proceeds without reference to the result of the urine culture. Similar misuse of bacterial cultures has been documented in the office management of pediatric patients (11) and in the management of hospitalized children and adults (12, 13). Correcting this problem requires increasing physician use of urine culture results by emphasizing that merely obtaining a urine culture is not sufficient, that management of patients is improved by attention to the culture result and by increasing physician awareness of the culture result by improvement in the flow of information from the laboratory to the physician. In the setting of a teaching hospital outpatient department, these objectives can be furthered by improving the return rate of patients from whom urine cultures have been obtained. Our observations suggest that the faculty supervising house staff and other physicians in the outpatient department can monitor the effectiveness of the physician’s performance by auditing patient records with particular attention as to whether or not written recommendations for follow-up care are present.

REFERENCES

1. Kass, E. H., Asymptomatic infection of the urinary tract. Trans. Ass. Amer. Physicians. 69, 56–64 (1956).
2. Kaye, D., (Ed.) “Urinary Tract Infection and its Management.” C. V. Mosby, St. Louis, 1972.
3. Kunin, C. M., “Detection, Prevention, and Management of Urinary Tract Infections.” Lea and Febiger, Philadelphia, 1972.
4. Kessner, D., and Kalk, C., “A Strategy for Evaluating Health Services.” National Academy of Sciences, Washington, D.C., 1973.
5. Fass, R. J., Klainer, A., and Perkins, R. L., Urinary tract infection: Practical aspects of diagnosis and treatment. J. Amer. Med. Ass. 225, 1509–13 (1973).
6. Lawson, D. H., et al., Urinary tract symptomatology in general practice. J. R. Coll. Gen. Pract. 23, 548–555 (1973).
7. Hulbert, J., Presentation, Bacteriological Diagnosis: Test of cure in urinary tract infection in general practice. J. R. Coll. Gen. Pract. 23, 556–60 (1973).
8. Mond, N. C., Percival, A., Williams, J. D., and Brumfitt, W., Presentation, diagnosis and treatment of urinary tract infection in general practice. Lancet I, 514–516 (1965).
9. Gallagher, D. J. A., Montgomerie, J. Z., and North J. D. K., Acute infections of the urinary tract and the urethral syndrome in general practice. Brit. Med. J. 1, 622–626 (1965).
10. Steensberg, J., Bartels, E. D., Bay-Nielsen, H., Fane, E., and Hede, T., Epidemiology of urinary tract diseases in general practice. Brit. Med. J. 4, 390–94 (1969).
11. Dolan, T. F., and Meyers, A., A survey of office management of urinary tract infections in childhood. Pediatrics 52, 21–24 (1973).
12. Edward, L. D., et al., Ordering patterns and utilization of bacteriologic culture reports. Arch. Intern. Med. 132, 678–682 (1973).
13. Minkin, M. J., Hierholzer, W. J., Jr., and Lee, R. V., Yale studies of patient care. I. The evaluation of the febrile patient. Yale J. Biol. Med. 49, 267–272 (1976).