The Dipslide in Diagnosis of Urinary Tract Infections

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Urinary tract infections (UTI's) are common in medicine. Symptoms may include fever, chills, frequency, and dysuria. Asymptomatic UTI's are also common, with a prevalence of one percent in school girls and ten percent in pregnant women. Pyuria, dysuria, and frequency may be absent in patients with UTI's or present in patients without UTI's. Therefore, a UTI must be bacteriologically diagnosed as >100,000 organisms/ml, usually of a single organism, in a properly obtained urine specimen. The dipslide is a simple, convenient, inexpensive device for the quantitative diagnosis of a UTI. Culture media are layered on both sides of the dipslide, one medium allowing growth of all organisms and the other medium favoring growth of enterobacteriae. After immersion in a clean catch urine specimen, the dipslide is incubated for 24 hours at 37C. Each urinary organism forms a colony "dot." The density of colony "dots" can be quantitated easily by comparison with standardized graphs. The dipslide is a highly accurate and sensitive tool that can be used for the diagnosis of UTI's, assessment of antimicrobial effectiveness, follow-up for presence of recurrence or relapse, and screening of high-risk individuals.

A urinary tract infection (UTI) is defined as the presence of significant bacteriuria in a properly obtained urine specimen. Under ordinary circumstances a culture with greater than 100,000 colonies/ml of a single organism represents significant bacteriuria and indicates presence of infection somewhere in the urinary tract. Urinary tract infections are common in medicine. They may present clinically as frank pyelonephritis with fever, chills, flank pain and prostration, or as cystitis – urethritis with frequency and dysuria. However, it has become clear that one cannot, with any degree of accuracy, clinically distinguish infection of the upper tract from that of the lower tract. That is, patients with "cystitis" may have radiological, histological, or immunological evidence of pyelonephritis. Patients with "pyelonephritis" may have strictly lower tract involvement. Hence, the term urinary tract infection or UTI without specific reference to the location of infection is preferred.

Patients with UTI's may be totally asymptomatic. This has been well documented by Kunin[1] in the United States and by others[2] in Europe who have demonstrated in school girls a one percent prevalence of asymptomatic UTI's. Others have demonstrated a ten percent prevalence of asymptomatic UTI's in pregnant females.[3] Many patients with asymptomatic UTI's become symptomatic with dysuria, frequency and even fever, chills, and flank pain. In children, other common symptoms are fever of unknown origin, short stature, recurrent abdominal pain, anemia, incontinence in a previously trained child, and foul smelling or cloudy urine. In infants, jaundice, irritability, and gastrointestinal symptoms such as vomiting, diarrhea, and constipation may signal the presence of a UTI. Recurrence of infection is very common, occurring in 40 to 80 percent of patients following the successful treatment of infection. In school girls with asymptomatic urinary tract infections, Kunin demonstrated that following each successful treatment there was an 80 percent chance of recurrence so that, on the average, school girls would experience 7 to 12 UTI's before "outgrowing" them.[4] Urinary tract infections may be associated with significant morbidity, with loss of time from school and work, and with frequent visits to the physician's office. The long-term relationship between urinary tract infection and chronic renal failure is far from clear.

Diagnosis of UTI

The diagnosis of a UTI is a bacteriologic one. Not only may patients with UTI's be asymptomatic but as many as half the patients with urinary tract symptoms, such as frequency and dysuria, will not have UTI's by culture and will not respond to antimicrobial therapy.[5] Pyuria may be absent in half of patients with urinary tract infection and present in half of patients without urinary tract infection.[6] Microscopic examination of the unspun urine for bacteriae, even by a skilled bacteriologist, carries an unacceptably high risk of over-detection of UTI's (ie, false positives),[7] leading to over-diagnosis and over-treatment of patients. Evaluation of urine turbidity or the presence of proteinuria is of no diagnostic value.

The unreliability of other methods of detection makes the urine culture the *sine qua non* for the diagnosis of a UTI. The growth of 10^5 or more colonies per ml of urine in a properly

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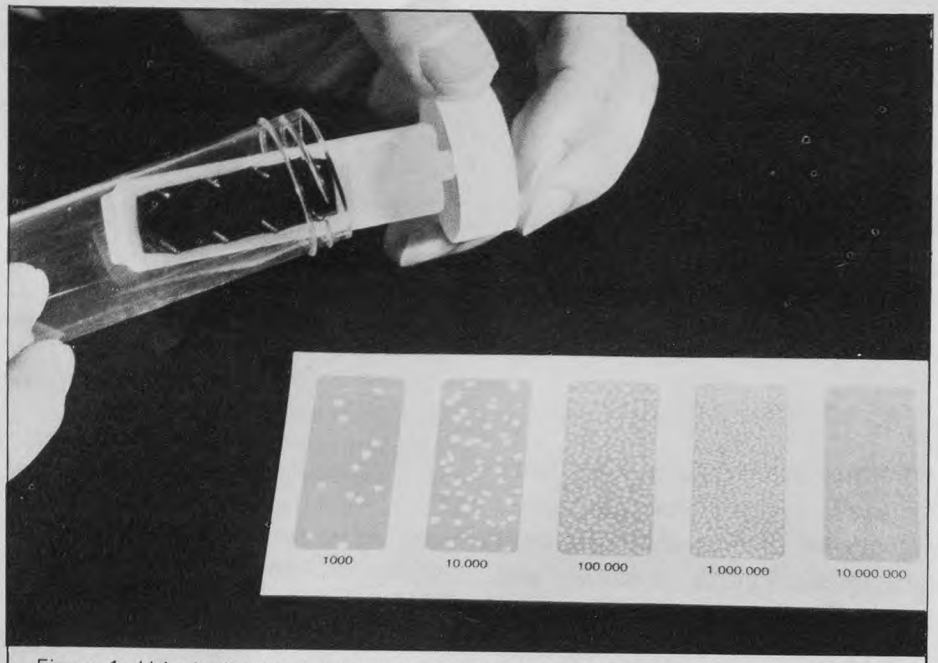

Figure 1. Uricult dipslide is displayed along with graphic standards indicating various colony counts

obtained, clean catch mid-stream urine carries an 80 percent probability of true infection. Twenty percent of positive cultures will be due to local perineal contamination and not represent true urinary tract infections. Two consecutive positive cultures raises the probability of true infection to 90 to 95 percent. A growth of 10^5 or more colonies per ml of urine from a male or from a catheterized specimen carries a 90 to 95 percent probability of true infection. Any bacteriae isolated from a suprapubic bladder puncture must be viewed as possible infection since the bladder is normally sterile.

False negative cultures may occur in patients taking antibiotics or in patients who have ingested copious amounts of fluid prior to urine culture and have diluted the colony count to 10^3 to 10^4 organisms. In addition, the streak method of culture commonly used in laboratories is associated with a ten percent incidence of false negatives. False positive cultures are unfortunately very common and are usually due to inadequate collection and transport of urine. Urine is an excellent culture medium. Organisms contaminating the culture may, within a few hours, multiply so rapidly as to reach counts of 10^5 colonies per ml of urine. Such contaminants may then be mistakenly attributed to an infected urinary tract. It is extremely important that urine for culture be properly obtained and quickly cultured (or refrigerated until culture is possible). Specimens may be accurately obtained by the mid-stream urine collection technique described in Table 1. In difficult or doubtful cases, suprapubic bladder puncture may be used to confirm the presence or absence of a urinary tract infection. Catheterization may be used if the practitioner is unfamiliar or inexperienced with the technique of suprapubic bladder puncture, but it is generally not recommended because of the five to ten percent incidence of infection caused by the catheterization itself.

Proper diagnosis of the urinary tract infection is extremely important, not only from the standpoint of management, but also from the standpoint of follow-up, which includes multiple repeat cultures for detection of recurrence (new infection) or relapse (inadequately treated infection). Proper radiologic evaluation, including an intravenous pyelogram and a voiding cystourethrogram, are especially important in the pediatric population, since first urinary tract infections in young girls and boys are associated with a 25 to 35 percent incidence of radiographic abnormalities.[2] Diagnosis, treatment, evaluation, and follow-up involve time and expense and underline the need for accurate diagnosis.

The Dipslide

The traditional laboratory verification of a urinary tract infection has required expensive pour-plate or streak-plate cultures of urine specimens. Moreover, specimens obtained at home or in the office often reach the laboratory after several hours of delay, leading to false positive urine cultures and the necessity of repeat cultures, doubling expense and inconvenience. What has been needed is a simple, inexpensive, convenient, and accurate way to diagnose a urinary tract infection. The dipslide appears to be the answer. The dipslide is a flat slide coated on both sides with solid culture media (Figure 1). One medium, a nutrient agar, allows for growth of most organisms, whereas the other medium, usually MacConkey's, favors growth of enterobacteriae and inhibits growth of unwanted contaminants. The slide is inexpensive and simple to use. The doctor, nurse, or patient simply dips the slide fully into a properly obtained urine specimen so that both slides are coated with urine, removes the slide, allowing it to drain a bit from its lower edge, and returns it to its container for incubation. Children, after proper cleansing, may void directly onto the slide agar surfaces. Although some authors have stated the dipslide can be read after 18 to 24 hours of incubation at room temperature, it is the experience of this author and others[7,9] that this can give false positive and false negative results. It is preferable that the dipslide be incubated for 18 to 24 hours at 37C and then be read by an experienced person. Each urine organism, upon incubation, forms a colony on the slide media. The total number of colonies is easily estimated by comparing colony "dot" density on the slide to a chart reproducing slides with various colony counts (Figure 1). Colony density greater than 10^5 indicates presence of a urinary tract infection. Colony densities between 10^4 and 10^5 may represent infection or contamination and warrant a repeat culture.

Table 1. Proper Technique for Collection of Urine Specimens

Female

Drink two glasses of fluid 30 minutes before collection. Try to collect a first morning urine specimen.

Sit on the toilet seat facing the back of the toilet.

Spread the labia with one hand and wash the area from which you pass urine gently from front to back with two sterile pads soaked in soapy water followed by two sterile pads soaked in tap water.

Pass a small amount of urine into the toilet.

Hold the collection container by the outside and pass the remainder of your urine into it.

Male

Drink two glasses of fluid 30 minutes before collection. Try to collect a first morning urine specimen.

Wash the penis (pull back foreskin if not circumcised) gently with two sterile pads soaked in soapy water followed by two sterile pads soaked in tap water.

Pass a small amount of urine into the toilet.

Hold the collection container by the outside and pass the remainder of the urine into it.

Table 2. Uses of the Dipslide*

Diagnosis of acute urinary tract infection
Assessment during therapy of antimicrobial effectiveness
Follow-up for presence of relapse and/or recurrence
Screening of high-risk populations

*Uricult — Medical Technology Corporation, Hackensack, New Jersey

Table 3
Causes of False Negative Dipslides

Patient on antibiotic therapy at time of culture
Contamination of urine collection jar with antibiotic cleansing solution
Low count because of marked diuresis
"Clean looking" agar due to extremely high, confluent colony count
Slide incubation at room temperature

Table 4
Causes of False Positive Dipslides

Delay in culture of the urine specimen
Vaginal discharge
Greater than 100,000 colonies per ml of mixed organisms usually (but not always) contamination
Slide incubation at room temperature

The dipslide can be used both in the office and in the home. It may be used for diagnosis of an acute urinary tract infection, for follow-up during treatment to confirm antimicrobial effectiveness and for follow-up after treatment to detect relapse and/or recurrence (Table 2). Drug sensitivity can be determined from sub-cultured positive dipslides. The dipslide is useful as a screening device in high-risk populations such as pregnant women, diabetics, patients with indwelling catheters, patients with congenital urinary tract anomalies, and patients with recurrent urinary tract infections. Asymptomatic bacteriuria is common enough in the school and pre-school age female population to warrant dipslide screening yearly. This will allow early detection of infection. In addition, there is some evidence indicating that most renal scarring and atrophy secondary to infection occurs in the young growing child. Early diagnosis and therapy may reduce the sequelae of such infections.

Dipslides have been shown to be highly accurate with a 95 to 99 percent agreement with pour-plate cultures. False negatives (Table 3) may occur with rare, gram-positive organisms, or with old dipslides with dried agar surfaces. Occasionally, where growth is confluent from spreading organisms or extremely dense colony counts, the surface appears clear and may be misread as negative. False positives (Table 4) are usually due to inadequate collection of urine. But even with unprepped, non-clean-catch urines, dipslide culture is associated with less than five percent false positive cultures.[2]

The dipslide media are stable and reliable for six months if stored in a refrigerator or kept at room temperature. Containers must be airtight to prevent media from drying.

Other inexpensive office and home techniques for detecting urinary tract infections are generally unacceptable. Although the nitrite and glucose methods, when positive, do point to infection, they have low sensitivity, missing 30 to 50 percent of infections.[7] When positive, however, they do have the advantage of immediate diagnosis of infection and therefore may be used as a supplement, but not as a replacement, for the dipslide.

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