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A REVIEW OF METHODS FOR DETERMINING SIGNIFICANT URINARY TRACT INFECTIONS

J. PETER JOHNSTON, M.D.*

VARIOUS METHODS have been advocated for determining the presence of urinary tract infections. The most generally accepted has been the quantitative culture procedure. Bacterial counts of 100,000 or more per ml. have now been generally accepted as indicative of urinary tract infection. This test, however, is both time consuming and expensive; and, therefore, does not lend itself well to use as a routine screening procedure, particularly in asymptomatic patients. Of the various alternatives proposed, the best studied have been the Griess test, the Tetrazolium test, and microscopic examination of the spun urinary sediment for bacteria.

The Griess test, originally used for determining water purity, consists when positive of the immediate appearance of a red color on addition of equal volumes of urine and Griess reagent, and depends on the ability of many organisms to reduce nitrates to nitrites. This property of reducing the nitrate is quite marked with coliform organisms, less with staphylococcal and proteus strains, and is absent in streptococcal, gonococcal, and Mycobacterium tuberculosis organisms according to the in vitro studies of Schaus. Other important variables affecting this method of detecting significant bacteriuria are the concentration of nitrates in the urine (from vegetables in the diet) and an adequate incubation time of the bacteria in the presence of these nitrates in the bladder. Clinical investigation of this test, including manipulation of these factors, has been reported by various authors. L. G. Smith et. al. studied 1,154 clean-catch urine specimens from patients hospitalized at the National Institutes of Health. Of 377 urines with a significant quantitative bacterial count, only 51 per cent yielded a positive Griess test. Modification of the test by incubating for one hour with potassium nitrate resulted in approximately a 12 per cent increase in positive tests. In a subsequent report on asymptomatic job applicants, 13 were found to have significant bacteriuria by the quantitative culture procedure (all E. coli). Ninety-two per cent of these had a positive Griess test. They concluded that best results occurred in outpatients on an adequate diet and using overnight urine specimens.

The Tetrazolium test depends on the ability of actively respiring bacteria to reduce triphenyl tetrazolium chloride to triphenyl formazan which is insoluble and

*Emergency unit.
JOHNSTON

red. Simmons and Williams studied 480 consecutive urines sent for bacteriologic study. One-hundred and thirteen of these had a significant quantitative culture; 94 of these had a positive tetrazolium test; there were false positives in 2 per cent of the normal urines. The error occurred with streptococcal and mixed infections. Smith and Schmidt using a different type of tetrazolium test were able to show only 70 per cent positive tests on 13 asymptomatic patients with significant quantitative cultures, and 35 per cent positive tests in a group of hospitalized patients with significant bacteriuria.

The more direct approach would seem to be microscopic examination of the urine. This has been done for many years but only recently have the results been carefully compared with quantitative cultures. Sanford reported on 91 cultures from symptomatic patients when urine cultures yielded a count of greater than 10,000 bacteria per ml. All had bacteria in the stained sediment. Five of 18 cultures containing less than 10,000 bacteria per ml. also had bacteria in the stained sediment. Based on the usual figure of 100,000 organisms per ml., this study would have given a higher percentage of false positives, but no false negatives. Rehm and Fishman studied 141 patients, 64 of whom had bacterial urine counts of greater than 100,000 per ml. All were positive on stained smear and 91 per cent were positive on an unstained smear. In the 77 patients having bacterial counts of less than 100,000 per ml., 12 per cent had positive stained smears and 16 per cent positive unstained smear. The difference between stained and unstained smear results was due primarily to difficulty in differentiating cocci from amorphous material or crystals. Kunin reported on 124 children in whom bacteria were seen in the unstained smear in all of the 67 having bacterial counts of 100,000 per ml. or more. He found 12 per cent false positive smears in the remaining 57 children.

Table I

Summary of Published Results of Various Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Source of Urine Specimen</th>
<th>Positive/No. Quant./Spec. Cult.</th>
<th>Per Cent of Positive Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Griess</td>
<td>Hospitalized patients (3)</td>
<td>377/1154</td>
<td>51%</td>
</tr>
<tr>
<td>Tetrazolium</td>
<td>Consecutive urines sent to bacteriology laboratory (5)</td>
<td>113/480</td>
<td>94%</td>
</tr>
<tr>
<td>Examination of stained sediment</td>
<td>Patients with GU symptoms (7)</td>
<td>64/141</td>
<td>100%*</td>
</tr>
<tr>
<td>Examination of unstained sediment</td>
<td>Previously abnormal qualitative urines or symptoms (8)</td>
<td>67/124</td>
<td>100%*</td>
</tr>
</tbody>
</table>

*12% false positives
URINARY TRACT INFECTIONS

SUMMARY

Of the chemical methods for detecting significant bacteriuria reviewed, only the Tetrazolium test of Simmons and Williams appears to have promise as a routine screening test. However, 6% false negative results were noted and the test requires a four-hour incubation.

It appears that the most reliable and least time consuming screening method now available for detecting significant bacteriuria is careful examination of the stained or unstained spun sediment. Published reports have shown a 100% positive correlation of this examination with significant quantitative urine cultures and 12% false positive results.

Though not a substitute for quantitative culture procedures it is a valuable adjunct to the diagnosis and treatment of urinary tract infections.

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REFERENCES
