Summary

In a double-blind cross-over trial of benziodarone and lactose there was no significant difference between the two substances as measured by the average number of attacks of angina pectoris per day in a group of 36 patients.

We wish to acknowledge the help of our technicians in the Cardiac Department, King's College Hospital, and of Miss A. O. Gadsby in arranging the trial. Genatosan Limited kindly supplied and dispensed the benziodarone (cardivix) and lactose.

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QUANTITATIVE URINE CULTURES

BY

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Marple (1941) and Kass (1955) have described methods for determining the urinary bacterial content. In the present paper a quantitative culture technique is compared with routine non-quantitative urine cultures. The second part of the paper describes the relation between white-cell excretion and bacterial content in urines from patients with acute and chronic pyelonephritis and asymptomatic bacteriuria.

Methods

The urines were obtained from normal subjects and from patients with a wide variety of disorders, including many with urinary infections; no patient was being given antibacterial treatment at the time that the observations were made.

The "clean" samples of urine were collected without a catheter and the white-cell excretion rates were measured by methods previously described (Little, 1962). The upper limit of normal urinary white-cell excretion was taken as 400,000/hour.

Quantitative cultures were performed within one hour of collection, using a pour-plate technique. One millilitre of urine was taken from the clean specimen and tenfold serial dilutions from 1:100 to 1:100,000 were made in a phosphate buffer. One millilitre from each of these four dilutions was placed in a Petri dish and 10–15 ml. of cooled melted nutrient agar was poured on and mixed. The plates were incubated for 48 hours at 37° C. (Mackie and McCartney, 1960). The number of colonies was counted at the most convenient dilution. A further 10 ml. of urine was taken from the clean sample. This was sent immediately to the routine laboratory and dealt with as a ward sample. A loopful of uncentrifuged urine was placed on a MacConkey and blood-agar plate and incubated overnight at 37° C. If organisms were grown the culture was reported as positive in the following semi-quantitative terms: scanty growth, moderate growth, growth, or heavy growth. The organism grown was identified. It is generally considered that a quantitative count of more than 100,000 organisms per ml. is due to infection and that counts below 10,000 are due to contamination (Kass, 1955).

A diagnosis of acute pyelonephritis was based on a history of loin pain, frequency, and dysuria in a patient with fever and loin tenderness. The patients with chronic

pyelonephritis all had an unequivocal renal biopsy and/or intravenous pyelographic changes consistent with this diagnosis. A patient was considered to have asymptomatic bacteriuria when two urine samples contained more than 100,000 organisms per ml. and at the time of these cultures the patients did not have symptoms of infection of the renal tract. Some of these patients later developed acute pyelonephritis and are included in both categories at different times.

Results

Comparison of Routine Cultures with Quantitative Cultures

The comparison was made on 205 urine specimens: 134 contained fewer than 10,000 organisms per ml., "growth"

FIG. 1.—Routine urine culture report of "growth" and "no growth" compared with the number of organisms found on quantitative culture. The broken line is at 10,000 organisms/ml. and the unbroken line at 100,000/ml. The blocks of dots at the bottom of the figure represent counts of from less than 100/ml. to 2,000/ml., and at the top of the figure counts greater than 10,000,000/ml. Each dot represents one urine sample.

being reported in 53 of these (Fig. 1); 15 contained 10,000 to 100,000/ml., "growth" being reported in 13; and 56 contained more than 100,000/ml., the routine culture report being that of "growth" in all of these, but in four the

growth was said to be "scanty" and in two to be "moderate." A routine culture report of "growth" was therefore made in 122 of the 205 urines. These contained from fewer than 100 to more than 10,000,000 organisms per ml.

In the remaining 83 urines the culture was reported as showing no growth; 81 contained fewer than 10,000 organisms per ml., and in the other two there were 18,000 and 25,000/ml. respectively.

In Fig. 2 the urines in which routine cultures showed "growth" have been divided into the three semi-quantitative categories which were used to describe the "growth" and compared with the quantitative bacterial counts. In two urines a "heavy growth" was reported; in both, the quantitative count was greater than 10,000,000 organisms per ml. In 72 urines the report simply stated

FIG. 2.—Qualitative report on routine urine culture compared with the number of organisms found on quantitative culture. Indications of numbers of organisms as Fig. 1.

that "growth" was obtained; 22 (30%) contained fewer than 100,000 organisms per ml. In six urines the report was that "moderate growth" was obtained: two contained more than 350,000 organisms per ml., two contained 7,000 and 25,000/ml., and two fewer than 1,000/ml. In 45 urines the report stated that the growth was "scanty": four contained more than 100,000 organisms per ml., five contained between 60,000 and 10,000/ml., and 36 contained fewer than 10,000/ml.

FIG. 3.—Acute pyelonephritis. Comparison of urinary bacterial content (Bact./ml.) and white-cell excretion rate (W.B.C./hr.). The horizontal line is at 100,000 bacteria/ml. The vertical line is at 400,000 white cells/hr. Each dot represents one patient.

FIG. 4.—Chronic pyelonephritis. Comparison of urinary bacterial content (Bact./ml.) and white-cell excretion rate (W.B.C./hr.).

FIG. 5.—Asymptomatic bacteriuria. Comparison of urinary bacterial count (Bact./ml.) and white-cell excretion rate (W.B.C./hr.). ● = Patients who have had symptoms of renal-tract infections. ○ = Patients without such symptoms.

Comparison of Quantitative Cultures and W.B.C. Excretion Rates

Acute Pyelonephritis (Fig. 3).—In the 28 patients studied in whom this diagnosis was made the bacterial content was always greater than 100,000/ml. and the white-cell excretion rate was greater than 400,000/hr.

Chronic Pyelonephritis (Fig. 4).—There were 32 patients with this diagnosis. In 14 the bacterial content was greater than 100,000/ml. and the white-cell excretion rate was above 400,000/hr.; in four the bacterial content was above 100,000/ml. but the white-cell excretion rate was below 400,000/hr.; in another 4 the bacterial content was below 100,000/ml. while the white-cell excretion rate exceeded 400,000/hr.; in 10 both the bacterial content and the white-cell excretion rate were within normal limits.

Asymptomatic Bacteriuria (Fig. 5).—There were 29 patients with this finding. In 15 the white-cell excretion rate was under 400,000/hr.; of these 15 patients, nine had a previous history of infection of the renal tract.

Discussion

It is no longer justifiable to catheterize the bladder to obtain urine for culture. Without a catheter, however, some contamination of the urine must often occur. Quantitative cultures make it possible to distinguish whether the organisms found in the urine are contaminants or whether they were present and multiplying in the urine before micturition. There is much evidence from many workers that bacterial counts below 10,000/ml. are due to contamination and counts above 100,000/ml. are due to infection of the renal tract (Kass, 1955; Kaitz and Williams, 1960; Brumfit and Percival, 1962). These conclusions are dependent on using quantitative culture techniques which include careful collection of the urine specimen and plating either immediately or after having kept the urine in the cold. The comparison described here is the first in which a quantitative technique is compared with what we believe is a widespread routine method in which neither quantitation nor refrigeration is used.

The results described in this paper show that a positive routine culture does not distinguish between contamination and infection. The resultant confusion is not lessened by identifying the organism, for of the 53 urines in which growth was reported but in which there were fewer than 10,000 organisms per ml., 41 contained a urinary-tract pathogen (*Escherichia coli*, proteus, or paracolon bacilli).

Nor is it helpful to qualify the extent of the growth with such terms as "scanty" or "moderate" (Fig. 2). On the other hand, the absence of growth on routine culture appears to be a reliable indication that the urine is not infected.

To decide whether a positive routine urine culture is due to contamination or infection it is a common practice for the urinary content of white cells to be used as a guide. The tendency of some laboratories to refuse to culture a urine unless it contains more than a "normal" number of white cells is an admission of this fact. Moreover, a positive urine culture is often ignored by the clinician if the number of white cells in the urine is not raised. But the results of routine methods for examining the white-cell content of the urine can be misleading; for instance, it has been shown that of 155 urines in which one to five white cells were seen per high-power field the white-cell excretion rate was raised in 42 (Little, 1962). In addition it has been shown above that even when the white-cell excretion rate is normal the urine may contain a large number of organisms, particularly in patients with chronic pyelonephritis or asymptomatic bacteriuria.

The patient's symptoms can be equally misleading in distinguishing between contamination and infection. Among the patients discussed above there were 29 with no urinary symptoms at the time when their urine contained more than 100,000 organisms per ml., and the presence of an asymptomatic bacteriuria in up to 8% of pregnant women is well recognized (Kass, 1959; Turner, 1961). Conversely, Boshell, MacLaren, and Metcalfe (1962) have described how 24 out of 99 pregnant women were treated with antibiotics for urinary-tract symptoms although only six had an infected urine.

Summary

The number of organisms found on a quantitative urine culture has been compared with the report of a routine culture in 205 urines.

In many instances it was not possible to distinguish from the routine report whether the urine was infected or contaminated.

In some patients with chronic pyelonephritis or asymptomatic bacteriuria the urine may contain large numbers of organisms though the white-cell excretion rate is normal.

It is concluded that the only consistent way to distinguish between contamination and infection in the urine is to use some form of quantitative culture.

This work was made possible by the kindness of Smith Kline and French Laboratories Ltd., who provided a whole-time research fellowship for P. J. L., and of the Dan Mason Research Foundation, who gave a substantial grant. Our thanks are due to Miss R. Paget and Miss J. Rennie for technical assistance.

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"HAIRBRUSH DIAGNOSIS" IN DETECTION AND ERADICATION OF NON-FLUORESCENT SCALP RINGWORM

BY

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Trichophyton tonsurans (var. *sulfureum*) in recent years has been the organism most frequently isolated from tinea capitis in Northern Ireland (Beare, 1958; Mackenzie and McArdle, 1960; Mackenzie, Corkin, and Bell, 1961). The infection is uncommon in adults, and as seen in dermatological clinics it is typically a disease of children. It is characterized by a comparatively low degree of infectivity, and clinical signs may range from the inapparent to the highly inflammatory. The former are chronic and may persist for many years (Pipkin, 1952).

In eradicating *T. tonsurans* from any community the presence of symptomless but infected individuals makes clinical detection exceedingly difficult. In addition there is no fluorescence of infected hairs under a Wood's lamp. For these reasons elimination of *T. tonsurans* from closed communities such as institutions has previously been regarded as virtually impossible.

From experience in Belfast (Mackenzie, Burrows, and Walby, 1960) it has been shown that clinical examination alone is inadequate for the detection of lesions that are trivial or virtually absent. Individuals with only a few discrete hairs infected can be regarded for practical purposes as carriers: although symptomless, they disseminate infection over a period of years, and can be responsible for a gradual build-up of infection potential. Thus in a

residential school for girls in Belfast 21 out of 128 children were shown to have become infected during a period of not less than four years (Mackenzie *et al.*, 1960).

When locating scalp lesions it was found that mycological sampling techniques were more practicable, more rapid, and more reliable than clinical examinations alone. By their means it was possible to detect all infected children in a school, and as a result total eradication of infection was eventually accomplished.

Of special significance in this earlier work was the fact that when the fungus was isolated on three or more successive occasions from any one child's belongings that child was invariably found to be infected. Using mycological techniques, seven children were shown to harbour infection after the fungus had been consistently isolated from their personal effects. In each case previous clinical examinations had failed to reveal its presence.

"Hairbrush diagnosis" was the term coined to denote the part played by mycological examination of hairbrushes in establishing diagnosis of non-fluorescent scalp ringworm. Other fomites which have been in contact with a child's scalp, such as hats, caps, combs, or pillow-slips, have also been examined on previous occasions, but in this study hairbrushes were used exclusively.