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Susceptibility Testing Performed in General Practice by Urinary Tract Infections

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Demonstration of significant bacteriuria by quantitative culture of a urine specimen by use of dip-slides is a well proved diagnostic procedure in general practice. Susceptibility testing from urine specimens by use of dip-slides or agar-plates seems likewise easy to perform in general practice, but commercial methods, modified for use in general practice by simplification of the standard disc diffusion method involve possible sources of errors. In a multipractice study, the predictive values of results from susceptibility testing in general practice from urine specimens, by use of two commercial methods are calculated. A considerable number of errors were found, mainly because susceptible bacteria were classified as resistant. The consequence of this is certainly that patients are treated with a drug, which is effective against the infecting organism, but the clinician possibilities for choice of drugs will be limited more than necessary.

Key words: susceptibility tests, diagnostic methods, urinary tract infection, general practice.

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The diagnosis of urinary tract infection in general practice is usually based upon the demonstration of significant bacteriuria by semiquantitative culture of a midstream specimen of urine. This procedure is widely accepted in general practice and carried out by use of dip-slide methods. The choice of antibacterial drug therapy can, if required, be based on standard susceptibility testing in bacterial laboratories. The results normally reach the physician within three to five days. It might be advantageous if susceptibility testing performed in general practice, could result in earlier establishment of adequate therapy. Methods for susceptibility testing of urine specimens in general practice are developed and offered for marketing .

In this study two of these methods, Sensicult (Orion) and Bact-plate (Roche-Diagnostica) are tested. Both are modifications of the standard disc diffusion method, as used in bacteriological laboratories.

Diagnostic aids for use in general practice must be feasible for personnel without special bacteriological training, and must be simple to handle. Therefore, the manufacturers of Sensicult and Bact-plate recommend inoculation of the testmedium directly from the urine specimen. This means that important steps in the standard laboratory method as isolation and identification of the bacterial strains and standardization of inoculum before incubation on the testmedium are omitted. For these reasons susceptibility testing methods like Sensicult and Bact-plate may possibly lead to errors, especially in case of mixed infections.

This study is carried out to investigate, if these suspected difficulties will lead to different results in susceptibility testing on Sensicult and Bact-plate, compared to susceptibility testing in bacteriological laboratory.

MATERIAL AND METHODS

Sensicult is a dip-slide, 30×93 mm, on both sides covered with a modificated Mueller-Hinton agar, which is non-selective. Inoculation is performed by dipping the slide in the urine specimen. By this procedure, the bacterial concentration cannot be standardized. After inoculation, antibiotic discs (Biodisk, Solna) are placed on the surfaces, where

two discs can be placed on each side. No prediffusion period is recommended. The dip-slide is incubated in 18–24 hours, where after examination is accomplished by measuring the inhibition zone around the disc.

Bact-plate is a 9 cm agarplate with Mueller-Hinton agar. The manufacturers manual recommend a graduated inoculum, depending on a microscopic interpretation of the bacterial concentration in the urine specimen. Antibiotic discs (Neo-Sensitabs) can be placed on the surface in a number of up to seven.

No prediffusion period is recommended and the plate has to be incubated for 16–24 hours. The examination is accomplished by measuring the inhibition zone by use of a scheme were zone sizes are graduated depending on the bacterial concentration upon the agar plate.

The study was carried out as a multipractice investigation. Twenty-five general practitioners familiar with the use of Sensicult and twenty-five familiar with the use of Bact-plate accepted to participate. The practitioners were asked to continue their routine and only include in this study urine specimens, where clinical reasons made susceptibility testing desirable. Results from the susceptibility testing in general practice were sent to the Institute of General Practice, and furthermore, were dip-slides from each urine specimen sent to the regional bacteriological laboratory (Statens Seruminstituts regionalafdeling, Aarhus) for susceptibility testing. Results from these two susceptibility tests were compared.

In the Sensicult group susceptibility testing included sulphonamides, ampicillin, nitrofurantoin and nalidixic acid. In the Bact-plate group susceptibility testing included sulphonamides, ampicillin, nitrofurantoin, nalidixic acid, trimethoprim and mecillinam. The bacteriological laboratory examined the dip-slides following routine methods, which means, that susceptibility testing of specimens with contamination or insignificant growth was not performed.

In cases where *Staphylococcus albus* and *aureus Streptococcus faecalis Pseudomonas species* and other gram-negative rods were found, susceptibility testing to certain antibiotics were omitted. Therefore a number of cases are excluded from comparison.

The result of susceptibility testing is: susceptible, intermediate or resistant. The total comparison of two susceptibility testings likewise will give three possible conclusions: Accordance = susceptible /susceptible or intermediate/intermediate or resistant/resistant. Minor error = susceptible/intermediate or intermediate/resistant. Major error = susceptible/resistant. In daily practice the clinician might be more interested in the predictive value of a given result. The predictive value is: true/true+false. Statistic tests for significant differences between the two methods are accomplished by X^2 test.

RESULTS

The urine specimens were collected from January to December 1981. During the trial 425 urine samples were sent to the bacteriological laboratory. Among these 41 were judged as contaminated and neither identification nor susceptibility testing were performed. In 48 samples two bacterial strains were found and six samples contained more than two. The remaining contained pure cultures. In the Sensicult group 232 samples were collected and in the Bact-plate group 193.

The total counting of results obtained in the two groups are shown in Table I, where results obtained by use of Bact-plate in average corresponded five per cent better to the results from the bacteriological laboratory, than results obtained by use of Sensicult. Statistic significant differences were found in susceptibility testing to ampicillin and nitrofurantoin. If we separate urine specimens containing pure cultures and specimens containing mixed cultures, the percentages of major errors will be 13% in the first, and 28% in the second group, susceptibility testing of all four antibiotics in average.

In Tables II and III the predictive values are shown. The predictive value of finding a bacterial strain susceptible, in both methods, were greater than 93% with regard to all four antibiotics. No statistic significant differences were found. The predictive value of finding a bacterial strain resistant varied from nine to 90%. Statistic significant differences were found between the two methods in results of all four antibiotics.

DISCUSSION

Comparative studies of methods of antimicrobial-susceptibility testing, even performed in bacterio-

Table I. *Major and minor differences in comparison of results of susceptibility testing by Sensicult and Bact-plate in general practice, and dipslides sent to bacteriological laboratory*

	Major errors				Minor errors			
	Sensicult		Bact-plate		Sensicult		Bact-plate	
	%	N	%	N	%	N	%	N
Sulphonamides	23	42/180	16	25/155	11	20/180	9	14/155
Ampicillin	11	19/166	5	7/145*	10	17/166	8	11/145
Nitrofurantoin	16	29/179	7	12/166*	23	42/179	13	22/166*
Nalidixic acid	17	28/167	17	26/155	13	21/167	12	19/155

* $p<0.05$.

logical laboratories, will lead to discrepancies to a certain degree (1). In acknowledgement of this, Kolesar et al. (2) planned a study where results of susceptible testing on Sensicult in general practice were compared to results of susceptibility testing in two different bacteriological laboratories. On average discrepancies in the two comparisons were six and eleven per cent, but discrepancies in the inter-laboratory comparisons were seven per cent.

Dornbusch et al. (3) in a multipractice study compared susceptibility testing by Sensicult to standardized susceptibility testing in a bacteriological laboratory and found discrepancies in 16%. After a period with training of, and personal instructions to the staff at the surgeries, another trial was carried out. But the agreement in results could not be improved. Nevertheless, there was better agreement between the two methods when results were evaluated by skilled bacteriologists. Then the discrepancies on average diminished to nine per cent (3). Kolesar as well as Dornbusch found that the majority of discrepancies resulted from classification of susceptible bacteria as resistant.

The quality of susceptibility testing of bacteria in simulated samples was evaluated by Hoffman et al. (4) in a multipractice investigation. Susceptibility to four antibiotics were tested on Sensicult resulting in discrepancies in only five to zero per cent in the two samples containing pure cultures, but in 64% in one sample containing a mixed culture. These results are not comparative to the studies mentioned above, but point out that the method seems inaccurate in case of mixed cultures.

In the present study the major discrepancies were on the same level as the results achieved by Kolesar (2) and Dornbusch (3). Likewise does the

Table II. *Predictive values of results (susceptible) from susceptibility testing of urine specimens performed in general practice by use of Sensicult and Bact-plate, compared to results obtained in bacteriological laboratory*

	Susceptible			
	Sensicult		Bact-plate	
	%	N	%	N
Sulphonamides	97	86/89	99	70/71
Ampicillin	95	94/99	94	98/104
Nitrofurantoin	98	105/107	97	111/115
Nalidixic acid	97	111/114	95	90/95
Trimethoprim			96	98/102
Mecillinam			93	81/87

Table III. *Predictive values of results (resistant) from susceptibility testing of urine specimens performed in general practice by use of Sensicult and Bact-plate, compared to results obtained in bacteriological laboratory*

	Resistant				
	Sensicult		Bact-plate		
	%	N	%	N	
Sulphonamides	44	31/70	65	46/71	($p<0.05$)
Ampicillin	67	34/51	90	28/31	($p<0.05$)
Nitrofurantoin	9	3/34	56	18/32	($p<0.01$)
Nalidixic acid	16	5/32	48	19/40	($p<0.01$)
Trimethoprim			63	22/35	
Mecillinam			25	9/36	

major part of discrepancies result from classification of susceptible bacteria as resistant. It is obvious that some of the discrepancies can be explained from difficulties in interpretation of the results from mixed cultures. Another explanation could be difficulties in defining the inhibition zone, depending on variation in the bacterial concentration. This probably explains some of the different results achieved by use of Sensicult and Bact-plate. The conclusion is, that the discrepancies between susceptibility test results performed in general practice and at the bacteriological laboratory are discouraging.

It is difficult to describe the ideal first choice of drug in treating urinary tract infections. Susceptibility testing in general practice by Sensicult or Bact-plate ensures that patients are treated with a drug, which is effective against the infecting organism. The problem is, that sensitive strains tested by use of Sensicult or Bact-plate often are found resistant, which will diminish the possibilities for choice of drugs, and may lead the general practitioner to use drugs which are less favorable.

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