Asymptomatic Bacteriuria in Diabetes Mellitus

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SUMMARY

A study was undertaken to determine the frequency of asymptomatic bacteriuria among 100 ambulant diabetic patients attending a diabetic outpatient clinic. At the same time, we assessed the reliability of the Uricult dip-slide method for detecting urinary bacterial growth. Significant bacteriuria occurred in 9% of the total diabetic group, largely attributable to the high prevalence in elderly diabetic women. Important characteristics of the affected diabetic patients included infection, commonly with *Escherichia coli*, frequently associated pyuria, good diabetic control with normal renal function and a high recurrence rate of bacteriuria after treatment. The dip-slide method compared quite favourably with the laboratory culture method, but it failed to detect 2 out of 8 cases with significant bacteriuria.

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Whether patients with diabetes mellitus have an increased susceptibility to urinary tract infections remains a controversial issue. Much of the conflicting literature has been reviewed by Thomsen.[1] A recent investigation indicated that true bacteriuria in the diabetic occurred almost exclusively in females, and especially in the older age groups.[2] In the present study we re-evaluate the problem in a representative group of diabetic outpatients, and assess the usefulness of the Uricult dip-slide (Orion Laboratories, Helsinki) as a reliable screening technique. The dip-slide method has been satisfactorily employed in a variety of other clinical situations, including paediatric practice,[3] protein calorie malnutrition,[4] urological units[5] and obstetric patients.[6]

PATIENTS AND METHODS

Urine samples were obtained from 100 ambulant patients attending the Diabetic Clinic at the Johannesburg Hospital. None of the patients admitted to symptoms of renal infection[7] or urinary incontinence at the time, and none had recently been catheterised; they were otherwise unselected. The group included 60 females, 40 of whom were over 60 years of age (Table I).

Since elderly women in general may be prone to bacteriuria,[8] a control group of 36 ambulant non-diabetic female patients over the age of 60 years, who attended the Outpatient Department for a variety of chronic medical disorders, were also studied. They, too, had no symptoms of recent kidney infection or urinary incontinence.

A clean voided midstream urine sample was collected from each subject, after perineal cleansing, in a sterile universal container. Uricult dip-slides (one side of which is coated with MacConkey's medium and the other with CLED agar) were dipped into the freshly voided specimens and then stood, in their sterile containers, at room temperature for 24 hours. (We chose this method since reports[3,6] claim equal reliability with formal incubation at 37°C, and also for convenience.) The urine samples were sent without delay to the bacteriology laboratory for concurrent examination. This consisted of microscopy and inoculation of culture plates used as a routine, similar in composition to the media coating the dip-slides. In 30 patients (14 diabetics and 16 controls) only the laboratory culture result was available for analysis, due to a temporary interruption of dip-slide supplies.

Degrees of bacterial growth on the dip-slides and plates were assessed as showing (*a*) no growth; (*b*) no significant growth (10^3 - 10^5 colonies/ml) and (*c*) significant growth ($>10^5$ colonies/ml). A urinary leucocyte count of more than 4 000/ml (centrifuged specimen) indicated significant pyuria. In patients yielding positive urine cultures, information about the chemical composition of the urine, blood sugar control and renal function at the time of study was obtained; appropriate antibiotic therapy was given for 2 weeks and a follow-up urine sample examined after 3 months.

RESULTS

Incidence of Bacteriuria in Diabetic Patients (Table I)

Significant bacterial growth occurred in 9% of patients, according to the culture plate results. The elderly female diabetic group was mainly responsible, providing 8 of the 9 'positive' cases and showing a group prevalence of 20%. Compared with the 2,8% incidence of bacteriuria in non-diabetic elderly females, a statistically significant difference (χ^2 5,38; $P<0,05$) emerged.

Correlation between the Two Methods of Urine Culture (Fig. 1)

The correlation between the laboratory plate and the dip-slide techniques for determining urinary bacterial growth in the 106 subjects (86 diabetics and 20 non-diabetic elderly females) is summarised in Fig. 1. The shaded blocks indicate agreement of clinical significance

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TABLE I. INCIDENCE OF BACTERIURIA IN DIABETIC PATIENTS AND NON-DIABETIC ELDERLY FEMALE CONTROLS

Group	Mean age (range)	No.	Incidence of bacteriuria No.	%
Total	**57 (16-82)**	**100**	**9**	**9**
Males	**54 (16-77)**	**40**	**1**	**2,5**
Females below 60 years of age	**42 (24-59)**	**20**	**0**	**0**
Females above 60 years of age	**68 (61-82)**	**40**	**8**	**20***
'Control' non-diabetic females above 60 years of age	**72 (61-88)**	**36**	**1**	**2,8**

* Significantly higher ($P<0,05$) than the non-diabetic female control group (as well as the other two diabetic subgroups).

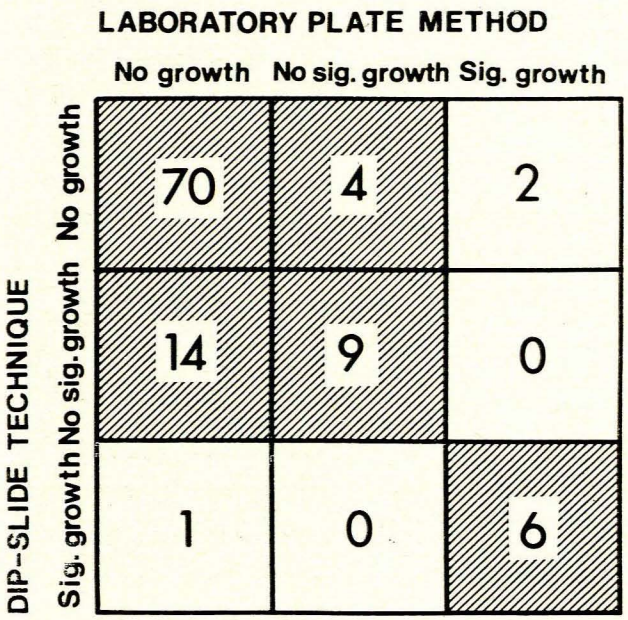

Fig. 1. Correlation between laboratory plate method and Uricult dip-slide technique for detecting urinary bacterial growth. The numbers in the blocks represent cases and the shaded blocks indicate agreement of clinical significance (see text).

(i.e. no discrepancy or a discrepancy *not* involving $>10^5$ bacterial growth in one test and a lesser growth in the other). Identical results were obtained in 85 of 106 cases (80%); clinically unimportant differences (no growth in one test and a 10^3 - 10^5 growth in the other) in 18 instances (17%); and a serious discrepancy arose in 3 patients (3%). The dip-slide technique failed to detect 2 of the 8 positive cases identified in the laboratory where paired comparisons were made; in one instance the laboratory grew *Staphylococcus* and in the other an *Escherichia coli*. (Two positive diabetic urines were examined in the laboratory only.)

Characteristics of the 9 Diabetic Patients with Significant Bacteriuria (Table II)

Several salient points emerge from the tabulated data. *E. coli* was the most frequent infecting organism; pyuria almost always accompanied the bacteriuria; both glycosuria and proteinuria were usually absent at the time of urine sampling; diabetic control appeared to be 'good' (random blood glucose below 150 mg/100 ml) in the majority of patients; renal function (assessed by blood urea level) was normal in all except one instance; and systemic hypertension occurred in one-third of the cases. Five of the 9 patients still had significant bacteriuria when re-examined after a 3-month interval.

DISCUSSION

This study confirms the impression that true bacteriuria in the diabetic is mainly confined to elderly diabetic women. Furthermore, the prevalence of bacteriuria among them

TABLE II. CLINICAL AND LABORATORY FEATURES IN 9 DIABETICS WITH SIGNIFICANT BACTERIURIA

Case	Sex	Age	Organism	Pyuria	Glycosuria	Proteinuria	Diabetic control*	Hypertension	Blood urea (mg/100 ml)	3-mo. follow-up
1	F	74	*E. coli*	Yes	Nil	Nil	Good	Present	40	*E. coli* still present
2	F	73	*Proteus*	Yes	Nil	Nil	Good	Present	34	Clear urine
3	F	63	*E. coli*	Yes	Nil	Nil	Moderate	Absent	88	Recurrence with *Proteus*
4	F	61	*E. coli*	Yes	Mild	Nil	Good	Absent	22	*E. coli* still present
5	F	68	*E. coli*	Yes	Nil	Nil	Good	Absent	36	Clear urine
6	F	61	*E. coli*	Yes	Nil	Mild	Good	Present	38	Clear urine
7	F	65	*E. coli*	Yes	Nil	Nil	Good	Absent	32	*E. coli* still present
8	F	62	*Klebsiella*	No	Nil	Nil	Moderate	Absent	27	*Klebsiella* still present
9	M	46	*Staph. pyogenes*	Yes	Nil	Nil	Good	Absent	31	Clear urine

* Good = random blood sugar <150 mg/100 ml; moderate = random blood sugar between 150 mg and 250 mg/100 ml.

was significantly greater than that of elderly non-diabetic females similarly investigated.

Criticisms can be levelled at our findings, e.g. that the number of patients in the various subgroups was relatively small and that the method of urine collection was not ideal. Repeated sampling or suprapubic aspiration of urine might have been more desirable.[9] The answer to this is that the study was a practical one to screen a representative cross-section of diabetic clinic attenders without undue inconvenience to patients or staff, and employing currently used outpatient procedures.

Reasons for the enhanced susceptibility of elderly diabetic females to asymptomatic bacteriuria are unclear. Factors such as inadequate diabetic control or impaired renal function do not appear to be critical, nor does the advanced age of the patients *per se*. Retrospective inquiry failed to reveal evidence of analgesic abuse as a cause.[10] Underlying structural abnormalities of the urinary tract might be important, and Batalla *et al.*[2] found a high incidence of neurogenic bladders with intravenous pyelography. This may also partly explain the frequency of recurrent bacteriuria on follow-up examination. Unfortunately information concerning pyelography was not available in our patients. Renal micro-angiopathy has been implicated as an important precursor of pyelonephritis in the diabetic,[11] but has not played an important role in this study, as significant proteinuria was absent in all 9 bacteriuric cases.

Finally, concerning the usefulness of the Uricult dip-slide technique as a screening procedure for significant bacteriuria in a diabetic population, our findings provide some support for what has been found in other clinical situations. A preliminary dip-slide test will reduce the laboratory workload by screening off negative urines; in those cases yielding significant growth, further investigations by standard methods can then be instituted. One disturbing aspect, however, was the failure of the method to detect 2 positive cases confirmed in the laboratory. The probable explanation is that incubation at room temperature retarded bacterial growth—especially in the patient with Gram-positive bacteriuria.[12] Incubation of the slides at 37°C may reduce the likelihood of false negative results.[13]

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