BACTERIA IN RENAL CASTS

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Bacteria are often found closely applied to the surface of renal casts in urine, sometimes in large numbers. Less frequently they can be observed within the substance of the cast, where their position can be confirmed by careful focusing. Occasionally they are seen within polymorphonuclear leucocytes incorporated in casts, but since in casts these cells are always rather shrunken the contained bacteria cannot be identified easily. The presence of bacterium-like structures in casts does not appear to have been previously recorded.

MATERIALS AND METHODS

During an assessment of the value of various methods of staining the urine sediment (Butterworth, 1969), bacterium-like structures were observed in casts stained with cadmium-methylene blue. Thereafter, over 400 urine specimens were examined by the same method, and any casts seen were examined under the oil-immersion objective for the presence of similar structures.

Cast protein and Tamm-Horsfall protein were prepared by the methods of McQueen (1962). For measurement of antibacterial activity, a saturated solution of Tamm-Horsfall protein was made by shaking an excess with 0.5 ml of distilled water and allowing it to stand overnight. A saturated solution of cast protein was prepared in the same way. The supernatants were added to 0.5-ml volumes of a suspension of Escherichia coli in peptone water containing approximately 10 organisms per mm³, and a control tube was prepared containing the same suspension and an equal volume of distilled water. The three tubes were incubated at 37°C for 16 hr, after which the numbers of bacteria present in each suspension were estimated by counting, after appropriate dilution, in a Neubauer chamber.

RESULTS

The phenomenon was observed in only ten cases, which are listed in the table. The diagnosis of chronic pyelonephritis was based on the evidence of quantitative cell counts and radiography; in case no. 2, quantitative bacteriological examination of the urine supplied additional evidence. The diagnoses in cases no. 5 and 10 were confirmed at post-mortem examination and in case no. 9 by percutaneous biopsy. Samples of urine from more than 100 further patients with probable pyelonephritis failed to show bacteria in casts; in most cases no casts were present.

In a predominantly granular cast, the granular material takes up the stain, whereas the hyaline matrix does so only faintly and any contained structures can be seen. Usually the structures were rods, but in cases no. 5 and 9 they were cocci. They bore such a close resemblance to bacteria outside the casts that there is little reasonable doubt that they were bacteria.

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Generally they occurred singly, though groups were seen in some cases. An unsuccessful attempt to establish their identity was made in cases where the cultured organism was *E. coli*. Casts were suspended in a polyvalent rabbit antiserum prepared against a mixture of strains of *E. coli*, and then washed. The casts were then treated with a fluorescent goat anti-rabbit globulin, but this unfortunately conferred strong non-specific fluorescence, even when it was used alone. No fluorescence was seen when casts were treated with fluorescent anti-human globulin.

Since some of the urines that contained these casts were sterile, it was thought possible that the cast protein might have some bactericidal or bacteriostatic effect. However, even in high concentration, neither cast material nor Tamm-Horsfall protein, of which casts are composed (McQueen), had any significant effect on the growth of *E. coli* in culture.

**TABLE**

Details of patients from whom samples of urine showed bacterium-like structures in casts

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Age</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>Result of urine culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63</td>
<td>F</td>
<td>Chronic pyelonephritis</td>
<td><em>E. coli</em></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>F</td>
<td>Chronic pyelonephritis; renal calculus</td>
<td><em>E. coli</em></td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>M</td>
<td>Bladder carcinoma; hydronephrosis</td>
<td><em>E. coli</em></td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>F</td>
<td>Pyelonephritis</td>
<td><em>E. coli</em></td>
</tr>
<tr>
<td>5</td>
<td>82</td>
<td>M</td>
<td>Chronic pyelonephritis</td>
<td><em>Staph. aureus</em></td>
</tr>
<tr>
<td>6</td>
<td>39</td>
<td>F</td>
<td>Chronic pyelonephritis</td>
<td>No growth</td>
</tr>
<tr>
<td>7</td>
<td>58</td>
<td>F</td>
<td>Chronic pyelonephritis</td>
<td><em>E. coli</em></td>
</tr>
<tr>
<td>8</td>
<td>53</td>
<td>F</td>
<td>Chronic pyelonephritis</td>
<td>No growth</td>
</tr>
<tr>
<td>9</td>
<td>22</td>
<td>F</td>
<td>Membranous glomerulonephritis</td>
<td>No growth</td>
</tr>
<tr>
<td>10</td>
<td>58</td>
<td>M</td>
<td>Chronic glomerulonephritis</td>
<td>No growth</td>
</tr>
</tbody>
</table>

**DISCUSSION**

It has been difficult to establish that bacteria are present in the kidney in chronic pyelonephritis. Culture of renal biopsies has yielded disappointing results (Israel and Joekes, 1968). In order to obtain a sample of ureteric urine for culture (Brumfitt, 1965), surgical assistance is required and a positive result does no more than indicate the possibility that the renal parenchyma is involved. The production of specific antibodies (Percival, Brumfitt and de Louvois, 1964) is correlated with structural and functional changes in the kidney, but does not directly demonstrate a renal infection. Proof of the occurrence of bacteria in casts, however, would provide strong evidence of their presence in the renal tissue, although it would not necessarily mean that they were there exercising a pathogenic role. In the present series the bacterium-like structures were found in two cases of glomerulonephritis, yet it is unlikely that bacterial invasion of the kidney is a pathogenic factor in any variety of that condition. It is more likely that the presence of these bacteria resulted from a localised complicating pyelonephritis or from a transient septicaemia.

It was found repeatedly that bacteria did not take up the stain while they were still motile, and it is therefore probable that those seen in casts were dead at the time of examination. This would explain the sterility of some of the urine specimens and also the failure of the bacteria to multiply and destroy the cast. Bacterial death might result from the natural antibacterial activity of the patient's tissues and serum, or from the administration of antibiotics. If it is the administration of antibiotics that prevents the destruction of the affected casts, this would explain the failure of early workers, such as Quensel (1918) who stained and illustrated casts of all types, to describe the phenomenon.

The infrequency of this occurrence and its lack of specificity for pyelonephritis make it unlikely that it can provide a basis for a worthwhile laboratory test. It is meanwhile unfortunate that the bacterial nature of these structures has not been proved. Proof might be
obtained with more refined fluorescent antisera, but it should be borne in mind that a coating of antibody derived from the patient may block specific fluorescence.

SUMMARY

Bacterium-like structures were seen in renal casts in the urine from eight patients with pyelonephritis and from two with glomerulonephritis. Although these structures were morphologically identical with bacteria, an attempt to demonstrate their nature with fluorescent antisera was unsuccessful.

Most of this work was performed in the Radcliffe Infirmary, Oxford, and I am grateful to the clinical staff there for access to their patients and case records.

REFERENCES

Percival, A., Brumfitt, W., and de Louvois, J.

BRAIN ABSCESS DUE TO TRICHOSPORON CUTANEUM

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PLATE XIII

There is increasing awareness amongst clinicians and microbiologists of the importance of infection by "opportunistic" bacterial, fungal or viral organisms. The patient described here had a brain abscess complicating a secondary deposit from a primary bronchial carcinoma; the fungus Trichosporon cutaneum was cultured from the abscess contents. We know of no previously recorded association of this organism with cerebral abscess. Although it is a recognised cause of white piedra of hair and occasional nail infections, it is not known to have other pathogenic roles in man.

CASE HISTORY

A. M., an African woman aged 39 yr, was admitted to King Edward VIII Hospital, Durban, from a peripheral hospital, with a 3-wk history of progressive weakness of the right side of the body. A chest radiograph taken at the latter hospital revealed a right-sided hilar mass, and a skull radiograph showed calcification of the falx cerebri, which was central in position.

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