operation, the risks of delaying surgery in patients with infective endocarditis, cardiac decompensation, and possibly emboli, far outweigh those of early surgery. Procrastination while attempting to cure the infection may result in myocardial damage and multiple organ failure, the major causes of postoperative mortality. Indeed, surgical excision may be the only means of eradicating infection. Recently Boyd et al. noted a 90% mortality in patients with uncontrolled infection on whom operation was delayed for 4-6 weeks. By contrast, in patients with uncontrolled infection who underwent immediate operation the mortality was 7%. In view of our observations and those of others, it is our policy to do early valve replacement in all patients with deteriorating cardiac function or severe cardiac failure and in those with recurrent emboli, despite potentially active infection and regardless of the duration of antibiotic therapy. Surgery for persistent sepsis alone (without cardiac failure or recurrent emboli) is debatable and, according to the available data, cannot be clearly resolved. We therefore concur with the statement of Manhas et al. that 'next to antibiotics, the introduction of open heart surgery in the management of infective endocarditis has been the single most significant recent advance in changing the prognosis of an entity which was otherwise uniformly fatal'.

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The Role of Radiology in Urinary Tract Infection in Children

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SUMMARY

Of 758 children examined by uroradiography at the Transvaal Memorial Hospital for Children, 232 (30%) had been referred for the diagnosis of urinary tract infection.

The incidence of radiological anomaly or abnormality in these children was an overall 30%; in the first 3 years of life this figure rose to 40%. Radiological investigation of these children should be undertaken routinely. Excretory urography alone is a satisfactory screening procedure in children over the age of 3 years; under this age, formal voiding cysto-urethrography is of immense importance.

The incidence of 70% of underlying radiologically detectable abnormalities associated with Pseudomonas infection was statistically significantly higher than the 30% found in association with all other infecting organisms.


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The role of radiology in the assessment of children presenting with urinary tract infections was investigated prospectively at the Transvaal Memorial Hospital for Children. The objects of this study were to assess: (i) the incidence of radiological abnormalities in children presenting with urinary tract infection; and (ii) the relationship of the infecting organism to radiologically demonstrable abnormalities or anomalies.

PATIENTS AND METHODS

During the period 1973 - 1975, excretory urography was performed 939 times and formal voiding cysto-urethrography 356 times on a series of 758 patients. Of these, 232 (30%) had been referred with a diagnosis of urinary tract infection established by clinical and laboratory investigations.

Pyuria without significant bacterial growth had been recorded in 39 children referred for investigation of urinary tract infection after being treated by their private practitioners. These children therefore had no record of urinary tract infection in the hospital documents. In the remainder
of the patients the incidence of urinary tract infection was documented.

Urine was collected in an adhesive bag and was cultured immediately in the case of outpatients, or by suprapubic puncture when practicable, in children under 1 year of age. In children over this age, urine was collected either by the clean-catch technique or by catheterization. A concentration of 100 000 organisms/ml in girls and 10 000 organisms/ml in boys was accepted as evidence of urinary tract infection. In all children over 2 years of age the bowel was prepared before excretory urography. Under this age no preparation was undertaken, in order to avoid problems associated with dehydration. Excretory urography with a voiding examination after the bladder had filled with contrast medium was performed on all 232 children. In addition, 150 children underwent formal voiding cysto-urethrography 4 weeks after the acute infection had been treated.

For the purposes of analysis, the children were divided into the following age groups (Figs 1 and 2): 0 - 1 year — 55 patients; 1 - 3 years — 44 patients; 3 - 5 years — 35 patients; 5 - 7 years — 27 patients; and 7 - 14 years — 71 patients. There were 150 girls and 82 boys. An almost 2:1 female predominance was noted at all ages, except in the first year of life, when the male to female incidence was equal (27 girls and 28 boys).

RESULTS

The total incidence of radiological anomalies or abnormalities was 40% in the first 3 years of life, declining to 30% in all older age groups (Fig. 3).

The commonest radiologically demonstrable abnormalities were: vesico-ureteric reflux — 18 cases; obstructive hydronephrosis at various levels — 16 cases; cortical scarring with normal calices, but no evidence of vesico-ureteric reflux — 8 cases; renal tract reduplication — 10
cases; bladder abnormality — 11 cases; renal dysplasia — 4 cases; non-functioning moieties — 2 cases; and urethral valve abnormality — 2 cases.

The incidence of meatal stenosis in girls was not assessed in this group of children because this could not be accurately determined radiologically. Vesico-ureteric reflux was graded according to the Colodny and Lebowitz scale.

The incidence of reflux was shown to be highest in the first year of life (13%) but thereafter it decreased to 7-9% (Fig. 4). In the older age groups it appeared to be constant throughout.

Grade 1 and grade 2 reflux were not considered to be of great significance, but grade 3 reflux, considered highly significant, was found in 10 of the 18 children (55%); 5 of these children were under 3 years of age.

Four major groups of infecting organisms were isolated from the urine sent for bacterial examination. The commonest organisms were *Escherichia coli* (57%), *Proteus* (13%), *Klebsiella* (10%), and *Pseudomonas* (3%).

As previously stated, 39 children (17%), who had previously been treated by their private practitioner, had no bacteria in the urine culture.

Children from whose urine coliform bacilli, *Proteus* and *Pseudomonas* were cultured had an equal incidence (30%) of radiographically demonstrated abnormalities or anomalies. This incidence was much higher (70%) in children with infection due to *Pseudomonas* ($P<0.02$).

**DISCUSSION**

In this series 30% of all patients who underwent uroradiological investigation had been referred with a diagnosis of urinary tract infection. The incidence of 30-40% of urinary tract abnormalities in these children is the same as that reported in other series in which the entity of distal urethral stenosis in girls is not acceptable.

The incidence of vesico-ureteric reflux, however, was only 13% in children under 1 year of age and 7% in older age groups. This is in contrast to a recorded incidence of 30-40% in previous series. The reason for this is that 82 children who presented with urinary tract infection did not undergo formal voiding cysto-urethrography, so that minimal degrees of reflux (grade 1 and grade 2) could well have been missed. This is not considered significant because the occurrence of grade 1 and grade 2 reflux in children over the age of 3 years is not considered serious.

The value of uroradiological investigation in children with urinary tract infection was again demonstrated, with emphasis on the use of voiding cysto-urethrography in children under 3 years of age, even if the excretory urogram appeared normal.

In this series no complications were associated with voiding cysto-urethrography, possibly because these examinations were postponed until at least 4 weeks after acute infection had been treated.

The radiological investigation of all children with a first episode of urinary tract infection is therefore warranted because of the high incidence of detectable radiological abnormality. Although the incidence of vesico-ureteric reflux was lower in this series, the association of pyuria, reflux and subsequent renal scarring must be remembered.

On radiological examination significant renal abnormality is likely to be found in the presence of *Pseudomonas* infection.

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