Composition of Urinary Tract Calculi in Children of Different Ages

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(Received 16 March, 1977; accepted for publication 8 June 1977)

Stones in children have become rare in Western countries since the disappearance of endemic bladder stones early in the present century and only a few studies of the composition of these stones have been made, mainly in the United States (Wenzl et al., 1968; Paulson et al., 1972; Bennett and Colodny, 1973; Malek and Kelalis, 1975) and in France (Brueziere, Gueriot and Lasfargues, 1974), Holland (Scholten, Bakker and Cornil, 1973) and Czechoslovakia (Vendl, 1975). These surveys show differences in stone-composition from one country to another, those from the United States and Czechoslovakia consisting predominantly of calcium salts, suggesting a metabolic cause, while those from France and Holland contained more magnesium ammonium phosphate, suggesting an infective origin. These differences appear to be age-related, infection stones being commonest in very young children and calcium stones most common in older children. Further evidence in support of this age-relationship has been obtained from observations on British children, on whom there has been little information hitherto.

![Graph](image0.png)

Fig. 1. Composition of calcium-containing stones from 23 children under 15 years of age. The letter at the foot of each column denotes the sex of the patient.
Materials

The survey covers the period 1966-76, during which time 32 calculi from children aged 15 years and under were received for analysis. These stones were removed from 25 patients (16 boys and 9 girls) and all were from the upper urinary tract except for 1 bladder and 1 urethral stone. The 25 patients represent 70% of all children treated for urinary tract calculi in the Leeds area (population 600,000) during the period 1966-76.

Methods

The stones were analysed by a quantitative chemical procedure (Hodgkinson, 1971) and were divided into three types: cystine, magnesium ammonium phosphate and calcium stones. Cystine stones were defined as those consisting predominantly of cystine, with or without other constituents, while magnesium ammonium phosphate stones were defined as stones containing more than 10% by weight of magnesium ammonium phosphate, usually in combination with calcium phosphate. Calcium stones were defined as those composed predominantly of calcium oxalate or calcium phosphate and containing less than 10% by weight of magnesium ammonium phosphate.

Results

2 patients had cystine stones and the remainder had stones composed of calcium or magnesium salts. 6 patients produced more than 1 stone, but the stones formed by any 1 patient were generally similar in composition and the mean values were calculated in these cases. 15 patients (60%) had stones composed mainly of magnesium ammonium phosphate and calcium phosphate, 1 patient had a poorly mineralised stone consisting mainly of calcium oxalate and calcium phosphate, and the remainder (28%) had stones composed predominantly of calcium oxalate (Fig. 1).

Figure 2 shows the stones, classified on the basis of their main mineral components, in relation to age.

![Chart showing percentage occurrence of different types of stones in relation to age. The numbers of patients in the three age-groups were 11, 8 and 6 respectively.](image)

*Fig. 2. Percentage occurrence of different types of stones in relation to age. The numbers of patients in the three age-groups were 11, 8 and 6 respectively.*
to the ages of the patients. This shows that the youngest children had stones consisting pre-
dominantly of magnesium ammonium phosphate while the older children had stones composed
principally of calcium salts.

Discussion

Most of the children in the youngest age-group had a *Bacillus proteus* infection, and 2 of these
patients also had anatomical abnormalities in their urinary tracts (megaureter in each case). Only
1 child in this group had a calcium stone. This patient had a massive bowel resection for volvulus
shortly after birth, with subsequent diarrhoea, and it is likely that this stone, which was composed
mainly of calcium oxalate, was due to increased oxalate absorption and hyperoxaluria secondary
to the bowel resection (Earnest *et al*., 1974). By contrast, only 1 of the children in the 11-15 year
old group had an infection stone; this patient had epispadias and a proteus infection.

The present survey provides further evidence of two types of paediatric stone disease: (1)
infection stones, composed largely of magnesium ammonium phosphate and occurring mainly
in children under 5 years of age, (2) stones composed mainly of calcium oxalate or calcium
phosphate, occurring mainly in older children. The reason for the variation in the reported
incidence of these 2 types of stone in different countries is still not entirely clear, but at least some
of the variation is probably due to methods of selection.

Summary

The composition of urinary tract calculi in children in relation to their age has been examined and
comparisons have been made with other published series.

It is concluded that paediatric stone disease can be divided into two main types: (1) infection
stones, composed largely of magnesium ammonium phosphate and occurring mainly in children under 5 years of age, (2) calcium stones, occurring mainly in older children.

The author wishes to thank Mr P. B. Clark and Mr R. E. Williams, Department of Urology, Leeds General
Infirmary, and Mr P. H. Smith, Department of Urology, St James’s Hospital, Leeds, for permission to consult the
hospital records of patients under their care.

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