Epidemiology of paediatric renal stone disease in the UK

R J M Coward, C J Peters, P G Duffy, D Corry, M J Kellett, S Choong, W G van’t Hoff

Background: The previous epidemiological study of paediatric nephrolithiasis in Britain was conducted more than 30 years ago.

Aims: To examine the presenting features, predisposing factors, and treatment strategies used in paediatric stones presenting to a British centre over the past five years.

Methods: A total of 121 children presented with a urinary tract renal stone, to one adult and one paediatric centre, over a five year period (1997–2001). All children were reviewed in a dedicated stone clinic and had a full infective and metabolic stone investigative work up. Treatment was assessed by retrospective hospital note review.

Results: A metabolic abnormality was found in 44% of children, 30% were classified as infective, and 26% idiopathic. Bilateral stones on presentation occurred in 26% of the metabolic group compared to 12% in the infective/idiopathic group (odds ratio 2.7, 95% CI 1.03 to 7.02). Coexisting urinary tract infection was common (49%) in the metabolic group. Surgically, minimally invasive techniques (lithotripsy, percutaneous nephrolithotomy, and endoscopy) were used in 68% of patients.

Conclusions: There has been a shift in the epidemiology of paediatric renal stone disease in the UK over the past 30 years. Underlying metabolic causes are now the most common but can be masked by coexisting urinary tract infection. Treatment has progressed, especially surgically, with sophisticated minimally invasive techniques now employed. All children with renal stones should have a metabolic screen.
Table 1  Random non-fasting urinary calcium:creatinine ratios; 95th centile reference range

<table>
<thead>
<tr>
<th>Age</th>
<th>Random Ca:Cr ratio, 95th centile (mmol/mmol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7 months</td>
<td>1.96</td>
</tr>
<tr>
<td>8–18 months</td>
<td>1.4</td>
</tr>
<tr>
<td>19 months–6 years</td>
<td>0.78</td>
</tr>
<tr>
<td>6–16 years</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Statistics
When comparing groups for risk factors, odds ratios with 95% CI were used in the Instat software package. In defining the population characteristics the median age was used as this was considered most representative.

RESULTS
Incidence, age, and sex at presentation
One hundred and twenty one patients (82 boys and 39 girls; 2.1:1 boys:girls), were included over the five year period (fig 1). The median age of presentation was 36 months for males (range 3–180 months) and 48 months (range 4–137 months) for females.

Presenting features
Presentation with the classic combination of renal colic and macroscopic haematuria was uncommon. Sixty six (55%) children had macroscopic haematuria, 61 (50%) abdominal pain, but only 36 (30%) patients had both symptoms. In 21 (17%) patients the stones were apparently asymptomatic and fortuitously detected. Interestingly the median height and weight of children on presentation was lower than average, on the 25th centile in 93 children (77%) who were measured (range 0.4th to 91st centile).

A positive family history of renal stones was present in 19 (16%) first degree relatives, rising to 40 (33%) if both first and second degree relatives were considered. Sixteen (13%) children were born prematurely (<37 weeks), and in 10 (8%) there was a history of prolonged immobility, principally secondary to neurological impairment. In 58 (48%) there was a previous history of urinary tract infection. This study did not aim to address the frequency of congenital renal anomalies in the children with stones. However, at least eight (7%) were known to have vesicoureteric reflux, six (5%) had stenosis within the urinary tract, and one child bilateral renal cortical cysts (the cause of which remains under investigation). Of these 15, three were defined as metabolic, four infective, and eight idiopathic stone formers.

Aetiology
Fifty three (44%) had an underlying metabolic abnormality, 36 (30%) were classified as having an infective aetiology, and in 32 (26%) no aetiological factor could be detected. Metabolic stone formers presented throughout childhood, in contrast to infective aetiologies which were more common in the under 6 age group, with 89% presenting in this period (fig 1).

Metabolic aetiologies
Of the 53 patients with a metabolic abnormality: 30 had hypercalciuria (57%), 12 cystinuria (23%), one hyperuricosuria (2%), five intermittent hyperoxaluria (9%), four primary hyperoxaluria (8%), and one child an unclassified hypercalcaemic condition (2%).

Within the hypercalciuric group, one child from a consanguineous marriage had the hypomagnesaemia, hypercalciuria (Michaelis-Manz) syndrome. Immobility and prematurity contributed to eight cases. The remainder had idiopathic hypercalciuria, with no other obvious exacerbating factors such as calciuric inducing medications. Interestingly, of these, 48% had a family history of nephrolithiasis. One child had persistent hypercalcaemia and an inappropriately raised parathormone level, but repeatedly normal 24 hour spot urine calcium excretion (the underlying diagnosis in this boy is under ongoing investigation).

The hyperoxaluric group consisted of four children with primary hyperoxaluria: three with type 1 and one child with non-type 1/type 2 (none had type 2). Four children had enteric hyperoxaluria secondary to small bowel pathology. Three of these were born prematurely, two of whom had bowel resection for necrotising enterocolitis. One child who was born at term had bowel resected for a rhabdomyosarcoma. The single child with uric acid stones underwent further investigation of the purine metabolic pathways but no underlying defect was detected.

Excluding the single patient with hyperuricosuria, between 45% and 58% (total mean 49%) of children with each of the defined metabolic abnormalities had presented with a urinary tract infection. Children with a metabolic abnormality presented at a median of 40 months (range 3–168 months) compared to 36 months (range 6–180 months) in the infective/idiopathic group. There were proportionally more males in the infective/idiopathic (male:female, 2.6:1) compared to the metabolic group (male:female, 1.7:1). The risk of presenting with bilateral stones was increased significantly in children with an underlying metabolic abnormality, with 14 of 53 (26%) having bilateral stones in the metabolic group compared to 8 of 68 (12%) in the non-metabolic group (odds ratio 2.7, 95% CI 1.03 to 7.02).

Infective stones
These occurred in 36 patients with a median age of presentation of 30 months. The male to female ratio was 1.6:1. Boys presented at an earlier age than girls (median of 24 months compared to 48 months). Two children with multiple stones had xanthogranulomatous pyelonephritis, resulting in chronic renal failure.

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Stone distribution
The stones were upper tract in 104 children (86%), unilateral on the left in 44 (36%), on the right in 38 (31%), and bilateral in 22 (18%). In four cases (3%) the stones were located in the bladder, and in seven (6%) in both the bladder and upper tract. In six (5%) the stones were passed, before determination of location.

Stone composition
The majority of stones analysed were composed of calcium oxalate or calcium phosphate (50%). Triple phosphate stones were detected in 32%; however in two cases (3%) of those analysed, the stone consisted of both triple phosphate and cystine, and both these children had cystinuria. These were diagnosed by virtue of their urinary investigations. In 44% of children stone analysis could not, or was not, undertaken (usually because they had undergone lithotripsy before metabolic evaluation and no fragments were available).

Stone removal
One hundred and eight (89%) children underwent a procedure to remove the stone(s) (fig 2). Commonly, a combination of techniques was used to achieve stone clearance. In 25 (21%) cases open surgery alone was performed. A review of the surgical management of a subset of these patients (treated between 1997 and 1999) has recently been presented. 15

DISCUSSION
The epidemiology of paediatric nephrolithiasis appears to have changed in the past 30 years. This study does not address whether the incidence of stone disease in children has changed, which has been reported to account for between 0.13 and 0.94 cases per 1000 hospital admissions in the western world, 12 but does indicate an apparent change in the aetiology of stone formation. Males continue to suffer more renal stones than females, a predominance that is confirmed aetiology of stone formation. Males continue to suffer more renal stones than females, a predominance that is confirmed.

In 17% the stone was detected fortuitously. We observed that children presenting with renal stones often have feeding and growth problems. The reduced mean height and weight (on 25th centiles) in the sample (77%) measured prior to stone removal, may support this observation, although reduced growth after prematurity or other concurrent illness may also be contributory factors.

The most striking difference that we have observed is the apparent reduction in the proportion of infective stones and the increase in underlying metabolic abnormalities from 16% thirty years ago 1 to 44% today (fig 3). In this study, we investigated every child, even if they presented with a UTI or had a triple phosphate stone. In previous studies some of these children may have been labelled as having “infective” stones. Our data suggests that a high proportion (49%) of such children have an underlying metabolic abnormality. Although urinary tract infection can lead to stone formation, the presence of a stone can itself also lead to a UTI. As in the previous study, we excluded transient hypercalciuria as this is commonly associated acutely with the stone episode and disappears after the stone is removed. 19 It is also possible that the reduced proportion of children with infective stones is related to the increased awareness, identification, and rapid treatment of urinary infection in children. 21 For whatever reason, it seems that the apparent incidence of underlying metabolic abnormalities found, using the diagnostic criteria of this study, is now similar to those found in parts of the United States 15 21–23 and other countries throughout the world. 24

Identifying the underlying metabolic abnormality is beneficial as it seems to predict more severe stone disease; these patients are more than twice as likely to present with bilateral disease compared to the infective/idiopathic group. It also permits the opportunity to identify siblings who have similar pro-lithogenic metabolic abnormalities to be detected before they develop overt stones. This allows treatment to be initiated early to help prevent stones forming.

The techniques and technologies available for clearance of renal stones in children have dramatically changed in the past few decades. 25–29 Thirty years ago stones were exclusively managed by open surgery, whereas in this study, 68% children were managed either by lithotripsy, percutaneous nephrolithotomy, or endoscopic approaches. The difficult stone may need a combined approach, and in 21% open surgery alone was performed. Changes in the medical management of stone disease have been more limited.

The results of this study indicate a change in the aetiology of renal stones in children in the UK in the past 30 years. Children with renal stones do not necessarily present with the classic symptoms of pain and haematuria. They are more likely to have an underlying metabolic abnormality, and can now be treated with minimally invasive surgical techniques. 30–32
We recommend that every child with a stone should have a metabolic evaluation, primarily to initiate preventive treatment early, but also to allow siblings to be screened if necessary.

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REFERENCES
Euroaspirations

We read with interest the recent article of Papadopoulos et al.1 The Euro was accepted with remarkable alacrity by the peoples of the eurozone. The franc, mark, guilder, lira, and other currencies were effectively replaced within one week in February 2002. The euro changeover was effective, efficient, and essentially painless. The currency has prospered with 20% growth since its introduction and is now worth approximately 70 pence sterling and one US dollar 15 cents.

In the first few months of the euro, we too noticed several children presenting to our emergency department having decided to see how well the euro went down. These were children in the oral exploratory ages of 1–3 years. As a consequence and for guidance to our emergency department colleagues, a “eurometer” was made (fig 1). Some of the euro coins are small and some ended up in the upper airway, the oesophagus, and the stomachs of toddlers and preschool children (fig 2). We have seen 22 such patients in first eight months of this year. A few euroretrievals were required.

The UK’s euro debate sees the euro as a threat to the national pound. Has anyone else considered the euroaspiration? “Should the UK stay in or out of the euro?” ask the headlines? Sweden plunged into controversy when it consulted its people in a euro referendum. Denmark is sitting on the fence. The UK is discussing and dallying on the issue. All accident and emergency departments in the eurozone ought to be cognisant of the potential of the 1 cent coin to lodge in the oesophagus or sit in the upper airway. The differential diagnosis of any toddler with acute upper airway obstruction should, in the eurozone, include euristridor.

We, like Dr Papadopoulos and colleagues, warn that if one aspires to euroconvert, one must accept euroaspirations.

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Reference

The Euro was accepted between thrombocytopenia and lethality. The occurrence of death rather than substitute variables, for example, severe malaria criteria, is the variable of interest. Among children suffering severe falciparum malaria, thrombocytopenia (<100 000/mm3) should be considered as predictive of a fatal outcome, especially in those with cerebral malaria or respiratory distress.1

The low level of lethality among severe cases (3.5%, 4/112) also suggests that clinical presentations observed in the Moulin et al study were less life threatening than in ours, even if 69 of their severe cases have been admitted in the same paediatric department where our study was conducted previously. It is well established that the case fatality rate varies according to clinical presentation1 and definition of severe falciparum malaria criteria. Thus any analysis of prognostic factors of malaria lethality must take into account the composition of the samples in terms of clinical presentations, for example, analysing the different syndromes separately. In our study, the association between thrombocytopenia and lethality was significant among children with cerebral malaria or respiratory distress but not among children only presenting with severe anaemia, convulsions, or hypoglycaemia. It is possible that the composition of the severe cases sampled by Moulin and others may have confused the association. Age is another confounding factor that was not controlled in the Moulin et al study. We showed that age was associated with both lethality and thrombocytopenia.

Furthermore, the exposure of children to malaria may be not so different between the samples studied by Moulin and others. In large areas of Dakar, the level of transmission is very low, less than one infective bite every 10 years. It is thus likely that a significant proportion of the children from Dakar, and to a less extent from Libreville, had never been infected before by Plasmodium falciparum. Without reliable information about the exact location of their habitat, it is inappropriate to estimate their level of previous exposure to malaria in urban areas where the level of transmission is heterogeneous.

Finally, it must be stressed that in the studies of prognostic factors of lethality, the occurrence of death rather than substitute variables, for example, severe malaria criteria, is the variable of interest. Among children suffering severe falciparum malaria, thrombocytopenia (<100 000/mm3) should be considered as predictive of a fatal outcome, especially in those with cerebral malaria or respiratory distress.1

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References


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Changes in pulmonary function following salbutamol in infants grouped by baseline $V'_{\text{maxFRC}}$ Z score

<table>
<thead>
<tr>
<th>Baseline Z score</th>
<th>Number</th>
<th>Mean change (SD) in $V'_{\text{maxFRC}}$ (ml/s)</th>
<th>Mean change (SD) in $V'_{\text{maxFRC}}$ Z score</th>
<th>Mean % change (SD) from baseline $V'_{\text{maxFRC}}$</th>
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<tr>
<td>$&lt;-2$</td>
<td>7</td>
<td>18.7 (19.3)</td>
<td>0.37 (0.34)</td>
<td>30.6 (24.8)</td>
</tr>
<tr>
<td>$&gt;2$</td>
<td>22</td>
<td>-2.38 (31.8)</td>
<td>-0.05 (0.39)*</td>
<td>-1.8 (18.7)*</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.005

The use of insulin pumps improves the metabolic control in children and adolescents with type 1 diabetes

We greatly appreciated the article by Torrance and colleagues’ about the use of insulin pumps and we agree with their conclusion that the benefits of continuous subcutaneous insulin infusion (CSII) outweigh the disadvantages. Our three year experience with CSII at the Juvenile Diabetes Regional Centre of Tuscany has shown that not only does this form of insulin administration enhance the compliance in children and teenagers with type 1 diabetes (TIDM), but it also represents an effective way to improve the metabolic control of our patients.

We studied the entire group of 34 (16 males, 18 females) TIDM patients aged up to 18 years followed at our centre, who in the period from January 2000 to November 2002 started CSII. CSII was continued it for at least one year without interruption. At the time of attaching the pump the mean age was 14.4 years (range 9–17.8) and the mean duration of diabetes was 6.2 years (range 0.6–15.8). We found that the mean HbA1C values of the group decreased from 8.35% (SD 1.08) at the beginning of the treatment.
with CSII, to 7.81% (SD 0.95) 12 months later (paired t test: p = 0.002). In addition, the mean daily insulin requirement of the patients dropped by 23.7%, from 58.2 IU (SD 15.3) to 44.4 IU (SD 11) (paired t test: p < 0.001); the mean body mass index did not vary significantly in the period (from 20.7 (SD 2.5) to 21.2 (SD 2.4)). During the period studied no episodes of hypoglycaemia occurred; one episode of ketoacidosis was caused by displacement of the cannula. No episode of local infection occurred. Three patients discontinued the CSII after the first year and one after the second year of treatment.

Our experience shows that use of an insulin pump improves the metabolic control of T1DM in children and adolescents, and reduces the daily insulin requirement.

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doi: 10.1136/adc.2003.046805

Reference


Read the label carefully

The figure shows the packaging of a “rice slice”, which a mother gave to her 23 month child, believing it to be free of any milk. The patient had an anaphylactic reaction shortly after ingesting a very small amount. On close inspection of the ingredients, casein is listed but not qualified as a milk protein.

The child initially presented at 8 weeks of age with a cutaneous reaction to cows’ milk formula on her second exposure, having previously been breast fed. She had raised specific IgE level to milk and a positive skin prick test (3 mm wheal with 6 mm erythema). Thereafter she was managed with an extensively hydrolysed formula and the family were given advice to avoid all milk and its derivatives. They were prescribed antihistamine but not an adrenaline auto-injector.

This case illustrates the difficulty of managing allergy in real life. It is easy to see how a product described as a “delicious alternative to cheese” could be wrongly thought to be milk free unless the ingredients are closely scrutinised. Thirty per cent of children diagnosed as allergic have been breast fed. She had raised specific IgE level to milk and a positive skin prick test (3 mm wheal with 6 mm erythema). Thereafter she was managed with an extensively hydrolysed formula and the family were given advice to avoid all milk and its derivatives. They were prescribed antihistamine but not an adrenaline auto-injector.

The ward patient name board is a familiar sight, placed prominently on most hospital wards. Concerns regarding guidance on patient confidentiality, stemming from the Caldicott report, led our trust to remove the boards from the general areas of the paediatric wards. They were placed in a less public area—generally the treatment room. It led to delays in staff being able to identify a child’s location and their nurse’s identity, and general dissatisfaction among the clinical teams.

The parents of 20 patients (age range 11 months to 13 years) on our regional paediatric oncology ward completed a questionnaire. Parents who had only recently received the diagnosis were excluded. Parents responded to five statements, with “strongly agree, agree, disagree, strongly disagree, or neither”.

(1) I object to having my child’s name and location on the board where everyone else can see it—17 disagreed (11 strongly), with 1 parent agreeing.

(2) I think that having the centrally placed name board helps the people looking after my child to quickly find out where my child is and who is looking after them—18 agreed (13 strongly), with 1 disagreeing.

(3) I think having my child’s name on the board represents a risk to their safety—18 disagreed (11 strongly), with no parents agreeing.

(4) I like to be able to look at the board to see which other patients whom we know are on the ward—18 agreed (13 strongly), with no disagreement.

(5) I would be happy for the name board to be reintroduced—19 agreed (15 strongly) with no disagreement.

Armed with these results, and mindful of various comments made by parents, the boards are back to their original place. On admission, the parents are asked whether they object to their child’s full name being placed on it. This appears to work well, with satisfaction among clinicians, parents, and managers—an unusual state of affairs!

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References


Board senseless

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References


The authors of the paper entitled Epidemiology of paediatric renal stone disease in the UK (Coward et al, Arch Dis Child 2003;88:962–965) would like to acknowledge the source of their data in Table 1. This table was adapted from data published in the paper by So et al (Pediatr Nephrol 2001;16:133–139).