

Suprapubic aspiration under ultrasound guidance in children with fever of undiagnosed cause

Heloise Buys, Linda Pead, Richard Hallett, Rosalind Maskell

Abstract

Objectives—To assess the ease of use of suprapubic aspiration of urine under ultrasound guidance in babies with fever of uncertain cause and to assess the importance of bacterial counts and pyuria in relation to abnormalities of the urinary tract and the importance of pyuria in the absence of bacteriuria.

Design—Analysis of urine samples obtained by suprapubic aspiration in babies and children from July 1991 to June 1992. The clinical records of the children with bacteriuria and sterile pyuria were examined retrospectively.

Setting—Neonatal and paediatric wards of a district general hospital.

Subjects—508 babies and children who had fever of uncertain cause or were seriously ill.

Results—No difficulties arose in the collection of 545 specimens. Bacteria were isolated from the specimens of 44 children, 24 of whom had abnormalities of the urinary tract. The bacterial count was <10⁶/l in 18 of the children with bacteriuria, 10 of whom had abnormalities. No white cells were seen in 22 of the 46 bacteriuric specimens; nine of the children with no pyuria had vesicoureteric reflux. 439 of the 499 non-bacteriuric specimens showed no white cells. 60 children had pyuria without bacteriuria.

Conclusions—The use of ultrasound guidance simplifies suprapubic aspiration of urine in babies. Low bacterial counts may be associated with abnormalities of the urinary tract. Laboratory techniques capable of detecting such counts reliably should be used. Pyuria is absent in half of babies and very young children with bacteriuria. It rarely occurs without bacteriuria, and if it does an explanation should be sought.

Introduction

The association of urinary tract infection in early childhood with renal scarring, hypertension, and renal failure and the importance of early diagnosis to prevent renal damage are recognised.¹ The diagnosis may be difficult and unreliable owing to the problem of obtaining satisfactory urine specimens from infants and babies. Suprapubic aspiration is accepted as the definitive sampling technique,^{2,3} but it is not widely used in Britain because inexperienced medical staff often find it difficult. No large series have been reported from Britain. When used under ultrasound

guidance, however, suprapubic aspiration is safe and easy,^{4,5} and is now part of the standard investigation of babies with fever of uncertain cause in our hospital. We studied the findings in specimens collected in this way over one year and recorded the results of imaging in children with bacteriuria and sterile pyuria.

Methods

From July 1991 to June 1992 senior house officers used suprapubic aspiration under ultrasound guidance to collect urine specimens from children in the neonatal and paediatric wards. Most specimens came from infants and babies with non-specific febrile illnesses but a few came from older children who were seriously ill or whose previous urine specimens, collected by other methods, had not yielded a definite diagnosis. Suprapubic aspiration was uniformly successful, and no ill effects were seen.

The specimens were transported to the laboratory immediately and processed on arrival. Uncentrifuged urine was examined by the inverted microscope technique ($\times 20$ objective).⁶ Specimens were inoculated with a 0.005 ml standard loop on to cystine lactose electrolyte deficient agar and incubated overnight in an atmosphere containing 5% carbon dioxide. We defined pyuria, for the purpose of this study, as the presence of any white cells on microscopy. We classified any growth on culture, whatever the count, as bacteriuria; pyuria and no growth as sterile pyuria; and no growth and no pyuria as a negative result. We obtained the clinical diagnosis and results of imaging of the children with bacteriuria retrospectively from the case notes. We examined the records of the children with sterile pyuria to find out whether they had been receiving antibacterial treatment when the specimen was collected. We also recorded the results of any imaging of children in this group.

Results

In all, 545 suprapubic aspirates were collected from 508 children during the year. Table I shows the age and sex of the children when the urine specimens were collected and correlates these data with the results of microscopy and culture. Table II shows the bacterial counts of the organisms isolated from 46 specimens from the 44 children with bacteriuria.

Thirty eight of the 44 children with bacteriuria underwent imaging of the urinary tract; of the rest,

TABLE I—Distribution of bacteriuria and sterile pyuria in 545 urine specimens collected by suprapubic aspiration by sex and age of children from whom specimens were taken. Figures are numbers of specimens

Age	Boys				Girls			
	Bacteriuria	Sterile pyuria	Negative result	Total	Bacteriuria	Sterile pyuria	Negative result	Total
≤ 4 weeks	7	29	119	155	5	12	84	101
5 weeks to 6 months	13	8	68	89	11	3	77	91
7 months to 1 year	6	4	28	38	2	2	32	36
13 months to 2 years	1	0	6	7	1	0	21	22
> 2 years	0	1	1	2	0	1	3	4
Total	27	42	222	291	19	18	217	254

Department of Paediatrics,
St Mary's Hospital,
Portsmouth PO3 6AD
Heloise Buys, registrar
Richard Hallett, consultant
paediatrician

Public Health Laboratory,
St Mary's Hospital,
Portsmouth PO3 6AQ
Linda Pead, research assistant
Rosalind Maskell, associate
specialist

Correspondence to:
Dr Hallett.

three had surgery for acute abdomen due to non-renal causes, one died of an infected meningomyelocele, one recovered and was discharged with a diagnosis of neonatal jaundice, and the parents of one cancelled the investigations. Ultrasound scanning and micturating cystourethrography were performed in 35 children; table III shows the findings. Vesicoureteric reflux was classified according to Smellie's criteria.⁷ Micturating cystourethrography alone was performed in three children: none showed reflux but one had a bladder residue. Intravenous urography or radionuclide scanning was undertaken in six children to elucidate abnormalities detected with ultrasound scanning or micturating cystourethrography. In all, 24 children (16 boys), with bacteriuria had radiological abnormalities (table IV).

Table V shows the bacterial counts in the 24 children with radiological abnormalities and how many of the children had pyuria; 10 (42%) had counts of $< 10^6/l$ and 9 (38%) had no pyuria. Of the 499 non-bacteriuric specimens, 439 (88%) showed no pyuria and the specimens from the remaining 60 children (42 boys) showed sterile pyuria. Forty one of the 60 children with sterile pyuria were neonates, of whom 17 were known to have been receiving antibiotics when the urine was collected. No definitive diagnosis was made in most of the neonates; many of them were premature and in incubators. Imaging of the urinary tract was undertaken in only 13 of the children with sterile pyuria and showed abnormalities in four: hydronephrosis (one), hydronephrosis and calculi (one), calculi (one), and bladder residue (one). Six of the 60

TABLE II—Results of culture of 46 urine specimens from 44 children with bacteriuria. Figures are numbers of specimens (numbers of specimens from children with pyuria in parentheses)

Organism	$> 10^6/l$	$10^5-10^6/l$	$< 10^6/l$
Coliform (pure growth)	22 (15)	8 (2)	4 (1)
Coliform (two types)	3 (3)	2 (0)	1 (0)
<i>Proteus</i> sp			1 (0)
<i>Pseudomonas aeruginosa</i>		1 (1)	
<i>Enterococcus faecalis</i>	1 (1)	1 (0)	
<i>Ps aeruginosa</i> and <i>E faecalis</i>	1 (0)		
Total	28 (20)	12 (3)	6 (1)

TABLE III—Findings of ultrasound scanning performed in 35 children with bacteriuria related to findings on micturating cystourethrography

Case No	Findings on ultrasound scanning	Findings on micturating cystourethrography
1-14	No abnormality	No abnormality
15, 16	No abnormality	Grade I VUR
17	No abnormality	Grade II VUR
18-25	No abnormality	Grade III VUR
26-28	No abnormality	Grade IV VUR
29	Right hydronephrosis and hydroureter	Right grade IV VUR
30	Full right renal pelvis	Right grade II VUR Left grade III VUR
31	Left duplex collecting system and right extrarenal pelvis	Right grade IV VUR
32	Right renal calculi	Bilateral grade IV VUR
33	Right dilated ureter	Bilateral grade IV VUR
34	Left hydronephrosis and dilated renal pelvis	Obstruction of the left pelviureteric junction and no VUR
35	Slightly dilated left collecting system	No VUR

VUR=Vesicoureteric reflux.

TABLE IV—Age of 24 children with bacteriuria in whom radiological abnormalities were found

Age	Boys (n=76)	Girls (n=8)	Total
0-4 weeks	5	3	8
5 weeks-6 months	9	3	12
7-12 months	1	1	2
13-18 months	1	1	2
Total	16	8	24

TABLE V—Results of culture of urine specimens from 24 children with bacteriuria in whom radiological abnormalities were found. Number of children with pyuria in parentheses

Abnormality	$> 10^6/l$	$10^5-10^6/l$	$< 10^6/l$
Vesicoureteric reflux	12 (9)	4 (1)	2 (0)
Vesicoureteric reflux and stone		1 (0)	
Hydronephrosis and obstruction of pelviureteric junction	1 (1)		
Trabeculated bladder		1 (1)	
Bladder residue	1 (1)		1 (1)
Dilated left collecting system		1 (1)	
Total	14 (11)	7 (3)	3 (1)

children with sterile pyuria either had evidence of previous bacteriuria or developed bacteriuria before the end of the study.

Discussion

The use of ultrasound scanning makes suprapubic aspiration of urine simple and has enabled us to incorporate the procedure into the routine investigation of babies with fever of undiagnosed cause. In one year bacteriuria was identified in this way in 44 children and sterile pyuria in 60. Urinary tract infection was excluded in the rest of the 508 children; this averted the need for unnecessary treatment with antibiotics, prolonged stays in hospital, and expensive and unnecessary investigations that may be prompted by false positive results in specimens collected by other methods.⁸ A study of the investigation of children in hospital with febrile convulsions found that only two urine specimens from 228 children were collected by suprapubic aspiration.⁹

About two thirds of the bacteriuric children who were investigated had abnormalities of the urinary tract; most of these were treated and managed according to accepted practice. Vesicoureteric reflux was detected in 14 children with normal findings on ultrasound scanning; as diagnosis at this early stage is accepted as the best way to prevent renal damage micturating cystourethrography should always be performed.

Low bacterial counts were found in the urine of two fifths of the children with abnormalities. Although other authors have accepted low counts in urine collected by suprapubic aspiration as evidence of bacteriuria, they did not state in how many children such counts were associated with abnormalities.² Clearly, not only should clinicians accept low counts as important but laboratories should use methods that can detect such counts and laboratory staff who read and report results should understand the importance of low counts. Many laboratory methods,^{10,11} often promoted to save time and money, do not detect low bacterial counts reliably. When they are substituted for culture of urine from sick children¹² important diagnoses may be missed.

Bacteriuria was detected in a slightly higher percentage of specimens from boys than girls (9% versus 8%). This agrees with Airede's findings in Nigerian children of twice as many abnormalities in boys as girls.³ Airede's finding is clearly related to the age group studied. Chiu *et al*,⁴ who studied children from birth to 14 years, found no significant difference between the sexes in the percentage with abnormalities but reported a male to female ratio of 3:1 for infections in children aged < 2 years.

Our findings challenge two widely held beliefs about pyuria. Firstly, we found that children with bacteriuria that is clinically important do not necessarily have pyuria: about half of the bacteriuric specimens showed no pyuria even when a low criterion for the detection of white cells was used, and nine children with no pyuria

Clinical implications

- Detecting urinary tract infection in early childhood is important for preventing renal damage
- Suprapubic aspiration of urine is considered in Britain to be a difficult technique
- This study showed that use of ultrasound guidance makes suprapubic aspiration in children and babies easy and safe
- Low bacterial counts were present in the urine of two fifths of the children with abnormalities of the urinary tract
- Clinicians should regard low bacterial counts as important

had vesicoureteric reflux. Secondly, few of the non-bacteriuric specimens showed pyuria. All the children from whom these specimens came were being investigated for febrile illnesses. Thus the view that pyuria often occurs as a non-specific response to fever seems untenable. Two thirds of the children with sterile pyuria were neonates, of whom many were premature and many were taking antibiotics; the possibility of bloodborne urinary tract infection, known to occur in neonates,¹³ is strong. Radiological abnormalities were found in about a third of the children who were investigated.

We suggest that clinicians should always seek an explanation for sterile pyuria and should consider the possibility of urinary tract infection if sterile pyuria persists.

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Skin test reactivity and number of siblings

University Children's Hospital, Munich, Germany

Erika von Mutius, paediatrician
Thomas Nicolai, paediatrician

Respiratory Sciences Center, Department of Pediatrics, University of Arizona, Tucson, Arizona, USA

Fernando D Martinez, paediatric pulmonologist

University Children's Hospital, Leipzig, Germany

Christian Fritsch, paediatrician

Research Centre for Environment and Human Health, Medis Institute, Munich, Germany
Peter Reitmeir, statistician

University Children's Hospital, Halle, Germany
Hans-Heinrich Thiemann, paediatrician

Correspondence and reprint requests to:
Dr E von Mutius, Universitätskinderklinik, Lindwurmstr 4, D-8000 München 2, Germany.

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Erika von Mutius, Fernando D Martinez, Christian Fritsch, Thomas Nicolai, Peter Reitmeir, Hans-Heinrich Thiemann

Abstract

Objective—To investigate the relation between skin test reactivity in children and number of siblings.

Design—Cross sectional survey among school-children aged 9-11 years. Skin prick tests in the children and self completion of written questionnaire by their parents.

Subjects—5030 children in Munich and 2623 children in Leipzig and Halle, Germany.

Main outcome measures—Atopic status assessed by skin prick tests.

Results—After possible confounders were controlled for, the prevalence of atopic sensitisation decreased linearly with increasing number of siblings (odds ratio=0.96 for one sibling, 0.67 for five or more siblings; $P=0.005$). In atopic children the severity of the skin test reaction as assessed by the weal size was not associated with the number of siblings.

Conclusions—Factors directly or indirectly related to the number of siblings may decrease the susceptibility of children to become atopic. Thus, declining family size may in part contribute to the increased prevalence of atopic diseases reported in Western countries over the past few decades.

Introduction

A strong inverse association between the number of siblings and the prevalence of hay fever in British children was reported by Strachan.¹ As the presence of older siblings had a stronger effect than the presence of younger siblings, the author suggested that factors such as viral infections early in life may prevent the

development of allergic sensitisation. His observations, however, were based on parents' answers to a questionnaire. It could be argued that the effects observed may have been affected by recall bias, as parents with many children may not remember a relatively mild disease such as hay fever as accurately as parents with only one or two children.

The aim of this report was to investigate the relation between the number of siblings and an objective measure of atopic sensitisation in children living in eastern and western Germany. We performed skin prick tests in 9-11 year old schoolchildren in a survey in Leipzig and Halle, East Germany, and Munich, West Germany, and related these findings to answers to a parental questionnaire on household size, socio-economic status, and occurrence of disease.

Methods

STUDY AREAS AND POPULATIONS

In former West Germany, all fourth grade pupils ($n=7445$) at all primary schools in Munich, a city of about 1.3 million inhabitants located in the south-western part of the country, were included in the study. All schoolchildren ($n=3105$) attending the fourth grade of a random sample of 39 schools in Leipzig and of 23 schools in Halle were studied in former East Germany. Leipzig, a city of about 535 000 inhabitants, is located in the southeastern part of the country in close proximity (35 km) to Halle, a city of about 300 000 inhabitants. These two cities are heavily polluted due to private coal burning and industrial emissions, whereas Munich has moderate industry but