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Has the prevalence of asthma increased in children? Evidence from the national study of health and growth 1973-86

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Abstract

***Objectives*—To estimate changes in the prevalence of reported symptoms of respiratory disease and reported diagnoses of asthma and bronchitis in primary school children in England between 1973 and 1986.**

***Design*—Mixed longitudinal survey.**

***Setting*—Representative sample of English primary schools in 22 areas.**

***Participants*—15 000 Boys and 14 156 girls each studied at least once between 1973 and 1986.**

***Data collected*—Whether, according to the parent or guardian, the child had wheezed, wheezed on most days or nights, or had attacks of bronchitis or asthma in the past year.**

***Results*—Within age groups trends in successive annual cohorts showed an increasing prevalence of asthma for each annual birth cohort (boys, 6·9%, $p<0·001$; girls, 12·8%, $p<0·001$) and of wheeze on most days or nights (boys, 4·3% per cohort, $p<0·001$; girls, 6·1% per cohort, $p<0·001$) and a falling prevalence of bronchitis (boys, −4·7% per cohort, $p<0·001$; girls, −5·8% per cohort, $p<0·001$). There was a smaller increase in the prevalence of wheeze whether or not it occurred on most days or nights, and this increase was significant only among the girls (boys, 1·0% per cohort, $p>0·05$; girls, 1·7% per cohort, $p<0·05$). Although the rate of increase of "asthma" was greater than the rate of decrease in "bronchitis," the baseline prevalence of asthma was much lower than that of bronchitis, and the total proportion of children with either diagnosis declined slightly over the whole period. The main change was an increase in the proportion of children whose parents stated that they had persistent wheeze and yet did not have a report of either "asthma" or "bronchitis."**

***Conclusions*—These results suggest that there has been a true increase in morbidity that is not simply due to changes in diagnostic fashion. The increase is large enough to explain much if not all of the increase in admission to hospital and mortality, and it underlines the importance of an understanding of the aetiology of asthma in tackling the causes of the recent increase.**

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Introduction

Mortality from asthma among 5-34 year olds increased between the mid-1970s and the mid-1980s.[1] This increase was the more surprising as mortality had been falling in most conditions for which there was effective prevention or treatment.[2] At the same time more children with asthma had been admitted to hospital[3,4] and consultations with general practitioners for asthma virtually doubled between 1970-1 and 1981-2.[5]

Each of these changes could be due to a change in medical practice, including a change in the use of diagnostic labels, or to a change in the prevalence of the disease. There is some indirect evidence that the prevalence of asthma may have been increasing, but other evidence suggests that there has been no change. Smith found an increase in the prevalence of asthma in Birmingham in the 1960s,[6] but this evidence was collected at a time of great demographic change when the city was being largely rebuilt. Wadsworth compared those who had been studied in the 1946 national perinatal survey with their firstborn offspring and showed that the children had a threefold greater chance of having been treated for asthma before their fifth birthday,[7] but this could have been explained by differences in management or differences in diagnostic practice. Hill *et al* estimated that the prevalence of wheeze in Nottingham schoolchildren increased 1-28% between 1985 and 1988 and suggested that the large increase in estimated "asthma" was due to a change in diagnostic labelling.[8] More recently Burr *et al* showed increases between 1973 and 1988 in both symptoms and bronchial response to exercise in 12 year old children attending schools in Caerphilly.[9]

On the other hand, Hay and Higginbottam, Anderson, and Hill *et al* have all pointed to the lack of any trend over time in the results from published surveys reporting the prevalence of asthma.[10-12] As Anderson points out, however, the interpretation of this evidence is difficult because the methods used in each survey are different and estimates of the prevalence of asthma are likely to be sensitive to these differences.[13] Geographical variation in the prevalence of asthma would also confound any estimate of trend from these data.

Indications that asthma may be an increasing problem are not confined to the United Kingdom. Upward trends in mortality have also been noted in New Zealand, France, Germany, Denmark, and possibly the United States.[14-16] Upward trends in hospital admissions have also been noted in New Zealand and the United States.[17,18]

This paper reports trends in the prevalence of respiratory conditions, including both diagnoses and symptoms, reported by the parents and guardians of children in the national study of health and growth between 1973 and 1986. Estimates of the trends in prevalence have been made for cohorts of children living in England and born between 1961 and 1981.

Subjects and methods

The subjects were English children aged from 4 to 12 years who took part in the national study of health and growth at least once between 1973 and 1986. In the national study of health and growth, which is primarily a surveillance study, primary schools in 22 areas in England were selected in 1972 and visited annually until 1982 and biennially thereafter. Children were eligible to take part while attending a participating school and as a result children have been included up to eight times between 1972 and 1982 and up to four times since then. The original design was described in detail by Chinn and Rona.[19]

TABLE I—*Data available for each cohort*

	Age*							
Year of birth	5	6	7	8	9	10	11	12
1961								WA
1962							WA	WA
1963						WA	WA	WA
1964					WA	WA	WA	WA
1965				WA	WA	WA	WA	WA
1966			WA	WA	WA	WA	WA	A
1967		WA	WA	WA	WA	WA	A	A
1968		WA	WA	WA	WA	A	A	A
1969		WA	WA	WA	A	A	A	A
1970		WA	WA	A	A	A	A	WA
1971		WA	A	A	A	A	WA	
1972	WA	A	A	A	A	WA		WA
1973	A	A	A	A	WA		WA	
1974	A	A	A	WA		WA		WA
1975	A	A	WA		WA		WA	
1976	A	WA		WA		WA		
1977	WA		WA		WA			
1978		WA		WA				
1979	WA		WA					
1980		WA						
1981	WA							

W = wheeze, A = asthma or bronchitis.
*Year of data collection minus year of birth.

TABLE II—*Number of English boys and girls eligible for study and percentage of total eligible for whom questionnaire was returned and information on respiratory conditions obtained*

	Boys			Girls		
	No eligible	% With questionnaire data	% With respiratory data	No eligible	% With questionnaire data	% With respiratory data
1973	3318	89·5	88·4	3149	90·1	89·3
1974	3426	90·5	86·9	3226	91·5	88·3
1975	3346	87·9	87·0	3172	88·9	87·8
1976	3222	86·0	85·2	3126	88·6	87·4
1977	3987	89·8	88·3	3797	90·4	89·0
1978	4065	89·1	88·2	3942	89·6	88·6
1979	3954	87·7	85·7	3800	88·6	86·7
1980	3492	87·5	85·4	3391	88·0	86·7
1981	3302	86·6	84·9	3166	87·1	85·6
1982	3515	87·6	86·1	3336	86·6	85·3
1984	3468	89·4	87·5	3236	89·2	87·7
1986	3483	90·9	88·8	3204	90·2	89·0

TABLE III—*Numbers (%) of children with reported symptoms and diagnoses in 1973*

Cohort:	1967	1966	1965	1964	1963	1962	1961
Age group:	6	7	8	9	10	11	12
			Boys				
Number in sample with information*	331	467	516	553	514	413	127
Asthma	8 (2·4)	20 (4·2)	17 (3·3)	8 (1·5)	13 (2·5)	16 (3·9)	2 (1·6)
Bronchitis	23 (6·9)	29 (6·1)	37 (7·1)	25 (4·5)	26 (5·1)	17 (4·1)	6 (4·7)
Occasional wheeze	53 (15·8)	74 (15·7)	71 (13·7)	59 (10·6)	58 (11·2)	43 (10·3)	7 (5·5)
Persistent wheeze	9 (2·7)	13 (2·8)	15 (2·9)	9 (1·6)	13 (2·5)	15 (3·6)	1 (0·8)
Persistent wheeze but no attacks of asthma or bronchitis	6 (1·8)	8 (1·7)	4 (0·8)	6 (1·1)	10 (1·9)	10 (2·4)	0 (0·0)
			Girls				
Number in sample with information*	341	494	485	514	476	379	115
Asthma	2 (0·6)	5 (1·0)	4 (0·8)	11 (2·1)	5 (1·1)	4 (1·1)	1 (0·9)
Bronchitis	20 (5·9)	25 (5·1)	24 (4·9)	23 (4·5)	16 (3·3)	10 (2·6)	4 (3·4)
Occasional wheeze	35 (10·2)	52 (10·5)	37 (7·6)	40 (7·8)	26 (5·4)	25 (6·6)	3 (2·6)
Persistent wheeze	8 (2·3)	10 (2·0)	7 (1·4)	7 (1·4)	5 (1·1)	6 (1·6)	1 (0·9)
Persistent wheeze but no attacks of asthma or bronchitis	5 (1·5)	7 (1·4)	3 (0·6)	4 (0·8)	2 (0·4)	3 (0·8)	0 (0·0)

*Numbers vary slightly; minimum given. Percentages are of actual number.

Thirteen areas continued in the study throughout the period with the same schools participating. Three continued with one change of school and the remaining six were replaced once, three in 1977 or 1978, and three in 1982 or 1984.

Data were collected on respiratory conditions by questionnaires with some variation in content. The question, "Has he or she suffered from any of these illnesses in the last twelve months? Asthma . . . Bronchitis . . ." was asked from 1973 to 1976 about all children who were not new entrants to the study and from 1977 onwards about all children. The questions "Does his or her chest ever sound wheezy or whistling?" and, if yes, "Does he or she get this on most days or nights?" were asked of all children followed up between 1973 and 1976 and all children in 1977, 1982, 1984, and 1986. A positive answer to the first question defined those with "occasional" wheeze, and a positive answer to both questions defined those with "persistent" wheeze.

A trend in prevalence over time for any of the symptoms or conditions is easily calculated, but because of the repeated data at different ages for most of the children the derivation of an appropriate standard error is not straightforward. Woolson and Clarke described a method that can be computed using the CATMOD procedure in SAS.[20,21] For each child in each age group from 5 to 12 (defined by year of survey less the year of birth) there were three categories for each respiratory condition: absent, present, or missing information. Children were divided by sex and into cohorts by year of birth, and the data for each condition were cross tabulated by age group. Some data were available for 21 cohorts born in 1961 to 1981 (table I). For each cohort and each age group we found the proportion (p) of those with the condition or symptoms of those in the cohort for whom information was obtained and calculated the logit ($\log_e p/(1-p)$) in accordance with usual methods for the analysis of proportions.[22] The pooled linear trend within age groups over cohorts with the appropriate standard error was then calculated using CATMOD. Owing to the very large size of the cross tabulation it was not possible to perform the analysis in a single run of SAS on the University of London computer centre's Amdahl machine. To overcome the difficulty for asthma and bronchitis the cohorts were divided into three groups of every third cohort, and the resulting three trends were averaged. For wheeze, as there were fewer data, two groups of every other cohort were used.

Quadratic time effects were calculated to assess the adequacy of the linear trends as summaries of the data. The trend in logit prevalence was multiplied by 13 to give an estimate of change over the 13 years of the study; the antilogarithm was derived and multiplied by 100 to give an approximate percentage increase. A 95% confidence interval for the 13 years' change was calculated as $\pm 1{\cdot}96 \times 13 \times$ standard error of trend, and the antilogarithms for the limits were derived and multiplied by 100 to give a 95% confidence interval for the percentage increase.

Results

About 6500 children were eligible for follow up each year from 1973 to 1976, and around 8000 (decreasing to around 6600) were eligible for the study between 1977 and 1986 (table II). Questionnaires were returned for between 86% and 91% of the participants; most gave information on respiratory conditions. Comparable data were not obtained from new entrants from 1972 to 1976 and so the data from the 1972 survey have been omitted and data on new entrants have been excluded between 1973 to 1976. New entrants to the

study during this period who were not followed up are therefore totally excluded from this analysis. A total of 15 000 boys and 14 156 girls were included at least once. There was little difference in the amount of information available on asthma or bronchitis or, in surveys in which the information was available, for occasional or persistent wheeze. In 1973, 95·3% of the questionnaires were completed by the mother or female guardian, 3·9% by the father or male guardian, and 0·8% by others. In 1986 these figures were 90·4%, 9·4%, and 0·1% respectively.

Table III shows the prevalence of reported symptoms and diagnoses in 1973, the first year of the study. Symptoms were generally more common in boys, and occasional wheeze and a diagnosis of bronchitis were clearly much less common in older children. Table IV shows changes in the percentage prevalence of one of these symptoms, persistent wheeze, in succeeding surveys for boys and girls separately. A general trend can be seen within each age group for rates to increase in succeeding cohorts. The calculations in table V confirm that these apparent increases are greater than could be expected by chance.

TABLE IV—*Prevalence (%) of persistent wheeze*

	Age group							
Cohort	5	6	7	8	9	10	11	12
				Boys				
1961								0·8
1962							3·6	1·7
1963						2·5	2·1	1·5
1964					1·6	1·9	1·7	1·5
1965				2·9	2·3	2·1	1·2	2·7
1966			2·8	2·4	1·3	1·6	1·9	
1967		2·7	3·3	2·8	1·5	2·0		
1968		2·4	3·1	2·3	3·3			
1969		2·9	2·6	3·0				
1970		3·2	3·3					1·7
1971		4·4					3·2	
1972	4·9					2·8		3·6
1973					3·7		4·1	
1974				2·8		1·8		2·1
1975			4·4		4·3		2·5	
1976		1·9		3·6		4·2		
1977	4·5		3·8		2·9			
1978		2·8		3·6				
1979	5·8		4·8					
1980		5·1						
1981	3·7							
				Girls				
1961								0·9
1962							1·6	1·0
1963						1·1	0·7	1·8
1964					1·4	1·5	1·4	0·0
1965				1·4	0·6	1·0	1·6	0·9
1966			2·0	2·6	1·8	1·6	1·6	
1967		2·3	2·2	1·5	0·6	1·4		
1968		2·2	1·3	1·3	2·3			
1969		3·3	1·7	1·4				
1970		1·4	1·9					3·7
1971		2·5					2·7	
1972	4·0					2·0		2·9
1973					2·1		1·1	
1974				3·1		1·1		1·9
1975			2·1		3·1		1·9	
1976		4·1		2·4		1·7		
1977	1·7		2·7		2·0			
1978		4·2		3·5				
1979	2·4		2·4					
1980		3·5						
1981	5·0							

There was a definite, highly significant ($p<0·001$) rate of increase in the prevalence of reported asthma over this period, and this was significantly greater in girls than boys. There was a smaller but also highly significant rate of fall in the prevalence of reported bronchitis over the same period, and this was approximately equal in girls and boys. There was a highly significant rate of increase in the prevalence of persistent wheeze, which was estimated to be slightly less than that in the prevalence of reported asthma in boys and approximately equal in both sexes. The estimated prevalence of occasional wheeze increased slightly but this was only marginally significant ($p<0·05$) in the girls. The quadratic time effects were not significantly different from zero except for that for asthma in girls ($p<0·05$); in this case it represented a trend that was itself increasing over time.

When diagnoses of "asthma" and "bronchitis" are combined there is a small fall in the prevalence of the total over the period, which is significant among boys ($p<0·05$) but not among girls. In both sexes there was a significant increase in the number of children with wheeze on most days or nights but without a diagnosis of either "asthma" or "bronchitis" ($p<0·001$). This change was greatest in boys.

Discussion

This analysis shows a definite increase in the prevalence of diagnosed asthma and of "wheeze on most days and nights" in English primary school children between 1973 and 1986 and provides the first national estimate of the increasing prevalence of asthma. It strongly suggests that local factors do not explain earlier observations[6,8,9] and that the review of surveys from different centres using different techniques[10-12] is misleading.

The initial areas were selected by stratified random sampling of employment exchange areas, and local medical and education authorities selected the schools within the chosen areas. The stratification of the employment exchange areas took account of the level of unemployment, uptake of free school meals, and the proportion of children leaving school at age 15. Though proportionally more areas were selected from the poorer areas, the distribution of the children by social class at the start of the study in 1972 was very close to the equivalent national figures for England and Wales at the 1971 census.[23] Estimates of change based on 22 different areas covering diverse parts of England are unlikely to be attributable to local changes in the composition of the population.

The methods used have been the same throughout the period. The same questions on respiratory health had been asked throughout the study, though questions on wheeze were not asked in all years. In most instances the same schools have been sampled. Where schools had to be replaced care was taken to find equivalent schools to replace them. Evidence that this strategy was successful comes from trends in height and weight, which did not differ significantly between

TABLE V—*Trend within age group per cohort in respiratory conditions from 1973 to 1986 and resulting estimate of percentage increase in prevalence over 13 years*

	Boys		Girls	
	% Trend in prevalence per annual cohort	% Increase over 13 years (95% confidence interval)	% Trend in prevalence per annual cohort	% Increase over 13 years (95% confidence interval)
Asthma	6·9**	138·3 (90·8 to 197·4)	12·8**	378·4 (250·1 to 554·2)
Bronchitis	−4·7**	−46·6 (−56·6 to −34·4)	−5·5**	−52·2 (−62·6 to −38·8)
Occasional wheeze	1·0	13·3 (−1·9 to 30·7)	1·7*	24·7 (4·4 to 48·9)
Persistent wheeze	4·3**	73·8 (30·6 to 131·1)	6·1**	116·7 (22·5 to 146·4)
Asthma and bronchitis	1·6*	−18·4 (−31·4 to −3·0)	0·05	−0·07 (−20·0 to 23·3)
Persistent wheeze, no asthma or bronchitis	11·1**	293·2 (190·0 to 431·3)	4·5*	76·3 (25·9 to 146·9)

*$p<0·05$. **$p<0·001$.

the replaced areas and the areas that were in the study throughout.[24] This was not true in Scotland, but the Scottish areas have for this reason not been included in this analysis. Each school was visited as far as possible in the same week each year. On rare occasions it was necessary to change the date of the visit by up to a maximum of one month.

It is not surprising that the number of children with a diagnosis of asthma has been increasing. Being diagnosed as having asthma is closely related to receiving specific treatment for the condition,[25,26] and there is already good reason to suppose that general practitioners are seeing more people who they recognise as having asthma.[5] It could be argued, however, that this represents an increasing awareness of asthma and the importance of treating it rather than a genuine increase in prevalence. Some support for this hypothesis is given by the overall decrease in the prevalence of asthma and bronchitis taken together. Such an interpretation does not, however, explain the increase in the prevalence of symptoms.

The greatest proportional increase among the boys, and a substantial increase among the girls, was in those with persistent symptoms but no diagnosis of either asthma or bronchitis. In view of the close association that is believed to exist between diagnostic labels and treatment this is particularly worrying. It may indicate an increasing number of untreated subjects with moderately severe disease—despite increasing prescription rates for the population as a whole. We do not, however, have any information on the drugs that were used over this period, and this remains only one possible interpretation of the data.

The estimated change in the prevalence of occasional wheeze is fairly small, and, though there is a positive trend for each sex, only that for girls is significant ($p<0.05$). The change in persistent wheeze is, however, more substantial and is significant for boys and girls ($p<0.001$). There are four possible explanations for this difference. Firstly, if a substantial proportion of the population became slightly more prone to wheeze this would show a greater increase in prevalence of severe disease.[27] Secondly, wheeze is a symptom of a heterogeneous group of conditions and children with persistent wheeze "on most days and nights" may represent a greater proportion of a particular subgroup that has increased in size. For instance, more severe wheeze and wheeze associated with atopic conditions are more likely to persist through early childhood[28] and adolescence[29] and be recognised as asthma. It is possible that this category of wheeze, rather than other more benign causes of childhood wheeze, has increased. Thirdly, occasional wheeze is likely to be a less specific marker of respiratory disorder than persistent wheeze, and subjects may be more likely to be misclassified when this marker is used than with the more specific marker. This could reduce the sensitivity of the question on wheeze for picking up changes over time. Finally, we cannot exclude the possibility that mothers have become more sensitive to their children's symptoms over this period and are systematically more likely to report wheeze as being "on most days or nights." Burr *et al* showed that the prevalence of severe grades of reactivity had increased more than that of milder responses to exercise.[9] The prevalence of a 15% fall in peak expiratory flow rate after exercise increased by 15% (from 6·7% to 7·7%) over the 15 years between their two surveys, but the prevalence of a 35% fall in peak expiratory flow rate increased by 156% (from 0·9% to 2·3%). This suggests that the greater proportional increase in severe disease is not simply the result of a reporting bias.

It is difficult to interpret direct comparisons between changes in mortality and changes in morbidity. Nevertheless, the increase in persistent wheeze over this time is approximately 5% a year, a figure similar to the increase noted in mortality from asthma in 5-34 year olds in the same period.[1] It might therefore be possible to explain the whole of the increase in mortality by the increase in prevalence, but the substantial sampling error and wide confidence intervals for all of these estimates should leave open the question of whether changes in treatment may also have affected mortality over this period.

The increase in the prevalence of severe and persistent wheeze is unexplained, but it may have been due to a general increase in the prevalence of atopy. Evidence for a concomitant increase in general practice consultations with hay fever[5] and for a rapid increase in the prevalence of eczema since 1946[30] support this view. Such an increase in the prevalence of atopy might have been brought about by an increased exposure to allergen, though there is little evidence that this has occurred. An alternative hypothesis is that vulnerability to sensitisation has increased. One environmental exposure that is known to alter this vulnerability is tobacco smoke; in particular, smoking in pregnant women has been associated with an increased concentration of IgE in cord blood of neonates and an increased incidence of atopy in the first year of life.[31] Maternal smoking has also been shown to be a risk factor for atopy later in adolescence,[32] which suggests that it leads to a long lived increase in atopy. The increasing prevalence of smoking in women of childbearing age up until the mid-1970s might therefore explain some of the increase in atopic disease, though there is insufficient information at present in the national study of health and growth to test this hypothesis adequately. An alternative hypothesis has recently been advanced by Strachan, who showed a strong negative association between the number of older siblings and the prevalence of atopic disease in children born in 1958.[33] He suggested that lower infection rates in early life may be associated with a higher incidence of atopy. There is little other evidence to support this hypothesis at the moment, but if it is correct the changes in family size over the last hundred years could have led to a change in the incidence of atopic disease.

The increase in prevalence of morbidity reported in this paper is sufficient to explain much of the increase in mortality and use of services over this period. The reasons for the increase are so far unknown, but large changes in prevalence underline the importance of understanding aetiology in order to formulate an appropriate strategy for dealing with the current international epidemic.

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Percutaneous cholecystolithotomy: the first 60 patients

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Abstract

***Objective*—To assess the feasibility and possible complications of percutaneous removal of gall stones.**

***Design*—Prospective study of the first 60 patients treated.**

***Setting*—The London Clinic.**

***Patients*—60 Consecutive patients with symptomatic gall stones who agreed to have them removed percutaneously.**

***Results*—56 Patients had stones successfully removed percutaneously. In four patients failure of access necessitated a cholecystectomy under the same anaesthetic. Two patients had an empyema of the gall bladder drained initially, followed by a second operation to remove the stones one week later. Seven patients had postoperative complications, and two had recurrences of biliary calculi.**

***Conclusions*—The techniques and instruments used in percutaneous nephrolithotomy can successfully be adapted for percutaneous removal of gall stones. The procedure is suitable for a wider range of patients than other techniques that leave the gall bladder intact.**

Introduction

Percutaneous nephrolithotomy and extracorporeal shock wave lithotripsy have now virtually replaced open renal surgery. We decided to use the method entailed in percutaneous nephrolithotomy to remove calculi from the gall bladder. Other techniques are available to clear biliary calculi, but they have certain disadvantages. Extracorporeal shock wave lithotripsy and dissolution treatment both require the gall bladder to be functioning and are restricted to particular types of stones, and with both procedures the calculi take a considerable time to clear.[1-4] Dissolution of calculi with methyl *tert*-butyl ether requires percutaneous access and is also time consuming.[5] Percutaneous cholecystolithotomy allows stones to be completely removed immediately and does not need a functioning gall bladder. We have previously reported our initial experience of the technique[6] and now report on our first 60 patients.

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Patients and methods

From November 1986 to September 1989 we selected 29 men and 31 women aged 25-74 (mean age 51) for treatment. All had symptomatic gall stones. Initially, we selected only patients whose gall bladder was functioning, but later we included patients whose gall bladders were not functioning if this was thought to be due to a stone obstructing Hartmann's pouch. None of the patients had any other medical conditions, and all elected to have percutaneous cholecystolithotomy after the alternatives had been explained. Each patient agreed to have an immediate cholecystectomy under the same anaesthetic if the procedure could not be completed satisfactorily. We assessed the gall bladder by oral cholecystography and ultrasonography, ultrasonography being used to determine its accessibility and the line of approach needed for the percutaneous track. Six hours before the operation each patient was given oral contrast medium (calcium ipodate 6 g) to aid fluoroscopic localisation of the gall bladder. Prophylactic antibiotics were given when the patients were anaesthetised.

TECHNIQUE

We anaesthetised patients on a fluoroscopic table and placed drapes to collect the irrigant, as for percutaneous nephrolithotomy. The gall bladder was localised by both ultrasonography and fluoroscopy and punctured, usually subcostally, with a 152 mm long dwell sheathed needle (Becton Dickinson, Ontario, Canada). A guidewire was introduced through the sheath and a 7 Charrière gauge pigtail catheter (Cook Urological, Letchworth) advanced into the gall bladder to aspirate the bile and minimise any leakage. The gall bladder was then filled with dilute contrast medium and the tract dilated up to 28 Charrière gauge with graduated metal dilators (Olympus, Keymed, Southend on Sea) under fluoroscopic control. Finally, an Amplatz sheath was inserted and the metal dilators removed, leaving the guidewire in place. Care was taken not to cause invagination of the gall bladder wall during the dilatation.

We used an 18 French gauge nephroscope (Richard Wolf, Mitcham, Surrey) to visualise the lumen of the gall bladder. Small stones were removed