PAPERS AND SHORT REPORTS

Deaths in children with a diagnosis of acute appendicitis in England and Wales 1980-4

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Abstract

Thirty five children died of acute appendicitis in England and Wales in 1980-4 compared with 204 in 1963-7. Thirteen of the 35 deaths in 1980-4 took place at home or on the day of admission to hospital before operation and a further 18 on the day of operation or the first day after it. Thirty one of the children had peritonitis. A third of the deaths were in children aged 0-4 years, and the hospital fatality rate in this age group was one death in 320 cases compared with one death in 4760 cases in children aged 5-14 years.

The fall in the number of deaths between the 1960s and the 1980s was due to improvements in medical care, a reduction in the incidence of appendicitis, and changes in the age structure of the child population. Difficulty and delay in diagnosis and inadequate intravenous therapy are now the main factors contributing to death.

Introduction

A study in the mid-1960s of 204 children who died of acute appendicitis over a five year period showed room for improvement in diagnosis, intravenous therapy, managing convulsions and hyperpyrexia, and anaesthesia.[1] The number of children discharged from hospital each year with a diagnosis of acute appendicitis has fallen from about 34 000 in the 1960s to 16 000 in the 1980s, but appendicitis is still one of the commoner reasons for a child to be in hospital.[2,3] The number of deaths each year has fallen gradually from 500 in the 1930s to 45 in the 1960s and to eight in the early 1980s.[4,5] Although death is now rare, it is still a tragedy for the individual family, and for every death there are likely to be several "near misses."

We therefore reviewed the deaths of the 39 children who died with a diagnosis of acute appendicitis from 1980 to 1984 to determine the current major causes of death.

Method

The method used was the same as that used in the earlier study. We bought from the Office of Population Censuses and Surveys a copy of the death certificates of the 39 children aged under 15 years whose death had been certified as being due to acute appendicitis (International Classification of Diseases codes 540-543). From the certificates we identified seven deaths at home but we did not seek further information about these children. We wrote to the consultants concerned with the remaining children via hospital medical records officers and to the coroner when information was not available.

Results

Source of information—We were sent the case notes of 20 children, a letter from a consultant about five, a coroner's report on five, and a hospital necropsy report on one. For the remaining eight children, including seven dying at home, we had only the death certificates.

Deaths from conditions other than "acute appendicitis"—We used the definition of "acute appendicitis" from the previous study, which included acute appendicitis, an illness being treated as if it were acute appendicitis, and an immediate complication of the treatment of either of these groups.

In four children death did not occur during an episode of acute appendicitis: two died from complications of appendicitis some years previously, another was a premature infant whose mother had had acute appendicitis in pregnancy, and the fourth was a child with leukaemia who developed typhlitis. We excluded these deaths from the rest of the study.

Age and sex distribution—There were 35 children with acute appendicitis. Twelve were aged 0-4 years, 11 were 5-9, and 12 were 10-14. There were 19 boys and 16 girls.

Place and time of death—In most cases the place and time of death could be identified (table I). Four children were resuscitated from an episode of cardiac arrest only to die later but we regarded the initial arrest as the critical event. Four of the 13 children who died before an operation could be

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TABLE I—*Time and place of death or initial cardiac arrest*

Time and place	No	Cumulative %
At home or during journey to hospital	8	23
Day of admission—no operation	5	37
During operation	1	40
First day after operation	17	88
Second day after operation	1	91
Fourth day after operation	1	94
28th day after operation	1	97
Not known	1	100
Total	35	

performed were aged less than 5. Eighteen of the 20 children who survived an operation died within two days.

Pathological lesions—The 11 children who died at home or in an accident and emergency department had appendicitis with peritonitis. Of the 24 children who died in hospital, 20 had appendicitis with peritonitis, three had appendicitis without peritonitis, and one did not have appendicitis at laparotomy.

Other features—All the children for whom we had case notes and who had peritonitis had been given a regimen of combined antibiotics. Four of the 13 children in whom diagnosis was delayed (see below) seemed from the notes to have some degree of mental handicap.

FACTORS CONTRIBUTING TO DEATH

It is never easy to define precisely why an individual patient dies, and this is especially so in a retrospective study of case histories. Nevertheless, we thought we had enough information about 22 of the 24 children dying in hospital to identify contributory factors. In 12 children two or three factors were present (table II).

We regarded delay or difficulty in diagnosis as occurring when a diagnosis was not made within 48 hours of the onset of symptoms. Fluid replacement was considered to be inadequate when only daily maintenance requirements or less were given in the presence of peritonitis or when colloid as well as appropriate electrolyte solutions were not given when there was clear evidence of oligaemia. Septicaemia was considered to be present in children with disseminated intravascular coagulation as well as those with a positive blood culture. Impaired immunity was present in one child with a longstanding agranulocytosis, in another with a familial immunodeficiency, and in a third with an IgG_2 deficiency.

Postoperative complications occurred in one child who developed gangrene of his large bowel a few hours after operation, in another with a gangrenous appendix at operation who developed peritonitis and died on the third day after operation, and in a third with a normal appendix who suffered an episode of acute respiratory obstruction after being given pethidine 2 mg/kg intramuscularly as a postoperative analgesic and about six hours later had a cardiac arrest.

Fatal anaphylaxis occurred in one child without peritonitis who developed severe bronchospasm 15 minutes after being given the muscle relaxant alcuronium chloride and in another who had an adverse reaction to intravenous metronidazole.

MORTALITY RATES AND HOSPITAL FATALITY RATES

In England and Wales between 1963-7 and 1980-4 there was a 9% fall in the total child population but a 25% fall in the number of children aged 0-4; a 50% reduction in the number of children discharged with a diagnosis of appendicitis or after appendicectomy; and a 46% increase in the number discharged with a diagnosis of abdominal pain.

The number of deaths each year fell from 40 to seven, and the population mortality rate fell by about 80%. The case fatality rate in hospital fell by 70% to 80%.

In the 1960s there was one hospital death for every 940 children discharged with a diagnosis of appendicitis and in the 1980s one death for every 3340 discharges. Young children continue to have a much higher case fatality rate than older children, with one death for every 320 discharges in 0-4 year olds compared with one in 4760 in 5-14 year olds.[2-5] (Tables of data from the Hospital In-patient Enquiry are available from HGP.)

TABLE II—*Factors contributing to deaths in hospital*

Factor	No
Delay or difficulty in diagnosis + inadequate fluid replacement	7
Delay or difficulty in diagnosis + septicaemia	4
Delay + inadequate fluid replacement + hyperpyrexia	1
Delay or difficulty in diagnosis	1
Inadequate fluid replacement	1
Impaired immunity	3
Postoperative complications	3
Anaphylaxis	2
Inadequate information	2
Total	24

Discussion

Although the falling incidence of appendicitis, the changing age structure, and possibly general improvements in children's health have reduced the number of children at risk of dying of appendicitis, these results show a number of impressive improvements, with fewer deaths overall and the elimination of anaesthesia, chronic sepsis, and hyperpyrexia and convulsions as factors contributing to death in hospital.

Difficulty in diagnosis and the resulting delay in starting treatment were, however, contributory factors in just over half the small number of deaths in this series and are known to be causes of morbidity from peritonitis in the large number of other children who do not die.[6-8] Interpreting the importance of abdominal pain is often difficult for parents, and families should be given guidance on the need to seek medical advice on potentially dangerous symptoms lasting for more than a few hours. General practitioners and hospital doctors are also faced with difficult diagnostic problems given the frequency with which episodes of abdominal pain have a benign outcome and the varied ways in which appendicitis may present.[9-11] In general practice the paediatric experience gained by many trainees during the hospital component of a vocational training scheme should be helpful, and in hospital active observation[12] and computer assisted diagnosis[13-15] are proving to be of value. Children with mental handicap or those taking immunosuppresive drugs present particular problems in diagnosis.

Further improvements in morbidity and mortality are likely to come from earlier diagnosis and surgery, which will reduce the proportion of children with appendicitis who develop peritonitis. More detailed studies are needed into the difficulties of this aspect of care.

It was disappointing to find inadequate intravenous fluid replacement still contributing to just over one third of the deaths. Peritonitis is known to cause fluid loss and as children already have relatively higher normal daily fluid requirements than adults vigorous intravenous replacement therapy is often required.[16-18] Many standard textbooks do not emphasise these points or give detailed guidance on fluid requirements in childhood, and hospitals admitting children with peritonitis should consider seriously the need for written protocols covering intravenous therapy and other aspects of care.

The fourfold reduction in the hospital fatality rate must reflect the wider application of better clinical practice. In surgical and paediatric care this will include better resuscitation, the introduction of peritoneal lavage, and the use of more effective antibiotics and in anaesthetic care the widespread use of endotracheal intubation and relaxant techniques, short recovery times, and better management of fluid balance before and during surgery. Such important improvements in patient care do not get the credit which they merit, but we are concerned about the time that it sometimes takes for established good practice to be implemented generally.

This study is a smaller version of several more comprehensive investigations into deaths undertaken on a national scale in the United Kingdom.[19-22] We share the belief that such studies have an educative effect[23] and by adding to information gleaned from studies in individual hospitals and units may lead to changes in the organisation of care and the provision of services.

Looking systematically at the outcomes of clinical care in terms of mortality and morbidity is a worthwhile activity, the cost of which

must be relatively small compared with the considerable expenditure in the National Health Service on a variety of management information systems of unproved value.[24] We hope that outcome studies by the medical profession are developed further to become a regular part of postgraduate medical education and to make a contribution to the assessment of the quality of care.

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SHORT REPORTS

Cryptorchidism in Scotland

Using data from the Hospital In-Patient Enquiry for England and Wales for 1962-81, Chilvers *et al* showed that the number of boys discharged from hospitals in England and Wales each year with a diagnosis of cryptorchidism increased by a factor of 2·3.[1] As part of a study into the validity of using the Scottish morbidity record system[2] to monitor trends in the incidence of a disease we studied the trends in hospital discharges and deaths of patients with cryptorchidism in Scotland from 1961 to 1985.

Methods and results

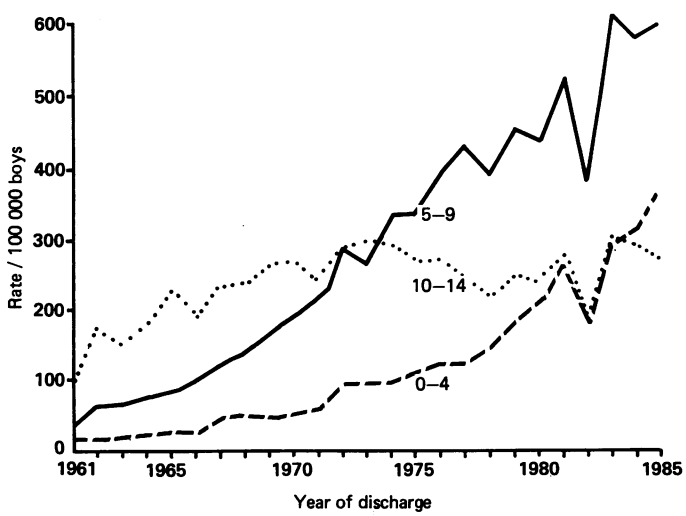
The data were obtained from the Scottish Morbidity Register (hospital inpatients record summary sheet; SMR1) for 1961-85 and the mid-year population estimates for 1961-85 of the Registrar General (Scotland). Annual data on cryptorchidism by year of discharge and date of birth were obtained from the Information and Statistics Division of the Scottish Health Services Common Services Agency.

The annual number of hospital deaths and discharges of boys aged 0-14 years diagnosed as having cryptorchidism increased from 326 in 1961 to 2084 in 1985. The rate per 100 000 boys increased 26-fold in those aged 0-4, with the greatest change in the last 10 years; 16-fold in those aged 5-9, with an almost linear increase over the 25 years of the survey; and threefold in those aged 10-14, the rate remaining relatively stable from 1972 (figure).

Comment

We found substantial increases in discharges of boys with cryptorchidism in different age groups during the 25 years 1961-85. Successive birth cohorts also showed similar increases for orchidopexy (unpublished observations). From the early 1970s the data for all age groups have shown a greater increase in Scotland than in England and Wales, the greatest difference being in the age group 0-4 years. Since 1980 SMR1 has increasingly included day cases, whereas the Hospital In-Patient Enquiry has not; removal of these day cases from the analysis, however, would not eliminate these differences. Possible errors in the information contained in SMR1 both over time and between hospitals are too small to explain changes of this magnitude (unpublished observations). It seems, therefore, that surgeons operate on younger boys in Scotland than in England and Wales.

Between the postneonatal period and puberty the diagnosis of cryptorchidism may be complicated by the cremasteric reflex and partial absorption of the processus vaginalis.[3,4] We studied the prevalence of cryptorchidism in neonates at examination on discharge from hospital and at examinations at school entry and school leaving age (unpublished observations; routinely available Scottish data). The rate of diagnosis in neonates on discharge from hospital remained virtually constant at 14/1000 live male births after reliable recording began in 1976; the rate on examination at school entry and school leaving age declined after peaking in 1973 (47·8/10 000) and 1974 (8·5/10 000), respectively. The cumulative rate of orchidopexy to age 14 in the cohort studied was predicted to be 3·8% compared with the rate of cryptorchidism of 1·4% recorded in the neonatal discharge records. A possible hypothesis to explain this apparent discrepancy is that surgeons may be operating inappropriately on children with retractile testes or that cryptorchidism is acquired after birth.



Discharge rates for cryptorchidism by age group 1961-85.

Surveillance of this trend is required. An increase in the number of orchidopexies without a true increase in the incidence of cryptorchidism should be discouraged. If the incidence of cryptorchidism has truly increased the reasons for this change need to be ascertained. We agree with Jones that babies need a careful postnatal examination and that the finding of a testicle outside the scrotum should lead to a surgical opinion before the first birthday.[5]