The changing face of paediatric cholecystectomy

If gallstone disease is on the increase in children, what does this mean for paediatric surgeons?

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Primary cholelithiasis, which has traditionally been thought of as a disease of middle age, is increasingly being encountered in a younger population.\textsuperscript{1} According to Hospital Episode Statistics (HES) data requested by our hospital trust, there has been an increase in the number of cholecystectomies performed in England in the paediatric age group. Although cholecystectomy is a routine procedure for adult surgeons, it is performed less commonly by paediatric surgeons. The HES data showed that 60,315 cholecystectomies were performed in 2009, of which only 184 (0.3\%) were for children under 16 years of age.

The evolving trends of epidemiology and management of paediatric cholecystitis over the past 12 years were analysed. The aim was to forecast future practice and develop strategies to deal with the increasing incidence of primary cholelithiasis presenting to paediatric surgeons.

\textbf{METHODS}  
A retrospective case note review was carried out of all cholecystectomies performed at Alder Hey Hospital in Liverpool between September 1999 and September 2011. The collected data included demographics, primary diagnosis, investigations, surgery and details of hospitalisation. The HES database was accessed to correlate our findings with the national statistics of England. The changing national incidence of cholecystectomy was analysed against the population data available from the Office of National Statistics (ONS).\textsuperscript{2} The paediatric surgical workforce data were obtained from the NHS Information Centre census.\textsuperscript{3} Time series forecasting analysis of data was performed on SPSS\textsuperscript{*} version 20 (IBM, New York, US). The forecast workload was analysed against the forecast workforce to predict the future profile of paediatric cholecystectomy.

\textbf{RESULTS}  
Ninety-three children had a cholecystectomy in our centre, performed by two surgeons who subspecialised in this procedure. Seventy-one children (76\%) were female and 60 (65\%) procedures were laparoscopic. The mean age at surgery was 13 years (range: 1–16 years). All children who underwent surgery were symptomatic, except three children with hereditary spherocytosis and asymptomatic cholelithiasis, where cholecystectomy was performed at the time of splenectomy.

Sixty-one children (66\%) had primary cholelithiasis with no underlying comorbidity. The rest had predisposing risk factors for gallstones such as haemolytic anaemia (hereditary spherocytosis, sickle-cell disease), cystic fibrosis, hyperlipidaemia and prolonged parenteral nutrition.

\textbf{Changing trends}  
Trends were observed in terms of: i) the increasing incidence of children presenting with primary cholelithiasis, ii) the increasing incidence of cholecystectomies performed and iii) the increasing incidence of laparoscopic procedures at our centre (Figure 1). It was noted, however, that the incidence of cholecystectomy for children with haemolytic anaemia did not change significantly.

Forecasting analysis on SPSS\textsuperscript{*} showed that if the current trend continues, the number of paediatric cholecystectomies will increase by 40\% during the next five years. The national data for England showed similar trends to those observed in our own study (Figure 2).

The population of children below the age of 16 years in England did not change significantly during the period of this study.\textsuperscript{4} This suggests that there has been a genuine increase in the incidence of primary cholecystectomy and therefore, quite possibly, primary cholelithiasis.

\textbf{Obesity and cholelithiasis}  
In our study group, the children presenting with primary cholelithiasis had typically higher weight centiles than the average for the general population. Nevertheless, we could discern no obvious trend towards increasing obesity during our study period (Figure 3).

\textbf{Complications}  
Complications were rare and no major complications were observed (Table 1). Our standard practice for suspected common bile duct (CBD) stones is to perform magnetic resonance cholangiopancreatography (MRCP) and then endoscopic retrograde cholangiopancreatography (ERCP) and sphincterotomy before cholecystectomy.

In our series, two children had successful passage of CBD calculi after ERCP but in one child the CBD stone was missed on MRCP and ERCP was required after cholecystectomy. On-table cholangiography (OTC) was not performed on any child.

\textbf{Surgical workload}  
Although the number of consultant paediatric surgeons in England has increased, they have not increased as rapidly as the number of cholecystectomies (Figure 2). If all paediatric surgeons were to perform cholecystectomies, each surgeon would still typically perform fewer than two cholecystectomies.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
\textbf{Year} & \textbf{Cholecystectomies} & \textbf{Surgeons} & \textbf{Cases per surgeon} \\
\hline
1999 & 92 & 98 & 0.94 \\
2009 & 184 & 121 & 1.52 \\
2016 (forecast) & 235 & 125 & 1.88 \\
\hline
\end{tabular}
\caption{Time series forecasting of paediatric cholecystectomies and paediatric surgeons in England}
\end{table}
During our 12 years of observation, the number of children in our centre undergoing cholecystectomy for cholecystitis secondary to pre-existing morbidity remained relatively constant. The increasing trend in the total number of cholecystectomies performed was solely due to children with primary cholelithiasis with no identified pre-existing medical condition.

The HES data have certain limitations. The data can be stratified according to the hospital where the procedure was performed. However, of the 21 paediatric surgical centres across England, only 4 are purely a children's hospital. In the other 17 centres, children's services are integrated with adult services. As a result, the operation performed in a paediatric centre in HES does not necessarily mean that the surgeon involved was a paediatric surgeon. Nevertheless, in our centre, which is a designated children's hospital, the increasing incidence of cholecystectomies for primary cholelithiasis was evident (Figure 1).

The ONS paediatric population data are stratified into different age groups: <1 year, 1–4 years, 5–9 years, 10–14 years and 15–19 years. The population under 15 years was therefore selected as a more similar population to our patient group.

Stone analysis was not performed routinely. Stone analysis results were available for five children with primary cholelithiasis and all of them were cholesterol stones.

An increase in the number of children with gallbladder disease has previously been observed. The reasons for this increase have been variously attributed to improved diagnostic modalities, changing pathology, and an increased awareness of emerging comorbidities such as childhood obesity and other associated risk factors. Our results demonstrate that most children with primary cholelithiasis have body weights above the 50th centile (Figure 4). Although we could discern no trend towards increasing body weight, this might reflect our modest sample size and it remains a possibility that the increased incidence of this disease may still be a reflection of increasing paediatric obesity.

Obesity is certainly a well-recognised risk factor for cholelithiasis both in younger children and adolescents. Weight centile was used instead of body mass index (BMI), as the heights of all children were not available. Unlike adults, absolute BMI values are not predictive of obesity in children because of their growth and development. BMI centile charts, which are more reliable in assessing childhood obesity, are not used routinely in our centre.

Time series forecasting is used commonly in market analysis; it has also been used in medicine to predict the incidence of disease, thereby assisting in strategic planning. Our results show that there is likely to be an increased demand for paediatric surgeons to perform laparoscopic cholecystectomy in the future. However, despite this increased demand, the overall number of cholecystectomies is likely to remain quite modest, not least when bearing in mind the increased number of paediatric surgeons. Issues of
training and competence must therefore be considered.

In a large series of 3,596 paediatric cholecystectomies, low-volume surgeons had patients with more complications, a longer length of hospital stay and higher costs than high-volume surgeons. For laparoscopic cholecystectomy, performance has been shown to improve throughout the first 200 operations, resulting in a 40% reduction in operative time and an ability to deal more effectively with difficult cases. For percutaneous nephrolithotomy (which is more commonly done in adults), competence may be reached after 60 cases and excellence after 115. According to HES data requested by our hospital trust, in 2009 only 0.3% of all cholecystectomies were performed in children. If all paediatric surgeons in England were to perform laparoscopic cholecystectomies and all cases were to be distributed equally among them, it would take each surgeon more than 100 years to accrue the 200 procedures necessary to achieve excellence (Table 2).

Consequently, in order to maintain an appropriate level of skill, it seems reasonable that paediatric surgeons should subspecialise such that laparoscopic cholecystectomy is undertaken by a limited number of surgeons. If we were to assume that 10 cases per year was an acceptable minimum, it would follow that only 17 surgeons across England could continue to perform this procedure (Table 2). That being the case, not all paediatric surgical centres in England would be able
to offer paediatric cholecystectomy and the service might require a modest degree of centralisation.

Unlike other centralised procedures, however, laparoscopic cholecystectomy is extremely common in the adult setting. As most paediatric cholecystectomies are performed on teenagers, it might reasonably be argued that this procedure should be left to the adult surgeons. The flaw in such a strategy is that it would leave an uncomfortable skills vacuum where younger patients are concerned, with possibly disastrous results. It is also fair to point out that laparoscopic cholecystectomy remains one of the most important ‘laparoscopic training procedures’, a consideration that is particularly relevant in a specialty where such procedures are relatively uncommon. The obvious solution would appear to be a multidisciplinary approach involving both a subspecialised paediatric surgeon and a high-volume adult surgeon. Nevertheless, in purely paediatric hospitals like our centre, access to adult services is limited.

For this reason, only two surgeons in the unit carry out cholecystectomies and can maintain high-level skills by performing a large number of cases. The complications were very low, owing to the subspecialisation (Table 1).

Our strategy of managing CBD calculi with ERCP before cholecystectomy was successful in all cases. In one child, a CBD calculus was missed preoperatively and ERCP had to be performed after cholecystectomy. OTC is not performed routinely in our centre. If a CBD stone is detected in OTC, the next surgical step would be laparoscopic CBD exploration. Owing to the rarity of cholecystectomy in children, it is extremely difficult to maintain competence to perform laparoscopic CBD exploration. So far, we have not come across a situation where ERCP failed. If that happens in future, we would plan the surgery along with an adult surgeon experienced in laparoscopic CBD exploration.

There are several training programmes in the UK in which general surgery or urology trainees rotate through paediatric surgery to gain the skills to operate on children. By contrast, none of the paediatric surgical training programmes rotate through any adult disciplines. For any paediatric surgical trainee who wanted to subspecialise in laparoscopic cholecystectomy, a period of training in a high-volume adult centre would clearly be extremely beneficial.

**CONCLUSIONS**

Primary cholelithiasis is increasing in children. The number of paediatric cholecystectomies is likely to increase by 40% in 5 years. Paediatric surgical centres should look to develop strategies to deal safely and effectively with this predicted increase. Centralisation of the procedure and subspecialisation among paediatric surgeons in each centre appears to be the solution for the future.

**References**