Cholecystectomy in Danish children — A nationwide study

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ABSTRACT

Background: An increase in the frequency of cholecystectomy in children has been described during the last decades [1,2]. Part of the reason is that more cholecystectomies in children are performed for dyskinesia of the gallbladder and not only for gallstone disease. We conducted the first nationwide study to describe outcome of cholecystectomies performed in children in Denmark by using data from the national Danish Cholecystectomy Database (DCD).

Methods: In the DCD, two data sources were combined: administrative data from the National Patient Registry (NPR) and clinical data entered into the secure Web site by the surgeon immediately after the operation. In the present analysis, we have included children ≤ 15 years from the five year period January 1, 2006, to December 31, 2010.

Results: In the study period 35,444 patients were operated with a cholecystectomy. Of these, 196 (0.5%) were ≤ 15 years. The median age was 14 years, and 82% were girls. Predisposing medical factors for gallstones (despite obesity) were found in only 5%. More than 50% were overweight, and one third were obese. Ninety-seven percent of the operations were completed laparoscopically, and the conversion rate was 0.5%. Nearly half of the operations (45%) were performed as same day surgery, and 80% of the children stayed in hospital 0 – 1 day without readmission. 91% were discharged within 3 days and not readmitted. Morbidity was low, and no bile duct lesions occurred. The 30 day mortality was zero.

Conclusion: Our nationwide outcome results indicate good quality with 91% of the patients discharged within 3 days without readmission, no bile duct injuries, and no mortality. All patients except two were operated for symptomatic gallstone disease in accordance to the Danish national guidelines. We have not experienced a demand or a need to expand the indications for cholecystectomy beyond gallstone disease.

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A considerable increase in the frequency of cholecystectomy in children has been described during the last decades [1,2]. Part of the reason is that more and more cholecystectomies in children are performed for dyskinesia of the gallbladder and not only for gallstone disease [3–5]. Moreover the incidence of gallstones in children, and thus cholecystectomies, has increased due to increasing obesity among children [6,7]. It is well known that children with specific medical diseases such as enzymatic disorders in the pyruvate/glucose metabolism, cystic fibrosis and hematological disorders leading to haemolysis are at risk of developing gallstones [6] but no evidence of an increase in these conditions has been shown and these cases represent a minority of the child cholecystectomies in most series [3,8].

From January 1 2006 to December 31 2011 it was mandatory to report all cholecystectomies performed in Denmark to a national Danish Cholecystectomy Database (DCD) [9]. The methodology of the DCD has previously been described and validated [10] and nationwide results and quality improvements have been described [11,12]. In the present study the aim was to evaluate the surgical quality of cholecystectomy in Danish children as well as the indications for the operation.

1. Methods

The database was founded by the Danish Surgical Society, led by a steering committee appointed by the society and funded by The Danish Regions (www.regioner.dk/in+english). All patients operated with a cholecystectomy were registered in the database and it was designed to monitor the surgical quality of cholecystectomy nationally and in each hospital.

Two data sources were combined to create the database: 1. Administrative data from the National Patient Registry (NPR) (run by the Danish Health and Medicines Authority) and 2. Supplementary clinical data entered into a secure web site by the surgeon immediately after the operation. The two sets of data were merged by the unique personal identification number assigned to all residents in Denmark and the database was approved by The Danish Data Protection Agency (www.Datatilsynet.dk/english).

The administrative data (from NPR) included diagnostic codes, length of hospital stay (LOS), readmission (in any Danish hospital)
within 30 days, the procedure codes for reconstructive surgery of the bile duct, other bile duct surgery, additional procedures performed within 30 days, and 30-day mortality.

The clinical data entered by the surgeon included information about the type and course of the operation: laparoscopic, conversion to open or primarily open cholecystectomy, findings by eventual perioperative cholangiography, method of cystic duct closure and reasons for conversion. Patient- and surgery-related risk factors such as body mass index (BMI), American Society of Anesthesiologist-

2.1. Patients and risk factors

In the five year period 35,444 patients were operated with a cholecystectomy. Of these 196 (0.5%) were ≤ 15 years. In five of these children an open cholecystectomy was performed in combination with other primary operations (two with traumatic liver resections, two with choledochal cysts and one with bowel obstruction due to cystic fibrosis). These patients are not included, leaving 191 children in the study. All patients, except two, had gallstone disease. One 15 year old boy was registered only with the diagnosis “constipation” and one 14 year old girl was registered with the diagnosis “unspecified disease of the gallbladder”. The number of patients operated per year did not increase during the five year period (Fig. 1).

The children were operated on 21 different departments and the number of operations varied from 1 to 25 between departments. Forty-two (22%) were operated on highly specialized centers also harboring pediatric surgeons. Children under the age of ten were all, except one, operated on the highly specialized departments.

In the present analysis we have included children ≤ 15 years from the five year period January 1 2006 to December 31 2010.

2. Results

### Table 1

<table>
<thead>
<tr>
<th>Age</th>
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<th>Range</th>
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</thead>
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<tr>
<td>14</td>
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<td>82</td>
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<td>4–15</td>
<td>35</td>
<td>18</td>
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<table>
<thead>
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<th>156</th>
<th>82</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>35</td>
<td>18</td>
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</table>

| Registration in both NPR* and the online database | 140 | 73 |
| Registration only in NPR | 51 | 27 |

| Diagnosis | Gallstone disease | 189 | 99 |
|          | Other†            | 2   | 1  |

| Predisposing factor besides obesity | 10 | 5 |
| Sphaeroeytosis                    | 8  |
| Enzymatic defect in the           | 2  |
| pyruvate/glucose metabolism       |    |

| Nutritional status (n = 136)       | 3   | 2  |
|                                   | 61  | 45 |
|                                   | 27  | 20 |
|                                   | 45  | 33 |
| Acute cholecystitis               | 12  | 6  |
| Sequelae of prior cholecystitis   | 17  | 9  |
| (chronic cholecystitis)           | 8   | 4  |
| Pancreatitis                      | 23  | 12 |
| A diagnosis of bile duct stones    | 1   | 0.5|
| Previous operation in upper abdomen | 5  | 3  |
| Type of operation                 | 5   | 3  |
| Laparoscopic converted to open     | 1   | 0.5|
| Laparoscopic                       | 185 | 97 |

| a NPR = National Patient Registry. |
| b One patient with “constipation” and one with “unspecified disease of the gallbladder”. |
| c BMI calculation only possible in 136 children where weight and height were registered in the online database. |

In the present analysis we have included children ≤ 15 years from the five year period January 1 2006 to December 31 2010.

Fig. 1. Number of cholecystectomies in children ≤ 15 years in Denmark 2006–2010.

Fig. 2. Distribution by age and gender of 191 Danish children operated with cholecystectomy in the five year period 2006–2010.
surgeon’s experience as well as details about the operation such as cholangiography and reason for conversion are not available.

The clinical characteristics of the patients are listed in Table 1. Eighty-two percent were girls and the median age was 14 years. The distribution of age and gender is shown in Fig. 2. Forty patients (21%) were under the age of thirteen. Predisposing medical factors for gallstones (besides obesity) were found in only 5% and primarily in the young age group (<13 years). One of the patients with predisposing medical factor was thirteen and nine were younger.

More than half of the patients were overweight and one third were obese.

Twelve patients (6%) were operated for acute cholecystitis and in 17 patients (9%) chronic inflammation with a thickened fibrotic gall bladder wall was found and registered by the operating surgeon. Eight patients (4%) had a pancreatitis prior to the operation. In 23 patients (12%) a diagnosis of bile duct stones was registered in the NPR. In only one of these patients an ERCP with removal of the stones was registered in the database the day before the cholecystectomy. Only one patient had been operated in the upper abdomen before and the cholecystectomy was completed laparoscopically with no complications.

2.2. Type of operation and conversion

In only five cases the operation was performed open by preoperative choice. One of these patients was a 4 year old girl with acute cholecystitis, three patients had hemolytic anemia and the operation was combined with an open splenectomy. The last patient was a 13 year old boy with a diagnosis of chronic cholecystitis and with a suspicion of a choledochal cyst indicating open surgery.

In one ten year old boy with chronic cholecystitis the laparoscopic operation was converted to an open procedure. He was discharged at day 7 and not readmitted.

Thus 185 operations (97%) were completed laparoscopically and the conversion rate was 0.5%.

2.3. Postoperative stay

Outcome results are shown in Table 2. Forty-five percent of the operations were performed as same day surgery. Eighty percent of the children had a “LOS 0–1 day without readmission”. Eleven percent stayed for 2 or 3 days without readmission and nine percent were admitted for more than 3 days or readmitted. Five of these patients stayed more than 3 days without readmission. Five of these patients stayed more than 3 days without readmission. Five of these patients stayed more than 3 days without readmission. Three were primarily open operations (vide supra). The other two were operated laparoscopically; one had a splenectomy as well and the other was reoperated (laparoscopically) for bleeding on day 0 (vide infra). The five open operations were admitted for 2, 4, 5, 5 and 6 days respectively with readmission in two.

As it appears from Fig. 3 patients with the risk factors acute cholecystitis and pancreatitis as well as patients with splenectomy had a slightly longer LOS.

2.4. Readmission

Thirteen patients were readmitted, 9 after a primary stay of 0–1 day, 1 after a primary stay of 2–3 days and 3 after a primary stay of 3 days. Two of these last ones were open operations including splenectomy. Additional procedures within 30 days were not registered in any of the readmitted patients.

2.5. Additional procedures and mortality within 30 days

In only one patient a surgical complication leading to reoperation was registered. This was a 14 year old girl who was reoperated laparoscopically within the first 24 h postoperatively due to intraabdominal bleeding. She was discharged at day 4 and not readmitted.

No bile duct lesions occurred and the 30 day mortality was zero.

![Fig. 3. Length of stay among 191 Danish children ≤15 years operated with a cholecystectomy in the five year period 2006–2010. *Include only the two risk factors acute cholecystitis and pancreatitis.](image-url)
3. Discussion

International studies have shown a rise in the number of cholecystectomies in children [1,2,14]. We did not see this trend in Denmark during the five year period we studied. In our material only 52% of the children were overweight or obese, which is much less than in other studies where the incidence was up to 90% [6,7,15]. In a recent comparison with 13 European countries, Israel and USA the BMI of Danish children aged 3–15 years was also the second lowest [16].

Another factor that contributes considerably to the international increase in child cholecystectomies is the growing proportion of operations performed for dyskinesia of the gall bladder [3–5,14]. K. Bielefeldt [14] showed recently a sevenfold increase from 1997 to 2010 in admissions for biliary dyskinesia in USA and found that at least 10% of cholecystectomies in the pediatric population were performed on this indication [14]. The author also suggests that the type of health insurance of the patient might influence the indications for cholecystectomy. Other studies confirm that an increasing fraction of child cholecystectomies (up to 50%) are performed for biliary dyskinesia [17–20]. The scientific evidence for this policy is sparse with only one randomized trial including 21 patients [21,22]. Success rates up to 80% have been reported after surgery for dyskinesia [18,23]. However, when a comparison was done to a control group treated conservatively the results were equal, with improvement of the symptoms within two years in about 75% of the patients in both groups [19]. The diagnosis biliary dyskinesia is defined as gallstone-like pain attacks combined with an ejection fraction below 35% during hepatobiliary iminodiacetic acid (HIDA) scanning with cholecystokinin (CCK) injection. Recently a novel diagnosis “Normokinetic biliary dyskinesia” has been suggested as an indication for cholecystectomy, in patients, where the biliary pain attacks could be reproduced by the CCK injection, but with normal ejection fraction [24]. The name itself is a “contradictio in adjecto”, and we find it worrisome to expand indications for surgery on such slender grounds. Thus discussions about the benefits of single incision laparoscopic cholecystectomy (SILC) for biliary dyskinesia in children [25] also seem premature as long as a valid foundation for performing the operation is still missing.

In the Danish material all but two of the children were operated for symptomatic gallstone disease. In the two patients (1%) the only diagnoses registered were “constipation” and “unspecified disease of the gallbladder” respectively and these two might have been operated for symptoms like biliary dyskinesia (or miscoded). The database does not allow further clarification of this. Similar data have been presented from Sweden, where the fraction of patients (including adults) operated with cholecystectomy for biliary pain without stones remains steady and around 2% [26]. Like Sweden, Denmark is a country with a national health care insurance system, and only six of the 191 children (3%) were operated in private clinics outside the public hospital sector. During the last ten years the Danish Health and Medicines Authority has initiated the publication of evidence based national guidelines within several clinical fields, including the treatment of gallstone disease [27]. There is consensus to follow these guidelines both within the public and the private health sector. Biliary dyskinesia is not included as an indication for cholecystectomy in these guidelines.

Of the 191 patients 140 (73%) were registered with data from both the NPR and the clinical database. This is a smaller degree of completeness of data than among adults where about 90% of the patients had both sets of data [10,11]. In the first years of the DCD uncertainties ruled whether children should be included in the mandatory registration or not. This explains the difference. However valid results about outcome (LOS, readmission, additional surgical procedures and mortality) all come from the NPR, in which all patients were registered. It is only the more detailed information about risk factors that come from the registration in the clinical database.

Our nationwide outcome results indicate good surgical quality with 91% of the patients discharged within 3 days without readmission and only one registered surgical complication, no bile duct injuries and no mortality. Minor surgical complications (e.g. wound infection) that do not need an additional procedure and medical complications (e.g. pulmonary or urinary infections) are not registered in the database, and might explain some of the readmissions. Due to the rather small numbers of operations in each department comparisons of outcome between departments are not meaningful. The majority of the operations were performed in departments of general and gastrointestinal surgery also taking care of the adult cholecystectomies. Only a minority of the patients (and often the youngest) were treated by pediatric surgeons. Chen et al. [28] recently concluded that a high volume of operations and laparoscopic experience is more important than surgeon specialty. Our study was not designed to draw further conclusions on this aspect, but the good nationwide results concerning safety support the policy.

To ensure a high quality in all aspects of the surgical care it is of course also of importance that the clinical care of the children follows the recommendations outlined for instance in the European Association for Children in Hospital (EACH) charter developed in Leiden 1988 [29]. Our study was however not designed to analyze this aspect.

Chen et al. [28] described the outcomes of 3596 pediatric cholecystectomies (age ≤18 years) performed on 1147 hospitals by 2233 surgeons (average of 1.6 pr surgeon) in the United States. The proportion of patients operated for biliary dyskinesia (if any) was not described. The mean LOS was 2.5 days and there was a rather high overall complication rate of 15%, among which severe complications such as bile duct injuries accounted for 0.08%, liver laceration for 0.05% and acute liver necrosis for 0.2%. The incidence of complicated gallstone disease, as indicated by more than one gallstone diagnosis, was about the same as in our series. However they included patients of 16 and 17 years and apparently only inpatients, which might explain some of the differences compared to the Danish experience.

A single centre study by Tannuri et al. [30] from Brazil described the outcome in 223 children (< 18 years) diagnosed with gallstone disease over a period of approximately 17 years. The median age in this study was lower (11 years) than in the Danish series probably explained by a much larger proportion of children with hemolytic disorders (62.3%). It is noteworthy also that in the Brazilian study 7.1% of the children had developed gallstones after bariatric surgery before the age of 18 years. No such patients are present in our nationwide study because bariatric surgery in Denmark is restricted (by the Danish Health and Medicines Authority) to patients ≥25 years. Furthermore only 60% of the Brazilian patients had symptoms before the operation, which is also a major difference from the Danish series where only symptomatic patients are operated according to our national guidelines [27]. The high incidence of children with predisposing hemolytic anemia in the Brazilian study may justify this as some authors find that children with these disorders should be offered cholecystectomy before symptoms appear [31]. The outcome results in this study were rather equal to ours: 91% of the patients were operated laparoscopically, 1.9% were converted to open operation, mean length of stay was 1.1 days and there were only 2 major complications and no injuries to the bile duct.

4. Conclusion

About 0.5% of cholecystectomies in Denmark are performed in children ≤ 15 years of age. The majority of the oldest children were operated on surgical departments that manage also adult laparoscopic cholecystectomies. Most children under the age of ten were operated in specialized centers also harboring pediatric surgeons. We find this advisable due to the need for specialized minor instruments and expertise with laparoscopic approach in the infant as well as child anesthesia. The clinical care of the youngest children is also best handled in the specialized pediatric wards.
The nationwide results are good with 97% of the operations completed laparoscopically and only one complication (bleeding) leading to additional surgery. A LOS ≤ 1 day without readmission was seen in 80% of the patients and 91% were discharged within three days without readmission. All patients except two were operated for symptomatic gallstone disease in accordance with the national guidelines. We have not experienced a demand or a need to expand the indications for cholecystectomy beyond gallstone disease.

References