Prolonged length of stay and many readmissions after appendectomy

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ABSTRACT

INTRODUCTION: The epidemiology of appendicitis seems to be changing; the proportion of complicated appendicitis cases is growing. The outcome of childhood appendectomy in Denmark has not previously been evaluated nationwide in Denmark.

MATERIAL AND METHODS: Data on all Danish children treated for appendicitis were obtained from the National Patient Registry. Re-operation, re-admittance or length of hospital stay (LOS) exceeding five days were considered non-satisfactory outcomes.

RESULTS: A total of 2,617 children, 55% boys and 45% girls, were operated at 32 hospitals. Their mean age was 11.1 years. Mortality was 0%. A laparoscopic procedure was used in 34% of the cases. The medians of the postoperative LOS were one day for both the open and laparoscopic appendectomy groups, the corresponding means were 2.5 and 2.0 days ($p < 0.05$). 4.5% had one or more re-operations. 18% had a LOS > 5 days or re-admittance. The typical reasons were wound infection, need for prolonged antibiotics treatment and simple, prolonged recovery.

CONCLUSION: The Danish practice for appendicitis has acceptable rates of re-operation, medians and means of LOS, and a rate of re-admission which is comparable to that reported in other studies. However, a non-satisfactory outcome after appendectomy in about 20% calls for improvement and further studies.

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Appendectomy is the most common acute abdominal surgical procedure performed on children in the Western societies. Appendicitis carries a risk of complications, places a significant burden on patients and involves considerable health care costs.

A recent Danish study showed that the incidence of acute appendicitis declined by 27% from 1996 to 2004 [1]. Several studies from other Western countries have also found a declining incidence of acute appendicitis and appendectomy [2-4], while others have reported levels to be constant [5, 6]. However, in the Danish study, the incidence of complicated appendicitis declined by only 10.1%. These findings may be explained by different manifestations of the disease taking different courses. Another explanation could be a change in management strategy with regard to diagnostics and treatment. We therefore evaluated outcomes after appendectomy in childhood in a nationwide study within the 2-year period 2006-2007.

MATERIAL AND METHODS

The data of all Danish children aged from zero to 16 years who were operated for appendicitis in the years 2006 and 2007 were obtained from the National Patient Registry (NPR). The NPR records all operations performed in Denmark. The registry contains data concerning procedures, diagnosis, dates, hospital, department and personal identification number etc.

The data were retrieved using the appendectomy procedure codes: KJEA00, KJEA01 and KJEA10 according to the Nordic classification of surgical procedures and the diagnostic codes of appendicitis: DK35.0, DK35.1, DK35.9, DK36.9 and DK 37.9 according to the International Classification of Diseases (ICD) 10. Furthermore, records of all re-admissions within 30 days of the primary operation were retrieved.

Apart from re-operation, any re-admission or primary stay exceeding five days were classified as a non-satisfactory outcome and discharge letters of nearly 100 of these patients were randomly requested from the hospitals. Reasons for reoperation, long hospital stay and/or re-admissions were categorized and analyzed. We excluded children with a normal appendix in whom appendectomy had been performed on other indications of abdominal pathology.

Data were analyzed using SPSS version 18 and a level of significance of 5% was chosen. The t-test was used to compare means, Pearson chi-square and Goodman and Kruskal tau were used to compare frequencies. The Kruskal-Wallis test was used to compare medians. Using NPR data, this study has been approved by the Danish Data Protection Agency. The study received no external funding.

Trial registration: not relevant.

RESULTS

A total of 2,617 children (55.4% boys and 44.6% girls) were operated at 32 hospitals. Their mean age was 11.1 years; the 30-day mortality was 0%. An open procedure

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was used in 1,716 (65%) of the cases, a laparoscopic procedure in 879 (34%), and 22 (1%) had appendectomy and drainage. The age distribution was as follows: 7.5% of the patients were 0-5 years old, 32.5% were 6-10 years old and 60% were 11-16 years old.

Diagnosis

There were three main diagnoses: DK35.0 acute appendicitis with perforation and/or peritonitis, DK35.1 acute appendicitis with abscess and DK35.9 acute appendicitis without peritonitis, perforation and abscess.

73% had a simple appendicitis and 27% had a complicated appendicitis, including 24% with perforation and 3% with abscess. These rates differed between age groups: 50% of the 0-5 year age group had complicated appendicitis ($p < 0.05$) vs. 28% of the 6-10 year group and 24% of the 11-16 year group. The rates of complicated appendicitis in the open and laparoscopic appendectomy groups and in the group with a non-satisfactory outcome are shown in **Table 1**.

Hospital stay

The median postoperative length of stay (LOS) was one day for both the open and laparoscopic appendectomy group (0-50 days and 0-48 days, respectively). The corresponding means were 2.5 and 2.0 days ($p < 0.05$). The medians of the total LOS including re-admissions were two days for both groups and the corresponding means were 3.4 and 2.9 days, respectively ($p < 0.05$). The group with drainage had a median length of postoperative and total stay of four days, while the means were 3.9 days and 5.4 days, respectively (this group was not included in results on satisfactory and non-satisfactory outcome).

The medians and means of the LOS of the age groups: 0-5, 6-10 and 11-16 years of age for the laparoscopic and the open surgery groups are shown in **Table 2**.

With further stratification into simple and complicated appendicitis, the significant differences of the means within the age groups were dissolved except for postoperative LOS in simple appendicitis in the 11-16-year group (**Table 3**).

Satisfactory outcomes

A total of 95.5% of the patients needed no re-operation, and 82% of the patients had a hospital stay of five days or less and no re-admission. These rates differed significantly at only three hospitals. 63% of the patients with complicated appendicitis and 89% of the patients with simple appendicitis had a hospital stay of five days or shorter and no re-admission ($p < 0.05$).

Non-satisfactory outcomes

A total of 123 patients had 1-9 re-operations. Five were excluded: one patient had re-resection of a carcinoid tumour and one patient had a tonsillectomy performed. We also excluded another three patients who had a laparotomy or laparoscopy one day apart from the appendectomy and a total hospital stay of only one to four days, suggesting that they underwent surgery around midnight and were wrongly coded with two primary procedures.

This left 118 (4.5%) patients with complications that needed a re-do operation or drainage. The mean age was 10.2 years (51% were boys and 49% girls); viz. figures that were comparable to the whole group. Twenty-eight (24%) from this group had a primary laparoscopic appendectomy and 91 (76%) had a primary open appendectomy. The re-do rate for the laparoscopic group was 3.2% and for the open group 5.3% ($p < 0.05$). The most common complication which needed a re-do operation or drainage was deep or superficial infection which was observed in 107 (91%) patients, while seven

TABLE 1

The frequencies of types of appendicitis in groups with laparoscopic and open surgery, p = 0.05. Percentage values.

	Complicated appendicitis	Simple appendicitis
All appendectomies	27	73
Laparoscopic appendectomy	22	78
Open appendectomy	31	69
Non-satisfactory outcome	55	45

TABLE 2

The median length of stay for groups with laparoscopic and open surgery. The values are days (mean).

	0-5 years	6-10 years	11-16 years
Laparoscopic appendectomy			
Postoperative LOS	3 (4.0)*	1 (2.4)	1 (1.9)*
Total LOS	3.5 (5.1)*	2 (3.3)	2 (2.7)*
Open appendectomy			
Postoperative LOS	3 (3.6)*	1 (2.2)	1 (2.4)*
Total LOS	4 (4.7)*	2 (3.1)	2 (3.6)*

LOS = length of stay.
*) $p < 0.05$. Age group 0-5 years compared with older age groups horizontally. Age group 11-16 years compared between laparoscopic and open appendectomy.

TABLE 3

The mean of length of stay in hospital, age group: 11-16 years. The values are days.

	Open appendicitis	Laparoscopic appendicitis
Complicated appendicitis		
Postoperative LOS	4.5	4.2
Total LOS	5.9	5.2
Simple appendicitis		
Postoperative LOS	1.6*	1.3*
Total LOS	2.4	2.2

LOS = length of stay.
*) $p < 0.05$.

TABLE 4

	0-5 years (n = 195)		6-10 years (n = 843)		11-16 years (n = 1.557)	
	complicated	simple	complicated	simple	complicated	simple
Laparoscopic appendectomy	50* (3/6)	0 (0/4)	36 (17/47)	10 (12/108)	28 (38/134)	10 (55/579)
Open appendectomy	52* (47/91)	21 (20/94)	38 (68/188)	10 (53/500)	38 (90/240)	11 (68/604)
Total	31*		18		16	

The frequencies of length of stay > 5 days and/or re-admission in the groups with laparoscopic and open surgery. The values are % (n/N).

*) $p < 0.05$. Age group 0-5 years compared with older age groups horizontally.

patients (6%) had an ileus operation, two (2%) had a right hemi-colectomy, one (1%) had a gastroscopy and one (1%) had an anoscopy. All the patients who needed re-operations had a LOS exceeding five days and/or one or more re-admissions.

Eighteen percent of the patients had a LOS exceeding five days and/or one or more re-admissions. The rate differed between 7.5% and 39% among the hospitals ($p < 0.05$). Among these patients, 40% had a total LOS > 5 days and one or more re-admissions, 29% had a total LOS <6 days, but including one or more re-admissions and 31% had a LOS >5 days without re-admissions. The rate of long LOS/re-admissions also differed between the age groups as shown in **Table 4**. In the laparoscopic appendectomy group, the rate was 14% and in the open appendectomy group it was 20% ($p < 0.05$).

Discharge letters confirmed that in 95% of the cases, our chosen indications of a non-satisfactory outcome did, in fact, concur with a non-satisfactory postoperative outcome. The remaining 5% consisted of the patient who were re-admitted for a re-resection of carcinoid appendix tumour, one patient who had a tonsillectomy and one who had a knee problem. Furthermore, one record was wrongly coded as a re-admission, as the patient was simply transferred to another department, and one patient who had an appendectomy was wrongly coded as appendicitis and re-admitted with gastroenteritis.

The main reasons for prolonged stay or re-admittance stated in the discharge letters were wound infection or deep infection (42%), need of prolonged antibiotics due to fever or elevated C-reactive protein or leucocytosis (20%), simple prolonged recovery (10%), pain (4%), constipation (3%), doctors' delay (3%) and pneumonia (2%).

DISCUSSION

The data are nearly 4-5 years old. Since then, the organization of surgery in children has increasingly adopted the recommendation of performing surgical procedures on children only in hospitals with a paediatric department. The extent to which these recommendations have been followed and the impact of such changes remain unknown.

The data from the NPR are nearly 100% valid regarding admission and discharge dates, age, sex and surgical procedure [7]. The validity of the diagnoses is probably lower as most discharge letters are written before the pathological diagnosis is known; the discharge letters contain the diagnostic code. This was investigated in a Swedish study [8], which found a surgeon overestimation of approximately 6%. In Sweden, these conditions are very similar to those seen in Denmark. It was not the purpose of this study to validate the NPR diagnosis by retrieving the pathological reports, and adding a pathological diagnosis would not change the conclusions.

The 27% of cases who had a complicated appendicitis is similar to what others have reported [9, 10]. The rates of open and laparoscopic appendectomies are in line with those reported in many other studies [10, 11] and they show the same increase in the rates of laparoscopy in the older age groups and in girls and a tendency towards using an open procedure in complicated cases [12]. The reason for using a laparoscopic approach is not addressed; it may be either the surgeon's choice or the department's preferred procedure, so data and results comparing the open and the laparoscopic approach should be interpreted with caution.

The medians and means of LOS are among the lowest compared with other studies [9, 13, 14]. Owing to our access to the unique NPR, it is possible to retrieve all re-admissions, which is a strength of the present study.

In 95% of the cases, the discharge letters validated the non-satisfactory indicator. The cut-off level of the non-satisfactory indicator was chosen as previous studies have shown that the patient is discharged one day post-operatively after simple appendicitis and three days post-operatively after complicated appendicitis [15, 16].

However, some authors recommend a longer antibiotic course, up to ten days, and some departments may recommend antibiotics for more than five days in patients with complicated appendicitis. If this is the case, some of the 146 patients (31% of the patients with a non-satisfactory outcome) with a LOS exceeding five days and no re-admittance could, in fact, have had a satisfactory outcome. If any, this will account for only a few patients as nearly half the patients with a non-satisfactory outcome had simple appendicitis as shown in Table 1.

Abdominal pain, flexed hip.

The proportion of non-satisfactory outcome in our study after appendectomy is high: about one out of five in total and nearly one out of three among young children. As previously stated, the LOS is at the same level as that reported in many other papers. The 12.5% rate of re-admission is slightly higher than the 0-10% found in other studies [9, 17]. The rate of non-satisfactory outcomes among the hospitals was significantly different in three of the 32 hospitals: two were lower and one was higher. We found no connection with the volume of patients treated. However, we cannot exclude that the local organisation deciding how acute paediatric patients are evaluated and the expert level of staff involved may have had an impact.

The reason for this high rate of non-satisfactory outcome remains unknown; nor is it known whether the rate is currently rising or falling. One reason for the high rate of non-satisfactory outcome could be patient/parents' and/or doctors' delay. Records of appendectomy admissions prior to the present one were, unfortunately, not sought; if any, records of admittance 0-10 days before the operation could have provided the rate of doctor's delay. In a review of children younger than three years of age with appendicitis, the average duration of symptoms was three days, and about 65% of the patients had been seen by a physician prior to the visit at which the correct diagnosis was made [18]. Also, Alexander et al [14] found means of symptom duration ranging from 1.7 to 4.8 days (1-30 days) in children 1-17 years of age. Another reason for the high rate of non-satisfactory outcome could be non-optimal management. In Denmark, a child with suspected appendicitis is most often considered a general surgery case. He or she will be admitted to a paediatric/surgical department and be seen by the fellow surgeon or general surgeon, one of whom will perform the operation. Danish data on radiological imaging and scoring systems have not been published as Danish publications mostly address the issue of open versus laparoscopic appendectomy [15] or antibiotic combinations and diagnostic aids [19].

Furthermore, optimisation could include focused public information, changing the organisation to have more senior doctors evaluate patients and preferably ensure that paediatric surgeons evaluate the youngest ones, in both cases together with the paediatric on call. Future research should target the use of more evidence-based scoring systems and, maybe, a more widespread use of ultrasound and computed tomography, diagnostic laparoscopy, revision of the antibiotic regimes and standardized postoperative care with evidence-based multimodal strategies to improve outcome. This is, of course, particularly relevant in centres where more than 20-30% of patients have a non-satisfactory outcome.

The mortality was zero (0%) which compares favourably with other nation-wide studies from England and Sweden reporting rates between 1.3 and 1.6 out of 10,000 appendectomies [3, 20].

In conclusion, Danish practice with regard to appendicitis shows an acceptable rate of re-operations, favourable medians and means of LOS and rates of re-admission comparable to those reported by other studies. However, a non-satisfactory outcome after appendectomy in about 20% calls for improvement and further research.

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CONFLICTS OF INTEREST: none

LITERATURE

1. Andersen SB, Paerregaard A, Larsen K. Changes in the epidemiology of acute appendicitis and appendectomy in Danish children 1996-2004. Eur J Pediatr Surg 2009;19:286-9.
2. Kang JY, Hoare J, Majeed A et al. Decline in admission rates for acute appendicitis in England. Br J Surg 2003;90:1586-92.
3. Stringer MD, Pledger G. Childhood appendicitis in the United Kingdom: fifty years of progress. J Pediatr Surg 2003;38(suppl 1):65-9.
4. Livingston EH, Woodward WA, Sarosi GA et al. Disconnect between incidence of nonperforated and perforated appendicitis. Ann Surg 2007;245:866-92.
5. Körner H, Söreide JA, Pedersen EJ et al. Stability in incidence of acute appendicitis. Dig Surg 2001;18:61-6.
6. Andreu-Ballester JC, González-Sánchez A, Ballester F et al. Epidemiology of appendectomy and appendicitis in the Valencian community (Spain), 1998-2007. Dig Surg 2009;26:406-12.
7. Nickelsen TN. Datavaliditet og dækningsgrad i Landspatientregisteret. Ugeskr Læger 2002;164:33-7.
8. Andersson R, Hugander A, Thulin A et al. Indications for operation in suspected appendicitis and incidence of perforation. BMJ 1994;308:107-10.
9. Newman K, Ponsky T, Kittle K et al. Appendicitis 2000: variability in practice, outcomes, and resource utilization at thirty pediatric hospitals. J Pediatr Surg 2003;38:372-9.
10. Whisker L, Luke D, Hendrickse C et al. Appendicitis in children: a comparative study between a specialist paeditric centre and a district general hospital. J Pediatr Surg 2009;44:362-7.
11. Jen HC, Shew SB. Laparoscopic versus open appendectomy in children: outcomes comparison based on a state-wide analysis. J Surg Res 2010;161:13-7.
12. McKinlay R, Neeleman S, Klein R et al. Intraabdominal abscess following open and laparoscopic appendectomy in the pediatric population. Surg Endosc 2003;17:730-3.
13. Taqi E, Hadher SA, Ryckman J et al. Outcome of laparoscopic appendectomy for perforated appendicitis in children. J Pediatr Surg 2008;43:893-5.

14. Alexander F, Magnuson D, DiFiore J et al. Speciality versus generalist care of children with appendicitis: an outcome comparison. J Pediatr Surg 2001;36:1510-3.
15. Pedersen AG, Petersen OB, Wara P et al. Randomized clinical trial of laparoscopic versus open appendectomy. Br J Surg 2001;88:200-5.
16. Klarskov B, Jørgensen B, Kehlet H. Åben operation for appendicitis acuta i accelereret forløb. Ugeskr Læger 2004;166:1015-7.
17. Collins HL, Almond SL, Thompson B et al. Comparison of childhood appendicitis management in the regional paediatric surgery unit and the district general hospital. J Pediatr Surg 2010;45:300-2.
18. Alloo J, Gerstle T, Shilyansky J. Appendicitis in children less than 3 years of age: a 28-year review. Pediatr Surg Int 2004;19:777-9.
19. Dueholm S, Bagi P, Bud M. Laboratory aid in the diagnosis of acute appendicitis. Dis Colon Rectum 1989;32:855-9.
20. Blomqvist PG, Andersson REB, Granath F et al. Mortality after appendectomy in Sweden, 1987-1996. Ann Surg 2001;233:455-60.