Laparoscopic versus open appendicectomy in children: A UK District General Hospital experience

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A B S T R A C T

Aims: The aim of this study was to evaluate the potential role of laparoscopic appendicectomy in reducing morbidity and length of stay in children compared to open procedures in a UK District General Hospital setting.

Methods: A three-year retrospective review of children ≤15 years with histologically confirmed appendicitis who underwent laparoscopic (LA) and/or open (OA) appendicectomy was performed. Choice of operation was based on individual surgeon's preference and on patient's body size. Data collected included rate of histologically complicated appendicitis, post-operative length of stay (LOS), and collective and differential morbidity rates, i.e., wound infection, intra-abdominal collection, and ileus. Chi-square and Mann–Whitney tests were used for statistical analysis. P < 0.05 was regarded as significant.

Results: Eighty children (70% male) were identified at median age 11 (3–15) years. They could be divided into complicated (n = 18, 22%) and simple appendicitis (n = 62, 78%). Appendicectomy was performed in all as an OPEN (n = 53, 66%) or LAPAROSCOPIC (n = 27, 34%) procedure. Both groups were comparable in gender distribution (P = 0.11) and rate of complicated appendicitis (30% vs. 19%, respectively; P = 0.14). Median age was significantly lower in the OPEN group [10 (3–15) vs. 12 (7–15) years; P < 0.004]. Laparoscopic appendicectomy had a significantly lower rate of collective morbidity (3.8% vs. 25.9%; P < 0.003), including lower rate of intra-abdominal collection (1.9% vs. 14.8%; P < 0.01). Median LOS was not significantly different (1 day vs. 2 days; P = 0.14).

Conclusion: Laparoscopic appendicectomy in children in a UK District General Hospital is safe and was associated with significantly less post-operative morbidity than the open technique.

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than 0.05 was considered significant. Negative diagnostic laparoscopy and normal appendices were excluded from the analysis.

2. Results

A total of 93 children were identified, 27 OA’s and 66 diagnostic laparoscopies and LA’s. Amongst the group who underwent laparoscopic procedures, the appendix was not removed from 7 (10.6%) patients and 6 (9.1%) patients had their appendix reported as histologically normal. All 13 cases were excluded from further analysis. All OA’s were confirmed as either inflamed or complicated appendicitis.

Of the 80 cases included in the study with confirmed appendicitis, 53 (66%) were LA’s and 27 (34%) were OA’s. Both groups were comparable in terms of gender distribution (34:19 vs. 22:5 male: female ration in LA and OA respectively; \( P = 0.11 \)) and rate of complicated appendicitis (19% vs. 30% for LA and OA respectively; \( P = 0.27 \)). Median age was significantly lower in OA group (12 (7–15) vs. 10 (3–15) years for LA and OA respectively; \( P < 0.01 \)) [Table 1].

The collective rate of complications in LA group was significantly lower than in OA group (4% vs. 26% respectively; \( P < 0.003 \)). Differential distribution of post-operative complications showed a lower rate of wound infection and intra-abdominal collection in LA group (1.9% vs. 14.8% for LA and OA respectively) [Tables 1 and 2].

Median post-operative LOS was one day shorter in LA than in OA but this was not statistically significant [1 (0–23) days, 0 being < 24 h admission, vs. 2 (1–11) days; \( P = 0.18 \)] (Table 1). 68% of the LA group were discharged within three days in comparison with 48% of OA group (\( P = 0.23 \)).

Further analysis was carried out after adjusting for age difference between the two groups by excluding all OA cases younger than 7 years (i.e. 7 cases in total) rendering the median age to be 12 and 11.5 years for LA and OA respectively (\( P = 0.25 \)). However, the two groups remained comparable in terms of gender proportion (\( P = 0.19 \)) and rate of complicated appendicitis (18.9% vs. 35%; \( P = 0.15 \)). Complication rate remained significantly lower in LA group (3.8% vs. 25% for LA and OA respectively; \( P < 0.01 \)) again LOS was not statistically significant (\( P = 0.15 \)).

3. Discussion

It is generally thought that general surgeons took up laparoscopic appendicectomy for adults relatively quicker than their peers in paediatric surgery. This could be secondary to instrument development, the lack of established training modules and the challenges imposed by the small body size of children. This slow pace in taking up LA in general and in children in particular reflects the existing debate on the risks and benefits of this procedure against the more traditional OA. However, there was a notable increase in the proportion of LA to OA performed over the last decade in both adults and children [6,7,9]. To complicate the matter further, there has been a long standing debate whether paediatric appendicectomy should be carried out by adult general surgeons. The suggestion of some clinicians that the improved outcome is directly related to surgical volume is countered by the lack of resources, the increasing morbidity and the cost associated with referring every child with appendicitis to a tertiary referral hospital [2,3,13]. A few reports highlight the added benefit of LA in children in special circumstances, e.g. complicated appendicitis and obese children [11,12]. It would seem logical in the presence of supportive evidence of benefits conferred by LA over OA in adults and in children alike, having a high volume of adults undergoing LA procedure could facilitate a move to performing LA in children which seems to be the case in many DGHs in the UK. The health and cost impact of performing LA in children in a DGH setting are poorly understood. In our study we found that LA in children confers similar advantages to the reported benefits in LA performed in adults and in children in tertiary referral hospitals.

The spectrum of acute paediatric surgical referrals to general surgeons in a DGH setting could be limited by a number of factors such as the lack of paediatric intensive care support, anaesthetist capabilities, and the type and the degree of involvement of paediatricians. In our setting, the decision to refer to a general surgeon or a tertiary paediatric surgical service is made by the paediatricians. Hence, it is potentially possible that a group of sicker or younger children was directly transferred to a tertiary centre and was therefore not included in our study cohort.

In this study, all normal appendices and negative laparoscopy were excluded to reduce potential bias. However, it is a non-randomised retrospective analysis of a small study population and as such any findings without significant \( P \) values should be used with caution. It is difficult to assess the impact of the limited size of the study population on LOS as even larger studies found it difficult to demonstrate significance in the difference between the two groups in LOS [10]. Additionally, the relatively higher rate of complications in OA in this cohort could be attributed to factors other than the type of procedure and might have influenced the initial choice of the type of operation and this is difficult to analyse in a retrospective study.

Although OA group had a significantly lower age limit, analysing the data after adjusting for age by excluding children younger than 7 years did not change the overall statistical outcome. Such adjustment will of course render the study population even smaller. Despite the study’s potential limitations, the outcome of this investigation suggests that undertaking LA in children in a DGH setting by adult general surgeons is safe provided adequate equipment, training and supervision are available. However, providing acute surgical services to the child population will never be purely based on surgical capabilities and will always rely on the availability of specialist supportive services, and it is imperative to maintain the right balance between providing prompt, efficient and safe DGH surgical services to children to facilitate proper utilisation of specialist paediatric surgical services at tertiary referral centres. To our knowledge, this is the

### Table 1

Comparison of Laparoscopic Appendicectomy (LA) and Open Appendicectomy (OA) within a study cohort of 80 paediatric patients with confirmed appendicitis.

<table>
<thead>
<tr>
<th>Operation</th>
<th>No of patients</th>
<th>Median age (Range)</th>
<th>Male (%): Female</th>
<th>Complicated appendicitis</th>
<th>Median (Range) LOS Days</th>
<th>Combined complication Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA</td>
<td>53</td>
<td>12 (7–15)</td>
<td>34 (64%): 19</td>
<td>10 (10%)</td>
<td>1 (0–23)</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>OA</td>
<td>27</td>
<td>10 (3–15)</td>
<td>22 (81%): 5</td>
<td>8 (30%)</td>
<td>2 (1–11)</td>
<td>7 (26%)</td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2

Morbidity in Laparoscopic Appendicectomy (LA) vs. Open Appendicectomy (OA) groups within a study cohort of 80 children with confirmed appendicitis.

<table>
<thead>
<tr>
<th>COMPLICATION</th>
<th>LA n = 53</th>
<th>OA n = 27</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-abdominal collection/abscess</td>
<td>1 (2%)</td>
<td>4 (15%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Erys</td>
<td>1 (2%)</td>
<td>0</td>
<td>0.47</td>
</tr>
<tr>
<td>Wound infection</td>
<td>0</td>
<td>3 (11%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Total</td>
<td>2 (4%)</td>
<td>7 (26%)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
only study to investigate LA in a DGH setting and its finding should prompt more work in this field.

We believe that performing laparoscopic appendicectomy in children in DGHs is safe and is associated with less post-operative morbidity by comparison to open appendicectomy.

References