Laparoscopic versus open appendectomy in children: a meta-analysis
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CRD summary
This was a meta-analysis comparing laparoscopic and open appendectomy in a paediatric population. It concluded that laparoscopic appendectomy can reduce post-operative complications such as wound infection and ileus. The methodology was generally appropriate, although the lack of a quality assessment and the pooling of different study designs mean that the pooled results may not be reliable.

Authors’ objectives
To use meta-analysis to compare laparoscopic and open appendectomy (LA and OA, respectively) in a paediatric population.

Searching
EMBASE, MEDLINE, and the Cochrane Library were searched for studies published between 1992 and 2004; the search terms were reported. The 'related articles' function was used to widen the search, with all abstracts, studies and citations being reviewed.

Study selection
Study designs of evaluations included in the review
Comparative studies of LA and OA were eligible. The included studies were of a prospective randomised design, a prospective non-randomised design, or a retrospective design.

Specific interventions included in the review
Eligible interventions were LA and OA procedures. Variations on standard laparoscopic procedures, such as hybrid procedures (laparoscopic-assisted) or single trochar techniques, were excluded. The conversion rate from laparoscopic to open was reported by approximately half of the studies: it ranged from 0 to 25.9%.

Participants included in the review
Eligible studies were those of paediatric populations or which described the study group as children. The participants were aged from 0 to 20 years; 2 studies contained participants who were over 18 years old, but the studies were still included as their populations were described as 'children'. The percentage of patients with severe appendicitis (gangrene, perforation and abscess) varied between studies, from 12.9 to 100% for open procedures and from 0 to 100% for laparoscopic procedures; 6 studies matched OA and LA groups for appendicitis severity. Participants were matched for one or more of the following characteristics in 14 studies: age, weight, gender, peritonitis, fever, duration of illness and raised white cell count.

Outcomes assessed in the review
Eligible outcomes were post-operative complications such as post-operative fever, post-operative ileus, wound infection and intra-abdominal abscess formation, as well as operative time and length of post-operative hospital stay. Studies that did not report the standard deviation for the means of continuous outcomes were excluded.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
The authors did not state that they assessed validity.
Data extraction
Two authors independently extracted the data and there was complete agreement between them. The numbers of each type of post-operative complication were extracted and used to calculate the odds ratio (OR) and 95% confidence interval (CI) for each study. Studies with zero events in one group had 0.5 added to each cell, while studies with no events in either group were excluded from the calculation of the pooled results. The mean difference and 95% CI were calculated for length of stay and operation time.

Methods of synthesis
How were the studies combined?
The studies were grouped by outcome and combined in meta-analyses using both fixed-effect and random-effects models. Only the random-effects results were presented for all outcomes. The absolute risk reduction and number-needed-to-treat (NNT) were also calculated. Publication bias was assessed using funnel plots.

How were differences between studies investigated?
Heterogeneity was assessed by repeating the analysis of post-operative complications using fixed-effect models and comparing the results obtained with those of the random-effects models, and by subgroup analyses. Subgroup analyses of study size (more than 50 in each arm), publication year (2000 or later), prospective studies and randomised studies were conducted. Chi-squared and I-squared statistical tests were also used.

Results of the review
Twenty-three studies were included: 7 randomised studies (743 OA cases, 494 LA cases), 4 prospective non-randomised studies (690 OA, 304 LA cases) and 12 retrospective studies (2,255 OA cases, 1,991 LA cases).

Post-operative complications.
There was a significantly reduced incidence of wound infection for LA compared with OA procedures (OR 0.45, 95% CI: 0.27, 0.75; NNT 28; based on 13 studies). There was little heterogeneity (I-squared 8.1%). The only subgroup analyses found to have statistical significance were those of studies with at least 50 patients and recent studies (published in 2000 or later). There was also a significant reduction in post-operative ileus for LA compared with OA (OR 0.5, 95% CI: 0.29, 0.86; NNT 69; based on 9 studies), with an I-squared value of 0%. A similar result was seen for the prospective subgroup, but the result for the randomised studies was no longer statistically significant. No significant differences were observed between LA and OA for intra-abdominal abscesses (OR 1.11, 95% CI: 0.73, 1.71; based on 16 studies) or post-operative fever (OR 0.66, 95% CI: 0.40, 1.09; based on 3 studies). No heterogeneity was observed (I-squared of 0% for each outcome).

Operative time.
Operative time was shorter for OA compared with LA, although this was not statistically significant (WMD 5.84 hours, 95% CI: -0.95, 12.63; based on 11 studies). There was considerable heterogeneity (I-squared 97.8%).

Length of hospital stay.
There was a significantly reduced length of post-operative stay for LA compared with OA (WMD -0.48 days, 95% CI: -0.65, -0.31 days; based on 10 studies). There was considerable heterogeneity (I-squared 96.1%).

Publication bias.
Funnel plots of post-operative complications for all studies and for only the randomised studies showed no evidence of publication bias.

Cost information
Four studies reported costs of hospital stay in the USA. The mean cost was $4,734 (+/- 2,199) for OA and $5,801 (+/- 1,776) for LA.
Authors' conclusions
The results of this meta-analysis suggest that, compared with OA, LA can reduce the post-operative complications of wound infection and ileus in children.

CRD commentary
This meta-analysis had a clearly stated research question and inclusion criteria relating to the population, intervention and outcomes. The search strategy was limited to three databases and it was unclear if unpublished material was sought, or if there were any language restrictions. Publication bias might therefore have been an issue; the authors presented funnel plots but did not discuss them in relation to publication bias. The data extraction was performed in duplicate with no disagreements. However, since the authors did not report how studies were selected for the review, it was therefore unclear whether appropriate steps were taken to reduce the risk of selection bias. There was no quality assessment and, although the meta-analysis methods were appropriate, the results from prospective and retrospective studies were combined without considering their different risks of bias.

Sensitivity analyses were conducted to explore reasons for heterogeneity. Such analyses looked at prospective studies only, and the subgroup of randomised studies led to different conclusions for wound infection and ileus. The outcomes of operative time and length of hospital stay were extremely heterogeneous, so their pooled results may not be very meaningful. The methods of this meta-analysis were generally appropriate, although the lack of a quality assessment and the pooling of different study designs mean that the pooled results may not be reliable.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that high-quality randomised trials comparing LA and OA in the paediatric population are needed. Such trials should consider and report the level of expertise of the surgeons, and also ensure that patient and disease factors are comparable between the two groups undergoing laparoscopic and open procedures.

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