Trends in utilization and outcomes of laparoscopic versus open appendectomy

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Laparoscopic appendectomy was compared with open appendectomy for the treatment of acute and complicated appendicitis.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients with acute or perforated appendicitis who underwent open or laparoscopic appendectomy. Patients who had undergone incidental appendectomy, or drainage of an appendiceal abscess without appendectomy, were excluded from the analysis. Also excluded were patients who had elective interval appendectomy.

Setting
The setting was secondary care. The economic analysis was carried out in the USA.

Dates to which data relate
The effectiveness data referred to 1 January 1999 to 31 December 2003. The dates to which the cost data related were not reported, and nor was the price year.

Source of effectiveness data
The effectiveness data were derived from a national academic/teaching hospital administrative database, the University HealthSystem Consortium (UHC) Clinical Database. This contains patient-level data derived from academic health centres and affiliate community hospitals.

Link between effectiveness and cost data
The costing was carried out retrospectively on the same sample of patients as that used for the effectiveness analysis.

Study sample
The sample size was not determined in the planning phase of the study, but it would seem that the sample size was rather big to assure a certain power. The patients included in the study were selected according to diagnosis and procedure codes based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), which were assigned to them in the database. All patients with the appropriate codes assigned, and who met the exclusion and inclusion criteria, were included in the study. Of the overall 60,236 patients included in the study,
19,151 had laparoscopic appendectomy and 41,085 had open appendectomy.

**Study design**
This was a retrospective cohort study. The database contained patient-level data derived from 129 academic institutions. The data were collected between 1999 and 2003 and the patients were followed-up for 30 days after their discharge. The authors did not report whether the data analysers were blinded to the groups.

**Analysis of effectiveness**
The authors did not state whether participants were excluded for having incomplete data. The primary health outcomes used in the analysis were:

- the mean length of hospitalisation,
- the 30-day readmission rate,
- complications (e.g. pulmonary complications, urinary tract complications, intra-abdominal infection, venous post-procedure haemorrhage), and
- observed and expected (risk-adjusted) in-hospital mortality.

The authors performed a bivariate analysis to evaluate differences in the baseline characteristics of the patients in the two groups, (p<0.05 considered statistically significant). Compared with patients who underwent open appendectomy, patients who underwent laparoscopic appendectomy were more likely to be female (47.4% versus 36.6%; p<0.01), white (59.1% versus 51.2%; p<0.01) and adults (72% versus 69%; p<0.01). They also had a lower severity of illness (82.9% versus 79.5%; p<0.01) and were less likely to have a perforated appendicitis (20.1% versus 31.8%; p<0.01). The authors did not report whether there was any adjustment for the confounding factors.

**Effectiveness results**
The mean duration of hospitalisation was 2.49 (+/- 2.46) days after laparoscopic appendectomy compared with 3.42 (+/- 3.39) days after open appendectomy, (p<0.01).

The laparoscopic group had a lower 30-day readmission rate, 1.01% compared with 1.27% in the open group, (p<0.01).

Accounting for all complications, the complication rate was lower in the laparoscopic group (6.1%) than in the open group (9.6%), (p<0.01).

Compared with open appendectomy, patients who underwent laparoscopic appendectomy also had lower rates of wound infection (0.81% versus 1.76%; p<0.01), pulmonary complications (0.37% versus 0.54%; p<0.01), and venous thrombosis or pulmonary embolism (0.04% versus 0.10%; p<0.05).

The rates of intra-abdominal infection and urinary tract complications were similar in the two groups.

Patients in the laparoscopic group experienced a higher rate of post-procedural haemorrhage (0.5% versus 0.26%; p<0.01).

The ratio of observed-to-expected in-hospital mortality was similar in the two groups (0.52 in the laparoscopic group versus 0.65 in the open group).

**Clinical conclusions**
The authors concluded that after taking differences in the patients’ characteristics into consideration, laparoscopic appendectomy resulted in shorter hospitalisation and a lower overall complication rate.
Measure of benefits used in the economic analysis
The authors did not derive a summary measure of benefits. In effect, a cost-consequences analysis was performed.

Direct costs
The cost components included in the analysis were not reported. The costs were derived from the same database used for the effectiveness data, but the unit costs and the quantities of resources used were not analysed separately. Patients' charges and centre-specific cost-to-charge ratios were used to estimate the costs. Since the costs were incurred during a short time, discounting was not carried out. Neither the price year nor dates relating to the costs were reported.

Statistical analysis of costs
The authors performed a bivariate analysis to account for differences in the costs between the two groups, using independent sample t-tests.

Indirect Costs
The indirect costs were not included in the analysis.

Currency
US dollars ($).

Sensitivity analysis
No sensitivity analysis was performed.

Estimated benefits used in the economic analysis
See the 'Effectiveness Results' section.

Cost results
The mean cost of the technique was $6,242 (+/- 3,935) for laparoscopic appendectomy and $6,260 (+/- 6,530) for open appendectomy. The difference was statistically insignificant, (p=0.7).

Synthesis of costs and benefits
The costs and benefits were not combined.

Authors' conclusions
Laparoscopic appendectomy performed in patients considered suitable for the procedure may result in better clinical outcomes than open appendectomy, without increasing the health service costs.

CRD COMMENTARY - Selection of comparators
The choice of the comparator was explicitly justified. Open appendectomy reflected a standard alternative to laparoscopic appendectomy in the authors' setting. You should decide if this represents a widely used technology in your own setting.

Validity of estimate of measure of effectiveness
The analysis was based on a retrospective cohort study, which may be prone to bias and might limit the validity of the comparison between groups. The authors acknowledged that their analysis was not based on a randomised controlled
trial, and that patients in the two groups differed in their baseline characteristics. The effectiveness data were derived from a comprehensive database, but it was not possible to comment on the quality of the data since no appropriate details were reported. The study sample seems to have been representative of the study population. Although no power calculations were reported, the sample size was probably large enough to assure that the results obtained were due to the interventions and not due to chance.

**Validity of estimate of measure of benefit**
The authors did not derive a summary measure of benefits. In effect, a cost-consequences analysis was performed.

**Validity of estimate of costs**
Although the perspective adopted was not explicitly reported, it could not have been societal since the indirect costs were not included in the analysis. It appears that the economic analysis has been carried out from the perspective of the health care provider (hospital). The costs and the quantities were not reported, thus it is impossible to know whether all the relevant costs were included in the analysis. These omissions would not enable the analysis to be easily reworked for other settings. In addition, no sensitivity analyses on the costs or quantities were performed, which may limit the interpretation of the study findings. The price year was not reported and it is difficult to know whether any adjustments of the costs were relevant. As costs were incurred for less than two years, discounting was not necessary and was not performed.

**Other issues**
The authors made detailed comparisons of their results with those of published studies. The issue of the generalisability of the results to other settings was not addressed. The authors do not appear to have presented their results selectively. The study enrolled patients who underwent appendectomy for acute and perforated appendicitis and this was reflected in the authors' conclusions.

The authors reported a number of limitations to their study. For example, the UHC database does not distinguish between intraoperative and hospitalisation costs. In addition, the database is restricted to inpatient information only. Therefore, appendectomies performed on outpatients and further outcomes, such as postoperative pain, quality of life or absenteeism from work, were not taken into consideration. Similarly, any complications occurring after a 30-day postoperative period were also not considered. Patients who initially underwent laparoscopic appendectomy and converted to open appendectomy were not accounted for either since the database does not include relevant information. For the same reason, negative appendectomy rates between the two groups could not be estimated.

**Implications of the study**
The authors did not make any explicit recommendations for changes in policy or practice, and no further research was explicitly identified. However, the analysis and discussion highlighted areas where greater information is necessary.

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