The morbidity of negative appendicectomy

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ABSTRACT

INTRODUCTION The increased use of diagnostic laparoscopy for management of right iliac fossa pain may have lowered the threshold for removing normal appendices, particularly as there is a perception that this practice carries little additional morbidity. The aim of this retrospective audit was to determine the negative appendicectomy rate after laparoscopic appendicectomy (LA) in our busy district hospital, and to compare the relative incidence and severity of complications after removal of an inflamed or non-inflamed appendix.

METHODS Adult patients who underwent LA in 2011–2012 were identified from theatre registers. Histology results were reviewed to differentiate between inflamed and normal appendices. Postoperative complications and events following discharge were identified via electronic patient records. Complication severity was stratified using the Clavien–Dindo classification.

RESULTS Over 2 years, 467 LAs were performed, of which 143 (30.6%) were for normal appendices. Significantly more negative appendicectomies were performed in women (43%) than in men (17%) ($p < 0.0001$). Complications were seen in 62 patients (13.3%). There was no significant difference between the complication rates for those who had an inflamed (16.6%) or non-inflamed (11.9%) appendix ($p = 0.141$). Similarly, there was no difference in the severity of complications between these groups. Reoperation or invasive intervention was required after four negative appendicectomies (2.8%).

CONCLUSIONS LA carries a similar morbidity regardless of whether the appendix is inflamed. Negative appendicectomy should not be undertaken routinely during laparoscopy for right iliac fossa pain.

KEYWORDS

Laparoscopy – Appendicitis – Complications

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Laparoscopic appendicectomy has largely replaced open appendicectomy as the treatment of choice in acute appendicitis, where it appears to confer a benefit in terms of expediting recovery and reducing complications.¹ As well as its therapeutic role, laparoscopy can be used to diagnose abdominal and pelvic pathology in patients with right iliac fossa pain. When the appendix is assessed through an open right iliac fossa incision, it is accepted practice to remove the appendix even when it looks normal. This avoids the problem of assuming that the appendix is absent should the patient appear to present with appendicitis subsequently. However, the popularisation of laparoscopic appendicectomy has generated a vigorous debate as to whether the ‘normal looking’ appendix should be removed routinely at a diagnostic laparoscopy for right iliac fossa pain.

Proponents of this practice argue that it avoids further surgery in the future should the patient re-present with similar symptoms and also that mucosal inflammation is sometimes observed in the apparently normal appendix. There is a general assumption that removal of the normal appendix is unlikely to increase the morbidity of the procedure but there is little evidence to substantiate this.

The practice of most surgeons in our unit is to remove a macroscopically normal appendix if, at laparoscopy, no

other cause for pain can be found. The aim of this audit was to identify our negative appendicectomy rate following laparoscopic appendicectomy, and to compare the nature and number of complications relating to negative and positive appendicectomy.

Methods

This audit was registered with our local audit department. All adult patients undergoing ‘laparoscopic appendicectomy’ or ‘diagnostic laparoscopy’ between January 2011 and December 2012 were identified from theatre registers. A standardised proforma was used to extract data from the electronic patient records of all hospital attendances, initial investigations and complications. In order to classify complications, we applied the standardised Clavien–Dindo system.²

Fisher’s exact test was used to analyse categorical data. Logistic regression analysis was used to examine factors that might predict negative appendicectomy. Those factors found to be significant predictors in univariate analysis ($p \leq 0.05$) were entered into a multivariate logistical regression analysis. All statistical analysis was undertaken using Stata® (StataCorp, College Station, TX, US) with results regarded as statistically significant at a p -value of ≤ 0.05 .

Results

Over the study period, 468 appendices were removed laparoscopically, of which 143 (30.6%) were histologically normal. There were 70 cases of perforated appendicitis, accounting for 15% of appendices overall. There were 71 complications following all appendicectomies (15.2%). The actual number of laparoscopic appendicectomies performed increased by 50% from 187 in 2011 to 281 in 2012. The proportions of negative appendicectomies and complications were stable over the two years of data analysis. However, the proportion of appendicectomies performed for a perforated appendix was significantly lower in the second year (19% vs 12%, $p<0.04$) although the absolute numbers of perforated appendices were similar (36 vs 34). These data are summarised in Table 1. Significantly more normal appendices were removed from women than from men (106 [42%] vs 39 [17%], $p<0.0001$).

The distribution of the 71 complications across sex and positive/negative appendicectomy is given in Table 2. No grade 2 or 3 complications were observed in the small male negative appendicectomy group. Otherwise, complications were distributed evenly across negative and positive groups for both men and women. As there were fewer grade 2 and 3 complications, the proportion of overall complications in the male negative appendicectomy group (5.4%) was lower than that in the female negative appendicectomy group (14.3%) but this was not statistically significant (Fisher's exact test $p=0.239$).

Table 1 Summary of data

	2011	2012	Total
Laparoscopic appendicectomies	187	281	468
Negative appendicectomies	57 (30.5%)	86 (30.6%)	143 (30.6%)
Perforated appendicitis	36 (19.0%)	34 (12.0%)*	70 (15.0%)
Complications	31 (16.6%)	40 (14.4%)	71 (15.0%)

* $p<0.04$ Fisher's exact test

The types of complications seen are shown in Table 3. With the exception of the small male negative appendicectomy group, the complications were remarkably similar, regardless of whether the appendix was inflamed. There were no intensive care admissions or deaths in the negative appendicectomy group. However, four grade 3 complications were observed in this group (two cases of port abscess, one case of laparoscopy and washout, and one case of radiologically guided drainage of collection).

Logistical regression analysis was conducted to determine factors that might predict cases of negative appendicectomy. Table 4 shows those factors that were examined along with the outcome of univariate and multivariate regression analysis with the odds ratios. At univariate analysis, female sex and younger age as well as lower white blood cell, C-reactive protein and bilirubin levels were found to be significant predictors of normal appendix histology. In subsequent multivariate analysis, all of these factors remained significant predictors of non-inflamed appendix except female sex.

Discussion

Before the widespread use of laparoscopic appendicectomy, it was accepted that some patients with suspected appendicitis would have a normal appendix removed. In this era, the reported rate of negative appendicectomy was above 10%.⁵ With laparoscopy and the availability of radiological investigations such as computed tomography and ultrasonography, some units have seen a decrease in their negative appendicectomy rate to less than 10%.^{5,4} Nevertheless, it is recognised that the wide availability of laparoscopy has lowered the threshold of surgeons to undertake this diagnostic procedure.^{5,6}

Furthermore, there is no agreed policy as to the management of the 'normal looking' appendix when no other cause for the patient's pain can be identified. Consequently, negative appendicectomy rates after diagnostic laparoscopy vary considerably.⁷ Our own rates are approximately 50% higher than the national average and were consistent over the two years of study despite a large increase in number of referrals over the second year. This increase resulted from the relocation of acute surgical operating from one of

Table 2 Distribution of complications

Clavien–Dindo grade	Positive appendicectomies			Negative appendicectomies		
	Total (n=325)	Male (n=181)	Female (n=144)	Total (n=143)	Male (n=37)	Female (n=106)
1	16 (4.9%)	10 (5.5%)	6 (4.2%)	7 (4.9%)	2 (5.4%)	5 (4.7%)
2	19 (5.8%)	10 (5.5%)	9 (6.3%)	6 (4.2%)	0 (0%)	6 (5.7%)
3	16 (4.9%)	8 (4.4%)	8 (5.6%)	4 (2.8%)	0 (0%)	4 (3.8%)
4	2 (0.6%)	1 (0.6%)	1 (0.7%)	0 (0%)	0 (0%)	0 (0%)
5	1 (0.3%)	1 (0.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
All complications	54 (16.6%)	30 (16.6%)	24 (16.7%)	17 (11.9%)	2 (5.4%)	15 (14.2%)

Table 3 Nature of complications

Clavien–Dindo group	Positive appendicectomies	Negative appendicectomies
I	Wound infection opened at bedside (<i>n</i> =9) Prolonged Ileus (<i>n</i> =2) Skin reaction to wound dressings (<i>n</i> =1) Diarrhoea (<i>n</i> =4) Haematuria (<i>n</i> =1)	Wound infection opened at bedside (<i>n</i> =6) Urinary retention (<i>n</i> =1)
II	Antibiotics for wound infection (<i>n</i> =12) Antibiotics for abdominal collection (<i>n</i> =7) Antibiotics for acquired pneumonia (<i>n</i> =4) Postoperative MI (<i>n</i> =1)	Antibiotics for wound infection (<i>n</i> =3) Antibiotics for acquired pneumonia (<i>n</i> =2) Antibiotics for urinary infection (<i>n</i> =1)
III	Acute port site hernia (<i>n</i> =1) Radiological drainage of collection (<i>n</i> =5) Drainage of wound under GA (<i>n</i> =10)	Radiological drainage of collection (<i>n</i> =1) Surgical drainage/wash out with GA (<i>n</i> =1) Port site abscess drainage with GA (<i>n</i> =2)
IV	ITU stay for pneumonia (<i>n</i> =2)	
V	Death (<i>n</i> =1)	

GA = general anaesthesia; MI = myocardial infarction

Table 4 Regression of factors predictive of normal appendix histology

Variable	Univariate analysis			Multivariate analysis		
	OR	95% CI	<i>p</i> -value	OR	95% CI	<i>p</i> -value
Female sex	3.64	2.36–5.61	<0.001	1.70	0.91–3.44	0.094
Age	0.95	0.94–0.97	<0.001	0.96	0.94–0.98	0.004
ASA grade	0.71	0.45–1.13	0.153	–	–	–
WCC	0.78	0.73–0.82	<0.001	0.82	0.76–0.90	<0.001
Platelet count	1.00	0.99–1.00	0.227	–	–	–
CRP	0.98	0.98–0.99	<0.001	0.99	0.98–0.99	0.048
Bilirubin	0.90	0.87–0.93	<0.001	0.93	0.88–0.97	0.001

OR = odds ratio; CI = confidence interval; ASA = American Society of Anesthesiologists; WCC = white cell count; CRP = C-reactive protein

our peripheral hospitals to our main site. As would be anticipated, the majority of normal appendices removed were from women, with almost half of all appendices removed from women in our unit being normal.

Our perception prior to this study was that removal of a normal looking appendix was unlikely to increase the morbidity of the operation significantly. Overall, our complication rates were consistent and within acceptable parameters.⁷ However, there was little difference in the complication rates of women having removal of an inflamed (16.7%) or a normal (14.2%) appendix. Male patients appeared to have a lower complication rate after negative appendicectomy (5.4%) although the low number of subjects in this group may well have led to an underestimation of its true complication rate as the number of grade 1 complications was broadly similar.

The finding that complications are not any lower when removing a normal as opposed to an inflamed appendix is

substantiated by a similar finding in the 2012 national appendicectomy audit.⁷ Moreover, the severity of complications in the negative and positive groups is also broadly similar, meaning that patients are just as likely to undergo invasive procedures or reoperations for complications arising after a negative appendicectomy. Previous studies have shown that a diagnostic laparoscopy alone carries a morbidity rate of around 2%.⁵ As the majority of our complications were infective, this would suggest that the additional removal of a normal appendix during a diagnostic laparoscopy increases postoperative morbidity substantially.

The argument used by some to justify removal of a macroscopically normal appendix is that histological evidence of inflammation can be found in a proportion of these. However, the natural history of such microscopic inflammation is unknown. There is a reasonable body of evidence to suggest that leaving a macroscopically normal

appendix does not result in adverse outcomes.^{5,9–11} Furthermore, there have been incidences of death resulting from removal of a normal appendix.^{8,15}

Our regression analysis identified a number of factors associated with normal appendicectomy, which have also been identified by others, including age, female sex, white cell count, C-reactive protein and serum bilirubin.^{7,14–16} It is likely that surgeons do not take this full range of parameters into account when confronted with the decision to remove a normal appendix. One study proposed a standardised decision making tool based on the macroscopic appearance of the appendix.¹⁷ Non-operative clinical information (such as the above parameters) could equally be incorporated into this process to aid objective decision making. Such objective rationale could reduce the negative appendicectomy rate and the resulting additional morbidity.

The main strength of our audit is the number of patients reviewed and that the use of standardised electronic records systems enabled us to include outcomes for all patients identified. Nevertheless, some minor complications occurring after discharge, where patients seek help from primary care, are unlikely to be included but such problems do not impact on hospital stay. It was not possible to correlate the surgeon's subjective assessment as to whether the appendix is inflamed with the histology in this audit. However, this subjective assessment did encompass the main focus of this audit.

Conclusions

Although a retrospective audit such as this can only produce level III evidence, its findings substantiate a growing body of data that suggests that removal of a histologically normal appendix appears to carry more morbidity than a diagnostic laparoscopy alone and is comparable with that of removing an inflamed appendix. While this issue may theoretically only be resolved with a randomised trial of appendicectomy versus no appendicectomy for the macroscopically non-inflamed appendix at laparoscopy, surgeons should re-evaluate the risk-benefit assessment of diagnostic laparoscopy for right-sided abdominal pain. In the distant surgical past, it was not uncommon to remove the appendix routinely during laparotomy to prevent subsequent appendicitis. This practice has declined. Should incidental appendicectomy at laparoscopy be any different?

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