



# Establishing the need for clinical follow-up after emergency appendicectomy in the modern era: Retrospective case series of 145 patients

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## ABSTRACT

**Introduction:** Emergency appendicectomy (EA) is a commonly performed operation, with an increasing number of EAs being performed as day-case. The aim of this study is to establish if there is a need for post-operative follow-up and if this could prevent adverse outcomes.

**Methods:** A retrospective analysis of patients who underwent EA at multiple centres over a six-month period was undertaken. They were contacted by telephone and a standardised questionnaire was used to ascertain post-operative outcomes, including duration of analgesia use, duration before return to normal daily activity (ADLs), surgical site infection rates (SSI) and rates of re-presentation to medical services. Patients were stratified into those who underwent laparoscopic versus open appendicectomy, smokers versus non-smokers, and body mass index (BMI).

**Results:** A total of 145 patients were included in the study. Patients undergoing open surgery (vs. laparoscopic surgery) required analgesia for significantly longer periods, with a significantly longer return to ADLs. Smokers, when compared to non-smokers experienced a significantly longer return to work/school; and significantly higher risk of SSI and re-presenting to accident & emergency; as did patients with a BMI > 30 when compared to those with a BMI < 30.

**Conclusion:** Most patients do not need formal outpatient assessment after EA. However, there is clearly a subset of higher risk patients who may benefit from this – patients who are smokers or obese. They have prolonged recovery times, and are at greater risk of SSI. Earlier surgical outpatient follow-up of these patients could prevent adverse outcomes.

## 1. Introduction

Appendicitis is a common cause of acute abdomen, and appendicectomy is a commonly performed operation. Significant changes in recent years have occurred in the management of appendicitis, which has led to decreased post-operative morbidity in these patients, including antibiotics, imaging methods such as ultrasound and computed tomography which improves the diagnostic certainty, and laparoscopic appendicectomy (LA) [1].

Despite this, approximately 10–20% of patients undergoing appendicectomy have an adverse outcome, with wound infections accounting for most of these [2]. To increase the safety of appendicectomy and decrease adverse outcome rates, it is essential to identify surgical methods or subgroups of patients who are more likely to have poorer outcomes. Modern practice has moved towards early discharge following appendicectomy, and also outpatient/day case appendicectomy [3–5]. Most hospital trusts in the UK do not routinely follow-up patients

undergoing appendicectomy in the outpatient department. Without this follow-up, it may be difficult to identify optimal surgical techniques and higher risk groups, as many adverse outcomes go unregistered. This has the potential to impact on the operating surgeons' own learning and opportunity to reflect.

There is limited, contemporaneous evidence for the mid-to long-term impact on a patient's life following appendicectomy. The literature on outpatient/day case appendicectomy focuses on feasibility and safety of the procedure, with most large volume studies focussing on outcomes such as complication rate of surgery [6–10], with follow-up periods of less than 6 months [1,11].

The aim of this study is to ascertain if there is a need for follow-up of patients undergoing EA in the modern era. With this, we assess whether such follow-up of patients would prevent post-operative adverse outcomes.

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**Table 1**  
Patient telephone questionnaire.

1. Was your operation keyhole or open?
2. Were you told the findings of your operation?
3. If yes, were you told your appendix was normal, inflamed, perforated or necrotic?
4. Were you discharged with a course of antibiotics?
5. Did you experience pain following discharge home? (Severity scale 0–10: 0 = no pain, 10 = worst pain ever)
6. Were you sent home with pain relief?
7. For how long did you take pain-relieving medication?
8. Was there any infection at the wound site following your surgery?
9. Did you visit your GP with problems related to the operation within 12 months?
10. Did your GP prescribe you any antibiotics?
11. Did you attend A&E because of anything related to the appendicectomy within 30 days after the operation?
12. Were you re-admitted to a ward in any hospital within 12 months of your operation?
13. Did you have another operation relating to your appendicectomy?
14. Are you employed?
15. If yes, what kind of work do you do?
16. How many days were you off work/school after your operation?
17. How many days was it before you were back to normal activities after your operation?
18. Do you smoke now?
19. Did you smoke at the time of your appendicectomy?
20. Are you diabetic?
21. What is your height in cm?
22. What is your weight in kg?

## 2. Methods

The study followed a cohort of patients who were retrospectively followed up. In August 2014, all patients who underwent appendicectomy from May to November 2013 were identified using electronic databases at two hospital sites in one South London hospital trust. Such patients are not routinely followed up as outpatients at either site. They were all contacted by telephone. In total, 145 patients were contactable and consented to answer a questionnaire (see Table 1). The questionnaire was used to determine incidence of surgical site infection (SSI), as defined by the Centres for Disease Control [12], analgesia requirement, the need for medical attention (at either their general practitioner, or an accident and emergency department, or hospital) and impact on return to school, work and activities of daily living (ADL), patient body mass index (BMI) and smoking status at the time of appendicectomy, and their current smoking status. The questionnaire covered their post-operative course for up to 12 months. The patient interviews began in August 2014.

Histology findings were taken from the hospitals' electronic pathology results system.

This work has been reported in line with the 'Strengthening the Reporting of Cohort Studies in Surgery' (PROCESS) criteria [13].

### 2.1. Calculation

Statistical analysis was performed using StatsDirect 2.5.7 software (StatsDirect, Altrincham, UK). The outcomes measures highlighted above were compared between procedural (i.e. open versus laparoscopic) and patient sociodemographic (i.e. smoking and BMI status) subgroups using a combination of the paired *t*-test, Wilcoxon signed rank test, chi-squared test and Fisher's exact test. Relative risk data are expressed with corresponding 95% confidence intervals below.

## 3. Results

145 patients were consented and questioned, including 64 males and 81 females. The age range was 6 years–78 years (median = 29) (Table 2).

**Table 2**  
Patient characteristics.

Patient characteristic			
Age (years)	Median	Range	
	29	6–78	
Gender (n)	Male	Female	
	64	81	
Smoking at time of appendicectomy (n)	Smokers	Non-smokers	
	28	117	
Body mass index (n)	BMI < 30	BMI > 30	
	122	23	
Patients' employment/ education status (n)	Employed	Unemployed/ retired	Full time education
	94	29	22

### 3.1. Surgical technique, histology and analgesia use

Table 3 demonstrates surgical technique, histology and analgesia use. Five laparoscopic cases were converted to open surgery, and that data is included in the tables under open appendicectomy (OA).

The average pain score for all patients on discharge was 4.7/10 and 75% patients reported being given analgesia on discharge. For all patients, analgesia was taken for an average 12.2 days (median = 7 days).

### 3.2. Re-presentation to medical services

Table 4 shows how many patients re-presented to medical services and why. One patient underwent appendicectomy and the histology demonstrated inflamed appendix, but there was clinical suspicion of caecal cancer during that admission, which was confirmed with further investigations.

One patient underwent appendicectomy and the histology was normal, but there was clinical suspicion of renal tumour during that admission, and this was later confirmed.

One patient underwent appendicectomy and the histology was normal. There was no clear evidence of any other pathology during the admission. However, the patient continued to experience a range of symptoms and was eventually diagnosed with Crohn's disease, and needed surgery for it.

We assessed relative risk of SSI and re-presenting to medical services amongst smokers and against body mass index (Table 5). The number of patients who were smokers, and the breakdown of patients by BMI is shown in Table 2. Twelve patients who smoked required follow-up post-appendicectomy.

The average BMI was 23.7 (range 18–39.3). Nine patients with a BMI > 30 had post-operative complications that required GP follow-up, A&E visit or hospital readmission.

### 3.3. Return to school/employment and ADL

Table 2 shows the number of patients employed part/full time, unemployed/retired, and in full time education.

For the entire cohort, the average time to return to normal activity was 27.6 days (median = 14 days). Table 6 shows how return to school/employment depended on surgical approach, smoking status, and BMI.

## 4. Discussion

The aim of this study was to ascertain if there is a need for follow-up of patients undergoing EA in the modern era; and with this, whether such follow-up could theoretically prevent post-operative adverse outcomes. This study is one of few, longitudinal studies conducted recently. The focus is on the mid-to long-term impact on a patient's life following appendicectomy.

**Table 3**  
Comparison of histology and analgesia use amongst entire cohort and by procedure approach.

Procedure (n)	Histology				Average no. of days using analgesia post-surgery	Difference (p value)
	Normal	Inflamed	Perforated	Gangrenous		
Total cohort (145)	25	84	21	15	12.2	n/a
Open appendicectomy (53) <sup>a</sup>	3	26	15	9	22.3	0.017
Laparoscopic appendicectomy (92)	22	58	6	6	6.5	

p < 0.05 indicates significant difference.

<sup>a</sup> Includes results of laparoscopic converted to open appendicectomy.

Appendicectomy is a safe operation, but not without complications, with the complication rate less than 5% in large studies [14]. These include wound infection, intra-abdominal abscess and adhesions, which can impact on recovery times [15]. Our study shows differences in outcomes depending on the surgical approach, smoking status and BMI.

Many studies have reported the benefits of the laparoscopic approach over OA, including decreased morbidity, cost-effectiveness and length of hospital stay [16,17].

This includes a 2004 analysis of over 43,000 patients [18]. Our study shows that patients who underwent LA required a significantly shorter course of analgesia than patients who had OA (Table 3); and that patients also benefit from faster resolution of symptoms, return to work, and normal activity post-operatively (Table 6).

The results in our study show that of the patients undergoing OA, half had perforated or necrotic appendix; whilst only 12.9% of patients undergoing LA had a perforated/necrotic appendix (see Table 3). It is recognised that the severe inflammation from perforation or localised abscess formation can prohibit a safe laparoscopic dissection [19]. Additionally, it can be expected that patients with a perforated or necrotic appendix are sicker prior to surgery and this can impact on post-operative recovery, rate of surgical site infections and need for antibiotics.

The length of time to return to work, risk of SSI, attending A&E post discharge, and readmission within three months of discharge is significantly higher for patients who smoke, or who are obese (with a BMI > 30) (Tables 5 and 6). This finding is consistent with other studies that have found that potential risk factors for poor outcome following surgery include obesity and smoking [20,21]. A study of over 6500 patients who underwent appendicectomy from 1975 to 2004 found that a BMI of 27.5 kg/m<sup>2</sup> or more and current smoking were associated with overall postoperative complications in patients with a non-perforated appendix [2].

It is well known that the efficacy of opioids and other analgesic agents are dependent on patients' body mass, and so obese patients are more likely to need higher doses for a longer duration; and they are less mobile. Obesity has been shown to be an independent risk factor for SSI even in clean-contaminated abdominal surgery [22], and also other types of surgery including coronary artery bypass graft surgery and orthopaedic surgery [23]. Studies have shown that levels of CD4 (+) helper and regulatory T cells are lower in adipose tissue; and that obese

patients have higher serum levels of inhibitory cytokines such as IL-1RA; other factors such as prolonged operative time and the need for increased retraction on the tissue of obese patients may also explain the higher risk of SSI [23].

Smoking is believed to suppress the immune system, and have an adverse effect on wound healing [24,25]. It is recognised that smokers have higher analgesia requirements, and are more likely to suffer from chronic pain than non-smokers [26].

Twenty-three patients (16%) attended A&E with pain, infection, abscess formation or wound dehiscence. Despite these attendances to the A&E department, or the GP, overall readmission rates to hospital following appendicectomy were low (6.2% in three months; 9% in one year). Some of these were for incidental diagnoses that were found or suspected at the time of surgery, rather than for complications from appendicectomy. This suggests that most patients who seek medical attention are being adequately cared for either by GPs or A&E.

In essence, we found that patients who are smokers, who have a BMI > 30 or who have open operations are more likely to develop SSI, require more analgesia and return to work and normal activities later than other patients, and are therefore deemed higher risk. Most of our patients who sought medical attention were adequately cared for by GP and A&E. So, do patients need follow-up post EA? Will this, in theory, prevent adverse outcomes?

Though the results do not indicate any clear need to follow up all or most of these patients, there is a clear subset of patient who at higher risk of developing complications and seeking medical attention i.e. smokers, patients who are obese, and those who undergo OA. Such patients may not need formal follow up, but should still be considered for closer scrutiny in the post-operative phase. This proposes the additional question of whether post-operative follow-up of higher risk groups would change post-operative adverse outcomes. If higher risk patients are found earlier in the post-operative period, it may prevent SSIs from developing, therefore shortening the length of return to work or school.

One of the limitations of the study is that our results date from surgery undertaken in 2013; however, the management of appendicitis has not changed drastically in recent years. There has been a shift towards outpatient/day case EA. Whilst our results do not detract from the feasibility or safety of this, they demonstrate a subset of patients that warrant closer follow up, and this can only be of value to

**Table 4**  
Number of patients re-presenting to medical services after appendicectomy and reasons.

	No. of patients presenting to GP	No. of patients presenting to A&E	No. of patients requiring hospital admission within 3 months of surgery	No. of patients requiring hospital admission within 12 months of surgery
	25	23	9	6
Reasons for presentation	SSI Pain	SSI Wound dehiscence Pain Bleeding	SSI Abscess requiring insertion of drain Further investigation for ongoing pain	Further investigation for ongoing pain Adhesiolysis surgery Incisional hernia repair Surgery for caecal cancer Surgery for renal cell carcinoma Surgery for Crohn's

SSI = surgical site infection; GP = general practitioner; A&E = accident & emergency department.

**Table 5**

Relative risk of smokers and patients with BMI > 30 developing complications post-surgery compared to non-smokers including SSI, re-presenting to GP, A&E and needing admission to hospital.

	SSI	Difference (p value)	Re-presenting to GP	Difference (p value)	Re-presenting to A&E	Difference (p value)	Readmission to hospital	Difference (p value)
Smokers vs non-smokers	2.21	0.029	1.63	0.1742	3.21	0.0032	8.36	0.0018
Patients with BMI > 30 vs patients with BMI < 30	2.13	0.0438	1.52	0.2377	3.09	0.0054	6	0.0081

p < 0.05 indicates significant difference.

SSI = surgical site infection; GP = general practitioner; A&E = accident & emergency department; BMI = body mass index.

practitioners of outpatient/day case EA.

The sample size is small. We consider the results to be generalizable though, as it has been conducted over two busy, typical general surgical units; and the demographics and proportion of OA to LA is similar to that of other large studies conducted on EA [8,9,14, and 18].

The questionnaire is vulnerable to response bias – e.g. patient attendance at the GP or A&E after surgery does not necessarily imply a postoperative complication has occurred;

Some patients discussed aspects of their care that was not covered by the questionnaire, such as poor nursing care or poor hygiene on the wards. Return to ADL and work, and analgesia use was also patient reported.

We did not assess peri-operative data i.e. operation notes and anaesthetic charts in our study.

Appendectomy remains very much a “training” procedure, and formal post-operative assessment of these patients would be useful for the operating surgeons to gather learning points. In an era where hospital stays are becoming shorter and patient turnover is greater, such learning opportunities are lost. Of course, this needs to be balanced with patient need and cost to hospitals. Our study does indicate that the majority of patients do well post procedure, and most complications are well managed by GPs.

We have asked whether follow up would prevent post-operative complications – if we have determined that further follow up is not absolutely necessary, how else can we prevent complications? We believe more focus on patient education would help – surgeons could also tailor their post-operative instructions depending on their BMI or smoking status e.g. encouraging them to exercise through pain, or to cease smoking completely.

Surgeons may also wish to refine their post-operative strategy based on our results – they may consider, for example, using clips to close skin wounds, or prescribing longer courses of antibiotics, knowing that patients who are obese or smoke are more prone to SSI.

Thus, traditional outpatient review may not be necessary; however, telephone reviews or “virtual clinics” post discharge may suffice, and may also reduce the need for these patients to seek attention from their GP or A&E department. This method of assessment has been shown to be cost-effective and acceptable to patients [27]. Telephone reviews and virtual clinics can be run by junior doctors and nurses; placing the onus on them to do so would provide them with learning opportunities. Our study has identified a subset of patients who would benefit from this.

**Table 6**

Comparison of average time taken to return to work for LA, Open, Smokers and BMI > 30.

	Procedure approach			Smoking			BMI		
	OA	LA	Difference (p value)	Smokers	Non-smokers	Difference (p value)	BMI > 30	BMI < 30	Difference (p value)
Average time to return to work/school (days)	33	13.2	< 0.0001	24.4	17.6	0.048	26.1	17.3	0.00155
Average time to return to ADLs (days)	48.5	17.6	< 0.0001	40.2	25.9	0.1364	49.7	24.3	0.0412

OA = open appendectomy; LA = laparoscopic appendectomy; BMI = body mass index.

**5. Conclusion**

Most patients do well following appendectomy without the need for formal outpatient assessment. However, there is variation in outcomes that is dependent on the surgical approach, and on whether patients are smokers or obese. We have identified risk factors that identify a subset of patients who may benefit from early post-operative review, which may be conducted in a virtual manner, which in turn may well reduce post-operative adverse outcomes. This would provide benefits to these patients, keep unnecessary outpatient visits and hospital costs down, as well as allowing surgeons to see how higher risk patients recover and learn from this assessment.

**5.1. Key findings and recommendations**

- Patients who are smokers, who have a BMI > 30 or who have open operations are more likely to develop SSI, require more analgesia and return to work later than other patients
- Although there is no need for routine follow up for patients undergoing EA, patients who are smokers, who have a BMI > 30, or who have OA should be considered for closer assessment in the post-operative phase
- Surgeons who regularly practice outpatient/day case appendectomy should bear in mind their patients' smoking status, BMI and which operative approach to utilise for these patients

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R Som: Writing, statistical analysis and project lead.  
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 Sri G Thrumurthy: Data analysis guidance.

Sophia Khattak: data collection.  
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 Paolo G Sorelli: Consultant lead and study design.

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#### Appendix A. Supplementary data

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