Current technical surgical practice of emergency appendicectomy: a cross-sectional survey of surgical registrars in the UK

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ABSTRACT

INTRODUCTION Appendicectomy remains one of the most commonly performed procedures in general surgery. The aim of this study was to explore variation in operative techniques of an appendicectomy among surgical registrars in England.

MATERIALS AND METHODS An anonymised survey was sent out to surgical registrars in the UK via email and social media. Subgroup analyses were performed comparing respondents based on their level of seniority and subspecialty background.

RESULTS A total of 168 respondents completed the survey, of whom 77.4% (130/168) were specialty trainees years 3–8 and 44.6% (75/168) were colorectal trainees. The majority (98.8%) preferred a laparoscopic approach to appendicectomy. Overall, 73.2% opted to use diathermy to divide an uninflamed mesoappendix. Half of the respondents (50%) preferentially used diathermy to control the appendicular artery, followed by 44% preferring use of metal or polymeric clips. The appendicular stump was most often secured with Endoloops (85.7%) when removing a macroscopically uninflamed appendix but less readily used in the visibly inflamed appendix (75.6%, $p = 0.01$). Colorectal and upper gastrointestinal registrars were more likely to use diathermy on the mucosa of the appendix stump compared with other subspecialties ($p = 0.03$). The majority (82.1%) of respondents extracted the appendix via a retrieval bag. Regarding skin closure, most respondents (69%) adopted absorbable subcuticular sutures. Preferential duration of postoperative antibiotic use following appendicectomy for complicated appendicitis varied among the respondents.

CONCLUSION There are similarities and differences across surgical registrars in terms of technical practice in appendicectomy, partially attributed to prior experience and training.

KEYWORDS

Appendicectomy – Education – Cross-sectional study

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Introduction

Acute appendicitis is one of the most common surgical emergencies worldwide.¹ Within the UK, laparoscopic appendicectomy remains the mainstay of treatment in patients with acute appendicitis with the majority performed by surgical registrars.^{2,5} There is wide variation in technical steps and equipment used during a laparoscopic appendicectomy between trainee surgeons. This is dependent on a multitude of factors including grade of surgical trainee, equipment available, operative difficulty and presence of complicated appendicitis. While appendicectomy is one of the most frequently performed emergency procedures in the UK, there remains a lack of consensus regarding intraoperative technical considerations.

This snapshot cross-sectional survey aimed to examine variation in preferential techniques implemented during a laparoscopic appendicectomy by general surgical registrars within the UK.

Materials and methods

A 15-point survey (Appendix 1) was designed by the executive committee of Surgical Trainees East of England Research (STEER) Collaborative, a trainee-led research collaborative group based in the UK. An online version of the survey was created using Survey Monkey. This was distributed to general surgical registrars via the STEER

mailing list and website (<https://www.steercollaborative.co.uk>) as well as social media platforms. The survey was active between January 2019 and October 2019 with anonymous responses collected. During this time, reminders were sent via all these channels. General surgical registrars of level ST3 or equivalent and above were included. Given that the study was voluntary and anonymised with no patient information involved, ethical approval was not required.

Scale variables were reported as medians with the accompanying interquartile range (IQR). Chi-square analyses were undertaken to compare groups and a p -value of 0.05 or less was considered statistically significant. Subgroup analyses were carried out comparing trainee groups according to their seniority/level of experience as well as subspecialty interest, to determine differences in practice. Trainees in the first half of higher surgical training (ST3–5) were designated as ‘junior trainees’ while those in the second half of training (ST6–8) or post-certification of completion of training (CCT) fellows were considered to be ‘senior trainees’. Training grade was used as an indirect proxy measure for operative experience. All statistical analyses were carried out using the Statistical Package for the Social Sciences.

Results

A total of 168 survey responses from general surgical registrars were received. Of these, 77.4% were trainees in higher surgical training (ST3–8), 17.2% were non-trainee registrars and 5.4% were post-CCT fellows (Table 1). Subspecialty interests are detailed in Table 2, with most registrars declaring colorectal (44.6%), upper gastrointestinal (27.4%) or hepatopancreatobiliary surgery (10.7%). Of those in higher surgical training or post-CCT, 78 (56.1%) were junior trainees (ST3–5) and 61 (43.9%) were senior trainees (ST6–8 or post-CCT).

Overall, 53.6% had previously performed more than 100 appendicectomies as the primary surgeon. The remaining respondents had performed less than 100 appendicectomies prior to survey completion: 0–20 (7.1%), 20–40 (7.7%), 40–60 (10.1%), 60–80 (10.7%) and 80–100 (10.7%). The vast majority (98.8%) of registrars preferred the laparoscopic approach for appendicectomies. The two respondents who opted for an open approach were registrars with a vascular or trauma surgery subspecialty interest.

Method of mesoappendix division

In the presence of an uninflamed mesoappendix, division was preferentially performed using diathermy via a laparoscopic instrument (hook, Petelin or Maryland instrument) by the majority of respondents (73.2%). Other methods included use of metal clips (10.1%), polymeric clips (Hem-o-loks; 7.1%), Endoloops (7.1%) and intracorporeal suture ligation (2.4%) all followed by mesoappendicular division. On discovering an inflamed mesoappendix, diathermy via a laparoscopic instrument remained the most common method implemented (69.6%) followed

by use of metal clips (10.7%), polymeric clips (Hem-o-loks) (8.3%), Endoloops (8.3%) and intracorporeal suture ligation (3.0%).

The results demonstrated that across all respondents ($n = 168$), practice did not change regardless of whether or not the mesoappendix was inflamed ($p = 0.769$). The senior trainee cohort was far less likely to use diathermy alone to divide an uninflamed mesoappendix (68.9%) compared with the junior trainee cohort, who implemented diathermy 82.1% of the time ($p < 0.001$). Interestingly, for an inflamed mesoappendix, the junior group did change practice and the rate of diathermy use dropped from 82.1% to 73.1% ($p = 0.025$). There were no differences across the different subspecialties in terms of dividing the inflamed or uninflamed mesoappendix.

Table 1 Declared stage of training of respondents

Stage of training	Respondents ($n = 168$)	
	(n)	(%)
ST3	32	19
ST4	20	11.9
ST5	26	15.5
ST6	16	9.5
ST7	23	13.7
ST8	13	7.7
Post-CCT	9	5.4
Non-trainee registrar	29	17.2
CCT, certificate of completion of training; ST, specialty training year.		

Table 2 Declared subspecialty interest of respondents

Subspecialty interest	Respondents ($n = 168$)	
	(n)	(%)
Colorectal surgery	75	44.6
Upper gastrointestinal surgery	46	27.4
HPB surgery	18	10.7
Breast surgery	10	6
Vascular surgery	5	3
Trauma surgery	5	3
Transplant surgery	4	2.4
Emergency surgery	4	2.4
Endocrine surgery	1	0.6

Method of appendicular artery division

Fifty per cent of the respondents reported preferential use of diathermy using a laparoscopic instrument for controlling and dividing the appendicular artery. Forty-four per cent would opt to use either metal (31.5%) or polymeric (12.5%) clips, while others reported using Endoloops (3.0%) or intracorporeal suture ligation (3.0%). There were no differences across the different subspecialties or training grades (junior vs senior) regarding preferential methods to control the appendicular artery.

Method of securing appendicular stump

For securing the appendicular stump following division at the base of an uninflamed appendix, 85.7% preferred using Endoloops. However, this proportion dropped in the presence of an inflamed appendix (75.6%, $p=0.01$). For an uninflamed appendix, the remaining respondents used polymeric clips (6.5%), linear stapler device (3.6%), suture ligation (2.4%) and metal clips (1.8%). For securing an inflamed appendicular stump, other techniques apart from Endoloops included use of a linear stapler device (10.7%), polymeric clips (6.5%), suture ligation (6.5%) and metal clips (0.6%).

If the appendicular base appeared inflamed and ischaemic, 78.6% would complete the operation laparoscopically by resecting the entire appendix and managing the caecal defect with a laparoscopic linear stapler (56.0%), primary closure with sutures followed by further seroserosal burying sutures (13.7%) or primary closure with sutures only (8.9%). The remaining registrars opted to convert to open to deal with the caecal defect. There were no differences between junior and senior trainees or between the subspecialties in terms of their management of an ischaemic base.

Following removal of the appendix and securing the base, 87.2% would perform no further operative steps on the residual appendicular stump; 12.5% would routinely burn the stump mucosa with diathermy and 4.8% would bury the stump. There were no differences in practice in terms of dealing with the stump across different levels of seniority ($p=1.00$) although trauma (20.0%) upper gastrointestinal (19.6%) and colorectal (13.3%) trainees were more likely to diathermy the mucosa compared with other subspecialties ($p=0.03$).

Specimen retrieval and skin closure

The preferred reported method of specimen extraction was the use of a retrieval bag (82.1%). A significant proportion (13.1%) of respondents would remove the appendix directly through a laparoscopic port and 4.2% through a port incision without a retrieval bag.

Absorbable subcuticular sutures were the preferred method of skin closure in uninflamed and complicated appendicitis (69.0% and 54.2%, respectively). A higher proportion of respondents tended to use interrupted sutures and staples in complicated appendicitis (22.6% and 8.9% respectively) compared with uninflamed appendicitis where interrupted sutures and staples were less readily used (7.7% and 0.6% respectively, $p<0.01$).

Postoperative antibiotics

The use of postoperative antibiotics following appendicectomy for complicated appendicitis (perforation, appendicular gangrene, free intra-abdominal purulent fluid) varied among respondents. The majority would prescribe intravenous or oral antibiotics for three (35.7%) or seven (42.9%) days following surgery; 13.7% would administer intravenous antibiotics for 24 hours postoperatively. The remainder opted to use other durations of antibiotics or no further antibiotics at all. There were no differences across the different subspecialties or across different levels of experience (junior vs senior).

Discussion

The main findings of this study are that while there are similarities in the way appendicectomies are performed within the UK, there are also significant differences in practice between registrars of both varying training grades and subspecialty interests within general surgery. In correlation with existing level one evidence, the preferred operative approach to appendicectomy among surgical registrars is laparoscopic.

Other important findings from our study include a majority preference in using diathermy for dividing the mesoappendix and appendicular artery. Endoloops were the preferred method of securing the appendicular stump, similar to previously published studies.⁴ Senior registrar trainees were more likely to manage an ischaemic inflamed appendicular stump laparoscopically compared with their junior counterparts. Most respondents extract resected appendices using a retrieval bag and opt to use absorbable subcuticular sutures for skin closure. The routine use of postoperative antibiotics for complicated appendicitis varied widely with most preferring a seven-day intravenous/oral course.

The laparoscopic approach for appendicectomy has been widely adopted over the traditional open approach by most surgeons. It is well established that laparoscopic appendicectomy is associated with reduced overall postoperative complications and postoperative pain, shorter hospital stays and quicker return to work and normal activities when compared with open appendicectomy.⁵⁻⁷ Other benefits of a laparoscopic approach include the ability to carry out a diagnostic laparoscopy to visualise other intra-abdominal and pelvic organs should the appendix appear macroscopically normal.⁸ As surgical experience with laparoscopic appendicectomy has increased over time, overall operative time has reduced.⁹ For these reasons, it is not entirely surprising that the vast majority of registrars completing our survey would opt to perform an appendicectomy laparoscopically. While there were differences in practice reported, there were also areas of uniformity irrespective of subspecialty or seniority.

Diathermy remains the preferred method of dividing the mesoappendix as well as controlling the appendicular artery according to our study regardless of whether or not the appendix appears inflamed. Operative time and cost

vary for each option in the armamentarium available to the surgeon for performing these operative steps. Monopolar diathermy compared with alternative methods has been shown to be safe and cost effective during appendicectomies from previous studies with equivalent complications rates.^{10–12} Polymeric clips (Hem-o-loks) have also been shown to be safe with dividing the mesoappendix and controlling vascular structures less than 16mm in size.^{13–14} Our study suggests that senior trainees are more inclined to use polymeric clips than their junior counterparts. Plausible explanations for this observation include increasing experience and confidence with their use, as well as previous studies demonstrating polymeric laparoscopic clips being more cost effective and efficient than Endoloops without compromise to operative time and complication rates.^{15–16}

Endoloops were the preferred method for securing both the uninflamed and inflamed appendicular stump in our study. The benefits of using laparoscopic Endoloops are well documented and include ease of use, clinical safety and cheap costs.¹⁷ Using a laparoscopic stapler during an appendicectomy is almost six times more expensive than using Endoloops; hence their limited preferential use in our study.⁴ However, in the presence of an ischaemic appendicular base, the majority of respondents preferred to use a laparoscopic stapler. Laparoscopic staplers have been shown to be particularly useful in such complex cases of appendicitis but have not demonstrated superiority over Endoloops for uncomplicated appendicitis.^{18–19}

For skin closure, most respondents used absorbable subcuticular sutures in both uninflamed and inflamed appendicitis. This approach has been shown to be safe in contaminating incisions given their low reactivity, tensile strength, better cosmetic result and reduced cost without increasing infective and dehiscence complications.²⁰

Duration of postoperative antibiotic use following appendicectomy for complicated appendicitis remains an area of contention. This survey is the first to examine UK trainee preferences on postoperative antibiotics in such cases. Most of our respondents stated they would prescribe seven days of either intravenous or oral antibiotics, probably due to the fear of intra-abdominal abscess formation. Several studies have shown that prolonging antibiotic use for longer than three days following operations for complicated appendicitis made no significant difference in reducing the development of intra-abdominal infections.^{21–22} Converting from intravenous to oral antibiotics to complete a full course made no difference to the rate of infective complications reported following appendicectomies.²³ Once enteral feeding is tolerated, it should be encouraged to allow patients to be discharged and to avoid undue adverse effects from the antibiotics. Evidence-based national recommendations are needed to provide guidance on the adequate length of the course of postoperative antibiotics in those with complicated appendicitis, however this time should be tailored to the clinical needs of each individual patient.

The limitations of this qualitative study include the small sample size, although there was a representative range of

registrars from differing subspecialty interests and training grades. Operative preferences from surgical registrars are likely to be influenced by experience and ease of use of surgical equipment as well as previous trainer preferences. Within this survey, geographical location of where surgical registrars were based was not included. This would have allowed further examination of variation in practice between different training regions in the UK.

Overall, this study highlights the current practice of performing appendicectomies by surgical registrars within the UK. There are both similarities and variation in appendicectomy technique among surgeons in training, which are potentially attributable to training grade seniority and subspecialty interest. Further studies are required to establish the optimal technique and postoperative antibiotic use for an appendicectomy as regards safety and cost effectiveness. This will help to reduce heterogeneity and standardise overall management of acute appendicitis.

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