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Original research

Effect of surgical experience on the macroscopic diagnosis of appendicitis: A retrospective cohort study

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HIGHLIGHTS

- We examined the accuracy of intraoperative macroscopic assessment of the appendix in correlation to the experience of the operator.
- The diagnostic accuracy amongst junior trainees, senior trainees and consultants did not differ with accuracy rates.
- The false negative rate was higher in females than in males (19.1% versus 7.2%; P = 0.007).
- The false positive rate was higher in males than in female patients (43.3% versus 22.2%; P = 0.05).
- We recommend that an appendicectomy be performed when clinically indicated regardless of macroscopic appearance.

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ABSTRACT

Background: We aimed to determine whether intraoperative macroscopic assessment of the appendix improves with surgical experience and whether the accuracy of the intraoperative assessment of the appendix is different in respect to sex of the patient.
Methods: Medical records of all appendicectomies performed during an 18-month period (2011–2012) at Westmead Hospital, Australia were reviewed. Accuracy of intraoperative macroscopic description correlating to histopathology was compared between groups based on the training level of the surgeon.
Results: Correlation between the intraoperative diagnosis and final histopathology result was 83.5% of the 303 cases. The diagnostic accuracy amongst junior trainees, senior trainees and consultants did not differ with accuracy rates of 85%, 81.6% and 88.2% respectively, (P = 0.44). The false negative rate was higher in females than in males (19.1% versus 7.2%; P = 0.007).
Conclusions: Our findings demonstrated that operator experience does not affect the accuracy of the intraoperative assessment of appendixes. We recommend that an appendicectomy be performed when clinically indicated regardless of macroscopic appearance.

1. Introduction

Appendicectomy for acute appendicitis is one of the most common surgical procedures performed in hospitals [1,2], with approximately 22,000 operations undertaken in Australia in 2010–2011 [3]. However, a reported 15–30% of normal appendixes are removed, suggesting inaccuracy of intraoperative assessment of the appendix [4,5]. There is concern existing about the ability of surgeon to reliably detect abnormal pathological findings of the appendix intraoperatively [6–8] with current literature reporting negative predictive value between 54.4% [6] and 74% [9] in open appendicectomy, and 41% [10] and 97% [11] in laparoscopic appendicectomy, questioning the ability of surgeons to adequately distinguish a normal appendix from an inflamed appendix. The question of whether or not to leave a normal looking appendix in place, has been widely disputed and a consensus has yet to be reached with some advocating for the removal of the appendix due to the potential of missed appendicitis [6,12], and others suggesting it is safe to leave in in situ [13,14]. Some authors advocate the removal of a normal looking appendix only in the context that there is no other existing explanatory pathology [15–17].

Previous studies have highlighted the low diagnostic accuracy rates in women (60%) when compared to males [18], which may be due to conditions that mimic appendicitis such as gynaecological abnormalities resulting in a higher incidence of false positive diagnosis in the female population [19]. High false negative rates of

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18.6% reported in a retrospective study also raises concerns of the increased risks of perforations and abscess formation if the macroscopically normal but histological abnormal appendix was left in situ [19].

Trainee surgeons play an integral role in the assessment and management of patients especially in large teaching hospitals under the supervision of experienced consultants. Laparoscopic appendicectomy has been generally considered a safe procedure for trainees with a study finding no difference in operative time and morbidity compared to qualified surgeons [20], whereas another study has reported an increase surgical operative times and complications when surgical trainees are involved [21]. However the ability of surgical trainees to make an accurate intraoperative diagnosis of appendicitis has not been fully evaluated.

We aimed to assess accuracy of the intraoperative assessment of the appendix in correlation to the histopathological diagnosis, and its association to surgeon experience and sex of the patient.

2. Methods

Following ethics approval, we conducted a retrospective chart review of all patients who underwent an appendicectomy between January 1, 2011 and July 2012, at Westmead Hospital, a tertiary referral hospital in Sydney, Australia.

Data was collected from patient medical records, operative theatre reports and histopathology reports. Patient demographics including sex, operative findings, operator details and final histological diagnosis were retrieved. Operative factors such as approach (open or laparoscopic) were noted. Patients who underwent incidental appendicectomy for reasons other than suspected appendicitis were excluded. One case where the operator was not documented on the report was excluded from the analysis.

The intraoperative macroscopic description was retrieved from the operation report. For comparison between intraoperative and histopathological findings, the histological diagnosis was taken to be the gold standard. The extent of macroscopic disease documented by the surgeon was identified and categorised into the grades of appendicitis: inflamed, suppurative, gangrenous, and complicated (perforated/abscess) formation. Six cases described as being phlegmonous appendicitis were included within the category of complicated appendicitis. Findings documented by the surgeon or the pathologist as faecolith or fibrosis obliterans were not recorded as acute appendicitis. Additional operative findings documented by the surgeon were noted.

The surgical level of the operating surgeon and assistant were reviewed, with the more senior surgeon who was scrubbed in identified as the main operator for this study. The Surgical Education & Training (SET) program is a recognised accredited five year surgical training program in Australia. Surgical Education & Training (SET) level was chosen as the standard of comparison was obtained for the surgeons involved during the time of the study. The grade of the operating surgeon was categorised as (1) Junior surgical trainees (senior Resident Medical Officer, SET 1 and 2); (2) Senior surgical trainees (SET 3, 4, and 5); and (3) Consultant level (Fellows and consultants). Senior resident medical officers included in the study were operators that were not affiliated with an accredited SET position and included unaccredited trainees. Based on these groupings, the accuracy of intraoperative macroscopic assessment of the appendix in correlation to histopathology was compared.

Statistical analysis of comparison the groups and its statistical significance was performed using Statistical Package of Social Sciences version 21. The chi square test was used and probabilities less than 0.05 were considered significant. A sample size estimate was calculated and required 555 patients in each group to reach a power of 0.8 and significance level of 0.05. However due to the retrospective nature of the study, we relied on available medical records to obtain our data. With our sample size, post hoc power analysis demonstrated that our study to have insufficient power to detect a significant difference between the three groups of surgical training levels (power = 0.27) and between the male and female groups (power 0.38).

3. Results

3.1. Demographics

Over the study period 303 patients underwent appendicectomy for suspected appendicitis, including 134 females and 169 males. The mean age of the study population was 30.9 years (age range 15–86 and 16–82 in females and males respectively). Appendicectomy was performed laparoscopically in the majority of cases (94.7%, 287/303), and an open approach was used in 16 patients, including nine cases which were converted from laparoscopy.

3.2. Analysis of intraoperative macroscopic assessment

The macroscopic description of appendicitis documented by the surgeon was termed as inflamed/inflammation in 44.6% of cases (n = 135), suppurative in 14.2% of cases (n = 43), gangrenous in 2.8% (n = 9) of cases and complicated appendicitis reported as perforation or abscess in 12.2% of cases (n = 37). The overall accuracy of intraoperative macroscopic assessment of the appendix was 83.5% (253/303) with a positive predictive value (PPV) of 89.7% (201/224). The accuracy rate was 100% when findings of gangrenous appendicitis or complicated appendicitis such as perforation or abscess were described. When suppurative appendicitis was observed there was a 95.3% (41/43) correlation to a positive histopathology and when inflammation alone was observed, the PPV was 84.4% (114/135).

The overall negative appendicectomy rate was 24.8% (75/303). Twenty three (10.3%) out of 224 patients who were deemed positive intraoperatively were found to have a normal appendix on microscopic examination.

Seventy-nine cases were reported as being macroscopically normal with 27 (34.2%) demonstrating signs of appendicitis on histopathology.

Preoperative imaging through CT and/or US was performed on 150 cases with radiological diagnosis of appendicitis in 90 of the cases (see Table 1). Of the 90 patients with preoperative imaging suggesting appendicitis, 2 cases were incorrectly diagnosed intraoperatively to have macroscopic signs of appendicitis. Conversely, of the 60 cases reported normal on preoperative imaging, 9 cases were described intraoperatively to be macroscopically normal, but histopathology demonstrated appendicitis.

Table 1
Macroscopic assessment of the appendix in cases with preoperative radiological assessment (N = 150).

	Histological assessment		
	Appendicitis	Normal	Total
Radiological positive (n = 90)			
Macroscopic positive	69	2	71
Macroscopic negative	7	12	19
Radiological negative (n = 60)			
Macroscopic positive	21	7	28
Macroscopic negative	9	23	32
Total	106	44	150