

# Acute appendicitis—a recent audit of an old problem

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We conducted a retrospective review of all patients who had an appendectomy performed at the Queen Elizabeth Hospital, Hong Kong, from January 1993 through December 1994. The diagnostic accuracy for true appendicitis was 74%. Nine per cent of patients had other pathologies, which also needed exploration. The diagnostic accuracy in female patients was 66%, compared with 82% for male patients ( $P<0.0001$ ). Female patients aged between 15 to 40 years were diagnosed accurately 62% of the time, which was significantly lower than the rate for other female patients ( $P=0.016$ ). The overall morbidity and mortality rates were 9.2% and 3%, respectively. Complicated appendicitis had a higher morbidity rate of 21%, compared with 9% for uncomplicated appendicitis ( $P<0.0001$ ). Results for patients who were operated on the day of admission were compared with those who were operated on the day after admission. No significant difference in diagnostic accuracy ( $P=0.46$ ), percentage of complicated appendicitis ( $P=0.7$ ), and morbidity rate ( $P=0.8$ ) was found.

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## Introduction

Acute appendicitis is a common surgical problem. Early recognition of the condition and prompt operation has been the most important factor in reducing morbidity and possible mortality from this disease. Attempts have been made to improve diagnostic accuracy but the results have been disappointing.<sup>1,2</sup> Good clinical judgement remains the most reliable means for correct diagnosis. A delay in surgery has been blamed for the development of complications including perforation, abscess formation, and gangrenous changes. However, the decision to operate in suspected appendicitis "for the benefit of doubt" has increased the number of unnecessary operations. Unnecessary appendectomies can also lead to complications.<sup>3</sup> Some authors have advised against making an operating decision in the early hours of the morning,<sup>4,5</sup> but

this has the drawback of delaying operation when it is needed. A period of observation for patients whose diagnosis is uncertain seems logical, although whether this would lead to delay has not yet been settled.

We reviewed all the appendectomies performed at the Queen Elizabeth Hospital over a two-year period. This review has two purposes. Firstly, being the most common surgical problem encountered, the results of treatment of appendicitis are one of the best indicators of staff performance. This can be measured by parameters such as diagnostic accuracy and morbidity and mortality rates. Secondly, by comparing the results of those operated on on the day of admission and those operated on on subsequent days, we hope this review answers some of the questions raised. Being a retrospective review, there are a number of factors that are not ideally controlled for. Some of the conclusions from this observation, however, should help shape any future prospective studies conducted on this common surgical problem.

## Subjects and methods

We retrospectively reviewed the records of all patients who had an appendectomy performed at the Queen

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Elizabeth Hospital between January 1993 through December 1994. The pre-operative diagnosis was either acute appendicitis or peritonitis. A right gridiron incision was used for patients with a pre-operative diagnosis of acute appendicitis, while a midline or right paramedian incision was used for patients with a diagnosis of peritonitis. All the appendices removed were examined histologically to assess diagnostic accuracy. The case records of all patients were studied for morbidity.

**Table. Causes of other pathology mimicking acute appendicitis**

Causes	No. (%)
Gynaecological causes	
Pelvic inflammatory disease	40 (46)
Ovarian cyst with complications	6 (7)
Endometriosis	3 (3)
<u>Subtotal</u>	49 (56)
Non-gynaecological causes	
Perforated peptic ulcer	2 (2)
Mucocoele/Adenoma of appendix	7 (8)
Carcinoid tumour	5 (6)
Caecal diverticulitis	24 (28)
<u>Subtotal</u>	38 (44)
<b>Total</b>	<b>87</b>

All patients admitted for suspected acute appendicitis were examined by an on-call registrar. The diagnosis of acute appendicitis or peritonitis was made by clinical examination supplemented by simple investigations (e.g. white cell counts). Once the diagnosis was made, operation was arranged for the same day. Patients in whom the diagnosis was uncertain had their breakfast withheld the following morning and were assessed by senior surgeons. If a diagnosis of acute appendicitis or peritonitis was made, then operation was arranged in a similar fashion.

The histological reports of all resected appendices and operative notes were reviewed. Patients were categorised into four groups. The first group were those with histological evidence of acute appendicitis, which is characterised by the infiltration of polymorphonuclear neutrophil leukocytes and mucosal congestion. The second group were those with complicated appendicitis, with evidence of perforation, abscess

formation, or gangrenous changes documented on the histological report or operative notes. The third group were those with no significant pathology found and a histologically normal appendix. The last group were those patients with other pathology recorded in the operative notes and in whom the histological examination of the appendix was normal. The morbidity of all patients was recorded.

The date of admission was compared with the date of operation. Patients who had their operation performed on the same day of admission were compared with those who had their operation performed on the day following admission. The diagnostic accuracy, percentage of cases of complicated appendicitis, and morbidity rates were compared.

Diagnostic accuracy was defined as the number of histologically-confirmed cases of appendicitis per 100 appendectomy operations. Macroscopically normal appendices with histological evidence of acute appendicitis were classified as acute appendicitis. Complicated appendicitis was defined as those cases where perforation, abscess formation, or gangrenous changes were detected during operation.

Chi-square test was used to examine the difference in proportion and significance was accepted as  $P < 0.05$ .

## Results

Nine hundred and eighty-two patients underwent appendectomy for acute appendicitis from January 1993 through December 1994. Five hundred and five were males and 477 were females. The mean age of these patients was 33.6 years. Seven hundred and thirty-one (74%) had a correct operative diagnosis that was confirmed histologically. Fourteen per cent (103/731) had complicated appendicitis and 9% (87/731) had other intra-abdominal pathologies, the causes for which are listed in the Table. An exploratory laparotomy was undertaken in all of these patients. One hundred and sixty-four (17%) had histologically "white appendices" with no abnormality detected. The overall diagnostic accuracy was 74%. Since patients with other pathology needed laparotomy anyway, the overall diagnostic accuracy rate of an acute abdomen requiring operation was 83% with 17% of patients having undergone unnecessary exploratory surgery.

The diagnostic accuracy for male patients was 82% (414/505) and 66% (317/477) for female patients. This difference was significant (Chi-square = 31.1,  $df = 1$ ,  $P < 0.0001$ ). The diagnostic accuracy within female pa-

tients was further broken down into different age groups for analysis. Knowing that most gynaecological problems occur in those aged between 15 to 40 years, this group was selected for comparison with other female patients. The diagnostic accuracy for this age group was 62% (183/295) compared with 74% (134/182) for other patients. This difference was also significant (Chi-square = 6.79,  $df = 1$ ,  $P=0.016$ ).

Eighty-seven patients had other pathology and were excluded from the analysis of morbidity. The overall morbidity rate of the 895 appendicectomies was 9.2%; 68 patients (7.6%) developed wound infection and 14 (1.6%) had serious complications. These included intra-abdominal abscess, septicaemia, cerebrovascular accident, aspiration pneumonia, caecal fistula, and gut infarction. Three died, giving a mortality rate of 0.3%. The morbidity rate for "white appendices" was 4% (6/164) and that for true appendicitis was 11% (77/731). This difference was significant (Chi-square = 7.53,  $df = 1$ ,  $P=0.006$ ). The morbidity rate for acute appendicitis was 9% (55/628), compared with 21% (22/103) for complicated appendicitis. This difference was significant (Chi-square = 14.9,  $df = 1$ ,  $P<0.0001$ ).

Five hundred and eight patients (52%) were operated on on the day of admission and 474 on the following day. For those who were operated on on the day of admission, 374 had acute appendicitis and 53 had other pathology necessitating laparotomy. For the patients whose operation was performed on the following day, 357 had acute appendicitis and 34 had other pathology necessitating laparotomy. The overall diagnostic accuracy of an acute abdominal condition warranting surgery on the day of admission was 84% (427/508) and for those operated on on the following day, it was 82% (391/474). This difference was not significant. Since the clinical course of patients with other pathology might be different, we excluded them from our subsequent analysis. The diagnostic accuracy (excluding the 87 patients with other pathology) was compared—the diagnostic accuracy of those operated on on the day of admission was 74% (374/508) and for the following day group it was 75% (357/474). This difference was not significant (Chi-square test,  $P=0.46$ ).

One hundred and three patients (14%) had complicated appendicitis. Forty-five (12%) were operated on on the day of admission and 58 (16%) were operated on on the following day. This difference was not significant (Chi-square test,  $P=0.7$ ). The morbidity rate for those operated on on the day of admission was 9.5% (43/455) and for those operated on on the following

day, it was 9.1% (40/440). This difference was not significant (Chi-square test,  $P=0.8$ ).

## Discussion

Acute appendicitis is a definite clinical entity, but there are some acute abdominal conditions that mimic acute appendicitis. Gynaecological causes are well known differential diagnoses and other non-gynaecological causes, such as perforated peptic ulcer, carcinoid tumour, mucocoele, adenoma of the appendix, and caecal diverticulitis are other possibilities. In this retrospective series, laparotomy was indicated in all patients with other pathology. The overall percentage of unnecessary explorations was 17%, which is comparable with recently reported studies.<sup>8</sup>

The choice of incision to be used was affected by the pre-operative diagnosis. While a gridiron incision was employed for all patients undergoing appendicectomy with a clinical diagnosis of acute appendicitis, this incision may not be adequate for exploring conditions such as perforated peptic ulcer or left-sided ovarian cyst. Frequently, the gridiron wound had to be closed and a new midline incision employed for patients with other pathology identified. Hence, a correct pre-operative diagnosis is important and saves a patient from having two wounds from an operation.

Only patients with a correct histological diagnosis were included in the calculation of diagnostic accuracy and morbidity rates because the clinical course of patients with other pathology is different from that of those with acute appendicitis. Since our objective was to review the results of treatment of acute appendicitis, the inclusion of these other patients was inappropriate.

Overall morbidity and mortality was 9.2% and 0.3%, respectively. Wound infection accounted for most of these complications. Complicated appendicitis had a much higher morbidity rate, compared with acute appendicitis. A decrease in complicated appendicitis should lower the morbidity rate. Delay in surgery has been recognised as a cause of complicated appendicitis<sup>6</sup>; both the patient and surgeon contribute to this delay. In those hospitals with resource constraints, clinical judgement remains the most reliable and cost-effective means of making a diagnosis. In some equivocal cases, overnight observation and repeated clinical assessment were employed and this may have accounted for some of the delay. In our hospital, the initial clinical assessment was made by an on call registrar and the patient was usually assessed

by a senior medical officer or consultant surgeon the following day. The percentage of cases of complicated appendicitis and the morbidity rates of these two patient groups were similar. The empirical approach of overnight observation and repeated assessment was not shown to increase the number of cases of complicated appendicitis.

This study also showed that women of child-bearing age had significantly lower diagnostic accuracy rates. This is not surprising, because a number of gynaecological emergencies that can occur in these patients may mimic acute appendicitis. Using overnight observation did not resolve their diagnosis and appendicectomies had to be arranged. If other pathology was found, a formal laparotomy was performed. Diagnostic laparoscopy is particularly useful in this group of patients. Firstly, it can reduce the number of unnecessary appendicectomies conducted.<sup>7</sup> Secondly, an additional or larger incision to diagnose conditions other than appendicitis is avoided, because both appendectomy and many gynaecological procedures can now be performed by laparoscopic means. Moreover, one planned open wound will be sufficient to deal with the problem in case there is a need to convert because the diagnosis will be established by the initial laparoscopic examination.

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