

## ORIGINAL ARTICLE

# Watchful Waiting Versus Interval Appendectomy for Patients Who Recovered from Acute Appendicitis with Tumor Formation: A Cost-effectiveness Analysis

Hung-Wen Lai, Che-Chuan Loong\*, Chew-Wun Wu, Wing-Yui Lui

*Department of Surgery, Taipei Veterans General Hospital, and National Yang-Ming University  
School of Medicine, Taipei, Taiwan, R.O.C.*

**Background:** Interval appendectomy after conservative treatment of appendicitis with tumor formation remains controversial. The purpose of this study was to evaluate the efficacy of interval appendectomy based on a cost-effectiveness analysis.

**Methods:** This was a retrospective study including appendicitis patients with tumor formation who received conservative treatment at first admission to Taipei Veterans General Hospital between January 1998 and December 2003. Demographic data, rate of recurrent appendicitis, and medical costs were analyzed.

**Results:** Of the 165 patients, 1 died after an acute myocardial infarction. The rate of recurrence of appendicitis after conservative treatment was 25.5%. The median cost of follow-up after conservative treatment was NT\$24,344. The median cost of interval appendectomy was NT\$47,746. The median cost of appendectomy after recurrent appendicitis was NT\$62,135. Routine interval appendectomy in all 164 patients would have cost NT\$7,830,344. The follow-up protocol with appendectomy after recurrence cost NT\$5,655,220. An additional NT\$2,175,124 (38%) would have been needed for routine interval appendectomy compared with the follow-up policy, an extra NT\$13,263 per person.

**Conclusion:** Routine interval appendectomy would increase the cost per patient by 38% compared with follow-up and appendectomy after recurrence. Routine interval appendectomy is not a cost-effective intervention. [*J Chin Med Assoc* 2005;68(9):431–434]

**Key Words:** appendicitis, appendicitis with tumor formation, interval appendectomy

## Introduction

About 2–6% of appendicitis presents as a palpable mass over the right lower quadrant of the abdomen.<sup>1–3</sup> The treatment of appendicitis with tumor formation has been debated for more than 100 years. Conservative treatment is an established practice, but the necessity of interval appendectomy remains controversial. Advocates of interval appendectomy propose that since the recurrence rate of appendicitis treated conservatively remains high,<sup>4–6</sup> appendectomy seems

to be the only way to definitely solve the problem. Appendectomy can also provide a definitive diagnosis, and may sometimes reveal an unexpected malignancy. However, another group of surgeons who oppose this policy<sup>7–9</sup> point out that the rate of recurrent appendicitis is around 6–20%,<sup>2,7,10</sup> and that the complication rate of interval appendectomy is not low (9–19%).<sup>2–4,11</sup> Furthermore, routine appendectomy may increase the cost for both patients and institutions. The purpose of this study was to evaluate the role of interval appendectomy based on a cost-effectiveness analysis.

\*Correspondence to: Dr. Che-Chuan Loong, Division of General Surgery, Department of Surgery, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, R.O.C.  
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## Methods

### Patients

We retrospectively surveyed patients admitted to Taipei Veterans General Hospital with the diagnosis of appendicitis between January 1998 and December 2003. Patients who had appendicitis with tumor formation treated conservatively at first admission were included. These patients were treated with intravenous fluid hydration, empiric antibiotics, and nothing per os for 7 days. Oral intake was resumed when their condition improved. Ultrasound- or computed-tomography (CT)-guided drainage or fluid aspiration was performed as needed. Patients were discharged after abdominal pain resolved, fever subsided, and good oral intake was resumed.

### Follow-up

Patients were followed up in the outpatient department. Colonoscopy or barium enema was suggested 5–6 weeks after discharge to exclude the possibility of coexistent colorectal cancer or other etiology such as cecal diverticulitis. Interval appendectomy, if to be performed, was suggested 6–12 weeks after discharge. Patients without interval appendectomy were followed up bimonthly for the first 6 months, then every 6 months up to 1 year. If signs of recurrent appendicitis appeared (such as right lower quadrant pain, or tenderness with or without fever), CT was repeated and appendectomy was performed if recurrent appendicitis was confirmed.

Medical charts were reviewed and demographic data were recorded. Length of hospital stay, complications, and any subsequent appendectomy (scheduled interval appendectomy or appendectomy for recurrent appendicitis) were recorded. Patients who did not undergo appendectomy at our hospital were followed by telephone interview.

### Medical cost

Total medical costs for each patient was calculated from data obtained from the Information Service Center at Taipei Veterans General Hospital. The cost-effectiveness of interval appendectomy was evaluated by comparing the total medical cost of routine interval appendectomy (IA group) and appendectomy performed after recurrence (F/U group). Median cost was used as representative of treatment cost due to the wide variation among individual patients.

### Statistical analysis

Mean hospital length of stay and cost in the 2 groups were compared using the unpaired Student's *t* test.

Operative complication rates were compared using Chi-squared analysis. Probability values less than 0.05 were considered statistically significant. The analysis was carried out using the Statistical Package for the Social Sciences (SPSS) version 11.0 (SPSS Inc, Chicago, IL, USA).

## Results

A total of 165 patients were included, 89 (54%) males and 76 (46%) females. The mean age was 53.7 years (range, 7–89 years). One patient died during hospitalization due to acute myocardial infarction (mortality rate, 0.6%). Among the remaining 164 patients, 70 underwent interval appendectomy before the recurrence of appendicitis. Interval appendectomy was performed at a mean of  $64 \pm 64$  days after discharge (range, 28–245 days). Among the 94 patients who did not undergo routine interval appendectomy, 24 suffered recurrent appendicitis, giving a rate of recurrent appendicitis of 25.5%. Twenty of these 24 recurrences (83.3%) occurred in the first 6 months. Twenty patients with recurrence underwent appendectomy and 4 received conservative treatment despite recurrence. The remaining 70 patients were followed regularly in the outpatient department (Figure 1). Mean patient follow-up was  $33 \pm 20$  months (range, 3–78 months).

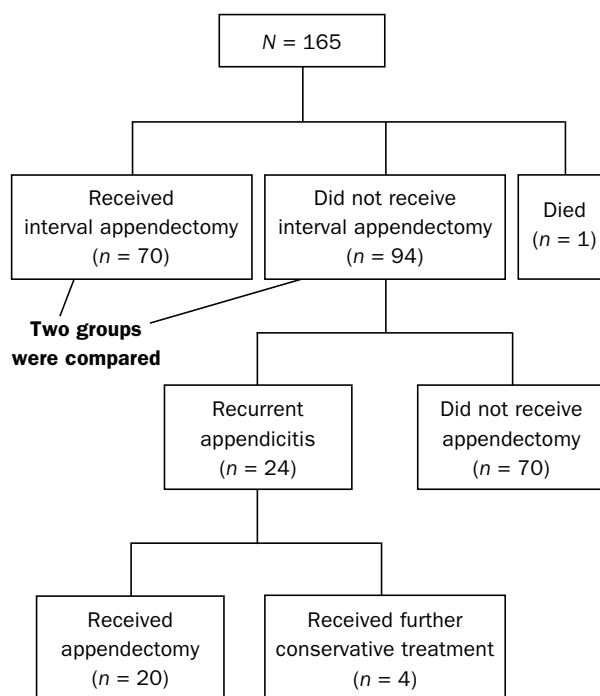


Figure 1. Patient distribution.

The median cost of the follow-up protocol after conservative treatment of appendicitis with tumor formation but no recurrence was NT\$24,344 (Table 1). The median cost of the interval appendectomy protocol was NT\$47,746. The median cost of appendectomy after recurrence was NT\$62,135. If interval appendectomy had been performed routinely in all 164 patients, the total medical cost would have been NT\$7,830,344. If all patients had been treated using the follow-up protocol with appendectomy performed only after recurrence, the total cost would have been NT\$5,655,220 (F/U group) (Table 2). An additional NT\$2,175,124 (NT\$2,175,124/5,655,220, 38%) would have been needed for routine interval appendectomy compared with the follow-up protocol, or an extra NT\$13,263 per patient.

## Discussion

Tumor formation after appendicitis (appendix mass) is the end result of a walled-off appendiceal perforation. Pathologically, it may represent a spectrum ranging from phlegmon to abscess.<sup>12</sup> The former is an inflammatory tumor consisting of the inflamed appendix, its adjacent viscera, and the greater omentum. The latter is a pus-containing appendiceal mass.

Although the surgical treatment of acute appendicitis is widely accepted, management of appendicitis with tumor formation has been controversial for more than a century. Murphy<sup>13</sup> encouraged a limited operation with drainage of pus

and removal of the appendix “if it is accessible and easily amputated”. Ochsner<sup>14</sup> introduced the non-operative approach because of fear that infection would spread with early surgical intervention. McPherson and Kinmonth<sup>15</sup> reported that non-operative management of appendicitis with tumor formation achieved a 76% success rate and 0.8% mortality rate. Later, with the advancement of surgery, anesthesia, and antibiotics, some surgeons advocated early appendectomy instead of observation.<sup>10,16,17</sup> However, early appendectomy was criticized because of the possibility of spread of previously confined infection, injury of inflamed viscera, a higher complication rate, and more unnecessary right hemicolectomy. Currently, the preferred approach to appendicitis with tumor formation appears to be conservative management.<sup>7,8,12,18</sup>

The success rate of conservative treatment of appendicitis with tumor formation ranges from 76% to 97%.<sup>6,15,17,19</sup> CT- or ultrasound-guided drainage of an appendix abscess has made surgical drainage less common.<sup>12,17,19</sup> However, the need for interval appendectomy after conservative treatment remains controversial. The reported incidence of recurrent appendicitis after conservative treatment of an appendix mass ranges from 0% to 20%.<sup>2-4,6-8,10-12,18</sup> The danger of recurrence is reported to be greatest during the first 6 months after the initial episode and minimal after 2 years.<sup>8</sup> The morbidity of interval appendectomy ranges from 3.4% to 19%.<sup>2-4,6,11,18,20-22</sup> Since the rate of recurrent appendicitis is not high and the morbidity of interval appendectomy is not low, physicians often face the dilemma of whether or not to perform interval appendectomy.

**Table 1.** Median cost of different treatment protocols for appendicitis with tumor formation

Group	Cost, NT\$ (range)	SD	Ratio
Follow-up without recurrence	24,344 (3,812–318,479)	67,787	1
Interval appendectomy	47,746 (37,709–129,763)	45,731	1.96
Appendectomy performed after recurrence	62,135 (17,216–360,330)	26,882	2.55

NT\$ = New Taiwan dollars; SD = standard deviation.

**Table 2.** Medical cost of 164 patients managed using different protocols

Protocol	Cost, NT\$	Total cost, NT\$	Average cost/patient, NT\$
Routine interval appendectomy	47,746 × 164	7,830,344	47,746
Conservative with expected recurrence*	(24,344 × 120) + (62,135 × 44)	5,655,220	34,483
Cost difference between protocols	7,830,344 – 5,655,220	2,175,124 <sup>†</sup>	13,263

\*With 164 patients and a 25.5% recurrence rate, 44 patients would suffer from recurrent appendicitis; <sup>†</sup>an additional NT\$2,175,124 is needed if routine appendectomy is performed, about a 38% increase compared with follow-up and appendectomy after recurrent appendicitis. NT\$ = New Taiwan dollars.

It is not economic from a cost-effectiveness point of view to perform routine interval appendectomy after conservative treatment of appendicitis with tumor formation, since 38% additional medical cost is incurred compared with appendectomy performed after recurrence of appendicitis. That means a median NT\$13,263 extra per patient with routine interval appendectomy.

The current health care market has encouraged surgeons to find ways of reducing cost without sacrificing quality of care. Appendicitis is a common disease and has received considerable attention in cost containment strategies. However, these strategies have focused mainly on reducing length of hospital stay in patients with gangrenous and perforated appendicitis rather than the cost of managing appendicitis with tumor formation. This article provides local data about managing patients with appendicitis with tumor formation and analysis of the cost-effectiveness of interval appendectomy. We estimate that the follow-up protocol would have resulted in a tremendous reduction in medical cost compared with scheduled interval appendectomy. It is thus more cost-effective for patients to be followed and undergo appendectomy only in case of recurrence. Hoffmann et al<sup>8</sup> also suggested that routine elective appendectomy can be safely omitted in more than 80% of patients.

In conclusion, routine interval appendectomy increased the cost to patients and institutions by 38%. It is, therefore, not cost-effective to perform interval appendectomy routinely after successful conservative treatment of appendicitis with tumor formation.

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