

Clinical Features of Complicated Acute Appendicitis

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Objective: To identify the clinical features associated with complicated (gangrenous or perforation) acute appendicitis in the patients who underwent appendectomy.

Material and Method: A consecutive series of adult patients with acute appendicitis who underwent appendectomy at Songklanagarind Hospital between 2005 and 2010 were retrospectively analyzed.

Results: Nine hundred twenty four patients were evaluated. Median (interquartile range) age was 34.9 (22.4, 50.1) years. There were 669 (72.4%) simple acute appendicitis and 255 (27.6%) complicated acute appendicitis. Multivariate analyses showed that age >60 years (OR 1.93, 95% CI 1.23-3.02), duration of symptoms >12 hours (OR 3.29, 95% CI 2.25-4.8), anorexia (OR 1.69, 95% CI 1.2-2.37), body temperature >38°C (OR 2.38, 95% CI 1.59-3.58), generalized tenderness (OR 5.36, 95% CI 2.4-11.95), guarding (OR 1.5 95% CI 1.08-2.08), bandemia (OR 1.65, 95% CI 1.16-2.34), pyuria (OR 1.66, 95% CI 1.07-2.57), urine specific gravity ≥ 1.020 (OR 1.66, 95% CI 1.18-2.33), and duration from visit to surgery >12 hours (OR 1.82, 95% CI 1.18-2.82) were related to complicated acute appendicitis.

Conclusion: Ten clinical features can be used to predict the risk of complicated acute appendicitis. However, the strong factors are duration of symptoms, body temperature, and generalized tenderness. They should be the useful tools for acute appendicitis management, especially in limited resources situation.

Keywords: Clinical features, Complicated appendicitis, Acute appendicitis, Ruptured appendicitis, Gangrenous appendicitis

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Acute appendicitis is a common cause of acute abdominal pain and appendectomy is the most frequent emergency abdominal operation⁽¹⁾. It is a wide spectrum of disease exists, ranging from mild inflammation to perforation and peritonitis. The minority (2-10%) will develop to inflammatory appendiceal mass (phlegmon or abscess)^(2,3), which usually has symptoms more than five days and right lower quadrant mass⁽¹⁾. The majority can be classified by pathology into two types, simple (non-advanced) appendicitis and complicated (advanced) appendicitis - perforated or gangrenous appendicitis. The second one was found in 13.8 to 51.6%⁽⁴⁻⁹⁾ of the cases, and has more severe and worse prognosis⁽⁹⁾.

Both simple and complicated appendicitis usually are treated by surgery. To distinguish whether a patient is having simple or complicated appendicitis pre-operatively is very helpful in terms of urgency of management, selection of the treatment strategies (surgery or medication, open or laparoscopic approach,

early or delay appendectomy), prediction of the risk of complications, and the expected post-operative course. The patients with gangrenous or perforating appendicitis require earlier surgery to prevent the infection from spreading. The aim of the present study was to assess the differences in symptoms, signs, and basic laboratory results between patients with simple acute appendicitis and those with perforating or gangrenous appendicitis.

Material and Method

The present study was approved by the Ethics Committee of the Faculty of Medicine of Prince of Songkla University. Patients with acute appendicitis based on pathological results who underwent surgery in Songklanagarind Hospital between January 2005 and December 2010 were collected retrospectively. All patients aged were equal or greater than 15 years. Exclusion criteria were the presence of right lower quadrant mass, pathological evaluation that did not confirm acute appendicitis, or patients under treatment with steroids, chemotherapy, or radiation.

Nine hundred twenty four consecutive eligible patients were included. The outpatient and inpatient medical records, operative notes, anesthetic notes, and pathology reports were reviewed using a standardized

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form designed for the purpose. Information extracted from the medical records included patient age, sex, symptoms and signs, complete blood count result, urinalysis result, duration of symptoms (time from onset of symptoms until arrived the hospital), duration from hospital arrival to surgery, length of hospital stay, and postoperative complications. The type of appendicitis, simple versus complicated, was determined by pathology. The appendix was considered simple if there was inflammation without gangrenous or perforation.

Statistical analysis

Statistical analyses were performed using the R program version 2.14.1 with Epicalc. Demographic and baseline characteristics of all patients were demonstrated as percentages, median and interquartile range (IQR). Chi-square test was used for categorical comparison variables and Wilcoxon Rank Sum test was used for ordinal comparison variables. Statistical significance was defined as a *p*-value less than 0.05. All tests were two-tailed with a 95% confidence interval (CI).

Multiple imputed datasets were created and variance estimates were calculated using R program. Multivariate logistic regression analysis was done to identify the clinical features associated with complicated acute appendicitis.

Results

Nine hundred twenty four patients were identified (448 male, 476 female), with median age of 34.9 years (range, 15-92). Two hundred fifty five patients (27.6%) had complicated acute appendicitis (82 gangrene appendix and 173 perforated appendix), and 669 patients had simple acute appendicitis. The morbidity rate was 11.8% in complicated and 1.3% in simple group. The median length of hospital stay was five days and 2.8 days in complicated and simple group, respectively.

The univariate analyses of complicated acute appendicitis were shown in Table 1. Age, duration of symptoms, migratory pain, anorexia, body temperature (BT), heart rate, severe tenderness, generalized tenderness, guarding, bandemia, urine specific gravity (spgr), white blood cell in urine, and duration between visit to operation were all found to be significant risk factors for complicated appendicitis.

The multivariate analyses of complicated appendicitis were shown in Table 2. It was found that age >60 years (OR 1.93, 95% CI 1.23-3.02), duration

of symptoms >12 hours (OR 3.29, 95% CI 2.25-4.8), anorexia (OR 1.69, 95% CI 1.2-2.37), BT >38°C (OR 2.38, 95% CI 1.59-3.58), generalized tenderness (OR 5.36, 95% CI 2.4-11.95), guarding (OR 1.5, 95% CI 1.08-2.08), bandemia (OR 1.65, 95% CI 1.16-2.34), pyuria (OR 1.66, 95% CI 1.07-2.57), urine spgr ≥1.020 (OR 1.66, 95% CI 1.18-2.33), and duration from visit to surgery >12 hours (OR 1.82, 95% CI 1.18-2.82) were related to complicated acute appendicitis.

Discussion

Although the imaging study such as ultrasonography or computed tomography (CT) can separate simple and complicated acute appendicitis⁽¹⁰⁾, Tsuboi et al⁽¹¹⁾ reported the sensitivity, specificity, and accuracy of CT scan for diagnosis of perforation were 95.0%, 96.8%, and 96.1%, respectively. However, the imaging study has high cost and complications. Moreover, they are not available in all hospitals, especially, in developing countries.

The aim of the present study was to identify the clinical features associated with complicated acute appendicitis (gangrenous or perforation) in the adult patients. Earlier studies have found an incidence of complicated appendicitis varying from 13.8% to 51.6%⁽⁴⁻⁹⁾, compared to 27.6% in the present study. Complicated appendicitis has a worse prognosis than simple appendicitis. We also found that complicated appendicitis had complications nine times higher than simple appendicitis.

The present study showed that age more than sixty year-old, delayed in presentation, presence of anorexia, three physical signs (fever, generalized tenderness, guarding), complete blood count and urinalysis findings (bandemia, pyuria, high urine specific gravity) and delay in surgical intervention were independently associated with increased rates of complicated acute appendicitis.

Moon et al⁽⁸⁾ reported that the incidence of perforated or gangrenous appendicitis was significantly high in patients who were older. In addition, other studies⁽¹²⁻¹⁴⁾ reported that the incidence of perforated appendicitis was significantly high in older. The present study found that patients older than 60 years had significantly higher incidence of complicated appendicitis. This might be explained by lower physiologic reserve in the elders, for example, poorer the appendiceal blood supply and host defense.

The present study found that complicated appendicitis occurred more frequent when delayed in presentation, similar to the finding of Ditillo et al⁽⁵⁾. In

Table 1. Patients characteristics

Characteristics	Total (n = 924)	Complicated appendicitis (n = 255)	Simple appendicitis (n = 669)	p-value
Median age (years) (IQR)	34.9 (22.4, 50.1)	42.9 (26.4, 57.1)	32.3 (21.4, 46)	<0.001*
Female (%)	476 (51.5)	124 (48.6)	352 (52.6)	0.312
Symptoms				
Median duration (hour) (IQR)	15.2 (7, 24)	24 (16.8, 48)	12 (7.2, 24)	<0.001*
Migratory pain (%)	424 (45.9)	102 (40.0)	322 (48.1)	0.041*
Anorexia (%)	507 (54.9)	169 (66.3)	338 (50.5)	0.004*
Nausea/vomiting (%)	578 (62.6)	165 (64.7)	413 (61.7)	0.453
Signs				
Median body temperature (degree Celsius) (IQR)	37.3 (36.8, 37.8)	37.6 (37, 38.2)	37.2 (36.8, 37.7)	<0.001*
Median pulse rate (per minute) (IQR)	86 (78, 98)	90 (80, 102)	84 (76, 96)	<0.001*
Median weight (kilogram) (IQR)	58.2 (51.6, 66)	58.2 (52, 65.5)	58.2 (51.5, 66.4)	0.958
Median height (centimeter) (IQR)	160 (154, 167)	160 (154.2, 165)	160 (154, 168)	0.997
Median body mass index 1.5 (kg/squarmeter) (IQR)	23.2 (20.7, 25.9)	23.5 (20.9, 25.9)	23 (20.5, 25.5)	0.524
Severe tenderness (%)	398 (43.1)	126 (49.4)	272 (40.7)	0.029*
Generalized tenderness (%)	44 (4.8)	33 (12.9)	11 (1.6)	<0.001*
Rebound tenderness (%)	528 (57.1)	144 (56.5)	384 (57.4)	0.922
Guarding (%)	423 (45.8)	145 (56.9)	278 (41.6)	<0.001*
CBC (total 906)				
Median hemoglobin (gram %) (IQR)	13.5 (12.5, 14.9)	13.4 (12.4, 14.8)	13.5 (12.5, 14.9)	0.213
Median white blood cell count (/mm ³) (IQR)	14,420 (11,880, 17,100)	14,450 (11,720, 17,620)	14,410 (11,888, 16,885)	0.527
Median% neutrophil (IQR)	81 (74, 86)	82 (75, 87)	81 (74, 86)	0.074
Presence of band (%)	267 (29.5)	99 (39.3)	168 (25.7)	<0.001*
UA (total 845)				
Rrine spgr ≥1.020 (%)	490 (58.0)	154 (66.4)	336 (54.8)	<0.003*
Hematuria (Rbc ≥3/HP)(%)	228 (27.0)	72 (31.0)	156 (25.4)	0.17
Pyuria (Wbc ≥5/HP)(%)	138 (16.3)	54 (23.3)	84 (13.7)	<0.001*
Median duration between visit to operation (hour) (IQR)	5.8 (4.1, 9)	6.8 (4.5, 11.3)	5.5 (4, 8.4)	<0.001*
Complication (%)	39 (4.2)	30 (11.8)	9 (1.3)	<0.001*
Median length of hospital stay (days) (IQR)	3.0 (2.6, 4.3)	5.0 (3.6, 6.8)	2.8 (2.4, 3.5)	<0.001*

IQR = interquartile range; CBC = complete blood count; UA = urinalysis; urine spgr = urine specific gravity; Rbc = red blood cell; Wbc = white blood cell; HP = high power field

* Statistically significant difference

Table 2. Multivariate analysis for complicated acute appendicitis

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
Age >60 years	2.23 (1.51-3.28)	1.93 (1.23-3.02)	0.004
Duration of symptoms >12 hours	4.01 (2.82-5.7)	3.29 (2.25-4.80)	<0.001
Anorexia	1.97 (1.46-2.65)	1.69 (1.20-2.37)	0.003
BT >38 degree Celsius	3.48 (2.43-4.99)	2.38 (1.59-3.58)	<0.001
Generalized tenderness	8.89 (4.42-17.89)	5.36 (2.40-11.95)	<0.001
Guarding	1.61 (1.21-2.16)	1.50 (1.08-2.08)	0.016
Bandemia	1.89 (1.39-2.57)	1.65 (1.16-2.34)	0.006
Pyuria	2.15 (1.48-3.13)	1.66 (1.07-2.57)	0.022
Urine spgr ≥1.020	1.52 (1.13-2.06)	1.66 (1.18-2.33)	0.004
Duration from visit to surgery >12 hours	2.05 (1.40-3.00)	1.82 (1.18-2.82)	0.007

BT = body temperature; urine spgr = urine specific gravity; OR = odds ratio; 95% CI = 95% confidence interval

addition, Sheu et al⁽¹³⁾ and Kearney et al⁽¹⁵⁾ also reported the same results for ruptured appendicitis. However, contradictory has shown for the studies of Moon et al⁽⁸⁾ and Teixeira et al⁽¹⁴⁾. Moon et al⁽⁸⁾ thought that the patients might have reported the wrong onset of symptoms, thus, wrong times may have been recorded. Sheu et al⁽¹³⁾ also found anorexia to be the only subjective symptom that related to ruptured appendicitis, similar to the present study.

Bickell et al⁽¹²⁾, Sheu et al⁽¹³⁾ and Kearney et al⁽¹⁵⁾ have found that higher body temperature was associated with ruptured appendicitis. The present study supported these results. On the other hand, Williams et al and Narsule et al^(16,17) reported that higher body temperature was not associated with ruptured appendicitis in children. The authors hypothesize that the different mechanism may explain by different in the age group of patients.

Ditillio et al⁽⁵⁾ reported that tenderness to palpation outside the right lower abdomen, right lower abdomen rebound and guarding were related to advanced pathology of the appendix. The present study showed that generalized tenderness (tenderness more than one quadrant) and guarding but not rebound tenderness were associated with complicated appendicitis.

Several studies have shown conflicting data for leukocytosis associated with complicated appendicitis^(8,12-14). The present study showed that either leukocytosis or neutrophilia was not associated with complicated appendicitis. However, the authors had found the correlation between bandemia and complicated appendicitis.

Current data show a 36 to 50% rates of abnormal urinalysis in adult acute appendicitis⁽¹⁸⁻²⁰⁾. It is still unknown whether it can predict complicated appendicitis. The present study showed that pyuria and high urine specific gravity (≥ 1.020) were associated with complicated appendicitis. The reasons for these could be explained by more prominence of periappendiceal inflammation and irritation to the ureter and urinary bladder in complicated appendicitis. Patients with complicated appendicitis have a higher degree of dehydration due to poorer oral intake and third space loss, causing a higher number of urine specific gravity, compared with simple appendicitis. In addition, dehydration may cause decreasing in appendiceal perfusion, reflecting on increasing of complicated appendicitis.

Duration from visit to surgery is mainly a hospital system factor. The shorter the duration, the

better outcome may not be achieved in the present time. Several studies have shown that delayed appendectomy was not associated with complicated or ruptured appendicitis^(5,12,13,21-23). However, some studies have found different results^(6,7,14,15,24-27). Duration from visit to surgery over 12 hours in the present study was associated with complicated appendicitis. According to the present study, we suggest that the appropriate time of appendectomy for acute appendicitis should not exceed 12 hours since the patients presentation.

In conclusion, the present study have demonstrated that clinical features (age, duration of symptoms, anorexia, body temperature, generalized tenderness, guarding, bandemia, pyuria, urine specific gravity, and duration from visit to surgery) can help predict the likelihood of complicated acute appendicitis. However, only duration of symptoms, body temperature and generalized tenderness are strong factors (OR >2). They should be useful tools for acute appendicitis management, especially in limited resources situation.

What is already known on this topic?

Complicated acute appendicitis has a worse prognosis and more urgency than simple acute appendicitis. Few studies have determined the clinical features associated with complicated acute appendicitis. Moreover, they have conflicting results.

What this study adds?

This study described clinical features associated with complicated acute appendicitis. They should be useful tools for acute appendicitis management, especially in limited resources situation.

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Potential conflicts of interest

None.

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ลักษณะทางคลินิกของโรคไส้ติ่งอักเสบเฉียบพลันแบบซับซ้อน

สมฤทธิ มหัทธโนบล, ศรีลา ลำเนา, ประกิต พุกษ์ประเสริฐ

วัตถุประสงค์: เพื่อศึกษาลักษณะทางคลินิกของผู้ป่วยโรคไส้ติ่งอักเสบเฉียบพลันแบบซับซ้อน (ไส้ติ่งเน่าหรือทะลุ) ในผู้ป่วยที่เข้ารับการผ่าตัดไส้ติ่ง

วัสดุและวิธีการ: ได้ทำการศึกษาแบบย้อนหลังเชิงวิเคราะห์ ผู้ป่วยโรคไส้ติ่งอักเสบเฉียบพลัน ที่มีอายุอย่างน้อย 15 ปี และได้รับการผ่าตัดไส้ติ่งในโรงพยาบาลสงขลานครินทร์ระหว่างปี พ.ศ. 2548 ถึง พ.ศ. 2553

ผลการศึกษา: ได้ทำการศึกษาผู้ป่วยจำนวน 924 ราย มีค่ามัธยฐาน (พิสัยควอไทล์) ของอายุเท่ากับ 34.9 ปี (22.4, 50.1) พบว่ามีจำนวนผู้ป่วยไส้ติ่งอักเสบเฉียบพลันแบบไม่ซับซ้อน 669 ราย (72.4%) และไส้ติ่งอักเสบเฉียบพลันแบบซับซ้อน 255 ราย (27.6%) การวิเคราะห์แบบ *multivariate analyses* พบว่าลักษณะทางคลินิกที่สัมพันธ์กับโรคไส้ติ่งอักเสบเฉียบพลันแบบซับซ้อน ได้แก่ อายุมากกว่า 60 ปี (OR 1.93, 95% CI 1.23-3.02) ระยะเวลาตั้งแต่เริ่มมีอาการจนมาถึงโรงพยาบาลมากกว่า 12 ชั่วโมง (OR 3.29, 95% CI 2.25-4.8) อาการเบื่ออาหาร (OR 1.69, 95% CI 1.2-2.37) อุณหภูมิสูงกว่า 38 องศาเซลเซียส (OR 2.38, 95% CI 1.59-3.58) อาการแสดงกดเจ็บของหน้าท้องแบบทั่วไป (OR 5.36, 95% CI 2.4-11.95) อาการแสดงหน้าท้องแข็ง (OR 1.5, 95% CI 1.08-2.08) การตรวจพบตัวอ่อนเม็ดเลือดขาวในเลือด (OR 1.65, 95% CI 1.16-2.34) การตรวจพบเม็ดเลือดขาวในปัสสาวะ (OR 1.66, 95% CI 1.07-2.57) ความถ่วงจำเพาะของปัสสาวะเท่ากับหรือมากกว่า 1.020 (OR 1.66, 95% CI 1.18-2.33) ระยะเวลาตั้งแต่ผู้ป่วยมาถึงโรงพยาบาลจนได้รับการผ่าตัดมากกว่า 12 ชั่วโมง (OR 1.82, 95% CI 1.18-2.82)

สรุป: มีลักษณะทางคลินิก 10 ประการ ที่สามารถใช้ทำนายโอกาสเกิดโรคไส้ติ่งอักเสบเฉียบพลันแบบซับซ้อนได้ อย่างไรก็ตาม ปัจจัยที่มีความสำคัญมากได้แก่ ระยะเวลาของอาการ อุณหภูมิ และอาการแสดงกดเจ็บของหน้าท้อง ผลการศึกษานี้น่าจะมีประโยชน์ในการดูแลผู้ป่วยโรคไส้ติ่งอักเสบเฉียบพลัน โดยเฉพาะอย่างยิ่งในสถานการณ์ที่มีทรัพยากรจำกัด
