Negative Appendectomy and Perforated Appendicitis Rate in the Acute Care Surgery Era

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Background: *Siriraj hospital is a tertiary-care teaching hospital. Ever since 2015, an acute care surgery division has been founded, overall, resulting in less pre-operative time of patient care. The most common problem is acute appendicitis so that the rate of negative appendectomy and complicated appendicitis have been used to compare with the past. In our country, the diagnosis of appendicitis still based on clinical manifestations and routine laboratory investigation. The correlation between the clinical characteristics and pathological subgroups was also determined in our study.*

Objective: *This study was designed to compare the rates of negative appendectomy and complicated appendicitis of patients who underwent urgency appendectomy between one-year before and after the establishment of acute care surgery division. Another purpose is to find the risk factors of negative appendectomy and complicated appendicitis.*

Results: *All 691 (344 in 2014 and 347 in 2015) patients' data were retrospectively collected. In 2015, the average age (39 year), pre-hospital time (24 hour), and portion of pre-operative imaging investigation (18.4%) were not significantly different from 2014. The female ratio was 50.9% in 2014 and 60.8% in 2015 ($p = 0.009$). The in-hospital pre-operative time was reduced for 102 minutes (5 hour 25 minute in 2014 to 3 hour 43 minute in 2015 $p<0.001$). The rate of negative appendectomy was 13.3%, and the rate of complicated appendicitis was 21.3% which not different between two years ($p = 0.207$). The length of stay of either period was similar at 2.5 days. The risk factors of negative appendectomy group were as followed: female gender, age <45, no vomiting, no fever, no guarding, and normal white blood cell counts. Whereas, the risk factors for complicated appendicitis were seen in the elderly from 45 years onwards, prolonged pre-hospital period after symptom onsets >12 hours, associated symptoms of anorexia and diarrhea, body temperature >38.5, tachycardia, tenderness beyond RLQ and guarding sign in physical examination, Neutrophil and band forms percentage >75%, and pre-operative imaging studies.*

Conclusion: *First year of acute care surgery division, we could reduce the burden of pre-operative interval for 1 hour 42 minute compared to 2014. The rate of negative appendectomy (13.3%) and complicated appendicitis (21.3%) were not different from previous year. Many of ordinary clinical findings were reliably implemented to predict the negative appendectomy and complicated appendicitis patient.*

Keywords: *Negative appendectomy, Perforated appendicitis, Acute care surgery*

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Siriraj Hospital is a tertiary-care teaching hospital in Thailand with more than 4,000 acute surgical patients per year. More than half of them present with acute abdomen. Since 2015, Department of Surgery of Siriraj Hospital has established Division of Acute Care Surgery to provide particular service for patients with acute surgical condition not regarding trauma nor patients under 15 years of age, which are under the service of Division of Trauma and Division of Pediatric Surgery, respectively. Division of Acute Care Surgery has a dedicated operating room and a full surgical team standby for 24 hours. The aim is to reduce pre-operative time in diagnosis and preparation and improve the service for patient with acute surgical condition. In this study, we aim to compare the rate of negative appendectomy and complicated appendicitis with the previous ones before the inception of the division. Acute appendicitis was selected for study because it is the most common disease in acute care surgery service.

The standard treatment of acute appendicitis at present is still urgency appendectomy. In the era before the technological advancement of radiological investigation is widely executed, it is reasonable to do emergency surgery because to delay the process would

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result in more complicated appendicitis, and hence more post-operative complications[1,2]. Even if there are many evidences deny these ideas[3], we used to accept the rate of negative appendectomy up to 20% if it keeps the rate of complicated appendicitis acceptable. As a matter of fact, both complicated cases and negative cases result in longer lengths of hospitalization and higher cost. From the past decade to now, the post-operative mortality rate has reduced to less than 1%; however the rate of complicated appendicitis is still the same around 20%. Therefore, the pre-operative diagnosis should be encouraged. By using computed tomography (CT) scan or ultrasonography, we can see that the tendency of negative appendectomy has incidentally reduced to just less than 10% recently[5,6]. Due to limitations in performing emergency pre-operative imaging in our country, the diagnosis of appendicitis at Siriraj Hospital is still mainly based on clinical symptoms, physical examination and basic laboratory investigation[7-9].

Objective

This study was designed to compare the pathological result of patients who undergo urgency appendectomy by comparing between the rates of negative appendectomy and complicated appendicitis between before and after the establishment of acute care surgery department. Another purpose is to find the risk factors of negative appendectomy and complicated appendicitis.

Material and Method

Medical record and clinical data of patients diagnosed with acute appendicitis one year before comparing with one year after the establishment of Division of Acute Care Surgery (2014 to 2015) were retrospectively reviewed. The data included all patients over 15 years old that underwent appendectomy with exceptions as followed: elective interval appendectomy cases, incidental appendectomy, patients with other final diagnosis such as ileal perforation, adenocarcinoma of cecum, lymphoma, complicated gynecologic diseases, omental necrosis etc., other non-inflammatory appendix conditions such as serrated adenoma, chronic appendicitis with xanthomatous granuloma, vasculitis of the appendices wall etc. However, acute appendicitis caused by appendiceal tumor like neuroma, mucinous cystadenoma were included in our study. The pathological results were then divided into three groups. The first group is "negative appendectomy" which the results are unremarkable i.e. submucosal lymphoid hyperplasia, fecalith, periappendicitis, fibrous obliteration congestion. The second group is "uncomplicated appendicitis" which contains early appendicitis, acute appendicitis, and suppurative appendicitis. The third group is "complicated appendicitis" that is consisted of microperforation, focal gangrene, focal perforation, necrotizing appendicitis, gangrenous appendicitis, ruptured appendicitis, perforated appendicitis, and appendiceal abscess. Demographic data of the patients, pre-hospital time, in-hospital pre-operating time, pre-operative imaging investigations were all retrieved from documented electronic medical records. Lengths of stay and post-operative complications were also reviewed to compare between the two eras.

In 2006 Ditillo et al[2] reported the rate of negative appendectomy of 7.5% from 1,287 appendectomies and the rate of complicated appendicitis of 25.8% from 1,081 of appendicitis cases. The sample size is 289 that calculated by estimating the infinite population proportion formula {Proportion (p) = 0.25, Error (d) = 0.05, Alpha (α) = 0.05, Z (0.975) = 1.959964}. The categorical variables were determined using Chi-square test. The comparison of mean was performed by independent sample t-test. The non-parametric variable was analyzed by Mann-Whitney u test. All statistical analysis was performed using the 15th version of SPSS program.

Results

During the 2-year study period, there were 701 patients who are more than 15 years old and underwent appendectomy. Ten of them were excluded because the pathological results were not acute appendicitis. Comparing between the two eras (Table 1), the average age are similar at around 40 years of age, but the proportion of female was significantly higher in the acute care surgery era (50.9% in 2014 vs. 60.8% in 2015; $p = 0.009$). The rate of pre-operative imaging (CT or US) was not significantly different (17.2% in 2014 vs. 18.4% in 2015 $p = 0.667$).

The timing data (Table 2), pre-hospital median times were almost identical at about 24 hours, overall in-hospital pre-operative time was reduced for 102 minutes in acute care surgery era (325 minutes in 2014 vs. 223 minutes in 2015 $p<0.001$). The time consumed in patients who were sent for imaging investigations was statistically shorter from 450 minutes in 2014 to 407 minutes in 2015. Similarly, in patients without radiologic evaluations, the time consumed is significantly shorter

Table 1. Dermographic data between 2014 vs. 2015

	2014 (n = 344)	2015 (n = 347)	*p*-value
Age, mean (year)	40±20	39±19	0.665
Female, ratio	175 (50.9%)	211 (60.8%)	0.009
% imaging (US/CT)	59 (17.2%)	64 (18.4%)	0.667

Table 2. Timing data between 2014 vs. 2015

	2014	2015	*p*-value
Pre-hospital time, median (hour)	24 (2 to 336)	24 (2 to 264)	0.949
In hospital pre-op time, median (minute)	325 (80 to 7,168)	223 (45 to 4,750)	
Without imagings	305 (80 to 7,168)	199 (45 to 1,136)	<0.001
With imagings	450 (125 to 4,667)	407 (125 to 4,750)	
% night-time OR	79.9%	79.5%	0.924
Length of hospital stay (LOS), median (hour)	59 (26 to 581)	58 (20 to 1,277)	0.526

at the median of only 199 minutes in 2015 compared with 305 minutes in 2014. Night-time OR (before 9 AM and after 4 PM) were equal at 80%. Also the length of stay between two years was identical at 2.5 days.

In each pathological group (Fig. 1), we found that in 2015 the rate of negative appendectomy was increased from 9% to 13.3% (31 vs. 46 patients), and the rate of complicated appendicitis was decreased from 22.1% to 21.3% (76 vs. 74 patients). The rate of uncomplicated appendicitis was decreased from 68.9% to 65.4% (237 vs. 227 patients). All with no statistical significance ($p = 0.207$).

The length of stay of "complicated appendicitis" group is significantly about 2 times higher than two other groups ($p<0.001$) at 4 days. After following-up with acute care surgery patients at 30 days, the "complicated appendicitis" group had highest rate of overall complications (31% $p<0.001$). The most common complications were wound problems which included superficial/deep surgical site infection, delayed primary suture, and seroma. Most of wound complications were in "complicated appendicitis" group at 20% comparing to 3% in "uncomplicated appendicitis" group. All 3 patients with complications in the "negative appendectomy" group had post-operative pain. The additional post-operative complications of the patients in 2015 were shown in Table 3.

Table 4 shows the additional clinical data of the patients in 2015 by dividing between three pathological subgroups. We found that the average

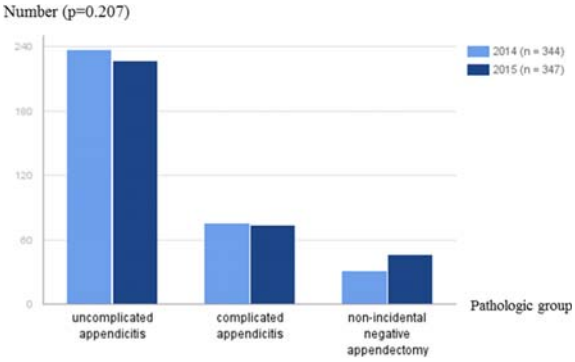

Fig. 1 Pathological report between 2014 vs. 2015.

age was the highest in "complicated appendicitis" group (48 years). The "negative appendectomy" group had lowest average age (30 years) and highest female ratio at 85% ($p = 0.001$).

In parts of clinical manifestations, migratory pain and nausea were not statistically different between each group. But anorexia, vomiting, and diarrhea were most frequent in "complicated appendicitis" group at 80.7%, 50.7% and 38.4% in that order. The body temperature mean was lowest in "negative appendectomy" group at 37.0±0.8 degrees celsius, whereas the mean temperature was highest in "complicated appendectomy" at 37.8±1.1 degrees celsius ($p<0.001$). The pulse rates were not clinically significant between three groups at lower than 100 beats per minute.

Physical examination showed tenderness

Table 3. Length of hospital stay (LOS) and complications in different pathological subgroups

	Total (n = 347)	Negative appendectomy (n = 46)	Uncomplicated appendicitis (n = 227)	Complicated appendicits (n = 74)	*p*-value
Median length of hospital stay (LOS) (hour)	58 (20 to 1,277)	49 (20 to 450)	50 (33 to 200)	97 (31 to 1,277)	<0.001
Complications in 30 days	42 (12%)	3 (6.5%)	16 (7%)	23 (31%)	<0.001
Wounds	22 (6.3%)	0	7	15	
Post-op pain	6 (1.7%)	3	2	1	
Intra-abdominal collection	3 (0.9%)	0	1	2	
Prolong ileus	2 (0.6%)	0	1	1	
Post-op obstruction	2 (0.6%)	0	1	1	
Congestive heart failure (CHF)	2 (0.6%)	0	0	2	
Septic shock	2 (0.6%)	0	2	0	
C. diff. infection	1 (0.3%)	0	1	0	
Fournier's gangrene	1 (0.3%)	0	0	1	
Acute urinary retention (AUR)	1 (0.3%)	0	1	0	

Table 4. Clinical characteristics of acute care surgery patients in 2015 VS pathological subgroups

	Negative appendectomy (n = 46)	Uncomplicated appendicitis (n = 227)	Complicated appendicits (n = 74)	*p*-value
Age (year)	30±13	39±18	48±21	<0.001
Female, ratio	84.8%	55.9%	60.8%	0.001
Median pre-hospital time (hour)	24 (5 to 168)	24 (2 to 264)	24 (3 to 168)	0.303
Migratory pain	63%	66.5%	67.6%	0.886
Anorexia	62.5%	60.4%	80.7%	0.019
Nausea	60.9%	61.5%	67.6%	0.646
Vomiting	23.9%	46.9%	50.7%	0.008
Diarrhea	34.8%	23.7%	38.4%	0.029
Temperature	37.0±0.8	37.3±0.8	37.8±1.1	<0.001
Heart rate (bpm)	93±20	89±17	97±18	0.005
Tenderness RLQ	91.3%	94.7%	71.2%	<0.001
Tenderness RLQ+	8.7%	5.3%	28.8%	
Guarding	4.3%	20.7%	41.1%	<0.001
Rebound	45.7%	53.3%	42.5%	0.233
WBC	12,250±3,637	14,568±4,653	15,104±4,556	0.002
Neutrophil & band (%)	82.2±7.8	79.8±9.9	83.4±8.2	0.011
GYNE consultation	20.5%	16.5%	17.8%	0.849
Alvarado score	6.7±2.0	7.3±1.7	7.8±1.6	0.004
Pre-op imagings	13%	15.4%	31.1%	0.006
Antibiotic at ER	58.7%	68.3%	69.9%	0.405
Consult to OR time interval (minutes)	198 (57 to 1,226)	210 (45 to 3,357)	278 (72 to 4,750)	0.117
Night-time OR	87.0%	80.2%	71.6%	0.118

beyond right lower quadrant at just 8.7% in "negative appendectomy" and 5.3% in "uncomplicated appendicitis". Nonetheless, 28.8% of the patients with complicated appendicitis had tenderness beyond right lower quadrant ($p<0.001$). The sign of guarding was found 2 times less in uncomplicated appendicitis comparing with complicated appendicitis, and was found in only 4.3% of the negative appendectomy

patients (p<0.001).

Laboratory investigations showed that the mean of WBC between complicated appendicitis, uncomplicated appendicitis and negative appendectomy were 15,104±4,556, 14,568±4,653 and 12,250±3,637 (p = 0.002). Whereas the percent of neutrophil and band form were 83.4±8.2, 79.8±9.9, 82.2±-7.8, respectively (p = 0.011).

Alvarado score[10] was also statistically different in each group (p = 0.004). Negative appendectomy had the average score of 6.7±2.0, uncomplicated appendicitis had the score of 7.3±1.7, and complicated appendicitis had the score of 7.8±1.6.

The imaging investigations were performed more than two times higher than other groups in complicated appendicitis group (31.1%) while the least investigated was in negative appendectomy group (13%). The antibiotic usage at ER, the GYNE consultation rate, the in-hospital pre-operating time interval, and the time of operation were not statistically different between all subgroups.

Multiple clinical manifestations were then divided into subgroups which would be used to find risk factors for negative appendectomy (Table 5) and

Table 5. Risk factors of negative appendectomy

	Appendicitis (n = 301)	Negative (n = 46)	OR	*p*-value
Age >45 year				
No	194 (64.5%)	40 (87%)	0.272 (0.112-0.662)	0.002
Yes	107 (35.5%)	6 (13%)		
Gender				
Female	172 (57.1%)	39 (84.8%)	0.239 (0.104-0.552)	<0.001
Male	129 (42.9%)	7 (15.2%)		
Anorexia				
No	85 (34.8%)	15 (37.5%)	0.891 (0.446-1.78)	0.744
Yes	159 (65.5%)	25 (62.5%)		
Vomiting				
No	156 (52.2%)	35 (76.1%)	0.343 (0.168-0.7)	0.002
Yes	143 (47.8%)	11 (23.9%)		
Diarrhea				
No	216 (72.7%)	30 (65.2%)	1.422 (0.736-2.747)	0.293
Yes	81 (27.3%)	16 (34.8%)		
BT >37.8				
No	216 (71.8%)	42 (91.3%)	0.242 (0.084-0.696)	0.003
Yes	85 (28.2%)	4 (8.7%)		
HR >100				
No	219 (73%)	32 (69.6%)	1.183 (0.601-2.33)	0.627
Yes	81 (27%)	14 (30.4%)		
Tenderness				
RLQ	267 (89%)	42 (91.3%)	0.771 (0.260-2.286)	0.638
RLQ + others	33 (11%)	4 (8.7%)		
Guarding				
No	223 (74.3%)	44 (95.7%)	0.132 (0.031-0.556)	0.001
Yes	77 (25.7%)	2 (4.3%)		
WBC >12,000 or <4,000				
No	59 (19.6%)	24 (52.2%)	0.223 (0.117-0.426)	<0.001
Yes	242 (80.4%)	22 (47.8%)		
Neutrophil & band >75%				
No	64 (21.3%)	8 (17.4%)	1.283 (0.57-2.886)	0.546
Yes	237 (78.7%)	38 (82.6%)		
Pre-op imagings				
No	243 (80.7%)	40 (87%)	0.628 (0.254-1.553)	0.311
Yes	58 (19.3%)	6 (13%)		

Table 6. Risk factors of complicated appendicitis

	Uncomplicated (n = 227)	Complicated (n = 74)	OR	*p*-value
Age >45 year				
No	155 (68.3%)	39 (52.7%)	1.932 (1.131-3.299)	0.015
Yes	72 (31.7%)	35 (47.3%)		
Age >55 year				
No	222 (73.8%)	43 (59.7%)	2.281 (1.3-4.004)	0.004
Yes	50 (22%)	29 (40.3%)		
Age >65 year				
No	206 (90.7%)	54 (73%)	3.633 (1.837-7.184)	<0.001
Yes	21 (9.3%)	20 (27%)		
Pre-hos time >12 hour				
No	83 (36.7%)	3 (4.1%)	13.737 (4.194-44.995)	<0.001
Yes	143 (63%)	71 (95.9%)		
Pre-hos time >24 hour				
No	181 (80.1%)	22 (29.7%)	9.507 (5.239-17.252)	<0.001
Yes	45 (19.8%)	52 (70.3%)		
Pre-hos time >48 hour				
No	213 (94.2%)	45 (60.8%)	10.559 (5.094-21.888)	<0.001
Yes	13 (5.8%)	29 (39.2%)		
Anorexia				
No	74 (39.6%)	11 (19.3%)	2.739 (1.333-5.627)	0.005
Yes	113 (60.4%)	46 (80.7%)		
Vomiting				
No	120 (53.1%)	36 (49.3%)	1.164 (0.686-1.973)	0.574
Yes	106 (46.9%)	37 (50.7%)		
Diarrhea				
No	171 (76.3%)	45 (61.6%)	2.008 (1.143-3.527)	0.014
Yes	53 (23.7%)	28 (38.4%)		
Fever >38.5				
No	207 (91.6%)	54 (74%)	3.833 (1.898-7.742)	<0.001
Yes	19 (8.4%)	19 (26%)		
HR >100				
No	176 (77.9%)	43 (58.1%)	2.538 (1.452-4.436)	0.001
Yes	50 (22.1%)	31 (41.9%)		
Tenderness				
RLQ	215 (94.7%)	52 (71.2%)	7.236 (3.346-15.646)	<0.001
RLQ + others	12 (5.3%)	21 (28.8%)		
Guarding				
No	180 (79.3%)	43 (58.9%)	2.672 (1.517-4.706)	0.001
Yes	47 (20.7%)	30 (41.1%)		
WBC >12,000 or <4,000				
No	46 (20.3%)	13 (17.6%)	1.193 (0.604-2.355)	0.621
Yes	181 (79.7%)	61 (82.4%)		
Neutrophil & band >75%				
No	57 (25.1%)	7 (9.5%)	3.209 (1.393-7.392)	0.004
Yes	170 (74.9%)	67 (90.5%)		
Pre-op imagings				
No	192 (84.6%)	51 (68.9%)	2.474 (1.344-4.553)	0.003
Yes	35 (15.4%)	23 (31.1%)		

complicated appendectomy (Table 6). The factors that were significantly different between the appendicitis group and the negative group were as followed: age less than 45 years old (3.676 $p = 0.002$), female (4.184

$p<0.001$), no vomiting (2.915 $p = 0.002$), no fever (4.132 $p = 0.003$), no guarding (7.575 $p = 0.001$), and normal WBC (4.484 $p<0.001$).

In aspect of complicated risk factors, the very high percentage of uncomplicated appendicitis cases (90.7%) were under 65 years old ($p<0.001$). The patients who had less than 12 hours pre-hospital time only results in very few complicated appendicitis, 4.1% to be exact ($p<0.001$). On the contrary, patients with pre-hospital period longer than 48 hours result in only 5.8% uncomplicated appendicitis ($p<0.001$). The other factors that were significantly different between the uncomplicated appendicitis group and the complicated appendicitis group were as followed: anorexia (2.739 $p = 0.014$), diarrhea (2.008 $p = 0.014$), fever more than 38.5 (3.833 $p<0.001$), tachycardia (2.538 $p = 0.001$), tenderness beyond right lower quadrant (7.236 $p<0.001$), guarding (2.672 $p = 0.001$), left shift more than 75% (3.209 $p = 0.004$), and pre-operative imaging study (2.474 $p = 0.003$).

Discussion

The division of Acute Care Surgery was founded in Siriraj Hospital from the start of year 2015. We only have two full-time surgeons on duty with needed supports from staffs in other divisions of General Surgery Department. The goal of our department is no different than other parts of the world, which is to improve the process of emergency patient care in general surgery practice[11-13]. Such as minimizing the time that patients have to wait in the emergency room when the surgeons are still not available, and maximize the efficiency of medical personnel/admission/OR management but still retain the standard of good practice as before or make some improvements. Acute appendicitis was selected for study because it is the most common disease in our services. So the rate of negative appendectomy and complicated appendicitis has been used to compare with the past.

At present, the mortality rate from appendicitis has seen a major decline. So the pre-operative diagnosis should be encouraged even though it adds more pre-operative period. Most of the patients that come to Siriraj Hospital are elderly people with lots of comorbidities and many referred cases from other hospitals as well. Those may consequently result in higher average age, female ratio and pre-hospital time.

However, our rate of 13.3% negative appendectomy and 21.3% complicated appendicitis are quite similar to many other reports such as the study of Seethal et al[14] in 2011 which collected retrospective data of 475,651 adults. There was 11.83% of negative appendectomy which decreased from 14.7% in 1998 and keeps reducing to 8.47% in 2007. Perforated or gangrenous appendicitis rate were below 20%.

In spite of the negative appendectomy rate and the complicated appendicitis rates remained the same, our division could significantly minimize the pre-operative time for 1 hour and 42 minutes. The overall time from consultation to operation was 3 hours and 43 minutes, which includes the processes of other departments as well not just surgery such as hospital administration, documentation, nursing care, laboratory investigations, and radiological investigations.

Importantly, the night-time operation was not decreased even though the night-shift personnel and numbers of operating rooms remain the same. So we would like to utilize our one available operating room in working time to minimize the night-shift burden.

The higher rate of negative appendectomy could have come from the high female ratio of patients, which was significantly increased from 50.9% in 2014 to 60.8% in 2015. Regarding the study of Hale et al[15] in 1997 reported 4,950 patients who underwent appendectomy, they concluded that the risk factor for negative appendectomy was with female gender.

Less than 1% decrease of complicated appendicitis rate could have consequences from late hospitalization, the median time was 24 hours after the symptom onset in both 2014 and 2015. From Ditillo et al[2] study in 2006 which reported on 1,081 patients more than 16 years of age who had appendicitis, they found that the pre-operative time from 23 hours onwards was the significant risk factor for advanced pathological results. And the risk kept increasing to 13 times after 71 hours of onset. Because our study shows only 102 minutes decrease of pre-operative time in 2015, therefore this could not significantly affect the rate of complicated appendicitis.

In the meantime, CT and ultrasound are widely used to help diagnose acute appendicitis[16]. Other than diminishing unnecessary operations they also help the physician make the treatment plan for suspected complication such as appendiceal abscess. According to the report of Surgical Care and Outcomes Assessment Program (SCOAP)[17], 3,540 appendicitis patients in 2006 to 2007 had the imaging investigation rate of 86% (91% CT and 9% US). These patients had 5.6% negative appendectomy and 17% perforation rate comparing to non-imaging investigation group, which

had 9.8% negative appendectomy and 15% perforation rate. In our study, the radiological investigations were used only in some cases (18.4%) in particular who had prolonged persisting symptoms for many days or physical abdominal palpation showed a lump in right lower region suspecting appendiceal abscess. So the complicated appendicitis patients were sent for radiological investigations at about 2 times more than other groups. Predictably, the least radiological investigated was in the negative appendectomy subgroup.

Due to limitations in performance of emergency pre-operative imaging investigation, the diagnosis of appendicitis at Siriraj Hospital still mainly based on clinical symptoms. So the clinical characteristics were used to find the correlation with negative appendectomy or complicated appendicitis patients in our study. The purpose was to find risks for negative appendectomy and also complicated appendicitis so that in the future we could use these radiological investigations for the most beneficial diagnosis.

According to the previous study by Hale et al[15] in 1997, they concluded that the risk for perforated appendicitis was the age over 45 years old. And the risk for negative appendectomy was female gender. Regarding to the study from Temple et al[18] in 1995, they found that patients with perforated appendicitis have 2.5 times longer pre-hospital time after onset of abdominal pain (57 hours) comparing with uncomplicated appendicitis (22 hours). The study by Tom Augustin et al[19] in 2011, showed that perforated appendicitis only found in less than 7% and 9% of patients having symptoms for less than 12 and 36 hours. The male gender had higher incidence of perforated appendicitis during the same time lapse. Other things that they mentioned were the patients which were more than 55 years of age with fever higher than 38.6 degrees celsius and had persistent abdominal pain for more than 24 hours had the highest risk of perforated appendicitis.

From our study, the risk factors for negative appendectomy were as followed: female, Age <45 years, no vomiting symptom, no fever, no guarding sign from physical examination, WBC within 4,000 to 12,000.

The tendency of higher age and longer pre-hospital time results in higher rate of complicated appendicitis than uncomplicated appendicitis (p<0.001). The fever of higher than 38.5 degrees celsius and tachycardia (>100 beats/minute) naturally put patients at risk, which was confirmed in many preceding studies. Other significant risk factors for complicated appendicitis were anorexia, diarrhea, tenderness beyond right lower quadrant, guarding on palpation, and more than 75% of neutrophils and band forms from blood counts. Pre-operative imaging correlates with the higher risk as well, it is possible because in Siriraj Hospital we practically choose the severe/prolonged cases to perform imaging investigations.

All of these findings point to the fact that taking adequate history of each patient, doing accurate and precise physical examination, and sending relevant laboratory investigation are significantly correlated with pathological results and may help reducing unnecessary imaging investigation respectively.

From the data throughout 2015, only 15 patients (4%) underwent laparoscopic appendectomy. Due to economic perspective, laparoscopic appendectomy costs a lot more than open appendectomy so it is not as widely performed especially in Thailand. Regarding the study of Sauerland S et al[20] in 2004, the result of laparoscopic appendectomy in terms of diagnostic value compared with open appendectomy is significant. Laparoscopy minimized negative appendectomy in reproductive female and decrease the numbers of surgical patients with no clear cause of abdominal pain. In terms of complication prognosis, laparoscopic appendectomy yielded less surgical wound infection but had higher risks for intra-abdominal abscess compared with open operation. Consequently, there could be future utilization of laparoscopic operation on emergency patients.

Conclusion

During the first year of acute care surgery in Siriraj Hospital, our division can minimize the burden of pre-operative time for 1 hour 42 minutes compared to 2014. Overall pre-operative time of 2015 is now 3 hours 43 minutes. The rate of negative appendectomy (13.3%) and complicated appendicitis (21.3%) are not different from previous year.

The risk factors of negative appendectomy are female gender, age <45 years, no vomiting symptom, no fever, no guarding sign, and normal range of white blood cell counts. The risk factors for complicated appendicitis are seen an the elderly from 45 years onwards, prolonged pre-hospital period after symptom onsets at more than 12 hours, associated symptoms of anorexia and diarrhea,body temperature >38.5, HR >100, tenderness beyond RLQ, guarding, Neutrophil and band forms percentage >75%, and pre-operative imaging studies.

What is already known on this topic?

All risk factors from previous studies that similarly affect the pathological grading of acute appendicitis conditions.

What this study adds?

The impact from the coming of acute care surgery department in outcome of those changes in management for the most common urgency surgical conditions.

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Potential conflicts of interest

None.

References

1. Von Titte SN, McCabe CJ, Ottinger LW. Delayed appendectomy for appendicitis: causes and consequences. Am J Emerg Med 1996; 14: 620-2.
2. Ditillo MF, Dziura JD, Rabinovici R. Is it safe to delay appendectomy in adults with acute appendicitis? Ann Surg 2006; 244: 656-60.
3. Ingraham AM, Cohen ME, Bilimoria KY, Ko CY, Hall BL, Russell TR, et al. Effect of delay to operation on outcomes in adults with acute appendicitis. Arch Surg 2010; 145: 886-92.
4. Andersson RE. The natural history and traditional management of appendicitis revisited: spontaneous resolution and predominance of prehospital perforations imply that a correct diagnosis is more important than an early diagnosis. World J Surg 2007; 31: 86-92.
5. Rao PM, Rhea JT, Rattner DW, Venus LG, Novelline RA. Introduction of appendiceal CT: impact on negative appendectomy and appendiceal perforation rates. Ann Surg 1999; 229: 344-9.
6. Krajewski S, Brown J, Phang PT, Raval M, Brown CJ. Impact of computed tomography of the abdomen on clinical outcomes in patients with acute right lower quadrant pain: a meta-analysis. Can J Surg 2011; 54: 43-53.
7. Lewis FR, Holcroft JW, Boey J, Dunphy E. Appendicitis. A critical review of diagnosis and treatment in 1,000 cases. Arch Surg 1975; 110: 677-84.
8. Wagner JM, McKinney WP, Carpenter JL. Does this patient have appendicitis? JAMA 1996; 276: 1589-94.
9. Paulson EK, Kalady MF, Pappas TN. Clinical practice. Suspected appendicitis. N Engl J Med 2003; 348: 236-42.
10. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Ann Emerg Med 1986; 15: 557-64.
11. Earley AS, Pryor JP, Kim PK, Hedrick JH, Kurichi JE, Minogue AC, et al. An acute care surgery model improves outcomes in patients with appendicitis. Ann Surg 2006; 244: 498-504.
12. Cubas RF, Gomez NR, Rodriguez S, Wanis M, Sivanandam A, Garberoglio CA. Outcomes in the management of appendicitis and cholecystitis in the setting of a new acute care surgery service model: impact on timing and cost. J Am Coll Surg 2012; 215: 715-21.
13. Madore JC, Collins CE, Ayturk MD, Santry HP. The impact of acute care surgery on appendicitis outcomes: Results from a national sample of university-affiliated hospitals. J Trauma Acute Care Surg 2015; 79: 282-8.
14. Seetahal SA, Bolorunduro OB, Sookdeo TC, Oyetunji TA, Greene WR, Frederick W, et al. Negative appendectomy: a 10-year review of a nationally representative sample. Am J Surg 2011; 201: 433-7.
15. Hale DA, Molloy M, Pearl RH, Schutt DC, Jaques DP. Appendectomy: a contemporary appraisal. Ann Surg 1997; 225: 252-61.
16. Rao PM, Rhea JT, Novelline RA, Mostafavi AA, McCabe CJ. Effect of computed tomography of the appendix on treatment of patients and use of hospital resources. N Engl J Med 1998; 338: 141-6.
17. Cuschieri J, Florence M, Flum DR, Jurkovich GJ, Lin P, Steele SR, et al. Negative appendectomy and imaging accuracy in the Washington State Surgical Care and Outcomes Assessment Program. Ann Surg 2008; 248: 557-63.
18. Temple CL, Huchcroft SA, Temple WJ. The natural history of appendicitis in adults. A prospective study. Ann Surg 1995; 221: 278-81.
19. Augustin T, Cagir B, Vandermeer TJ. Characteristics of perforated appendicitis: effect of delay is

confounded by age and gender. J Gastrointest Surg 2011; 15: 1223-31.
20. Sauerland S, Lefering R, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. Cochrane Database Syst Rev 2004; CD001546.

อัตราไส้ติ่งปกติและไส้ติ่งแตกในยุคศัลยศาสตร์ฉุกเฉิน

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ภูมิหลัง: โรงพยาบาลศิริราชเป็นโรงเรียนแพทย์และเป็นโรงพยาบาลระดับ tertiary care ต้องรับดูแลผู้ป่วยที่มาด้วยภาวะฉุกเฉินทางศัลยกรรมเป็นจำนวนกว่า 4,000 รายต่อปี โดยมากกว่าครึ่งหนึ่งเป็นผู้ป่วยที่มีภาวะฉุกเฉินในช่องท้องตั้งแต่เริ่มปี พ.ศ. 2558 แผนกศัลยศาสตร์โรงพยาบาลศิริราชได้ก่อตั้งหน่วยงานศัลยศาสตร์ฉุกเฉิน acute care surgery เพื่อมาพัฒนาการดูแลผู้ป่วยที่มีภาวะเร่งด่วนทางศัลยกรรมเหล่านี้โดยไม่รวมผู้ป่วยอุบัติเหตุ และผู้ป่วยที่มีอายุต่ำกว่า 15 ปี ทางหน่วยงานมีการเริ่มเก็บข้อมูลสถิติขั้นตอนต่าง ๆ อย่างเป็นระบบ มีห้องผ่าตัดของตัวเอง 1 ห้อง และมีทีมศัลยแพทย์คอยรองรับผู้ป่วยตลอด 24 ชั่วโมง โดยรวมสามารถลดระยะเวลาการดูแลผู้ป่วยช่วงก่อนผ่าตัดได้ เนื่องจากโรคอันดับหนึ่งที่รับปรึกษาคือ ภาวะไส้ติ่งอักเสบ acute appendicitis and complications ดังนั้นอัตราของไส้ติ่งปกติ negative appendectomy และไส้ติ่งแตก complicated appendicitis จึงถูกนำมาศึกษาเปรียบเทียบกับในอดีต ประเทศไทยโดยเฉพาะในโรงพยาบาลของเรา การวินิจฉัยและการตัดสินใจให้การรักษาในผู้ป่วยที่สงสัย ภาวะปวดท้องเฉียบพลันจากไส้ติ่งอักเสบส่วนใหญ่ ยังใช้อาการ อาการแสดง และการแปลผลการตรวจพื้นฐาน ทางห้องปฏิบัติการเป็นหลัก การตัดสินลักษณะทางคลินิคของผู้ป่วยก่อนผ่าตัด จึงส่งผลต่อผลการรักษาข้อมูลดังกล่าวจึงถูกนำมาหาความสัมพันธ์กับผลการตรวจทางพยาธิ เพื่อบอกปัจจัยเสี่ยงของกลุ่ม negative appendectomy และ complicated appendicitis

วัตถุประสงค์: การศึกษานี้ออกแบบเพื่อเปรียบเทียบผลการตรวจทางพยาธิของผู้ป่วยที่มารับการผ่าตัดภาวะไส้ติ่งอักเสบแบบฉุกเฉิน โดยพิจารณาจากอัตราของไส้ติ่งปกติ negative appendectomy และไส้ติ่งแตก complicated appendicitis ระหว่างก่อนและหลังมีหน่วยงาน acute care surgery และหาปัจจัยเสี่ยงต่ออัตราของไส้ติ่งปกติ negative appendectomy และไส้ติ่งแตก complicated appendicitis

วัสดุและวิธีการ: ค้นข้อมูลผู้ป่วยย้อนหลัง 1 ปีก่อนและ 1 ปีหลังมีหน่วยงาน acute care surgery คือตลอดทั้งปี พ.ศ. 2557 และ พ.ศ. 2558 ของผู้ป่วยอายุมากกว่า 15 ปีทุกราย ที่ได้รับการผ่าตัดภาวะไส้ติ่งอักเสบแบบฉุกเฉินไม่รวมผู้ป่วยที่ถูกนัดมาผ่าตัด interval appendectomy ไม่รวมผู้ป่วยที่ตัดไส้ติ่งแบบไม่มีอาการ incidental appendectomy ข้อมูลทั่วไปของผู้ป่วยเวลาที่ผู้ป่วยปวดท้องก่อนมาถึงโรงพยาบาล เวลาตั้งแต่ได้รับปรึกษาจนผู้ป่วยเข้าห้องผ่าตัด การส่งตรวจทางรังสีวินิจฉัยก่อนผ่าตัดได้จากเวชระเบียนอิเลคโทรนิค ซึ่งถูกบันทึกในช่วงก่อนผ่าตัดและเวลาที่อยู่ในโรงพยาบาลถูกบันทึกเพื่อเปรียบเทียบระหว่างสองปี

ผลการศึกษา: มีจำนวนผู้ป่วยรวม 691 ราย อายุเฉลี่ย 40 ปี เมื่อเปรียบเทียบกับปี พ.ศ. 2557 หลังมี acute care surgery สัดส่วนเพศหญิงเพิ่มขึ้นจากร้อยละ 50.9 เป็นร้อยละ 60.8 p = 0.009 ผลการตรวจทางพยาธิพบอัตรา negative appendectomy เพิ่มจากร้อยละ 9 เป็นร้อยละ 13.3 และอัตรา complicated appendicitis ลดลงจากร้อยละ 22.1 เหลือร้อยละ 21.3 p = 0.027 อัตราการส่งตรวจทางรังสีวินิจฉัยเพิ่มขึ้นจาก ร้อยละ 17.2 เป็นร้อยละ 18.4 p = 0.667 ระยะเวลาก่อนผ่าตัดลดลงลดลง 102 นาที จาก 325 นาที เหลือ 223 นาที p<0.001 ค่ากลาง LOS ลดลงจาก 59 ชั่วโมง เป็น 58 ชั่วโมง p = 0.526 ปัจจัยเสี่ยงของกลุ่ม negative appendectomy ได้แก่ เพศหญิง p<0.001 อายุน้อยกว่า 45 ปี p = 0.002,

ไม่มีไข้ p = 0.003, ไม่มีอาการอาเจียน p = 0.002, ไม่มี guarding p = 0.001, และ WBC ปกติ p<0.001 ส่วนปัจจัยเสี่ยงต่อ complicated appendicitis ได้แก่ แนวโน้มอายุที่มากขึ้นตั้งแต่ 45 ปี p = 0.015, เวลาปวดท้องก่อนมาโรงพยาบาลที่นานขึ้นกว่า 12 ชั่วโมง p<0.001, anorexia p = 0.005, diarrhea p = 0.014, ไข้มากกว่า 38.5 p<0.001, HR >100 p = 0.001, tender RLQ + others p<0.001, guarding p = 0.001, %neutrophil >75 p = 0.004, และ pre-op imaging p = 0.003

สรุป: *ปีแรกของหน่วยงาน acute care surgery ในโรงพยาบาลศิริราช สามารถลดระยะเวลาการดูแลก่อนผ่าตัด สำหรับผู้ป่วยที่สงสัยภาวะไส้ติ่งอักเสบไปได้ 1 ชั่วโมง 42 นาที ใช้เวลาก่อนผ่าตัดรวม 3 ชั่วโมง 43 นาที โดยอัตรา negative appendectomy และ complicated appendicitis ไม่แตกต่างกับปีก่อน ปัจจัยเสี่ยงของกลุ่ม negative appendectomy ได้แก่ เพศหญิง อายุน้อยกว่า 45 ปี, ไม่มีไข้ ไม่มีอาการอาเจียน, ไม่มี guarding, WBC ปกติ ส่วนปัจจัยเสี่ยงต่อ complicated appendicitis คือแนวโน้มอายุที่มากขึ้นตั้งแต่ 45 ปี, เวลาปวดท้องก่อนมาโรงพยาบาลที่นานขึ้นกว่า 12 ชั่วโมง, anorexia, diarrhea, ไข้สูงกว่า 38.5, HR >100, tender RLQ + others, guarding, % neutrophil >75, และ pre-op imaging*