

Case Analysis

Acute Appendicitis in Pregnancy

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Key Words

Acute appendicitis;

Appendectomy;

Pregnancy

Purpose. Acute appendicitis is one of the most common non-obstetric emergencies during pregnancy and early appendectomy is the usual treatment of choice. Because accurate diagnosis in pregnant women is more challenging due to the combined obstetric symptoms, this study reviewed such cases.

Methods. From October 1993 to July 2008, 31 pregnant patients who underwent appendectomy for acute appendicitis at the National Taiwan University Hospital were identified. Data on their gestational age, symptoms, leukocyte count, abdominal sonography, pathologic diagnosis, and peri-operative obstetric events were obtained through a retrospective chart review.

Results. Of the 31 patients who underwent appendectomy, 25 had confirmed acute appendicitis by histopathology. The patients were divided into the negative appendectomy (NA) group (n = 6) and the positive appendectomy (PA) group (n = 25). The median leukocyte count was 14,970/mm³ in the PA group and 11,695/mm³ in the NA group ($p = 0.048$). The symptom of right lower quadrant pain was 100% in the NA group ($p = 0.004$). Abdominal sonography had 80% sensitivity and 75% specificity. Among the first, second and third trimesters, diagnostic accuracy was 88.9%, 73.3%, and 85.7%, respectively (average 80.6%). Ten patients were complicated by obstetric events, including fetal death (n = 1) and artificial abortion (n = 2). Obstetric events were more in the PA group.

Conclusions. The diagnostic accuracy of acute appendicitis in pregnant women is comparable to that of the general population. Physical examination and history taking remain important. Early appendectomy prevents complicated conditions. There are more obstetric events in pregnant patients of true appendicitis.

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Acute appendicitis is one of the most common non-obstetric emergencies in pregnancy. Its incidence is not higher in pregnant patients than in age-matched females, and even lower incidence is observed.¹ Diagnosis is based on physical examination, laboratory parameters, and imaging tools. However, pregnant women are more challenging because obstetric symptoms mimic true appendicitis. Early appen-

dectomy is usually advised to prevent potential adverse impact on the fetus.

In earlier studies, the accurate diagnosis rate in such conditions is about 64%.^{2,3} Classic obstetric teaching has been that upward change of pain location due to displacement of the appendix is secondary to a growing uterus.⁴ The presence of typical pain pattern, epigastric pain migrating to the right lower quadrant

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(RLQ), needs to be validated. Nonetheless, ultrasonography helps clinicians detect appendicitis in gravid conditions and avoids radiation exposure from computed tomography (CT) scan.⁵ This study aimed to review cases of acute appendicitis in pregnancy.

Materials and Methods

From October 1993 to July 2008, 36 patients with acute appendicitis during pregnancy at the National Taiwan University Hospital were identified based on the ICD-9 codes for diseases and interventions. Five patients were excluded because no appendectomy was performed. Chart review and analysis provided details regarding gestational age, presenting symptoms, laboratory data, abdominal sonography, operative finding, complications, obstetric events and hospital course.

Gestation age was grouped by the definition of classic obstetric reference.⁶ Diagnostic accuracy was defined as the percentage of resected appendices with pathologic diagnosis of acute appendicitis from the total number of appendectomies. Pathologists confirmed the appendicitis by histologic examination according to a previous report.⁷ Complicated appendicitis was considered as those with perforation or abscess formation.

The Fisher exact test was used for categorical data and the Whitney-Mann U-test for numerical variables. Probability values < 0.05 were considered statistically significant.

Results

Thirty-six (36) patients diagnosed with acute appendicitis in pregnancy were identified during the study period but five patients without appendectomies were excluded. Six patients underwent negative appendectomy. There were 42682 deliveries at the hospital during the study period, corresponding to an estimated incidence of 1 in 1707 deliveries (25/42682). The operated patients were divided into the negative appendectomy (NA) group (n = 6) and the positive appendectomy (PA) group (n = 25).

Demographic data of two groups was showed in

Table 1. The median leukocyte count was 11,695/mm³ in the NA group and 14,970/mm³ in the PA group ($p = 0.048$). Leukocyte count was > 10,000/mm³ in both groups but significantly higher in the PA group. Median body temperature was not statistically significant.

Acute appendicitis was confirmed pathologically in 25 of the 31 (80.6%) women. Eight cases (32%) were in the 1st trimester, 11 (44%) in the 2nd trimester, and 6 (24%) in the 3rd trimester. The diagnostic rate was 88.9%, 73.3%, and 85.7% in the first, second and third trimester, respectively (Fig. 1).

The presenting symptoms of the PA and NA group were summarized in Table 2. Typical shifting pattern of pain was confirmed in 11 patients (44%) in the PA group but none in the NA group ($p = 0.065$). Though this finding did not reach statistical significance, we concerned that shifting pain still occurred in pregnant patients and remains important. Right low quadrant (RLQ) pain was 33% and 100% in the PA and NA groups ($p = 0.004$), which meant that RLQ pain was more associated with false appendicitis. Complicated appendicitis rate was 24% (n = 6) in the PA group, including one abscess formation. There was wound infection in two patients in the PA group (8%) but none

Table 1. Characters of the patients

	PA* (n = 25)	NA** (n = 6)	p value
Age, median	32 (19-40)	29.5 (21-32)	0.316
Gestational age			0.600
1-14	8	1	
15-28	11	4	
29-40	6	1	
Body temperature, median	37.0 (35.2-38.4)	36.8 (35.6-37.5)	0.437
Leukocyte count, median	14,970 (8,830-26,990)	11,695 (9,020-20,880)	0.048 [†]
Shifting pain	11 (44%)	0	0.065
RLQ pain	8 (32%)	6 (100%)	0.004 [†]
Histologic finding			
Normal	0	6 (100%)	1.000
Simple	19 (76%)	0	1.000
Complicated	6 (24%)	0	1.000
Wound infection	2 (8%)	0	1.000
Length of stay, median, day	6 (2-44)	3.5 (2-5)	0.04 [†]
Maternal mortality	0	0	1.000
Obstetric events	9 (36%)	1 (16%)	0.634

* PA: Positive Appendectomy; ** NA: Negative Appendectomy

[†] Statistic significance: $p < 0.05$

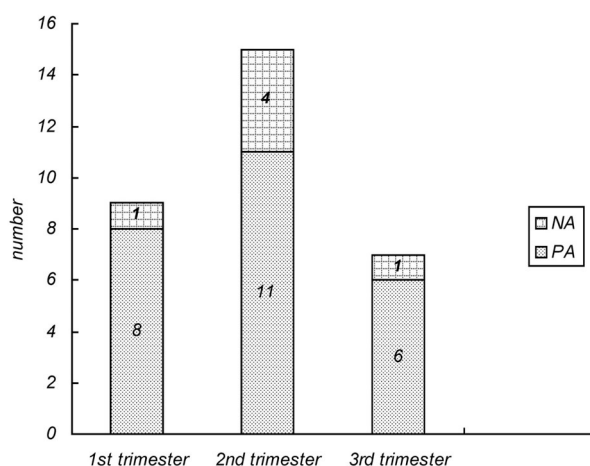


Fig. 1. Number of patients in each trimester.

PA: Positive Appendectomy; NA: Negative Appendectomy

in the NA group. The median length of hospital stay was 6 days and 3 days in the PA and NA groups, respectively ($p = 0.044$). Mortality rate was zero.

Abdominal echography was performed in 19 patients, with a sensitivity of 80% and specificity of 75% (Table 3). No computed tomography or magnetic resonance imaging was performed.

Among the 31 patients, peri-operative obstetric events occurred in 10 cases (Table 4). There were more obstetric events in the PA group, including one intrauterine fetal death at 34 weeks of gestation because the patient hesitated with the surgery. Two artificial abortions were requested after positive appen-

Table 3. Abdominal sonography performed in PA and NA group

	PA* (n = 25)	NA** (n = 6)
Echo performed	15	4
Positive	12	1
Negative	3	3
Sensitivity	12/15 (80%)	-
Specificity	-	3/4 (75%)

* PA: Positive Appendectomy; ** NA: Negative Appendectomy

Table 4. Perioperative obstetric events in PA & NA group

	PA* (n = 25)	NA** (n = 6)
Synchronous CS [#]	4	1
Preterm labor	2	0
Artificial abortion	2	0
Fetal death	1	0
Total number	9 (36%)	1 (16%)

[#] CS: cesarean section; * PA: Positive Appendectomy; ** NA: Negative Appendectomy

dectomy, while two patients suffered from pre-term labor after positive appendectomy and required tocolytic medication. One obstetric event in the NA group was an undue cesarean section to facilitate appendectomy in a 38-week pregnant woman.

The operation time interval after symptom onset in the PA group was analyzed (Table 5). Complicated appendicitis was more in patients receiving operation later than 24 hours but obstetric events distributed more in short operation interval.

Table 2. Symptoms of pain in the patients

	Positive appendectomy (n = 25)					
	Shifting pain	RLQ	RUQ	Pelvic	Epigastric	Flank
Gestation age						
1-14	5	2	0	1	0	0
15-28	4	4	1	2	0	0
29-40	2	2	0	0	1	1
Total	11 (44%)	8 (32%)	1 (4%)	3 (12%)	1 (4%)	1 (4%)
	Negative appendectomy (n = 6)					
	Shifting pain	RLQ	RUQ	Pelvic	Epigastric	Flank
Gestation age						
1-14	0	1	0	0	0	0
15-28	0	4	0	0	0	0
29-40	0	1	0	0	0	0
Total	0 (0%)	6 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Table 5. Complicated cases in relation to operation time in PA group (n = 25)

	< 24 hours*	> 24 hours**
Complicated appendicitis [#]	2	4
Simple appendicitis	16	3
Obstetric events	7	2
Without obstetric events	11	5

[#] including perforation and abscess formation

* < 24 hours: from symptom onset to operation less than 24 hours

** > 24 hours: from symptom onset to operation more than 24 hours

Discussion

In the general population, the lifetime risk of acute appendicitis is about 8.6% for males and 6.7% for females.⁸ The incidence is not higher in pregnancy.⁹ The incidence of appendicitis in pregnancy in this study is one in 1707, which is lower than the 1:810 reported by Torsten et al¹⁰ and 1:1440 by Mazze et al.³ Early appendectomy is always advised for appendicitis in pregnancy to prevent any potential adverse impact on the fetus. However, diagnosis is more challenging because of the concomitant obstetric symptoms.

Body temperature does not have any clinical relevance to support or exclude acute appendicitis. Leukocytosis, a physiologic change during pregnancy,¹¹ may mask the inflammatory signs of appendicitis. One previous report has concluded that leukocyte count or body temperature has no clinical value in diagnosing appendicitis in the general population.¹² Its diagnostic relevance in pregnancy remains to be validated by further study.

Regarding pain presentation, the results here reveal that RLQ pain is associated more with false appendicitis, a statistical finding that contradicts previous reports.^{13,14} It may be that RLQ pain in pregnancy requires more differential diagnoses and may not always be related to true appendicitis. Recognizing the shifting pain still helps in the diagnosis of acute appendicitis in pregnant patients. The impressive illustration of displacement of appendix by growing uterus in Baer's study⁴ suggested that somatic pain caused by acute appendicitis should migrate as well. In the PA group (Table 2), pain location outside of RLQ is 24%

and it could be RUQ or flank area in late pregnancy. Complicated appendicitis could be expected if appendectomy is late to perform.

Several imaging modalities are used to help in diagnosing appendicitis. Abdominal sonography is valued for its real-time and minimal radiation exposure.⁵ However, its competency always depends on experienced operators. In the study patients who received abdominal sonography, the sensitivity and specificity are not so impressive to be considered a competent diagnostic utility. This may be due to variations between individual operators. Although computed tomography has diagnostic superiority,¹⁵ there is significant concern for its use in pregnancy due to the potential teratogenesis. The risk of central nervous system effects is greatest with radiation exposure at 8-15 weeks of gestation.¹⁶ Ionizing radiation is unlikely to induce teratogenic effects before the 2nd week and after the 20th week of embryonic age.¹⁷

Intravenous iodinated contrast seems safe in pregnancy. Fetal risk of anomalies does not increase with radiation exposure less than 5 rads (0.05 Gy) according to the current practice guidelines.¹⁶ Magnetic resonance imaging (MRI) is another useful tool for elective cases of suspected appendicitis but intravenous gadolinium is labeled as category C by the Food and Drug Administration (FDA) in America.¹⁷ A previous report suggests that positive predictors of fetal loss are associated with complicated appendicitis and negative appendectomy.¹⁸ In this study, obstetric events are mainly in the patients of true appendicitis. All three fetal losses are in the PA group while there is no fetal loss in the NA group. We believe that obstetric events are more associated with true appendicitis (Table 4) and surgical intervention is beneficial in this condition. Delayed appendectomy results in complicated status, which impacts on fetal safety.

Conclusions

Accurate diagnosis of acute appendicitis in pregnant women is comparable to that of the general population. There is a higher negative appendectomy rate in the 2nd trimester. Careful history taking and physical examination remains important in diagnosing

acute appendicitis in addition to modern imaging tools. Early appendectomy prevents complicated conditions. There are more obstetric events in pregnant patients of true appendicitis. Due to the limited number of cases, more studies are warranted to establish clinical evidence.

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病例分析

懷孕婦女的急性闌尾炎

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目的 急性闌尾炎是懷孕婦女最常見的腹部急症之一。及早闌尾切除一直是被視為首選的治療方式，然而懷孕婦女同時合併有婦產科的症狀，因此對於急性闌尾炎的診斷被認為是比較困難。我們回顧本院接受闌尾切除手術的懷孕婦女來加以探討。

方法 從 1993 年 10 月到 2008 年 7 月一共有 31 位懷孕婦女經診斷是急性闌尾炎而在臺大醫院接受闌尾切除手術。我們回顧收集這些病人的臨床資料包括懷孕週數，表現症狀，白血球數，術前超音波，病理診斷及相關產科事件。

結果 31 位懷孕婦女接受闌尾切除手術，經病理切片分析符合急性闌尾炎者有 25 位。我們把 31 位病人分成陽性闌尾炎切除組 ($n = 25$) 及陰性闌尾炎切除組 ($n = 6$)。白血球數在陽性闌尾炎切除組較高 ($p = 0.048$)，右下腹疼痛在陰性闌尾炎切除組表現為 100% ($p = 0.004$)，至於腹部超音波的敏感度是 80% 而專一性是 75%。正確診斷率在不同的三月期 (trimester) 分別是 88.9%，73.3%，85.7%，平均診斷率為 80.6%。有 10 位婦女出現產科事件，包括一位死產以及兩位人工流產。

結論 急性闌尾炎的正確診斷率在懷孕婦女是相當於一般人，理學檢查以及問診對於診斷仍然相當重要，及早闌尾切除可避免複雜的窘境，然而產科事件在陽性闌尾炎的病人的確比較多。

關鍵詞 急性闌尾炎、闌尾切除術、懷孕婦女。