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Original Article

Acute appendicitis in pregnancy; A single center experience

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ABSTRACT

Objective: In our study, we aimed to share the data of our patients who were diagnosed with acute appendicitis during pregnancy in our clinic. **Materials and Methods:** Pregnant women who were operated for acute appendicitis between April 2008 and May 2021 were included in the study. Demographic data of the patients, gestational week, physical examination and laboratory values at the time of admission, ultrasonography findings, type of surgery performed, surgical findings, pathology results and fetal-maternal complications that developed during postoperative follow -up were reviewed retrospectively through the hospital system.

Results: From the clinicopathological features of the patients, only re-operation due to appendiceal stump leakage (p:0.04) and drain placement during operation (p:0.046) were significantly associated with miscarriage. Although complications and abortion rates were higher in patients with perforation and periappendicular abscess, the difference was not statistically significant.

Conclusion: Detailed history and physical examination are key for the diagnosis of acute appendicitis in pregnant women. Any patient with right lower quadrant pain, nausea, vomiting and fever, who has tenderness and defensive rebound in the right lower quadrant on physical examination should be considered as appendicitis after obstetric causes are excluded, until proven otherwise.

Keywords: appendicitis; pregnancy; ultrasonography

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Introduction

Appendicitis is one of the most common surgical emergencies in general surgery practice. It is a condition characterized by the development of inflammation in the organ wall and localized peritonitis due to obstruction in the appendix lumen or due to other intra-abdominal causes. The development of appendicitis is due to multifactorial causes and is thought to occur as a result of a combination of both genetic and environmental factors. However, its pathophysiology is not fully understood. [1,2] There are scoring systems, such as Alvarado, based on physical examination and laboratory values developed for the diagnosis of appendicitis in the general population. [3] In addition, the rate of correct diagnosis has increased considerably with imaging methods such as ultrasonography (US) and computed tomography (CT). However, when it comes to pregnant women, the effectiveness of the methods used in daily practice decreases considerably. Appendicitis is the most common cause of extrauterine acute abdomen during pregnancy. Its incidence varies between 1/1250 and 1/1500. [4] Fifty percent of cases are seen in the second trimester of pregnancy. [5] Scoring systems used in the normal population for the diagnosis of appendicitis cannot be used during pregnancy. The increase in the symptoms of nausea, vomiting and abdominal pain due to the increase in the size of the uterus and the change in its hormonal profile during pregnancy reduces the value of these symptoms in the diagnosis of acute appendicitis. [6] Since physiological leukocytosis is observed during pregnancy, increased leukocyte values, which guide the diagnosis of acute appendicitis, can be misleading.

In pregnancy, especially as the uterine volume increases, the rate of visualization of the appendix by US decreases.

The importance of US is mostly to exclude obstetric pathologies. Due to its teratogenic effects, the use of tomography during pregnancy is avoided. Detailed history and physical examination are key for the diagnosis of acute appendicitis in pregnant women. [7] Any patient with right lower quadrant pain, nausea, vomiting and fever, who has tenderness and defensive rebound in the right lower quadrant on physical examination should be considered as appendicitis after obstetric causes are excluded, until proven otherwise.

In our study, we aimed to share the data of our patients who were diagnosed with acute appendicitis during pregnancy in our clinic and highlight the different aspects in diagnosis and treatment compared to the normal population.

Material and methods

The study was planned as a retrospective descriptive study. Ethics committee approval was obtained from Tepecik Education and Research Hospital Noninterventional Clinical Studies Ethics Committee (Approval number 2022/05-05) before starting the study. Pregnant women who were operated for acute appendicitis between April 2008 and May 2021 were included in the study. Pregnant women who were followed up with the suspicion of acute appendicitis during pregnancy but were not operated or who were operated due to other surgical emergencies were excluded from the study.

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Demographic data of the patients, gestational week, physical examination and laboratory values at the time of admission, US findings, type of surgery performed, surgical findings, pathology results and fetal-maternal complications that developed during postoperative follow-up were reviewed retrospectively through the hospital system.

Statistical Analysis

Statistical analysis was done with IBM SPSS Statistics software, version 25.0. As the descriptive statistics, the number of units (n), percent (%), mean \pm standard deviation (SD), median (Q1-Q3) values were given. The normal distribution of data and continuous variables were evaluated by Shapiro Wilk, normality test and QQ graphs. Of the comparison of the continuous variables of the two groups, the Independent Sample T test was used for variables with normal distribution, and Mann - Whitney U test for variables that did not fit the normal distribution. Pearson Chi-Square tests were used to evaluate categorical variables. Univariate analysis was performed to find potential risk factors and then multivariate analysis to identify independent factors. $p < 0.05$ value was considered statistically significant.

Results

In total, 26 patients were included in the study. The mean age was 27.5 ± 5.3 . The mean gestational week was 20 ± 7.5 . Four (15.4%) of the patients were in the first trimester, 14 (53.8%) in the second trimester, and 8 (30.8%) in the third trimester. None of the patients had diabetes or hypertension. According to the physical examination findings, all patients had abdominal tenderness. Defense was positive in ten (38.5%) patients and rebound in 18 (69.2%) patients. According to laboratory values, white blood cell count (WBC) median was 14950/uL (Q1-Q3; 11750-17600). The median C-reactive protein (CRP) was 45mg/L (Q1-Q3; 9.5-215.5). All patients were evaluated with US in the preoperative period. The number of patients diagnosed with appendicitis by US was six (23.1%). No additional obstetric pathology was detected by US in any of the patients. The mean time from admission to surgery was 7 ± 6.2 hours. Laparoscopy was performed in two (7.7%) patients and laparotomy was performed in 24 (92.3%) patients. In surgical findings; perforated appendicitis was detected in five (19.2%) patients and periappendicular abscess in seven (26.9%) patients. Abdominal drain was used for 6 (26.9%) patients. When the pathology results were examined, well-differentiated neuroendocrine tumor of the appendix was detected incidentally in two (7.7%) patients and low-grade mucinous neoplasia of the appendix was detected in one (3.8%) patient. Postoperatively one (3.8%) patient was reoperated for appendiceal stump leakage. Abortion occurred in two (7.7%) patients. No maternal or fetal complications developed in the other 24 (92.3%) patients. The clinicopathological features of the patients are summarized in Table 1.

From the clinicopathological features of the patients, only reoperation due to appendiceal stump leakage ($p:0.04$) and drain placement during operation ($p:0.046$) were significantly associated with miscarriage. Although complications and abortion rates were higher in patients with perforation and periappendicular abscess, the difference was not statistically significant.

Discussion

Although pregnancy is a physiological process, it affects the diagnosis and treatment methods used in the diagnosis of acute appendicitis due to the changes it causes in the female body. Especially after the first trimester, the growth of the

uterus from the pelvis into the abdomen causes displacement and compression symptoms in other abdominal organs. [8] The appendix is usually displaced towards the right upper quadrant or towards the pelvis. [9] In addition, physiological flexibility in the anterior abdominal wall during pregnancy may mask the signs of peritonitis. [6] On physical examination, 38.5% of our patients were positive for defense and 69.2% for rebound.

Table1. Clinicopathologic features of the patients

	All Patients	Without Complication	Miscarriage	p-value
	n=26	n=24	n=2	
Age, mean \pm SD	27,5 \pm 5,3	27,3 \pm 5,4	29 \pm 4,2	0,678
Pregnancy week, mean \pm SD	20 \pm 7,5	20,4 \pm 7,7	15 \pm 2,8	0,338
Trimester				0,395
1	4 (15,4)	4 (16,7)	0	
2	14 (53,8)	12 (50)	2 (100)	
3	8 (30,8)	8 (33,3)	0	
Comorbid diseases	6 (23,1)	6 (25)	0	1,000*
Abdominal Tenderness	26 (100)	24 (100)	2 (100)	-
Defense	10 (38,5)	9 (37,5)	1 (50)	1,000*
Rebound	18 (69,2)	16 (66,7)	2 (100)	1,000*
USG	6 (23,1)	6 (25)	0	1,000*
WBC, median (Q1-Q3)	14950 (11750-17600)	14850 (11050-17600)	15350 (14800-.)	0,812
CRP, median (Q1-Q3)	45 (9,5-215,5)	32,5 (9,2-213,8)	215 (215-215)	0,615
Surgery type				0,151*
Laparoscopy	2 (7,7)	1 (4,2)	1 (50)	
Laparotomy	24 (92,3)	23 (95,8)	1 (50)	
Perforation	5 (19,2)	4 (16,7)	1 (50)	0,354*
Abscess	7 (26,9)	6 (25)	1 (50)	0,474*
Drain placement	6 (23,1)	4 (16,7)	2 (100)	0,046*
Pathology				0,064
Appendicitis	23 (88,5)	22 (91,7)	1 (50)	
Neuroendocrine tumor	2 (7,7)	1 (4,2)	1 (50)	
Mucinous neoplasia	1 (3,8)	1 (4,2)	0	
Reoperation	1 (4)	0	1 (100)	0,04*

*Fisher's Exact test was used

USG: Ultrasonography, WBC: White blood cell count, CRP: C-reactive protein

The fact that the defense positivity rate is low compared to the normal population [3] supports that the anatomical and physiological changes mentioned above mask the physical examination findings.

Another condition that complicates the diagnosis during pregnancy is the increase in physiological inflammation.

This makes laboratory values that facilitate recognition of acute inflammatory processes useless. Leukocytosis (WBC>11000/uL), which is the most frequently applied parameter in daily practice, is a physiological condition in pregnant women. However, in a previous population-based study on this subject, it was found that WBC>18000/uL was significant for the diagnosis of appendicitis. [10] The median WBC value of our study group was 14950. Only three (11.5%) patients had over 18000 value of WBC and value of the remaining 23 (88.5%) patients was not helpful for diagnosis. In our study, diagnosis of acute appendicitis by US during pregnancy was found at lower rates (23.1%) compared to the literature. In a previous study on the accuracy rate of US for the diagnosis of acute appendicitis in pregnant women, 57% of the patients had positive US findings. But there was an 18.4% false positive rate. In addition, there was a 36.3% false-negative rate in the patient group with negative US. [11] We believe that an experienced surgeon should diagnose acute appendicitis after detailed history and physical examination and use US to exclude obstetric pathologies. Because, in a previous study, it was seen that the rate of negative appendectomy was similar to the normal population, despite the low accuracy rate of ultrasonography in diagnosis. [12] In our study, negative appendectomy was performed in two (7.7%) patients.

Another important issue is to decide on the type of operation after the diagnosis. Laparoscopic appendectomy is routinely performed in our clinic; however, there are some reasons for avoiding laparoscopy when the patient is pregnant. Firstly, laparotomy shortening the operation time of the patient will shorten the exposure time of the patient to anesthetic drugs, thus reducing the possibility of harming the fetus. In a previous study, the duration of appendectomy was found to be significantly lower in pregnant patients compared to the general population, and this was attributed to the low use of laparoscopy in pregnancy. [13] The second reason is to cause iatrogenic injury due to increased uterine volume during trocar insertion into the abdomen. Considering that most pregnant appendicitis cases occur in the second trimester, trocar insertions pose a higher risk compared to a normal abdomen. [14] The last one is CO₂ insufflation. Due to the insufflation of the abdomen with CO₂, intra-abdominal pressure increases, and it is thought that fetal complications may increase due to the decrease in blood flow to the uterus and the deterioration of the fetoplacental circulation. [15] For these reasons, surgeons avoid laparoscopic appendectomy during pregnancy. In our study, laparoscopy rate was %7.7. However, no maternal or fetal complications were encountered. Laparoscopy is a technique that can be used safely during pregnancy, as demonstrated by the studies in the literature on this subject. [16,17]

Although the incidence of appendicitis in pregnancy is similar to the normal population, it is known that complications such as perforation and abscess are higher than in the normal population. [5,18] It has been previously reported that this increases fetal loss rates. While the rate of fetal loss is around 3-5% in cases of non-perforated appendicitis, this rate can rise to 20% in cases of perforated appendicitis. [6,19] Fetal loss occurred totally two (%7.7) patients; in one with perforated appendicitis and in one both with pericecal abscess and perforated appendicitis. Drains were placed in two patients, and one patient was re-operated. Re-operation due to appendiceal stump leakage and drain placement during operation were significantly associated with miscarriage. Pericecal abscess and perforated appendicitis were not associated with miscarriage probably due to the small number of patients.

In our study, negative appendectomy was performed in two (7.7%) patients and this rate was similar to the literature. Two patients (7.7%) had well-differentiated (Grade 1)

neuroendocrine tumors and one patient (3.8%) had low-grade mucinous neoplasia. In all three patients, tumors were limited to the appendix so no additional intervention was required. Although pregnant appendicitis cases are generally in the young age group, pathology results should be followed closely due to the 11.5% malignancy rate of our study. The need for additional intervention or medical treatment is a situation that should be decided with a multidisciplinary approach in terms of maternal and infant health.

The limitations of our study included being retrospective, single center, small number of patients and due to the absence of a control group, pregnant appendicitis cases were compared with the normal population over the literature.

Disclosure

Authors have no potential conflicts of interest to disclose.

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