The European Research Journal 2023;9(2):384-390 Original Article

DOI: 10.18621/eurj.1244855 *General Surgery*

Complicated and uncomplicated acute appendicitis in pregnancy: a single center experience

İsmail Hasırcı[1], Mehmet Eşref Ulutaş[2]

[1]Department of General Surgery, University of Health Sciences, Konya City Hospital, Konya, Turkey; [2]Department of General Surgery, Derecik State Hospital, Hakkari, Turkey

ABSTRACT

Objectives: Acute appendicitis is the most common non-obstetric pathology requiring emergency surgery on pregnant women. The aim of the study is to show the effect of uncomplicated and complicated acute appendicitis on pregnancy.

Methods: This study was conducted retrospectively at the Department of General Surgery of Konya City Hospital. Pregnant patients who underwent surgery for acute appendicitis from January 1, 2020, through December 31, 2021, were included in the study. The cases were divided into two groups as complicated and uncomplicated appendicitis and compared. The demographic, clinical, and laboratory findings of the patients were obtained by screening the patient files. The cases were divided into two groups as complicated and uncomplicated appendicitis and compared.

Results: The study included 46 pregnant patients with a mean age of 25.9 years. The mean gestational age of the patients at the time of surgery was 16.5 weeks. Of the patients, 47.8% were in the first trimester. Open appendectomy was performed in 35 (76.1%) patients, and laparoscopic appendectomy in eight (17.4%). Seven (15.2%) appendicitis cases were complicated. A negative appendectomy was performed in two (4.3%) patients. Preterm labor was seen at a rate of 28.6% in the complicated appendicitis group and 5.1% in the uncomplicated appendicitis group ($p = 0.04$), and the mean operative times were 65.8 and 46.1 minutes, respectively ($p < 0.001$).

Conclusions: Both postoperative complications due to surgery and obstetric complications increase in patients with complicated appendicitis; therefore, it is particularly important to closely follow up these cases.

Keywords: Appendicitis, complication, laparoscopy, pregnancy, preterm labor

Acute appendicitis (AA) is the most common non-obstetric pathology requiring emergency surgery in pregnant women (PW). It has been reported to affect 0.1-0.3% of PW every year [1]. It is especially common in the second trimester [2]. AA is seen less frequently in PW compared to non-pregnant women. Therefore, it is considered that pregnancy may have a protective effect against AA through hormonal changes [3].

In patients who have undergone surgery for non-obstetric reasons, AA is the cause with the highest rate of premature birth and fetal loss. In AA, the rate of

Received: ***January 30, 2023;*** *Accepted:* ***February 18, 2023;*** *Published Online:* ***February 21, 2023***

How to cite this article: *Hasırcı İ, Ulutaş ME. Complicated and uncomplicated acute appendicitis in pregnancy: a single center experience. Eur Res J 2023;9(2):384-390. DOI: 10.18621/eurj.1244855*

e-ISSN: 2149-3189

Address for correspondence: *Mehmet Eşref Ulutaş, MD., Derecik State Hospital, Department of General Surgery, Merkez Mah., Hastane Cad., No: 112/A, 30800 Derecik, Hakkari, Turkey. E-mail: esref_ulutas@hotmail.com, Phone: +90 438 461 33 07, Fax: +90 438 461 31 83*

fetal loss has been reported to be 2.6%, while this rate increases up to 10.9% in the cases of complicated AA with peritonitis [4]. Fetal loss usually occurs within the first postoperative week [5]. In PW, negative appendectomy rates have been reported to be in the range of 23-33% [6, 7]. Obstetric complications are more common in those who have undergone a negative appendectomy; therefore, utmost care should be taken when diagnosing AA in this patient population.

The first and most important step in the diagnosis of AA in the general population is a physical examination (PE). Although PE findings are also important in PW, they may be altered, especially in the later stages of pregnancy, with the enlargement of the uterus and the displacement of the intra-abdominal organs. In these patients, ultrasonography (USG) is usually the first-line imaging method used. However, magnetic resonance imaging (MRI) remains the most important imaging modality to exclude appendicitis [6, 8].

Laparoscopy appendectomy (LA) and open appendectomy (OA) are performed in the surgical treatment of AA. Some authors have indicated 26-28 weeks of gestation as the upper limit for laparoscopic interventions in PW [1]. However, recent studies have reported that there is no such upper limit, and that laparoscopy can be used in any suitable patient [9]. Although research suggests that OA is safer, many studies have reported that LA is a safe procedure that does not increase the risk of maternal complications with open surgery [10-17]. However, laparoscopy also has certain disadvantages, such as the possibility of uterine injury, technical difficulties due to uterine enlargement, and the risk of carbon dioxide absorption due to impaired uterine blood flow [18].

AA can be classified into two groups as complicated and uncomplicated. Perforated, gangrenous and plastron appendicitis are classified in the complicated group. Studies have shown that surgical and obstetric complications are higher in complicated pregnant appendicitis cases compared to uncomplicated appendicitis [19].

This study aimed to examine the clinical data of AA in a PW, the surgical methods used in treatment, the problems that occurred in the postoperative period, and the effects of AA on pregnancy. In addition, the effect of complicated appendicitis on pregnancy was also investigated.

METHODS

Trial Design

This study was conducted retrospectively at the Department of General Surgery of Health Sciences University Konya City Hospital. Approval was obtained from the Ethics Committee of KTO Karatay University Faculty of Medicine (decision number: 50517, date: December 30, 2022), and written informed consent from all participants. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Participants and Eligibility Criteria

PW who underwent surgery for AA between January 1, 2020, and December 31, 2021, were included in the study. Inclusion criteria: Being aged 18 and over, being pregnant, and undergoing surgery with a pre-diagnosis of AA. Exclusion criteria: Age under 18 years, undergoing surgery for reasons other than AA, patients whose information cannot be reached from hospital records or by phone. According to the surgical findings and final pathology results, the cases were divided into two groups as complicated and uncomplicated appendicitis. Perforated, gangrenous and plastron appendicitis were included in the complicated appendicitis group.

Outcomes

The files of the patients included in the study were examined, and demographic characteristics and clinical data, such as preoperative imaging methods, surgical methods applied, operative time, postoperative complications, length of hospital stay, and follow-up information about pregnancy and pregnancy outcomes were recorded.

Pregnancy outcomes were obtained from the hospital records. For those who gave birth in another healthcare center, the related data were obtained by calling the patients. Data on patients who terminated their pregnancy voluntarily for reasons other than medical necessity were also recorded.

The primary outcome of the study was determined as preterm labor or the premature rupture of mem-

branes, defined as deliveries within one month after surgery. The limit for preterm labor was accepted as 37 weeks. The secondary outcome was clinical data, including leukocyte count at admission, C-reactive protein (CRP) value, time interval of onset of symptoms to admission to hospital, time interval of admission to hospital to surgery time, surgical procedures performed, length of hospital stay, operative time, postoperative complication rates, complicated appendicitis rates, and pathology results. The recorded data were compared between the complicated and uncomplicated appendicitis groups.

Statistical Analysis

Prior to the statistical analysis, the Kolmogorov-Smirnov and Shapiro-Wilk normality tests were performed. If normality could not be achieved in even one of the groups, non-parametric test methods were preferred. Then, the Mann-Whitney U test was conducted to compare the variables obtained by measurement between the groups. The chi-square and Fisher's exact tests were used to analyze the relationship or differences between the groups in terms of categorical variables. Comparative results between the groups and other demographic characteristics were presented using the rates of qualitative variables. Quantitative variables were shown with mean and median (minimum-maximum) values. The Statistical Package for the Social Sciences (SPSS), version 22.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analyses, and a p value of < 0.05 was accepted as the statistical significance limit.

Table 1. Demographic and clinical data

	Value
Maternal age (years), mean ± SD (range)	25.9 ± 4.9 (18-37)
Gestational week at surgery (week), mean ± SD (range)	16.5 ± 7.6 (3-30)
Trimester, n (%)	
First	22 (47.8)
Second	16 (34.8)
Third	8 (17.4)
Nulliparity, n (%)	26 (56.5)
Multiparity, n (%)	20 (43.5)
History of miscarriage, n (%)	5 (10.8)
Comorbidity (HT, DM, or CHD), n (%)	3 (6.5)
WBC ($\times 10^3$/uL), mean ± SD (range)	14.3 ± 4.1 (7-25)
CRP (mg/dL), mean ± SD (range)	23.9 ± 31.1 (3-157)
Diagnosis method, n (%)	
Ultrasonography	35 (76.1)
Magnetic resonance imaging	11 (23.9)
Length of hospital stay (day), mean ± SD (range)	2.4 ± 1.5 (1-7)
Readmission, n (%)	5 (10.8)
Complications, n (%)	5 (10.8)
Superficial SSI	1 (2.2)
Deep SSI	2 (4.3)
Spinal syndrome	1 (2.2)
Non-specific abdominal pain	1 (2.2)

Data are presented as mean ± standard deviation, range (minimum-maximum), and frequency. SD = standard deviation, WBC = white blood cell, CRP = C-reactive protein, HT = hypertension, DM = diabetes mellitus, CHD = coronary heart disease, SSI = surgical site infection

RESULTS

Between 1 January 2020 and 31 December 2021, there were 53 PW who were operated on with the diagnosis of AA. Seven patients whose hospital records or data could not be reached by telephone were excluded from the study. Thus, 46 patients were included in the study. The mean age of these patients was 25.9 years. It was the first pregnancy of 26 (56.5%) of the patients. There were five (10.8%) patients with a previous history of miscarriage, and three (6.5%) patients with the comorbidities of hypertension, diabetes mellitus, and coronary heart disease (Table 1).

The mean gestational age of the patients at the time of surgery was 16.5 weeks. Twenty-two (47.8%) patients were in the first trimester, 16 (34.8%) were in the second trimester, and eight (17.4%) were in the third trimester.

The mean time interval of onset of symptoms to admission to hospital was 7.4 hours in all patients. The mean time interval of admission to hospital to surgery time was 3.1 hours. (Table 2).

According to the blood tests performed before surgery, the mean white blood cell (WBC) count was 14.3 ×103/uL, and the mean CRP value was 23.9 mg/dL. The AA diagnosis was made using USG in 35 (76.1%) of the patients and MRI in 11 (23.9%). OA was performed in 35 (76.1%) patients, and LA in eight (17.4%). Conversion from laparoscopy to open appendectomy was required in three (6.5%) cases. Seven (15.2%) AA cases were complicated. A negative appendectomy was performed in two (4.3%) patients.

Table 2. Surgical and clinical data

	Value
Time interval of admission to hospital to surgery time (hour), mean ± SD (range)	3.1 ± 1.1 (1-5)
Time interval of onset of symptoms to admission to hospital (hour), mean ± SD (range)	7.4 ± 1.8 (5-12)
Preterm labor, n (%)	4 (8.7)
Term delivery, n (%)	39 (84.8)
Cesarian section	12 (26.1)
Normal vaginal delivery	27 (58.7)
Spontaneous abortion, n (%)	3 (6.5)
Fetal loss, n (%)	3 (6.5)
Surgical procedure, n (%)	
Open appendectomy	35 (76.1)
Laparoscopic appendectomy	8 (17.4)
Conversion to open surgery	3 (6.5)
Operative time (minute), mean ± SD (range)	49.4 ± 13.1 (28-76)
Complicated appendicitis, n (%)	7 (15.2)
Negative appendectomy, n (%)	2 (4.3)
Pathology result, n (%)	
Appendicitis	38 (82.6)
Normal appendix	2 (4.3)
Neuroendocrine tumor	3 (6.5)
Mucinous cystadenoma	1 (2.2)
Benign lymphoid hyperplasia	2 (4.3)

Data are presented as mean ± standard deviation, range (minimum-maximum), and frequency.

The mean operative time was 49.4 minutes, and the mean length of hospital stay was 2.4 days (Tables 1 and 2).

In the postoperative period, five (10.8%) patients were readmitted to the hospital due to the development of complications. One of these patients had a superficial surgical site infection, two had deep surgical site infections, one had spinal syndrome, and the other had non-specific abdominal pain. All patients were treated medically. These complications were only seen in the patients who underwent OA, with no postoperative complication occurring in the cases in which a LA was performed. There was no maternal mortality in our study. Thirty-nine (84.8%) patients had term deliveries, while preterm labor was seen in four (8.7%) patients and spontaneous abortion occurred in three (6.5%). Of the term deliveries, 58.7% were delivered through the vaginal route and 26.1% were delivered through a cesarean section. The pathology results were AA in 38 (82.6%) patients, normal appendix tissue in two (4.3%), neuroendocrine tumors in three (6.5%), benign lymphoid hyperplasia in two (4.3%), and mucinous cystadenoma in one (2.2%) (Table 2).

When the complicated and uncomplicated appendicitis groups were compared, there was no significant difference in terms of WBC count, CRP, postoperative complications, the rate of spontaneous abortion, length of hospital stay, readmission rate, and gestational week at surgery. There was no significant difference between the two groups on the time interval of onset of symptoms to admission to hospital and the time interval of admission to hospital to surgery time. Preterm labor was observed in 28.6% of the patients in the complicated appendicitis group and 5.1% of those in the uncomplicated appendicitis group ($p = 0.04$). The mean operative time was 65.8 minutes in the complicated appendicitis group and 46.1 minutes in the uncomplicated appendicitis group ($p < 0.001$) (Table 3).

DISCUSSION

AA is one of the most common causes of emergency surgery in PW [1]. The rates of premature birth and fetal loss increase significantly in patients that have undergone surgery with this diagnosis. In the literature, it has been reported that AA is particularly more frequent in the second trimester [2]. However, in the

Table 3. Comparison of the complicated and uncomplicated appendicitis groups

	Complicated appendicitis (n = 7)	Uncomplicated appendicitis (n = 39)	*p value*
Gestational week at surgery, mean ± SD (range)	19.8 ± 8.4 (5-30)	15.5 ± 7.1 (3-30)	0.15
Time interval of onset of symptoms to admission to hospital (hour), mean ± SD (range)	8.3 ± 2.2 (6-12)	7.3 ± 1.8 (5-10)	0.29
Time interval of admission to hospital to surgery time (hour), mean ± SD (range)	3.6 ± 0.9 (2-5)	3.1 ± 1.1 (1-5)	0.24
WBC (10^3/mm^3), mean ± SD (range)	16.3 ± 5.1 (8-23)	13.8 ± 3.8 (7-25)	0.16
CRP (mg/dL), mean ± SD (range)	36.1 ± 54.3 (4-157)	19.7 ± 22.3 (3-75)	0.24
Postoperative complication, n (%)	2 (28.6)	3 (7.7)	0.10
Preterm labor, n (%)	2 (28.6)	2 (5.1)	**0.04**
Spontaneous abortion, n (%)	0	3 (7.7)	0.5
Fetal loss, n (%)	0	3 (7.7)	0.5
Length of hospital stay (day), mean ± SD (range)	3 ± 1.6 (1-6)	2.1 ± 1.3 (1-6)	0.14
Readmission, n (%)	2 (28.6)	3 (7.7)	0.10
Operative time (minute), mean ± SD (range)	65.8 ± 10.6 (47-76)	46.1 ± 10.7 (28-75)	**< 0.001**

Data are presented as mean ± standard deviation, range (minimum-maximum), and frequency. SD = standard deviation, WBC = white blood cell, CRP = C-reactive protein

current study, it was more common among the patients in the first trimester (47.8%).

The imaging method used as the first choice in diagnosis is usually USG. However, USG can be non-diagnostic many times. For this reason, MRI is the safest method to exclude AA [6, 8]. In our study, USG was used most frequently (76.1%), but in cases where USG could not make a diagnosis, MRI was used in 23.9% of the cases. Despite the PE and imaging methods, negative appendectomy can be performed frequently in PW. This rate has been reported in the range of 23-33% [6, 7]. In our study, this rate was lower than in the literature and was found to be 4.3%.

The negative effect of AA on fetal loss and preterm labor is known. In the literature, the fetal loss rate was reported as 2.6% in uncomplicated cases and 10.9% in complicated cases [4]. Fetal loss rate was determined as 6.5% in all patients in our study. In a systematic review, the rate of preterm labor in AA cases was reported as 8.1% [20]. All patients in our study, this rate was found to be 8.7%, which is consistent with the literature. In addition, this rate was found to be significantly higher in complicated appendicitis cases (28.6%-5.1%) ($p = 0.04$). This supports the knowledge that obstetric problems are higher in complicated cases, as stated in the literature. In the literature, the rate of postoperative complications varies between 5% and 20%, depending on the complexity of the cases [19]. In our study, the postoperative complication rate was found to be 10.8%, which is consistent with the literature. These complications were surgical site infections and spinal syndrome, which were treated medically. While no postoperative complications were found in patients who underwent LA, all complications were found in patients who underwent OA. This suggests that laparoscopy is superior both in terms of wound infection and spinal syndrome due to spinal anesthesia.

Surgery for AA can be performed with the laparoscopic or open method [1, 10, 12-15]. In our study, open surgery was performed in 76.1% of the patients, and laparoscopy in 17.4%. In three (6.5%) cases, conversion to open surgery was required due to the complicated nature of appendicitis. As stated in the literature, both laparoscopy and open surgery can be applied to PW [10].

In our study, the mean operative time was 49.4 minutes, which is consistent with the literature [14]. As expected, the operative time was significantly longer in the complicated appendicitis group ($p < 0.001$). The length of hospital stay was 2.4 days, which is similar to the value reported by a systemic review (3 days) [11].

The final pathology results were consistent with AA in 38 (82.6%) patients, a normal appendix in two (4.3%), and other conditions, such as neuroendocrine tumors, mucinous cystadenomas, and benign lymphoid hyperplasia in six (13%). In a previous study conducted in Turkey, the incidence of non-appendicitis pathology results was reported to be 8.3% , indicating a higher rate in our study [20].

Limitations

The most important limitation of this study concerns its retrospective design and small number of cases.

CONCLUSION

AA is one of the most common causes of emergency surgery in PW. In this patient population, the risk of preterm delivery and fetal loss is high, especially in complicated appendicitis cases. Therefore, when AA is suspected in PW, it is important to make a rapid diagnosis using USG and MRI methods, and to perform surgical treatment with a laparoscopic or open method without delay.

Authors' Contribution

Study Conception: İH; Study Design: MEU; Supervision: İH; Funding: MEU; Materials: İH; Data Collection and/or Processing: MEU; Statistical Analysis and/or Data Interpretation: İH; Literature Review: MEU; Manuscript Preparation: İH and Critical Review: MEU.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

Financing

The authors disclosed that they did not receive any grant during conduction or writing of this study.

REFERENCES

1. Barnes SL, Shane MD, Schoemann MB, Bernard AC, Boulanger BR. Laparoscopic appendectomy after 30 weeks pregnancy: report of two cases and description of technique. Am Surg 2004;70:733-6.
2. Hee PP, Viktrup L. The diagnosis of appendicitis during pregnancy and maternal and fetal outcome after appendectomy. Int J Gynecol Obstet 1999;65:129-35.
3. Andersson REB, Roland EB, Lambe M. Incidence of appendicitis during pregnancy. Int J Epidemiol 2001;30:1281-5.
4. Cohen-Kerem R, Railton C, Oren D, Lishner M, Koren G. Pregnancy outcome following non-obstetric surgical intervention. Am J Surg 2005;190:467-73.
5. Corneille MG, Gallup TM, Bening T, Wolf SE, Brougher C, Myers JG, et al. The use of laparoscopic surgery in pregnancy: evaluation of safety and efficacy. Am J Surg 2010;200: 363-7.
6. Lemieux P, Rheaume P, Levesque I, Bujold E, Brochu G. Lemieux, Patrice, et al. Laparoscopic appendectomy in pregnant patients: a review of 45 cases. Surg Endosc 2009;23:1701-5.
7. McGory ML, Zingmond DS, Tillou A, Hiatt JR, Ko CY, Cryer HM. Negative appendectomy in pregnant women is associated with a substantial risk of fetal loss. J Am Coll Surg 2007;205:534-40.
8. Pedrosa I, Levine D, Eyvazzadeh AD, Siewert B, Ngo L, Rofsky NM. MR imaging evaluation of acute appendicitis in pregnancy. Radiology 2006;238:891-9.
9. Jackson H, Granger S, Price R, Rollins M, Earle D, Richardson W, et al. Diagnosis and laparoscopic treatment of surgical diseases during pregnancy: an evidence-based review. Surg Endosc 2008;22:1917-27.
10. Cheng HT, Wang YC, Lo HC, Su LT, Soh KS, Tzeng CW, et al. Laparoscopic appendectomy versus open appendectomy in pregnancy: a population-based analysis of maternal outcome. Surg Endosc 2015;29:1394-9.
11. Walsh CA, Tang T, Walsh SR. Laparoscopic versus open appendicectomy in pregnancy: a systematic review. Int J Surg 2008;6:339-44.
12. Palanivelu C, Rangarajan M, Parthasarathi R. Laparoscopic appendectomy in pregnancy: a case series of seven patients. JSLS 2006;10:321.
13. Rizzo AG. Laparoscopic surgery in pregnancy: long-term follow-up. J Laparoendosc Adv Surg Tech A 2003;13:11-5.
14. Lyass S, Pikarsky A, Eisenberg VH, Elchalal U, Schenker JG, Reissman P. Is laparoscopic appendectomy safe in pregnant women? Surg Endosc 2001;15:377-9.
15. Wu JM, Chen KH, Lin HF, Tseng LM, Tseng SH, Huang SH. Laparoscopic appendectomy in pregnancy. J Laparoendosc Adv Surg Tech A 2005;15: 447-50.
16. Kirshtein B, Perry ZH, Avinoach E, Mizrahi S, Lantsberg L. Safety of laparoscopic appendectomy during pregnancy. World J Surg 2009;33:475-80.
17. Sadot E, Telem DA, Arora M, Butala P, Nguyen SQ, Divino CM. Laparoscopy: a safe approach to appendicitis during pregnancy. Surg Endosc 2010;24:383-9.
18. Fatum M, Rojansky N. Laparoscopic surgery during pregnancy. Obstet Gynecol Survey 2001;56:50-9.
19. Humes DJ, Simpson J. Acute appendicitis. BMJ 2006;333:530-4.
20. Yilmaz M, Akbulut S, Kutluturk K, Sahin N, Arabaci E, Ara C, et al. Unusual histopathological findings in appendectomy specimens from patients with suspected acute appendicitis. World J Gastroenterol 2013;19:4015-22.