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Appendectomy during Pregnancy: A Survey of Two Army Medical Activities

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Acute appendicitis is the most common nonobstetrical surgical condition of the abdomen complicating pregnancy. Appendectomy reportedly is performed during pregnancy once for every 1,500 deliveries. Although the incidence of appendicitis occurring in pregnant women is considered to be the same as in nonpregnant women, the signs and symptoms, and the laboratory findings usually associated with appendicitis in the nonpregnant condition, are frequently unreliable during pregnancy. Using the Computer Diagnostic Data System, we completed a retrospective analysis on all appendectomies performed at two Army Medical Activities (MEDDACs) during a 2-year period. With a representative large Army MEDDAC and a representative medium-sized Army MEDDAC studied, the incidence of appendectomy during pregnancy was the same frequency as in previous reports. The only consistent finding in all pregnant patients who underwent appendectomy was right lower quadrant abdominal pain. Presenting signs and symptoms, clinical evaluations, laboratory findings, and surgical management is discussed. No morbidity or mortality occurred during this study.

Introduction

Appendectomy is known to be the most common nonobstetrical operative intervention in the pregnant patient,¹⁻¹⁵ with a reported incidence of 1:355 to 1:11,479 deliveries (see Table I). Appendicitis in the pregnant patient has challenged the obstetrician-gynecologist, general surgeon, and primary care physician alike since Hancock first reported on this condition in 1848.^{1,14,15} Although maternal mortality is rare,¹¹ fetal mortality has decreased to less than 9% when appendectomy is performed early in the disease process.^{3,11,15}

Two reports on appendectomy performed in military hospitals were recently published. Hale et al.¹⁶ reported a total of 4,950

appendectomies performed in 147 Department of Defense hospitals during a 12-month period. Although 1,762 patients (35.6%) in this series were female, pregnancy was not reported and appendectomy during pregnancy was not addressed. Velanovich et al.¹⁷ reported on 202 patients, 32% female, who underwent surgery for suspected appendicitis at a military (U.S. Army) hospital. Pregnancy was not discussed in this report.

Two Army Medical Activities (MEDDACs), one large and one medium-sized, were retrospectively surveyed to determine if appendicitis during pregnancy was diagnosed early and appendectomy performed before perforation and development of peritonitis. It is known that morbidity and mortality are markedly increased when perforation and peritonitis occur.^{3,14,15} It is also known that the diagnosis of appendicitis is more difficult during pregnancy because of displacement of the appendix cephalad with uterine enlargement and with physiologic changes in the gastrointestinal tract, urinary system, hemopoietic system, and abdominal musculature.¹⁻¹⁵ Our findings are presented (see Table II), and traditional clinical and laboratory findings associated with appendicitis are discussed.

Methods

Blanchfield Army Community Hospital is a large Army MEDDAC located at Fort Campbell, Kentucky. DeWitt Army Community Hospital is a medium-sized Army MEDDAC located at Fort Belvoir, Virginia. The classification of size is based on the number of beds, patient work load, and the number of procedures performed.

Using the International Classification of Diseases, Ninth Revision, Clinical Modification procedure codes system,¹⁸ a retrospective analysis of all appendectomies performed between January 1, 1996, and December 31, 1997, at Blanchfield Army Community Hospital and DeWitt Army Community Hospital was completed. Hospital charts of all pregnant patients who underwent appendectomy were retrieved for analysis. Personal data, presenting signs and symptoms, laboratory findings, types

DeWitt Army Community Hospital, Fort Belvoir, VA, and Blanchfield Army Community Hospital, Fort Campbell, KY.

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TABLE I
REPORTED INCIDENCE OF APPENDICITIS COMPLICATING PREGNANCY

Author	Year	Incidence
Black ¹	1960	1:355
Lee ⁶	1965	1:805
Weingold ⁴	1983	1:833
Mazze ¹⁴	1991	1:936
Hoffman ¹²	1954	1:983
Al-Mulhim ⁵	1996	1:1,102
Tamir ⁹	1990	1:1,400
Babaknia ¹	1976	1:1,500
Gomez ⁷	1979	1:2,188
Cunningham ²	1975	1:2,700
Bailey ¹³	1986	1:4,172
Horowitz ¹⁰	1985	1:6,600
Tedenat ¹	1925	1:11,479

of anesthesia administered, operative incisions selected, histologic diagnosis, and days hospitalized were recorded (Table II).

Total deliveries during this study period were retrieved from the delivery room delivery logs at each MEDDAC. These data are summarized in Table III.

Results

A combined total of 6,050 obstetrical deliveries and 245 appendectomies were performed at the two representative Army MEDDACs during this study. Six appendectomies were performed on pregnant patients. Blanchfield Army Community Hospital (Fort Campbell MEDDAC), a large Army MEDDAC with 241 beds, recorded 3,859 deliveries and four appendectomies during pregnancy (1:965 incidence). DeWitt Army Community Hospital (Fort Belvoir MEDDAC), a medium-sized Army MEDDAC with 68 beds, recorded 2,191 deliveries and two appendectomies in pregnant patients (1:1,095 incidence). All six pregnant patients who underwent appendectomy were older than 17 years of age (range, 17–34 years; mean, 24.6 years); half were primiparas and half were multiparous. The three primiparas were in the first trimester and the three multiparas were in the second trimester of pregnancy. The combined incidence of appendectomy complicating pregnancy was 1:1,008, similar to the incidence of 1:1,102 reported by Al-Mulhim⁵ and more frequent than the 1:1,500 incidence reported by Babaknia et al.¹ based on a combined series of 503,496 patients.

All six pregnant patients who underwent appendectomy presented with a history of right lower quadrant (RLQ) pain of 24 hours duration or less (see Table II). This was the only consistent finding in all six patients and the only abnormal finding in one of these patients. Two patients complained of nausea and vomiting, and one of these patients also complained of anorexia during the previous 24 hours. Two patients were febrile on examination, and four were found to have leukocytosis with a left shift during laboratory analysis.

As shown in Table II, laparoscopy was performed on three patients. Two patients underwent laparoscopic appendectomy and one required an open procedure because the appendix could not be visualized through the laparoscope. All four open appendectomies were performed through a muscle-splitting in-

cision (McBurney's) over the point of maximum tenderness. General anesthesia was administered in four patients and epidural anesthesia was used in two patients. Four patients were given antibiotics preoperatively, and only one patient received tocolytic therapy to prevent premature uterine contractions. Histology confirmed appendicitis in five patients (83.4%). The only patient with a normal appendix histologically was reported to have a normal appendix by the surgeon at the time of surgery. The average period of hospitalization was 2.6 days (range, 1–5 days). There was one complication, probably unrelated to the procedure. One patient developed an oral herpes simplex virus lesion after surgery. No prenatal mortality occurred in this study.

Discussion

Although appendectomy is reported to be the most commonly performed obstetrical surgical operation of the abdomen during pregnancy,^{1–15} it remained an infrequently performed operation in two Army MEDDACs surveyed during 1996 and 1997.

The usual signs and symptoms reported in patients with acute appendicitis include periumbilical abdominal pain progressing to the RLQ, nausea, vomiting, anorexia, fever, increased pulse rate, rebound tenderness and guarding, rectal tenderness, and leukocytosis with a shift to the left.^{1–15}

As reported by most authors^{1–15} and demonstrated in the present series, many of the common signs and symptoms of appendicitis are unreliable or not demonstrated during pregnancy. Only abdominal pain was present in all six patients in this series. The literature reports the presence of abdominal pain in 94% to 100% of pregnant patients confirmed to have appendicitis.^{2,4,5,9,15}

Of the traditional "signs" elicited during physical examination in patients with appendicitis, only Alder's sign¹⁹ (if a patient with RLQ abdominal pain is turned on her left side and the point of maximum tenderness is unchanged, the lesion is extrauterine and possibly appendix) and Bryan's sign¹⁰ (with the pregnant patient supine, if RLQ pain persists when the uterus is shifted to the right side, the test is suspicious for appendicitis) are consistently elicited in appendicitis during pregnancy. Common signs of appendicitis not consistent during pregnancy include Kovsing's sign^{8–10} (referred pain), Blumberg's sign⁸ (rebound tenderness), psoas sign^{9,15} (RLQ pain exacerbated with extension of the right thigh), and obturator sign⁹ (hypogastric pain with passive internal rotation of the flexed right thigh).

When evaluating a pregnant patient for appendicitis, nonobstetric conditions mimicking appendicitis that must be ruled out include pyelonephritis, cholecystitis, pancreatitis, gastroenteritis, kidney stone, bowel obstruction, salpingitis, mesenteric adenitis, and adnexal torsion. Obstetric conditions confused with appendicitis during pregnancy include ectopic pregnancy, threatened abortion, abruptio placenta, preterm labor, round ligament pain, degenerating uterine fibroid, and chorioamnionitis.^{1,4,6,11,12} Laboratory analysis of blood and urine, and abdominal or vaginal probe ultrasound evaluation, may be diagnostic and supplement the physical examination. A recently published report²⁰ described the accuracy of computed tomography of the appendix in detecting appendicitis, but computed tomography should not be considered for use during pregnancy because of radiation exposure to the fetus.

Although the appendix undergoes no specific changes in

TABLE II
PERSONAL DATA AND CLINICAL FINDINGS ON SIX PREGNANT PATIENTS UNDERGOING APPENDECTOMY

	Fort Belvoir MEDDAC			Fort Campbell MEDDAC		
	K.D.	T.F.	S.F.	A.S.	Z.L.	J.W.
Age (years)	34	17	28	25	23	21
Weeks pregnant	13	26	12	19	12	18
Obstetric history	G3P2AB0	G1P0	G3P1AB1	G1P0	G4P2AB1	G1P0
Race	White	Black	White	White	Hispanic	White
Complaint	RLQ pain	RLQ pain	RLQ pain	RLQ pain	RLQ pain, N, V	ABD pain, N, V, F, A
Physical findings	Pain	Pain, fever	Pain	Pain	Pain	Pain, fever
Laboratory findings	Normal	WBC 19.6, shift	WBC 13.4	WBC 17.5	WBC 13.6	Normal
Antibiotics	No	Yes	Yes	Yes	No	Yes
Tocolytics	No	Yes	No	No	No	No
Laparoscopy	Yes	No	No	No	Yes	Yes
Anesthesia	Epidural	Epidural	General	General	General	General
Incision type	McBurney's	McBurney's	McBurney's	McBurney's	Laparoscopy	Laparoscopy
Operative findings	Suspicious	Normal	Salpingitis	Appendicitis	Appendicitis	Normal
Histology	Suppurative appendicitis	Normal	Early appendicitis	Acute appendicitis	Acute appendicitis	Acute appendicitis
Days hospitalized	2	3	5	2	1	3
Complications	None	None	None	None	None	Oral HSV

G, gravida (number of pregnancies); P, para (number of deliveries); AB, abortion (number of abortions); RLQ, right lower quadrant; ABD, abdominal; WBC, white blood count; Shift, left shift, immature WBCs; HSV, herpes simplex virus; N, nausea; V, vomiting; A, anorexia; F, fever.

TABLE III

TOTAL OBSTETRICAL DELIVERIES AND TOTAL APPENDECTOMIES, JANUARY 1, 1996 TO DECEMBER 31, 1997

	Fort Campbell MEDDAC	Fort Belvoir MEDDAC
Total deliveries	3,859	2,191
Total appendectomies	116	129
Male	79	65
Female	37	64
Older than 17 years	28	43
Pregnant	4	2

pregnancy,²¹ it progressively migrates out of the RLQ up into the right upper quadrant with uterine enlargement.^{1-14,22-24} This change in position of the appendix caused by uterine enlargement was demonstrated by Baer et al.²² in 1932, when radiologic studies using barium on 78 pregnant women revealed an upward migration of the appendix above the iliac crest after the first trimester. As shown in Figure 1, the appendix remains in the RLQ during the first trimester, moves to the pelvic brim region during the second trimester, and rises into the lower right upper quadrant in the third trimester.

Laboratory evaluation frequently is not dependable in detecting appendicitis during pregnancy because of normal physiologic leukocytosis. A white blood count (WBC) of 11,000 to 12,000/mm³ or greater is commonly seen in normal pregnancy; however, a shift to the left (greater than 75-80% polymorphonuclear leukocytes) is significant in all instances.^{1-14,22-24} Although two patients in the present study had normal WBCs, four patients had WBCs of 13,000/mm³ or greater and only one patient had a left shift (see Table II).

When appendicitis is suspected in a pregnant patient pre-

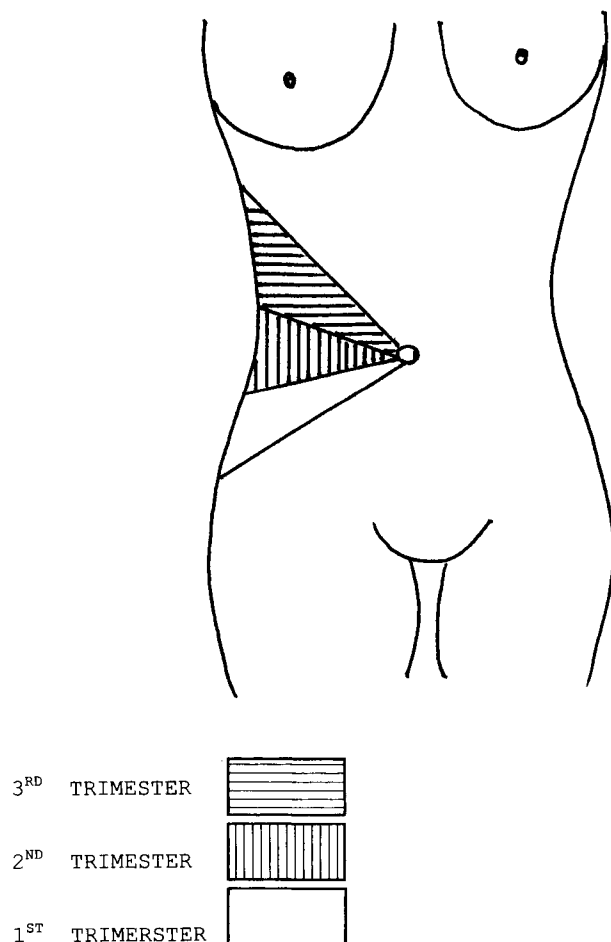


Fig. 1. Position changes of the appendix as pregnancy progresses to term.

senting with symptoms, clinical signs, and laboratory findings compatible with acute appendicitis, early surgery is necessary. A high index of suspicion and surgical aggressiveness should always prevail so that perforation and peritonitis will be prevented. Perinatal morbidity and mortality remain low with simple appendicitis, but fetal loss increases to 35% to 40% when perforation and peritonitis occurs.^{4,15} Al-Mulhim⁵ reported fetal wastage of 100% with perforated appendix. No perforations occurred and no perinatal mortality or wound infections occurred in the present series.

Surgical management may include traditional open procedures or laparoscopic appendectomy. Open appendectomy may be performed through a muscle-splitting incision (McBurney's or Rocky-Davis) over the point of maximum tenderness or through a low midline or right paramedian incision. Most surgeons prefer a muscle-splitting incision over the point of maximum tenderness,^{1-14,24} which can be performed using either general intubation or conduction (epidural or spinal) anesthesia. Although the choice of anesthesia depends on the preference of the anesthesiologist for open appendectomy, laparoscopic procedures are usually performed under general anesthesia because the induced operative pneumoperitoneum renders conduction anesthesia unsatisfactory in relieving operative pain for the patient. In the present series, all surgeons preferred muscle-splitting incisions over the point of maximum tenderness for open appendectomies. General anesthesia was used at Blanchfield Army Community Hospital, whereas DeWitt Army Community Hospital anesthesiologists and surgeons chose epidural anesthesia.

Of the six patients in this series, histology confirmed appendicitis in five (83.4%); one patient (16.6%) had a histologically normal appendix. This compares favorably with the negative laparotomy rates of 17% reported by Horowitz et al.¹⁰ and 17.5% reported by Weingold.⁴ Negative laparotomy rates during pregnancy of 20% to 25% may be anticipated,⁵ and rates as high as 36% have been reported.¹⁴

Some authors report antibiotics and tocolytics being given preoperatively when appendicitis is suspected.^{4,8-10,23,24} In their series of 41 appendectomies during pregnancy, Bailey et al.¹³ administered preoperative antibiotics to 12 patients, postoperative antibiotics to 17 patients, and tocolytics to 1 patient. In the present series, 4 of the 6 patients received antibiotics and 1 of these patients received tocolytics. Mayer and Hussain²³ state that the routine use of antibiotics in all cases of acute appendicitis is controversial. Firstenberg and Malangoni²⁴ report that all patients with acute appendicitis require antimicrobial therapy. Most authors agree that postoperative antibiotics should be used in all patients with perforation, peritonitis, or abscesses.

The distribution of appendicitis during pregnancy was previously thought to be equal among the three trimesters, but recent studies have shown a preponderance in the second trimester.²³ Firstenberg and Malangoni²⁴ noted a preponderance of cases during the first two trimesters. These studies correlate with our

report, which found half the cases of appendicitis in the first trimester and half in the second trimester. A mean hospital stay of 2.6 days (range, 1-5 days) has no comparison in our literature search on appendectomy during pregnancy.

In summary, this retrospective study reports all appendectomies performed during pregnancy at two Army MEDDACs, one large and one medium-sized, during a 2-year period. The incidence of 1:1,008, the signs and symptoms and laboratory findings, the surgical methods and anesthesia selected, and the negative laparotomy rate are comparable with those reported in the literature. The absence of perinatal mortality and morbidity may be related to the absence of appendix perforation and peritonitis attributable to aggressive surgical intervention.

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