Suspected acute appendicitis in female patients

Trends in diagnosis in emergency department in a University Hospital in Western region of Saudi Arabia

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ABSTRACT

Objectives: To determine the negative appendectomy rate; utilization, accuracy of Alvarado scale, ultrasound (US), computed tomography (CT) in diagnosis of acute appendicitis.

Methods: Hospital records of 124 female patients admitted for suspicious of acute appendicitis from January 2003 - January 2004 to the Emergency Department (ED) at King Abdul-Aziz University Hospital, Jeddah, Saudi Arabia were reviewed retrospectively. We reviewed the age of patients, clinical presentation, Alvarado scale, US, CT, histopathological diagnosis of appendicular specimen.

Results: A total of 124 female patients aged 6-64 years were presented to ED with right iliac fossa pain. Of the total, 103 patients have appendectomies (83.1%), 21 (16.9%) patients underwent conservative treatment. Prevalence of advanced appendicitis was 13.7% and negative appendectomy rate was 27.2%. Accuracy rate of appendicitis with Alvarado scale was 67.7%, US was 57.9%, CT was 66.7%. Postoperative complications were found in 2.4%. Positive correlation was found between advanced cases and Alvarado scale (r=0.338), and hospital stay duration (r=0.250, $p<0.01$).

Conclusion: Clinical findings and experience remain of major importance in appendicitis-diagnosis. When appendicitis appears with atypical presentations, it remains a clinical challenge. In such cases, laboratory and imaging investigation may be useful in establishing a correct diagnosis. Alvarado scoring system is easy, simple and cheap complementary aid for supporting the diagnosis of acute appendicitis especially for junior surgeons.

Saudi Med J 2006; Vol. 27 (11): 1667-1673

Acute appendicitis (AA) is major surgical abdominal disease in emergency departments (EDs).[1] It is estimated that 7-12% of world's population will develop AA.[2] Its diagnosis usually depend on presenting history, clinical evaluation, and laboratory tests. It has been estimated that clinical diagnosis accuracy of acute appendicitis range between 76-92%.[3] A clinical decision to operate leads to the removal of normal appendix in 15-40%.[4] Negative appendectomies are one of the burdens facing physicians, patients, and the society, as appendectomy increases hospital stay expenses. As perforations are avoidable and highly dangerous appendicitis complications, reduction in negative appendectomies should not be achieved at the expense of increase in perforation numbers.[4]

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Received 30th April 2006. Accepted for publication in final form 25th July 2006.

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Accurate pre-operative diagnosis of acute appendicitis remains difficult; particularly in child-bearing age female.[5] Diagnostic aids can dramatically reduce negative appendectomies, perforations, hospital stay. These aids include laparoscopy, scoring systems, ultrasonography, computerized tomography, magnetic resonance, which are each available in different settings and have different advantages and disadvantages.[6]

When imaging techniques are unavailable other inexpensive aids, such as scoring systems are needed.[7] It was stated that Alvarado score of 7 or more was recommended for any appendectomy diagnosis.[8]

There are few emergency physician-directed studies that have analyzed diagnostic accuracy of appendicitis in ED. The objectives of this study were to: 1. calculate current negative appendectomy rate; 2. investigate significance of clinical predictors contributing to diagnostic decision making; 3. evaluate the sensitivity of Alvarado scoring systems in the diagnosis of acute appendicitis; and 4. examine the current utilization of ultrasound scan (US), computed tomography (CT) in patients undergoing appendectomy.

Methods. This retrospective study included female patients (n=124, age ranged 6-68 years) admitted to ED, King Abdul-Aziz University Hospital, Jeddah, Kingdom of Saudi Arabia for suspicious of acute appendicitis during January 2003 – January 2004. Patients were excluded if they had evidence of generalized peritonitis; right iliac fossa (RIF) palpable mass, confusion state as result of sepsis, analgesic drugs taken 2 hours before examination and pregnancy.

Demographic data, presenting symptoms, physical findings, laboratory, US, CT results, histopathological findings, in hospital delay (defined as time pass form admission to emergency room till surgical procedure), postoperative complications were collected from the patient's records. Imaging studies were performed for equivocal cases, and not for all patients. Results of US, CT were coded as being diagnostic for appendicitis, suggestive of appendicitis, confirming alternative diagnosis or normal. The criteria for the diagnosis[10] of appendicitis by US are the appendix is identified as a blind-ending, nonperistaltic bowel loop originating from the cecum with maximal compression, the diameter of the appendix is measured in the anteroposterior dimension. The scan is diagnostic if a noncompressible appendix 6 mm or greater in the anteroposterior direction is demonstrated. The presence of appendicolith establishes the diagnosis. The presence of thickening of the appendiceal wall and periappendiceal fluid is highly suggestive. Sonographic demonstration of a normal appendix, which is an easily compressible blind-ending tubular structure measuring 5 mm or less in diameter, excludes the diagnosis of acute appendicitis. Documented CT findings of acute appendicitis are divided into appendiceal changes (appendiceal enlargement, appendiceal wall thickening, appendiceal wall enhancement, appendicolith, intramural air), cecal apical changes (focal cecal apical thickening, arrowhead sign, cecal bar), and inflammatory changes in the right lower quadrant of the abdomen (periappendiceal fat stranding, extraluminal fluid, phlegmon, abscess, lymphadenopathy, terminal ileal wall thickening, colonic wall thickening).[11]

White blood cell was considered elevated if above reference range (4.0–11.0 × 10^9/L), leucocytosis (>10,500 leucocytes/mm^3), left shift (presence of >75% neutrophils or immature forms, band or metamyelocytes). Alvarado scale is 10-point scoring system for appendicitis diagnosis, based on symptoms, signs, blood neutrophil count (**Table 1**).[8,9]

Final diagnoses were established by histological evaluation, by follow-up in case of conservative management. Twenty-one patients (16.9%) were under conservative treatment, 2 of them (9.5%) had appendectomy later and 19 (90.5%) their symptoms improved and discharged due to non surgical causes as (gynecological causes, non specific abdominal pain and gastroenteritis). Surgical approach were open or laparoscopy [n=87 (84.5% versus n=16 (15.5%)]. Diagnostic accuracy was defined as proportion of removed appendices with histologically proven acute appendicitis of total number of laparotomies for suspected acute appendicitis.[12] Patients with an inflamed appendix were considered early presenters, those with gangrenous or perforated as advanced cases.

Table 1 - Alvarado score for diagnosis of acute appendicitis.[8]

Symptom/sign/test	Score
Migration of pain	1
Anorexia	1
Nausea, vomiting	1
Tenderness in right iliac fossa	2
Rebound pain	1
Raised temperature (≥37.31°C)	1
Leukocyte count	2
Differential leukocyte count (neutrophils ≥ 75%)	1
Total	**10**

Statistic analysis. All tests were performed using the Statistical Package for Social Science (SPSS) for windows version 12 (Chicago, IL, USA). Categorical variables between groups were compared using chi-square test. Correlation between variables was made using Pearson equation. Data were expressed as mean ± SD or percentage. A $p<0.05$ was considered significant. Sensitivity (true positive/true positive + false negative), specificity (true negative/ true negative + false positive), positive predictive value (true positive/ true positive + false positive), negative predictive value (true negative/ true negative + false negative), accuracy of diagnostic methods were evaluated.

Results. Most of the studied patients had regular menses (89.5%) while irregular menses was found in 6.5% and amenorrhea in 4%. No previous operations were carried out in 88%, while 12% underwent previous operations (**Table 2**).

Most common complaint were nausea 83.9%, then rebound tenderness in 78.2%, RIF pain 77.4%, vomiting 74.2%, McBurney's point tenderness was 74.2%. Pain site was mostly in right iliac fossa (94.4%). Duration between pain onset and 1st day of last menses was (1-97 days), pain duration (6-480 hours). Mean Alvarado scale was 6.36 ± 2.16 with most of patients (62.1%) scored between 0-6 (**Table 3**). Leucocytosis was found in 53.2%, while neutrophilic shift in 58.1%. Urine analysis showed leucocytes in 16.1%, ketonuria 12.1%, hematuria 8.9%, proteinuria 8.1%, glucosuria 2.4%, and bacteria 2.4%. Sonography was carried out in 41.9%, while CT in 9.1%. Ultrasonography was normal in 11.3%, while sonography showed diagnosis of appendicitis in 12.9%, suggestion of appendicitis 9.7% or confirm alternative diagnosis 8.1%. Whereas CT showed diagnosis of appendicitis in 4%, suggestion of appendicitis 1.6% and confirm alternative diagnosis 2.4%. Preoperative (clinical and radiological) diagnosis was acute appendicitis 91.9% or ovarian cyst 8.1% (**Table 4**).

Surgical delay ranged from 1-12 hours (5.53 ± 1.63 hours) and operation time ranged from 30-150 hours (78.33 ± 28.94 hours). Patients presented early in 108 cases (86.3%), while late presentation with gangrene and perforated appendix was found in 17 cases (13.7%). Under conservative treatment were 16.9% of patients; of them 9.5% had appendectomy. Postoperative complications were 2.4% (0.8% wound infection, 1.6% paralytic ileus, 0.8% pelvic abscess). Duration of hospital stay ranged from 1-12 days (2.64 ± 1.73 days).

Table 5 shows the histopathological results of the patients. Patients presented either early or late

Table 2 - Demographic characteristics of studied population.

Characteristics	Results (n=124)	Significance
Age (years) (means±SD)	23.41±10.38	
(Range)	(6 -64)	
Nationality		
Saudi	55 (44.4)	
Non-Saudi	69 (55.6)	$p>0.05$
Marital status		
Married	64 (51.6)	
Single	60 (48.4)	$p>0.05$
Menses		
Regular	111 (89.5)	
Irregular	8 (6.5)	
Amenorrhea	5 (4)	
Previous operations		
No previous operations	109 (88)	
Cesarean section	5 (4)	
Cholecystectomy	4 (3.2)	
Cholecystectomy & renal stones	1 (0.8)	
Tonsillectomy	1 (0.8)	
Dilatation and curettage (D&C)	1 (0.8)	
Thyroidectomy	1 (0.8)	
Cardiac catheterization	1 (0.8)	
Oophorectomy	1 (0.8)	

Table 3 - Clinical presentation of studied patients.

Data	No. of cases (%), (n=124)	Significance
Presenting symptoms and signs		
Nausea	104 (83.9)	
Rebound tenderness	97 (78.2)	
RIF pain	96 (77.4)	
Vomiting	92 (74.2)	
Tenderness over McBurney's point	92 (74.2)	
Pain worse by cough	27 (21.8)	
Lower abdominal guarding	27 (21.8)	
Generalized peritonitis	23 (18.5)	
Rovsing's sign	14 (11.3)	
Urinary symptoms	11 (8.9)	
Recurrent lower abdominal pain	6 (4.8)	
Rectal tenderness	1 (0.8)	
Pain site		
Right iliac fossa	117 (94.4)	
Umbilical region	4 (3.2)	
Right hypochondrium	2 (1.6)	
Diffuse abdominal pain	1 (0.8)	
Last menstruation (1st day)	13.21±13.08	
(means±SD, Range)	(1-97)	
Duration of pain (hours)	40.39±50.71	
(means±SD, Range)	(6-480)	
Alvarado Scale	6.24 ± 2.01	
(means±SD, Range)	(1-9)	
0-6	77 (62.1)	
≥7	47 (37.9)	$p<0.01$

RIF - right iliac fossa

Table 4 - Laboratory and imaging results in suspected acute appendicitis.

Data	No. of cases (%) (n=124)
Blood analysis	
WBCs (mean ± SD, range) (× 10^9/L)	12.09 ± 5.10 (3.80-28.40)
Leucocytosis	66 (53.2)
Neutrophils (%)	74.83 ± 15.65 (25.50 - 96.70)
Shift to left of neutrophils	72 (58.1)
Urine analysis	
Leucocytes in urine	20 (16.1)
Ketonuria	15 (12.1)
Hematuria	11 (8.9)
Proteinuria	10 (8.1)
Glucosuria	3 (2.4)
Bacteria in urine	3 (2.4)
Sonography	
Not done	72 (58.1)
Normal	14 (11.3)
Diagnosis of appendicitis	16 (12.9)
Suggestion of appendicitis	12 (9.7)
Confirm alternative diagnosis	10 (8.1)
Computed tomography scanning	
Not done	114 (91.9)
Diagnosis of appendicitis	5 (4)
Suggestion of appendicitis	2 (1.6)
Confirm alternative diagnosis	3 (2.4)
Preoperative **(clinical & radiological) diagnosis**	
Acute appendicitis	114 (91.9)
Ovarian cysts	10 (8.1)

Table 5 - Correlation between histopathology and preoperative diagnosis in operable cases.

Histopathology (n=103)	Preoperative diagnosis N(%)	
Normal appendix	25	(24.3)
Suppurative appendicitis	40	(38.8)
Gangrenous appendicitis	10	(9.7)
Minimal catarrhal changes	8	(7.8)
Perforation appendicitis	7	(6.7)
Fibrous obliteration of appendical lumen	5	(4.9)
Follicular lymphoid hyperplasia	4	(3.9)
Ovarian cyst	2	(1.9)
Tuberculosis of colon	1	(1)
Hemorrhagic appendicitis	1	(1)

Table 6 - Results of Alvarado score, sonography, computed tomography in acute appendicitis.

Results	Alvarado (n=124)	Sonography (n=38)	Computed tomography (n=6)
True positive (number)	41	17	3
True negative (number)	23	5	1
False positive (number)	34	7	2
False negative (number)	5	9	-
Sensitivity (%)	(89.1)	(65.4)	(75)
Specificity (%)	(40.4)	(41.7)	(33.3)
Positive predictive value (%)	(54.7)	(70.8)	(60)
Negative predictive value (%)	(82.1)	(35.7)	(100)
Accuracy	84 (67.7)	22 (57.9)	4 (66.7)

(gangrene, perforated appendix) (86.3% versus 13.7%). Twenty-five cases were falsely diagnosed as acute appendix (24.3%), ovarian cyst (1.9%), tuberculosis of colon (1%) by histological examination. This gave false negative appendectomy rate of (27.2%).

Table 6 shows the results of Alvarado scale, US, CT in acute appendicitis.

Positive correlation was found between advanced cases and Alvarado scale (r=0.338), hospital stay (r=0.250, $p<0.01$).

Discussion. Appendicitis is the most frequent abdominal emergency.[12,27] The life time cumulative incidence is 6.7% for women. Classical presentation of anorexia, RIF pain, peritonitis, elevated white blood cells are diagnostic for appendicitis. However, 30% of patients with documented appendicitis have atypical presentation, 30% of patients with probable appendicitis have alternative diagnosis.[9,13,14] This study showed although history taking, physical examination remains a diagnostic cornerstone in RIF pain patients, and not all patients have classical presentation. In this study, 53.2% showed leucocytosis, 58.1% neutrophilic shift to left. White blood cell count with slight shift to left was elevated in 90% appendicitis, meanwhile 60% of patients with normal appendix showed elevated WBC, making this marker unspecific.[15]

Appendicitis is overlooked in 33% of premenopausal females with presumed gynecological condition, responsible for 40% misdiagnoses. Negative appendectomy rate is 45%, gynecological cause found in more than half of cases.[10] In consistence[16,17] gynecological disorders were the main reason for multiple pathologic conditions and negative appendectomy in our patients.

Traditional view of appendicitis holds that appendiceal perforations are related to delay in diagnosis and therapy, also non-therapeutic appendectomies are related to diagnostic errors or inadequate judgment.[14,18] Analysis of our data and literature review indicates that most delay occurs

before patient arrives in the hospital. Non-therapeutic appendectomies, are performed due to lack of sensitive, specific, accurate diagnostic tools.[19] In this study, incidence of perforated appendix was 13.7% while others were 14 - 40%.[13,20] Consistent with other reports,[1,21] our patients in-hospital delay was 2.64 days. In this study a positive correlation between perforation and hospital stay duration was found. Similarly, no difference in-hospital delay between perforated and non-perforated appendicitis was found.[14,18] Temple et al[22] recorded an average total delay as 2.57 times longer in perforated appendicitis. Meanwhile, Liu et al[1] reported that in-hospital observation did not increase perforation[21] but improve diagnostic accuracy.[23] White et al[24] found few ruptures occur while patients are in hospital. Colson et al[25] hypothesized if all patients were operated within 12 hours of presentation, perforation rate would reduce from 41 - 20%. In contrast, this study did not find any association between duration of symptoms and rate of perforation.[19,22] Maroju et al[19] found that advanced appendicitis have symptoms approximately 2.4 times longer than early appendicitis.

In this study, conservative management was adopted for 17.3% patients for uncertainty, 2 of them 9.5% required surgery for development of definitive appendicitis. In this study, false negative were due to failure to visualize appendix.[26] Studies in favor of delay, close observation argue that at least one third of questionable cases will finally not need surgery. Others conclude negative appendectomy is problematic, as appendectomy is not totally harmless procedure[19] but missed ruptured appendixes have more consequences. Surgeons have traditionally accepted 20% rate of negative appendectomy.[27]

As result of diagnostic difficulties, negative appendectomies may be a significant burden for health system.[28] Diagnostic tools assist in diagnosis. Among others, scoring systems were introduced for suspected appendicitis patients.[9] Alvarado scale is highly sensitive for classifying suspected appendicitis patients.[8] In this study, sensitivity was 89.1%, specificity 40.4%, positive predictive value was 54.7% and negative predictive value was 82.1%, and accuracy of Alvarado scale was 67.7%. Score of >7 correlated with advanced appendicitis. Test specificity was low in our patients, which is contradictory to others.[29] This could be explained by that our patients were females with low predictive value,[29] and the difficulty experienced by ER physicians in scoring. Use of objective scoring will aid to interpret patient's examination results, not only more reasonably but also quickly.[7] Accuracy of clinical examination is reported to be 71-97% depending on examiner's experience.[30] Current negative appendectomy rate of 27.2% is similar to others (20%-35%).[14,17] In contrast, Rosengren et al[31] reported low negative appendectomy rate (15.8%) in their institution as women presenting with equivocal lower abdominal pain were transferred for gynecological assessment.

Abdominal sonography may aid in the diagnosis of acute appendicitis. Approximately 41.9% of our patients had US, which was performed to evaluate our patients for any gynecologic pathology or in equivocal cases. However, this examination did not decrease negative appendectomy rate. Ultrasonography sensitivity was 65.4%, specificity 41.7%, positive and negative predictive values (70.8% and 35.7%), and accuracy 57.9% in our patients, which is low compared to others that showed US overall sensitivity of 86% (from 75 - 92%), specificity of 96% (from 94 - 100%).[32] One explanation for the discrepancy could be that sonography was performed by junior radiologist. We suggest that sonography for diagnosing acute appendicitis should be performed by special experienced radiologist and not to replace clinical judgment. Method of graded compression sonography is well established by several trials with reported sensitivities of 77–89%, specificities of 94–96%.[33] Although graded compression ultrasound is non-invasive, without radiation or contrast medium exposure, it will be poorly tolerated due to pain, and has low negative predictive value limiting its 'rule-out' value.[32] The main role for sonography may be for equivocal case. Patient should not be sent home after negative sonography, unless on clinical basis.[34] Others reported that sonography routine use has decreased negative appendectomies without improved missed diagnoses.[20,35] It is necessary that US skill for acute appendicitis is passed on to junior staff on ER who can use to help attain diagnosis of acute abdomen.[36]

Computed tomography in diagnosis of acute appendicitis had sensitivities of 88 - 100%, specificities 91 - 99%, and accuracies 94 - 98%.[7,37,38] Rao et al[39] noted that CT use in suspected appendicitis improved patient care, and lower costs. Since that time, dramatic increase in CT use in suspected appendicitis was noticed.[24] In this study, CT sensitivity was 75%, specificity 33.3%, positive and negative predictive values (60% and 100), and accuracy was 66.7%. Our low accuracy could be explained by our limited number of patients who had CT scan. Most investigators used CT for equivocal cases. Rosengren et al[31] found normal CT associated with low incidence of positive appendectomy, confirming discharge

suitability for appendicitis evaluation. Computed tomography significantly alter management in 60-79% of atypical presentation, but 28% of patients with equivocal result still have appendicitis risk (35-40%).[11,40] Patients who carried out CT have lower negative appendectomy than accepted.[38] Others demonstrated negative appendectomy rate of 8.3% in females with atypical presentation following CT.[41,42]

In conclusion, clinical judgement remains of great value in the diagnosis of appendicitis. The percentage of misdiagnosis of appendicitis is significantly higher among women. Diagnostic imaging have not yet been shown to improve the outcome, so limiting imaging to truly equivocal cases and using it early in diagnostic workup may improve outcomes in this group of patients. Ultrasonography is a highly user dependent, and operator skill may be an important factor in the diagnostic accuracy of appendicitis. Alvarado scale is a simple and cheap complementary aid for supporting the diagnosis of acute appendicitis, especially for junior surgeons.

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