Original Article

Clinical Indicators Versus Ultrasonography for Diagnosis of Acute Lower Abdominal Pain in Females of Reproductive Age Group

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Abstract

Background: *The accurate and precise diagnosis of acute pelvic pain (APP) in reproductive-age women is challenging. As all common diagnoses of APP are emergency conditions, timely diagnosis, and management are essential.* ***Aim:*** *to verify clinical markers for APP diagnosis among reproductive-age females who may have experienced appendicitis, obstetrics and gynaecological (OB-GYN) pain, or non-specific abdominal pain (NSAP).,* ***Patients and Methods:*** *This was an observational prospective clinical study. It included 150 female patients with APP who were admitted to the Emergency Department (ED) of the Main University Hospital, Faculty of Medicine, University of Alexandria.* ***Results:*** *Between the clinical diagnosis and ultrasound (US) diagnosis, there was a difference that was significant statistically (p< 0.001). Although the clinical indicators showed high specificity and positive predictive value (PPV) (100%, for both), they showed poor sensitivity, negative predictive value (NPV), and accuracy (40%, 10%, and 41%, respectively). On the contrary, the ultrasound reported high sensitivity, PPV, and accuracy (95%, 99%, and 94%, respectively) but the specificity and NPV were 0% for both. Ultrasound could detect appendicitis with higher sensitivity and specificity (95%, and 100% respectively) than the clinical diagnosis (91%, and 53% respectively).* ***Conclusion:*** *The combinations of clinical and ultrasound findings could be valuable as predictors of the underlying pathology of APP in females. Patients would be admitted to the appropriate departments more promptly as a result, perhaps cutting down on the amount of time needed for diagnosis in the emergency room.*

Keywords: *Acute, Pain, Reproductive-age females.*

Introduction

Reproductive-age women frequently suffered from acute lower abdominal pain, or pelvic pain (APP), which frequently leads to hospital referrals because it can be challenging to determine the exact source of the pain and offers a wide variety of possible diagnoses, the majority of which have gastrointestinal (GI), mostly appendicitis or obstetrics and gynaecological origins (OB-GYN), including ectopic pregnancy, pelvic inflammatory diseases (PID), and complex cysts in ovaries. [1-3]

The issue must be examined accurately and quickly because delayed diagnosis causes the treatment of urgent conditions to be delayed and wrong diagnosis can result in improper surgical intervention.[4, 5] In many cases, it is difficult to make an accurate

diagnosis of APP because of the close anatomical and physiological relationships between pelvic systems, comparable clinical manifestations of many illnesses, and overlapping symptoms, especially in the context of an emergency. [6]

The crucial first step in treating individuals who are of reproductive age and have pelvic pain is to determine whether or not they are pregnant. [7] Applying clinical prediction criteria, which are systematic clinical evidence applications for predicting difficult clinical circumstances,[8] is a good technique for detecting APP-involved pain among reproductive-age females .[9] Based on the differential diagnosis that is clinically considered to be the most suitable, imaging modalities are selected. Therefore, to evaluate the suspicion index among the underlying many etiologies, a comprehensive clinical examination of the patient is required. The history, physical examination, and correlation with the laboratory tests should be applied as a basis for diagnostic considerations prior to selecting a radiologic examination.[10, 11]

When an obstetrical or gynecologic etiology is suspected, trans-vaginal (TVUS) and trans-abdominal (TAUS) pelvic ultrasonography is the ideal imaging modality for first examination due to its wide availability, ionizing radiation absence, and flexibility of diagnosis.[12] However, several urgent conditions need further diagnostic imaging, such as applying the computed tomography (CT) scan or magnetic resonance imaging (MRI).[7]

The goal of this study was to verify clinical markers for APP diagnosis among reproductive-age females who may have experienced appendicitis, OB-GYN, or non-specific abdominal pain (NSAP).

Patients and Methods

This was an observational prospective clinical study. It included 150 female patients with APP and were admitted to the Emergency Department (ED) of the Main University Hospital, Faculty of Medicine, University of Alexandria. The study included female patients whose ages ranged from 15 to 50 years who presented to the ED with APP. However, we excluded readmitted patients to reduce miss-classification bias and patients whose chief complaints were not APP.

All patients were subjected to a thorough history taking, including personal history (age and marital status), history of abdominal pain (pain duration, and shifting of pain from the peri-umbilical area to the right lower quadrant), associated GI symptoms (anorexia, nausea, vomiting, and diarrhea), and OB-GYN symptoms (pregnancy and abnormal vaginal bleeding at the time of admission). Complete physical examination was conducted for all patients including body temperature measurement, systolic blood pressure (SBP), pulse rate (PR), sites of tenderness, and signs of peritoneal irritation (guarding and rebound tenderness). Laboratory investigations e.g. CBC and pregnancy test were recorded.

Ultrasound (US) examination was performed first with a 3.5 megahertz curvilinear transducer and then with 7 megahertz linear transducer. The procedure was carried out under the supervision of a consultant radiologist. All possible causes were evaluated by thoroughly examining all organs of the lower abdomen. Ultrasonographic findings with the possible diagnosis were recorded in every patient proforma containing relevant information.

Ethical considerations: The current work was done after approval of the Local Ethical Committee of the Faculty of Medicine, Alexandria University. Informed consent was obtained from every patient included in the study, explaining the aim and the procedure of the research. Complete confidentiality was ensured throughout the study procedures.

Data management and statistical analysis: The data was gathered, coded, reviewed, and applied to Rstudio 2.3.2 of the Statistical Software for the Social Sciences. For the quantitative data, we used frequency counts and percentages; for the parametric data, we used mean, standard deviation, and range; and for the non-parametric data, we used median and interquartile range (IQR). The sensitivity,

specificity, positive predictive value (PPV), and negative predictive value (NPV) of clinical parameters and US examination for APP diagnosis were assessed. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant when
$P < 0.05$.

Results

Table I demonstrates the demographic characteristics, pain history, GI symptoms, and Gynecological conditions of patients. The majority of patients aged between 15 and 35 years, and married (66.7%) According to the history of abdominal pain, the duration of pain lasted more than 24 hours in 50.7% and less than 24 hours in 49.4%. Shifting of abdominal pain occurred in 57.3%. While 92% suffered from right lower Q pain and 30.7% suffered from left lower Q pain. Anorexia was reported in 78 patients (52%), nausea and vomiting were found in 102 patients (68%) and diarrhea was shown in 8 patients (5.3%). Among 150 patients, 30 patients (20%) were pregnant. Eight percent of patients suffer from abnormal vaginal bleeding at the time of admission.

The physical examination and CBC laboratory investigations in all studied cases was mentioned in Table II**.** Guarding or rebound tenderness was diagnosed in 49.3, systolic blood pressure was around 90 mmHg in 12%, the temperature was normal in 32% and pulse rate was normal in 41.3%. Hematocrit was less than 36 in 58.7%, leukocytosis WBCs were more than 10000 in 48% and neutrophils were more than 75 in 50.7%.

A comparison between clinical and ultrasound findings showed that the clinical examination overestimated the acute appendicitis cases and underestimates the gynecological cases. While cases with NSAP were comparable by both clinical and ultrasound examinations. The diagnosis suggested by the clinical examination and ultrasound examination showed a statistically significant difference at ($p<0.001$) with 42% correct diagnosis in appendicitis detection and 11.8% correct diagnosis in gynecological detection (Table III).

A ROC curve of clinical diagnosis was constructed to detect the final diagnosis and the corresponding areas under the curve (AUC) was found to be (70.1%) (Figure 32) while detecting the final diagnosis with Ultrasound was with (AUC) to be (52.7%) (Figure 1), where sensitivity=40 % and 95% respectively and specificity= 100% and 0% respectively. (Table 4). The ROC curve analysis to assess the diagnostic performance of the US and clinical diagnosis for the detection of Appendicitis is shown in Figure 2. It was found that Ultrasound could detect appendicitis with higher sensitivity and specificity (95%, and 100% respectively) than the clinical diagnosis (91%, and 53% respectively) (Table 4).

Table (I): Distribution of all studied cases according to demographic characters, pain history, Gastrointestinal symptoms, and Gynecological conditions:

Age categories:		
	15 < 25	54 (36.0%)
	25 < 35	54 (36.0%)
	35 < 45	36 (24.0%)
	45 < 49	6 (4.0%)
Marital Status:		
	Single	50 (33.3%)
	Married	100 (66.7%)
Duration of pain:		
	< 24 hrs.	74 (49.3%)
	≥ 24 hrs.	76 (50.7%)

Shifting of abdominal pain:		
	Yes	86 (57.3%)
	No	64 (42.7%)
Right Lower Q pain:		
	Yes	138 (92.0%)
	No	12 (8.0%)
Left Lower Q pain:		
	Yes	46 (30.7%)
	No	104 (69.3%)
Anorexia:		
	Yes	78 (52.0%)
	No	72 (48.0%)
Nausea & Vomiting:		
	Yes	102 (68.0%)
	No	48 (32.0%)
Diarrhea:		
	Yes	8 (5.3%)
	No	142 (94.7%)
Pregnancy:		
	Yes	30 (20.0%)
	No	120 (80.0%)
Abnormal vaginal bleeding at time of admission:		
	Yes	12 (8.0%)
	No	138 (92.0%)

Table (II): Distribution of all studied cases according to Physical examination and Laboratory investigations:

Guarding or rebound tenderness:		
	Yes	74 (49.3%)
	No	76 (50.7%)
Systolic blood pressure (90 mmhg):		
	Yes	18 (12.0%)
	No	132 (88.0%)
Temperature (37.5):		
	Yes	48 (32.0%)
	No	102 (68.0%)
Pulse rate (100 B/min):		
	Yes	62 (41.3%)
	No	88 (58.7%)
Hematocrit ≤ 36:		
	Yes	88 (58.7%)
	No	62 (41.3%)
Leukocytosis WBCs ≥ 10000:		
	Yes	72 (48.0%)
	No	78 (52.0%)
Neutrophils ≥ 75:		
	Yes	76 (50.7%)
	No	74 (49.3%)

Table (III): Diagnosis suggested by the clinical examination system and Ultrasound system in all studied cases:

	Ultrasound Diagnosis					
	Appendicitis	**Gynecological**	**NSAP**	**Total**	**Correct diagnosis (%)**	**p**
Clinical Diagnosis:						
Appendicitis	38 (90.5)	28 (56.0)	24 (41.4)	90	42%	**<0.001***
Gynecological	4 (9.5)	16 (32.0)	14 (24.1)	34	11.8%	
NSAP		6 (12.0)	20 (34.5)	26	-	
Total	42	50	58	150		

Table (4): The diagnostic accuracy of Ultrasound (US) and clinical diagnosis for detecting the final diagnosis and for detecting Appendicitis:

		Final diagnosis				**Sensitivity**	**Specificity**	**PPV**	**NPV**	**Accuracy**
		Positive (n=149)		Negative (n=1)						
		No.	%	No.	%					
Total sample (n=150)	**Clinical diagnosis**					40%	100%	100%	10%	41%
	Positive	60	40.0%	0	0.0%					
	Negative	89	59.3%	1	0.7%					
	Ultrasound					95%	0%	99%	0%	94%
	Positive	141	94%	1	0.7%					
	Negative	8	5.3%	0	0.0%					
		Final diagnosis				**Sensitivity**	**Specificity**	**PPV**	**NPV**	**Accuracy**
		Appendicitis (n=44)		Negative (n=106)						
		No.	%	No.	%					
Total sample (n=150)	**Clinical diagnosis**					91%	53%	44%	93%	64%
	Appendicitis	40	26.7%	50	33.3%					
	Negative	4	2.7%	56	37.3%					
	Ultrasound					95%	100%	100%	98%	98.7%
	Appendicitis	42	28%	0	0.0%					
	Negative	2	1.3%	106	70.7%					

Figures

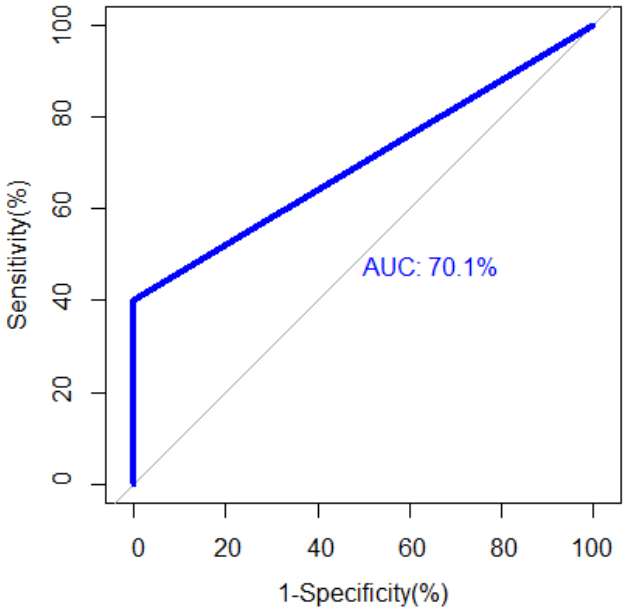

Figure (1): ROC curve for Clinical diagnosis versus final diagnosis

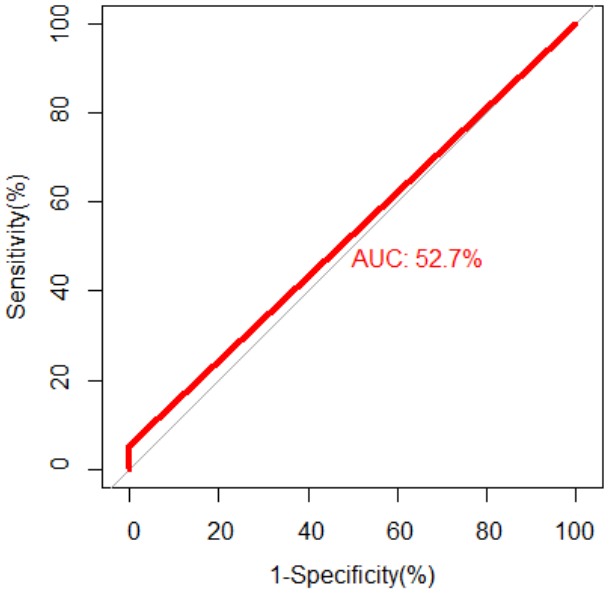

Figure (2): ROC curve of Ultrasound versus final diagnosis

Discussion

Despite the fact that the overall diagnostic efficacy of combining medical history, physical examination, and laboratory tests appears to be insufficient to arrive at a final accurate diagnosis of APP,[13] this technique seems to be useful for distinguishing between urgent and non-urgent causes of AAP, and it supports the choice to schedule further imaging tests in patients who could have an urgent problem that is perhaps urgent.[14]

In this study, we discovered a difference that was very significant statistically between the clinical diagnosis and the US-based diagnosis ($p< 0.001$). This was obviously apparent when using clinical indicators alone, as overestimation of appendicitis cases and underestimation of gynecological cases were reported. While we obtained more differential diagnoses when adding ultrasound to evaluate our patients.

Our findings agree with the findings of a prior retrospective investigation by Archibong et al.[24] on 15 female patients who had been clinically diagnosed with acute appendicitis, undergone surgery for it, and were later found to have unrelated gynecological diseases. In the resected appendices, histopathological examinations found 80% "normal" tissue and 20% that was "mildly inflamed". One of the right ovarian cysts in seven (46.7%) of the patients was bilateral. Four (26.7%) of the patients had corpus luteum cysts in addition to the four patients who had bilateral salpingitis, bilateral pyosalpinx, a right ovarian cyst with bilateral salpingitis, and a ruptured right tubal pregnancy. These findings suggest that the number of cases diagnosed with appendicitis is overestimated when relying solely on clinical diagnosis.

According to other studies, the use of diagnostic imaging aids in the clinical diagnosis and affects treatment choices in unselected people with acute abdominal pain.[14, 25, 26]

In this study, in order to assess the diagnostic performance of clinical indicators compared to ultrasound diagnosis, Roc curve analyses were performed. Although the clinical indicators showed high specificity and PPV (100%, for both), they showed poor sensitivity, NPV, and accuracy (40%, 10%, and 41%, respectively). On the contrary, the ultrasound reported high sensitivity, PPV, and accuracy (95%, 99%, and 94%, respectively) but the specificity and NPV were 0% for both. Our findings suggested incomplete and improper diagnostic performance for both tools when used individually, and for better diagnosis, both clinical indicators and ultrasound must be used together to increase the sensitivity, specificity, and the diagnosis accuracy. These combinations of clinical and ultrasound findings could be valuable as predictors of the underlying pathology of acute pelvic pain.

The present clinical or laboratory tests alone, according to Lietzén et al.[18] who stressed the requirement for imaging, are insufficient for the differential diagnosis of appendicitis.

Also, Laméris et al.[14] looked for the best method for accurately identifying urgent diseases in individuals with acute abdominal discomfort. They claimed that the first clinical diagnosis led to a lot of false positive urgent diagnoses, which were greatly diminished post CT or ultrasonography. The ultrasound sensitivity for diagnosing patients with acute abdominal pain was 70% (67% to 74%) which was lower than that reported in our study. But they discovered that CT had the highest sensitivity (88%) and missed just 6% of urgent cases.

On the contrary, Jearwattanakanok et al.[27] emphasized the role of clinical diagnostic indicators in the acute pelvic tenderness diagnosis among females. The clinical signs that may help distinguish appendicitis from conditions such as OB-GYN, NSAP, and acute lower abdominal pain among reproductive women include anorexia, nausea, vomiting, shifting abdominal pain, diarrhoea, the tender site involved tenderness, guarding and rebound tenderness, pregnancy, leucocytosis, and neutrophil over 75%.

Also, in subsequent work, Jearwattanakanok et al.[5] subsequently developed a clinical score with the following components: (1) guarding or rebound tenderness; (2) pregnancy; (3) discomfort in stomach regions; (4) leukocytosis; (5) peripheral neutrophils 75% ; and (6) the occurrence of diarrhoea. The score's sensitivity and specificity for the diagnosis of appendicitis were 89% and 70%, respectively, whereas for the diagnosis of OB-GYN, the corresponding values were 66.67% and 94.85%. They arrived to the conclusion that the clinical scoring system can distinguish between different disorders in young adult females who are suffering acute lower abdomen pain.

In 1986, one hundred years after the publication of the first report on acute appendicitis, the US for diagnosing acute appendicitis became popular.[28] The study found that in the acute appendicitis diagnosis, sensitivity was 89% and specificity was 100%. Later, several additional researchers confirmed the same conclusions. [29-31] which were comparable to our results. We found that ultrasound could detect appendicitis with higher sensitivity and specificity (95%, and 100% respectively) than the clinical diagnosis (91%, and 53% respectively), indicating the superiority of ultrasound in diagnosing acute appendicitis over the clinical diagnosis. This reported difference between both clinical and ultrasound findings may result from atypical clinical features of appendicitis may occur, and lack of experience, leading to potential delays in diagnosis and management.

Therefore, it is crucial to perform an US on this patients subset who experience pain in their lower abdomen and may have acute appendicitis since a false positive diagnosis can lead to unnecessary surgery, negative procedures, and occasionally sequelae of complications involving adhesions..

Also, more recent studies conducted by Arooj et al.[32] and Yoendra[33] reported a specificity of 84% and 81%, and sensitivity of 94% and 92%, respectively. Both investigations came to the same conclusion: ultrasonography is an effective diagnostic tool in emergency conditions to prevent needless surgical operations.

Meltzer et al.[34] prospective study, which included 261 adult patients with suspected appendicitis, found that, in contrast to our findings of high sensitivity and low specificity of clinical examinations in diagnosing acute appendicitis, the unstructured clinical judgment that appendicitis was either the most likely or second-most likely diagnosis showed sensitivity and specificity of 93% (95% CI 82% to 98%) and 33%. Finally, Golden et al.[35] who appeared to confirm our findings, came to the conclusion that clinical ratings do not eliminate the requirement for imaging to rule out appendicitis when a physician feels it essential.

We recognize that this analysis might have a few drawbacks. Without performing a randomized clinical trial, we were able to draw the comparisons given here because of the study's design, which included a thorough diagnostic assessment of all patients who were included, meticulous data collection, and a diagnosis assigned after each stage. We did not evaluate how imaging affected patient treatment and outcome in our approach.

Conclusion

Women of reproductive age who experience APP have diagnostic challenges. Early and precise abdominal pathology diagnosis is crucial to reduce morbidity and mortality as well as the cost of repeated ER visits, hospital stays, and emergency surgery. As clinical findings are not always enough for a definitive diagnosis, and in view of the legality, adequate radiological investigations (such as abdominal US) should be used appropriately and sufficiently to increase the accuracy of the suggested diagnosis. Overall, our data suggested the combinations of clinical and ultrasound findings could be valuable as predictors of the underlying pathology of APP in females. Patients would be admitted to the appropriate departments more promptly as a result, perhaps cutting down on the amount of time needed for diagnosis in the emergency room.

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