Clinical Indicators for Differential Diagnosis of Acute Lower Abdominal Pain in Women of Reproductive Age

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Abstract

Background: Acute lower abdominal pain in women of reproductive age is a challenging condition for clinical diagnosis. Computerized tomography yields high accuracy, but may not be cost-effective in low-middle income countries. Selective diagnostic approach based on clinical findings may be more appropriate.

Methods: Medical record review was performed on patients aging between 15 - 50 years who admitted to the surgical department or obstetrics and gynecology (OB-GYN) unit because of acute lower abdominal pain during January to December 2008. Patients were eventually categorized into appendicitis, OB-GYN conditions, or non-specific abdominal pain (NSAP). Clinical indicators were studied for diagnostic values using polytomous logistic regression applied to likelihood ratio for positive test (LR+) and confidence interval (CI).

Results: Anorexia, nausea and vomiting, shifting of abdominal pain decreased the likelihood of OB-GYN conditions. Diarrhea increased the likelihood of NSAP. Right lower quadrant tenderness increased the likelihood of appendicitis but decreased the likelihood of OB-GYN conditions. Left lower quadrant tenderness decreased the likelihood of appendicitis but increased the likelihood of OB-GYN. Guarding or rebound tenderness increased the likeli-hood of appendicitis but reduced the likelihood of NSAP. Leucocytosis (white blood cell count ≥ 10,000) increased the likelihood of appendicitis but reduced the likelihood of OB-GYN and NSAP. Neutrophil ≥ 75% increased the likelihood of OB-GYN but decreased the likelihood of NSAP. Pregnancy reduced the likelihood of appendicitis and increased the likelihood of OB-GYN.

Conclusion: Gastrointestinal symptoms, sites of abdominal tenderness, guarding or rebound tenderness, leucocytosis, neutrophil ≥ 75% and pregnancy are clinical indicators that may help differentiating appendicitis, common OB-GYN conditions, or NSAP in acute lower abdominal pain in women of reproductive age.

Keywords: Lower abdominal pain; Pelvic pain; Appendicitis; Ectopic pregnancy; Ovarian cyst; Non-specific abdominal pain; Likelihood ratio; Polytomous logistic regression

Introduction

Abdominal pain is a common chief complaint of patient at emergency departments. Diagnosis of abdominal pain, especially for lower abdominal pain in women of reproductive age, is challenging. Appendicitis, pelvic inflammatory disease (PID), ectopic pregnancy, and complicated ovarian cyst are common conditions that cause acute lower abdominal pain in childbearing age women [1].

As all common diagnoses of acute lower abdominal pain are emergency conditions, timely diagnosis and management are important. Physical examination alone, for example, pelvic examination has low accuracy in diagnosing lower abdominal pain [2]. Diagnostic investigations such as trans-vaginal ultrasound, computerized tomography (CT), magnetic resonance imaging (MRI), and laparoscopy are used with more accuracy [3-8]. These sophisticated investigations, however, require time, resources and medical specialties. The universal uses of these special investigations may not be available in every hospital, and transferring patients for investigation may result in delayed treatment. In appendicitis, for example, a study showed that more accurate diagnosis was associated with higher rate of ruptured appendicitis [9]. In low-middle income countries special investiga-

Table 1. Demographic Characteristic and Clinical Findings of Patients With Appendicitis, Obstetrics-Gynecological Conditions (OB-GYN), and Non-Specific Abdominal Pain (NSAP)

Characteristics	Appendicitis (n = 382)		OB-GYN (n = 97)		NSAP (n = 63)		P-value
	n	%	n	%	n	%	
Age (yr)							
> 25	169	44.2	41	42.3	27	42.9	
Mean (SD)	30.1	(11.3)	28.9	(8.8)	29.9	(10.4)	0.937*
Single	193	50.8	49	51.0	33	53.2	0.943
Duration of pain (hr)							
> 24	94	24.6	39	40.2	21	33.3	
Mean (SD)	31.2	(32.0)	52.4	(65.9)	34.9	(37.4)	0.413*
Shifting of pain	142	31.2	6	6.2	11	17.5	< 0.001
Anorexia	43	11.3	2	2.1	6	9.5	0.010
Nausea and vomiting	200	52.4	15	15.5	20	31.8	< 0.001
Abnormal vaginal bleeding	1	0.1	28	28.9	2	3.2	< 0.001
Diarrhea	29	7.6	4	4.1	13	20.6	0.002
Temperature ≥ 37.5 °C	124	33.3	14	14.6	12	19.4	< 0.001
Pulse rate (/min)	(n = 374)		(n = 97)		(n = 62)		
Tachycardia (≥ 100)	115	30.6	24	24.7	10	16.3	
Mean (SD)	90.8	(15.5)	88.0	(17.4)	85.2	(17.0)	0.021
Systolic blood pressure (mmHg)	(n = 374)		(n = 97)		(n = 61)		
Hypotension (< 90)	4	1.1	12	12.4	1	1.6	
Mean (SD)	121.8	(15.9)	112.4	(18.5)	117.9	(14.3)	< 0.001
RLQ tender	374	97.9	71	73.2	53	84.1	< 0.001
LLQ tender	15	3.9	48	49.5	6	9.5	< 0.001
Guarding/rebound tenderness	255	66.8	34	35.1	13	20.6	< 0.001
Hematocrit (%)	(n = 336)		(n = 86)		(n = 55)		
Mean (SD)	38.0	(3.9)	33.3	(6.0)	36.5	(5.9)	< 0.001*
WBC (/mm^3)	(n = 292)		(n = 71)		(n = 53)		
≥ 10,000	245	83.9	42	59.2	19	35.9	
Mean (SD)	14,204.5	(4,638.4)	11,875.9	(4,531.9)	9,958.8	(5,200.0)	< 0.001*
Neutrophil (%)	(n = 281)		(n = 69)		(n = 51)		
≥ 75	171	60.9	39	56.5	10	19.6	< 0.001
Pregnancy	7	1.8	47	48.5	3	4.8	< 0.001

* Kruskal-Wallis equality-of-populations rank test.

tions and medical specialties are not widely available. Diagnostic procedures, using combination of clinical findings and routine laboratories as diagnostic indicators, is probably more cost-effective and safe.

Patients and Methods

Patients

Patients were women aged 15 to 50 years who admitted to the surgical department or obstetrics and gynecological department in a tertiary care hospital during January to December 2008 with a chief compliant of acute lower abdominal pain within 14 days. The patients were eventually diagnosed with one of these conditions, appendicitis, common obstetrics and gynecological conditions (complicated ovarian cyst, PID, or ectopic pregnancy), or non-specific abdominal pain conditions (NSAP).

Study variables

Study variables are patients' baseline data (age and marital status), history of abdominal pain including duration of pain, shifting of pain from peri-umbilical area to right lower quadrant. Associated gastro-intestinal symptoms (anorexia, nausea, vomiting, and diarrhea), and gynecological conditions or symptoms (pregnancy and abnormal vaginal bleeding at time of admission) were recorded. Physical examination findings including body temperatures above 37.5 degree Celsius, systolic blood pressure, pulse rate, sites of tenderness, and signs of peritoneum irritation (guarding and rebound tenderness) were noted. Laboratory results from completed blood count and urine pregnancy test were also recorded.

Data source and bias

We used data from medical record reviews. Patients with re-admission were excluded to reduce miss-classification bias. To minimize missing data of clinical signs and symptoms, medical records without notes on these variables are recorded as 'negative' for such signs and symptoms. Data were recorded in electronic case record forms.

Statistical analysis

Descriptive statistics (percentages, means, and standard deviations) were used for describing data. To test for differences among the three diagnostic categories, we used exact probability tests for categorical data, one-way ANOVA and Kruskal-Wallis equality-of-populations rank test for continuous data as appropriated. We applied the concept of regression model for likelihood ratios of positive test (LR+) [10] by using polytomous logistic regression to identify signifi-

cant diagnostic indicators. Results were reported in LR+ and 95% confidence interval (CI).

Results

Medical records of five hundred sixty three (563) patients were reviewed. Twenty one (21) patients were excluded because their chief complaints were not acute lower abdominal pain. Of the 542 patients remaining for analysis, appendicitis was the final diagnosis in 382 patients, obstetrics and gynecological (OB-GYN) conditions in 97 patients, and non-specific abdominal pain (NSAP) in 63 patients. For OB-GYN group, ectopic pregnancies were diagnosed in 48 patients, complicated ovarian cysts in 42 patients, and PID in 7 patients.

Age, marital status, and duration of pain were not different (P = 0.937, 0.943, and 0.413). Shifting of abdominal pain was observed more often in appendicitis (31.3%) than in OB-GYN (6.2%) and in NSAP (17.5%, P < 0.001). Gastro-intestinal symptoms such as anorexia, nausea and vomiting, were less observed in OB-GYN. The proportion of diarrhea in NSAP was higher (31.8%) comparing to OB-GYN (4.1%) and appendicitis (7.6%, P = 0.002) (Table 1).

Low-grade fever was found in 33.3% of appendicitis patients, 14.6% of OB-GYN, and 19.4% of NSAP (P < 0.001). There were twelve OB-GYN patients (12.4%) presented with hypotension. Left lower quadrant tenderness was predominated in OB-GYN patients (49.5%, 3.9% in appendicitis, and 9.5% in NSAP, P < 0.001). Right lower quadrant tenderness was reported in almost every appendicitis patient (97.9%), and in high proportions of OB-GYN (73.2%), and of NSAP (84.1%, P < 0.001). Similarly, guarding and rebound tenderness was found more often in appendicitis (Table 1).

Leucocytosis (defined as white blood cell count $\geq$ 10,000/mm^3) was found in 83.9% of appendicitis, 59.2% of OB-GYN, and 35.9% of NSAP (P < 0.001). Percentage of neutrophil $\geq$ 75% was less observed in NSAP (19.6%, 60.9% in appendicitis, and 56.5% in OB-GYN, P < 0.001). Pregnancy was associated more often with OB-GYN group (Table 1).

Multivariable analysis

We analyzed all diagnostic indicators simultaneously, using the concepts of regression model for likelihood ratio of positive test, with polytomous logistic regression, to determine the effect of each indicator on the likelihood of each of the three diagnostic categories. Diagnostic indicators that increase the likelihood of appendicitis were: right lower quadrant tenderness, guarding and rebound tenderness, and leucocytosis. Left lower quadrant tenderness, pregnancy reduced likelihood of appendicitis. Indicators that increase likelihood of OB-GYN were: left lower quadrant tenderness, neutrophil

Table 2. Likelihood Ratio of Positive Test (LR+) of Diagnostic Indicators From Multivariable Analysis

Indicators	Appendicitis		Obstetric-gynecological conditions		Non-specific abdominal pain	
	LR+ (95%CI)	P	LR+ (95%CI)	P	LR+ (95%CI)	P
Age > 25yr	1.07 (0.91 - 1.26)	0.395	1.09 (0.68 - 1.76)	0.711	0.71 (0.33 - 1.53)	0.379
Single	0.95 (0.80 - 1.12)	0.542	1.34 (0.84 - 2.14)	0.216	1.06 (0.49 - 2.30)	0.884
Duration of pain > 24 hr	1.11 (0.94 - 1.31)	0.237	0.86 (0.51 - 1.44)	0.567	0.89 (0.50 - 1.57)	0.677
Shifting of pain	1.13 (0.99 - 1.28)	0.068	0.36 (0.13 - 0.99)	0.047	0.76 (0.35 - 1.68)	0.501
Anorexia	0.98 (0.81 - 1.17)	0.792	0.34 (0.13 - 0.88)	0.027	1.66 (0.69 - 4.00)	0.258
Nausea and vomiting	1.06 (0.93 - 1.19)	0.375	0.42 (0.23 - 0.76)	0.004	0.90 (0.50 - 1.63)	0.728
Abnormal vaginal bleeding	0.23 (0.03 - 1.51)	0.125	1.15 (0.56 - 2.39)	0.701	0.24 (0.03 - 2.30)	0.217
Diarrhea	0.84 (0.63 - 1.10)	0.207	0.85 (0.32 - 2.25)	0.738	2.93 (1.55 - 5.56)	0.001
Temperature ≥ 37.5 °C	1.00 (0.88 - 1.14)	0.955	0.71 (0.38 - 1.33)	0.282	1.06 (0.54 - 2.06)	0.863
Tachycardia	0.95 (0.83 - 1.09)	0.441	1.05 (0.61 - 1.81)	0.852	1.22 (0.62 - 2.43)	0.565
Systolic BP ≤ 90 mmHg	0.88 (0.33 - 2.31)	0.792	2.08 (0.82 - 5.29)	0.124	0.78 (0.10 - 6.07)	0.816
RLQ tender	2.30 (1.17 - 4.51)	0.016	0.53 (0.31 - 0.93)	0.026	0.75 (0.31 - 1.82)	0.528
LLQ tender	0.22 (0.10 - 0.48)	< 0.001	3.59 (2.27 - 5.66)	< 0.001	0.79 (0.30 - 2.13)	0.647
Guarding/rebound tenderness	1.25 (1.10 - 1.43)	0.001	0.69 (0.42 - 1.12)	0.131	0.37 (0.19 - 0.71)	0.003
Hematocrit < 33%	0.84 (0.65 - 1.09)	0.190	1.61 (0.87 - 2.98)	0.126	0.98 (0.43 - 2.23)	0.960
WBC ≥ 10,000/mm^3	1.74 (1.38 - 2.20)	< 0.001	0.38 (0.20 - 0.74)	0.004	0.36 (0.20 - 0.67)	0.001
Neutrophil ≥ 75%	1.00 (0.88 - 1.15)	0.956	1.96 (1.11 - 3.45)	0.021	0.33 (0.16 - 0.66)	0.002
Pregnancy	0.31 (0.14 - 0.69)	0.004	2.24 (1.18 - 4.25)	0.014	1.18 (0.32 - 4.29)	0.806

Table 3. Summarized Direction of Likelihood of Diagnosis (Appendicitis, Common Obstetric and Gynecological Conditions; OB-GYN, or Non-Specific Abdominal Pain; NSAP) for Each Clinical Indicators

Diagnostic indicators	Likelihood of diagnosis		
	Appendicitis	OB-GYN	NSAP
Anorexia		Decrease	
Nausea/vomit		Decrease	
Shifting of pain		Decrease	
Diarrhea			Increase
RLQ tender	Increase	Decrease	
LLQ tender	Decrease	Increase	
Guarding/rebound tenderness	Increase		Decrease
Pregnancy	Decrease	Increase	
WBC ≥ 10,000/mm^2	Increase	Decrease	Decrease
Neutrophil ≥ 75%		Increase	Decrease

≥ 75%, and pregnancy. Shifting of abdominal pain, anorexia, nausea and vomiting, right lower quadrant tenderness, and leucocytosis decreased likelihood of OB-GYN. Diarrhea increased likelihood of NSAP, while guarding and rebound tenderness, leucocytosis, and neutrophil ≥ 75% reduced likelihood of NSAP (Table 2, 3).

Discussion

Diagnosis of acute lower abdominal pain in a young adult woman is sometimes a challenging clinical situation. Both appendicitis and obstetrics and gynecological conditions need emergency management; therefore, timely and precision of diagnosis is warranted. Studies showed that CT, especially, spiral CT had higher accuracy in diagnosis of appendicitis than ultrasound [11, 12]. In addition, CT scan resulted in changes of diagnosis in 6-36% of acute lower abdominal pain patients [13]. Ultrasound still has its role in pregnant patients because of no radiation exposure [4].

Cost-effectiveness of CT is controversial. In one study, CT showed a reduction of cost in reproductive women with right lower abdominal pain by reducing the cost of unnecessary appendectomy [14]. However, the cost-effectiveness of CT is questionable when health re-imbursement scheme is global budgeting. Selective use of CT, therefore, was advised [15, 16].

Clinical scoring scheme is another approach to diagnosis of appendicitis. Alvarado's scoring scheme was developed for discriminate appendicitis from other causes of abdominal pain [17]. Recently, it was applied for admission criteria rather than as a diagnostic tool [18].

One limitation of clinical scoring schemes for diagnosis of acute lower abdominal pain in reproductive women is that they were designed for diagnosis of single disease. When more than one diagnosis is the outcomes of interest in diagnostic studies, polytomous logistic regression may be applied [19, 20]. In the present study, obstetrics and gynecological conditions were also common causes among these patients and urgent treatments for such conditions were important. The rationale of data analysis in the present study was to study the effect of clinical diagnostic indicators for appendicitis and OB-GYN simultaneously with NSAP. Therefore, polytomous logistic regression was used.

In multivariable polytomous logistic regression for likelihood ratio of positive test, anorexia, nausea and vomiting were associated with decreased likelihood of diagnosis OB-GYN. Anorexia, nausea and vomiting are symptoms associated with gastrointestinal system while OB-GYN is associated with uro-genital system. Signs of peritoneal irritation such as guarding and rebound tenderness, when presented, were associated with decreased likelihood of NSAP.

Effects of clinical indicators that were summarized in Table 3 can be applied in selective approach to women at reproductive age who presented with acute lower abdominal pain. Patients with right lower quadrant tenderness, guarding and rebound tenderness, complete blood counts show leucocytosis and neutrophil more than 75%, but are not pregnant and have no tenderness on left lower quadrant are likely to be appendicitis. General surgeons should be consulted to man-

age these cases. Patients without gastro-intestinal symptoms (anorexia, nausea and vomit), no shifting of abdominal pain, no tenderness on right lower quadrant, no leucocytosis, but present with pregnancy and left lower quadrant tenderness are likely to be OB-GYN conditions. They should be managed by gynecologists. Patients who do not have signs of peritoneal irritation (guarding and rebound tenderness), no leucocytosis and present with diarrhea are possibly NSAP. They can be observed and periodically evaluated for progression of abdominal pain.

Conclusion

Clinical diagnostic indicators that may help differentiate appendicitis, OB-GYN conditions, and NSAP in acute lower abdominal pain in reproductive women are: anorexia, nausea and vomiting, shifting of abdominal pain, diarrhea, site of tenderness, guarding and rebound tenderness, pregnancy, leucocytosis, and neutrophil over 75%.

Conflict of Interest

The authors declared none.

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