

## Evaluation of Multislice-CT compared with Ultrasound Abdomen and Pelvis in Diagnosis of Acute Appendicitis in Female of Reproductive Age

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### Abstract

Appendicitis is the commonest causes of the acute abdominal pain and most frequent causes for an urgent abdominal surgical operation. Recently, it is clarified that the appendix may have an immune-protective function and working as a lymphoid organ especially in young age. Other theories claimed that appendix work as storage for "good" colonic bacteria. Moreover, others theories claimed that it is a just developmental remnant and without function. The present investigation was done between March 2016 and July 2019, and including 60 female patients in reproductive age who clinically suspected as acute appendicitis with Alvarado score. Then, the female patients were divided to 2 groups; Group A, including 30 patients, the primary diagnosis based on Alvarado score with pelvic-bdominal sonography and group B, including 30 patients, the primary diagnosis of acute appendicitis depend up on Alvarado score and multislicepelviabdominal CT. All patients in the 2 groups were complaining from acute rtlower abdominal pain with Alvarado score more than 3. All patients in the 2 groups diagnosed of acute appendicitis were managed by open appendectomy. Postoperative final results were depended on the histopathological evaluations of the samples. Multislice-pelvi-abdominal CT play an important role in diagnosis of acute appendicitis in female patients and it is more sensitive and specific than the modified Alvarado score plus US abdomen and pelvis. CT abdomen and pelvis rule out other pelvic pathology, and so lowering the high rates of -veappendectomy and increase accuracy of final diagnosis of acute appendicitis.

### Introduction

Appendicitis is the commonest causes of the acute abdominal pain and most frequent causes for an urgent abdominal surgical operation [1]. Acute appendicitis is with average 233/100,000 population and more frequent within 10 to 19 year age, and the incidence is increased among men; male to female ratio of 1.4: 1, who have a lifetime incidence of 8.6 compared with 6.7 for women [2]. Exactly, the appendix function has been a debated topic. Recently, it is accepted that the appendix may have an immune-protective function and acts as a lymphoid organ especially in the younger person. Other theories claimed that the appendix acts as a storage vessel for "good" colonic bacteria. Still, others argue that it is a just developmental remnant and has no real function [3-5].

Acute appendicitis is mainly depends on the personal symptoms and signs [6]. Right lower abdominal pain, and periumbilical pain radiating to the right lower abdomen are the most accurate signs and symptoms for diagnosis acute appendicitis in adult. Diminished bowel sounds, a +ve Ro using sign a +ve obturator, and a +ve psoas sign are the most accepted for diagnosis in acute appendicitis in children [7].

Final diagnosis is depending on the patient's medical history, a physical examination and routine lab. In young healthy males with right lower abdominal pain, a -ve appendectomy rate less than 10 has been considered acceptable, while a rate that approaches 20 was often seen in female of reproductive age in whom other pelvic processes can confound the evaluation [8].

Although, it's a common health problem, the acute appendicitis ruling is still difficult to find, especially in young, elderly, and in female of reproductive age. Different gynecologic or genitourinary inflammatory conditions can present with symptoms and signs look like to those of acute appendicitis [9].

### Keywords

Acute appendicitis; Alvarado score; US and Multislice-CT abdomen & pelvis; Open appendectomy

The various score systems were formed to elevate the diagnostic accuracy of appendicitis which are with non-invasive, low-cost, and easy to use [10].

The commonest score system between surgeons is Alvarado score, that was started in 1986 as the simple addition of points correlated to 8 clinical parameters (**Table 1**) [11]. The modified Alvarado score omitted the last point of the original score (shift to the left Neutrophils) (**Table 2**) [12].

**Table 1:** Alvarado score.

Parameters	Score
Migratory right iliac fossa pain	1.0
Anorexia	1.0
Nausea and Vomiting	1.0
Right iliac fossa tenderness	2.0
Rebound tenderness	1.0
Fever	1.0
Leucocytosis	2.0
Shift to the left neutrophils	1.0
Total Score	10

**Table 2:** Modified Alvarado score.

Parameters	Score
Migratory right iliac fossa pain	1.0
Anorexia	1.0
Nausea and Vomiting	1.0
Right iliac fossa tenderness	2.0
Rebound tenderness	1.0
Fever	1.0
Leucocytosis	2.0
Total Score	9.0

Recently, a clinical scoring system was performed, named the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score, which modified in 2008 at the surgery department, Raja Isteri Pengiran Anak Saleha Hospital, Brunei Darussalam [13]. The score involve 14 parameters clinically (**Table 3**).

**Table 3:** RIPASA score.

Parameters	Score
Female	0.5
Male	1.0
Age<39.9 years	1.0
Age>40 years	0.5
Right iliac fossa (RIF) pain	0.5

Migration of pain to RIF	0.5
Anorexia	1.0
Nausea and vomiting	1.0
Duration of Symptoms<48 hours	1.0
Duration of Symptoms>48 hours	0.5
RIF tenderness	1.0
Guarding	2.0
Rebound tenderness	1.0
Rovsing's sign	2.0
Fever	1.0
Raised WBC	1.0
Negative urine analysis	1.0
Total score	16.5

It is impracticable to own a eventual preoperative ruling for acute appendicitis. The only confirmation of diagnosis is by the postoperative histopathology examination. Diagnosis of appendicitis has a considerable rate of negative appendicectomy varying from 20-40% [14].

Pelviabdominal ultrasound is highly operator dependent, needs a height standard of talent and experience, and may be complicated in some situations (sever pain, overlying gases). Moreover, sonography frequently does not allow the detection of normal or perforated appendixes [15].

CT scans have been clarified as having a better sensitivity (94%) and specificity (95%) for ruling appendicitis [16]. Therefore, performing a CT scan may modify the ruling of appendicitis, but it would increase the healthcare costs. The sensitivity, specificity and ruling accuracy of the modified Alvarado and RIPASA scores are lower than those of a CT scan [15].

CT performed with low radiation dose techniques demonstrates comparable diagnostic performance to standard dose CT [17]. A positive CT results indicate that the treatment for appendicitis should be initiated, whereas a negative result indicates that a normal appendix has been visualized and appendicitis is highly unlikely as the diagnosis.

## Aim of Work

The present investigation was performed to investigate the importance of multislice-CT abdomen and pelvis in primary ruling of acute appendicitis of female patients in reproductive age and relating it with final results compared with pelviabdominal sonography.

## Patients and Methods

Between March 2016 and July 2019, this investigation including 60 female patients in reproductive age who clinically suspected as acute appendicitis with Alvarado score. Then, the female patients were divided to 2 groups; A & B.

Group A, including 30 patients, the primary ruling based on Alvarado score with pelviabdominal sonography and group B, including 30 patients, the primary ruling of acute appendicitis based on Alvarado score and multislice-CT abdomen and pelvis. All patients in the 2 groups were complaining from acute RT lower abdominal pain with Alvarado score more than 3.

All patients were explained about the aim of the present investigation with ethical aspects and a written consent was taken as past medical history, and previous operations, full clinical examination, routine laboratory investigations (complete blood count, random blood sugar, coagulation profile, renal and liver functions, plus pregnancy test in married patients).

All patients in the 2 groups diagnosed with acute appendicitis were operated by conventional method of open appendicectomy. Postoperative final diagnosis was based on histopathological assessment of the specimen. The efficacy in each group was evaluated by measuring specificity, sensitivity, +ve predictive value, -ve predictive value and veappendicectomy rate.

### Inclusion criteria

- All the patients included in this study were female aged between 17 and 50 years old (reproductive age) with symptoms and sings of acute appendicitis in whom emergency appendicectomy was done.
- Patients who were willing to participate in this study.

### Exclusion criteria

- Patients who were not willing to participate in the study.
- Patients with acute or chronic renal impairment.
- Patients with known allergy to the oral or IV contrast.
- Patients refused oral and IV contrast for CT abdomen and pelvis.
- Patients refused surgical treatment after primary diagnosis.
- Patients with pregnancy.

### US finding in acute appendicitis

Ultrasound detect free fluid in the right lower abdomen, along with a visible appendix with higher blood flow with color Doppler, and non-compressibility of the appendix, as it is essentially a walled off abscess. Other secondary US signs of acute appendicitis have the presence of echogenic mesenteric fat around the appendix and the acoustic shadowing of an appendicolith [18].

### CT examination protocol

800–1000 ml of oral contrast medium for bowel opacification was applied to the patients 60–90 min before scanning. The scan is applied with the patient in the supine position, following an IV injection of 100–120 ml of iodinated contrast medium with a rate of 3 ml/Sec and a scan delay of approximately 60 sec. The using of IV and oral contrast medium gives data for inflamed appendix with surrounding tissues [19].

### Results

All 60 patients were female, age from 17 to 50 years old, clinically suspected complaining from acute appendicitis. The clinical data collected for all cases in the 2 groups was as follow:

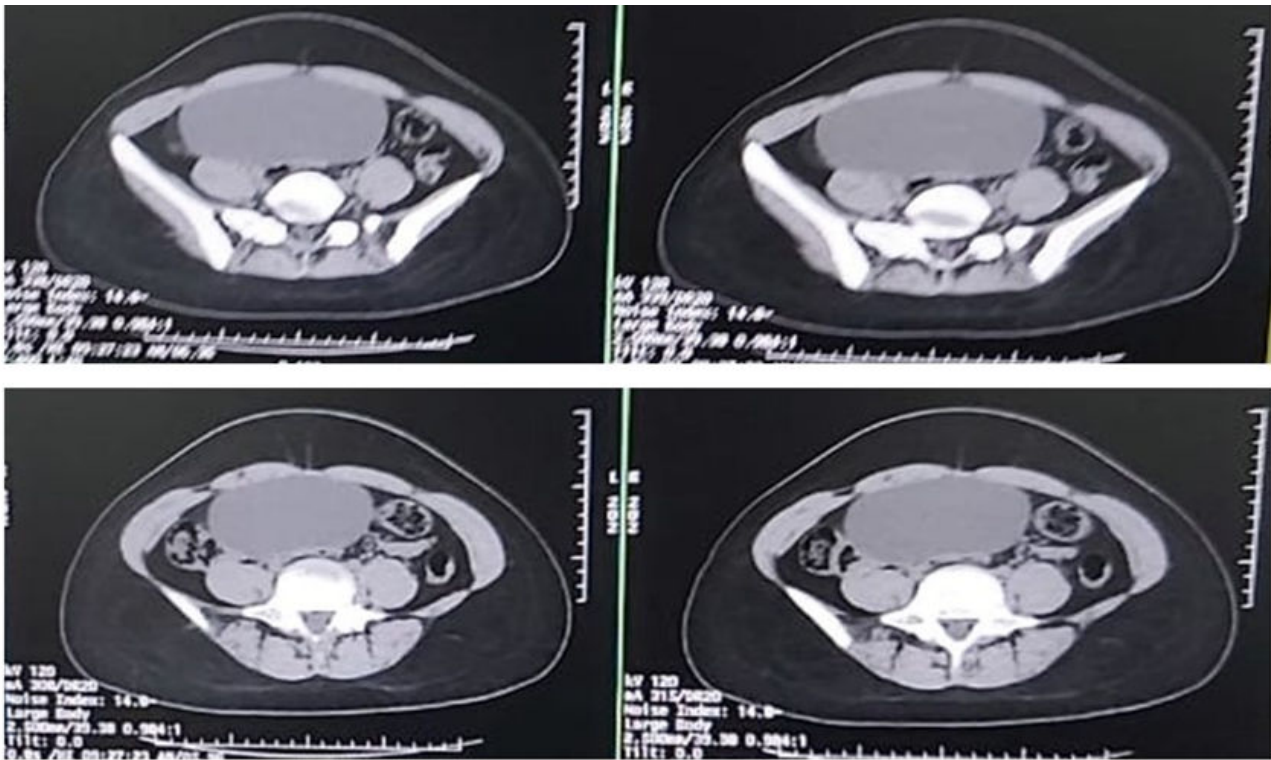
Rt lower abdominal pain was the commonest presenting symptom in all 60 cases (100%) in group A and B, anorexia 18 (60%) in group A, and 20 (66.6%) in group B, nausea and vomiting 15 (50%) in group A and 16 (53.3%) in group B and fever 14 (46.6%) in group A and 16 (53.3%) in group B.

All 60 patients scored from 3 to 9 after clinical and laboratory investigations, according to Alvarado score. They classified into 2 groups, in which group A including 30 patients, pelviabdominal US done for them and group B including 30 patients, pelviabdominal multislice CT with oral and IV contrast done for them (**Figures 1, 2 and 3**).

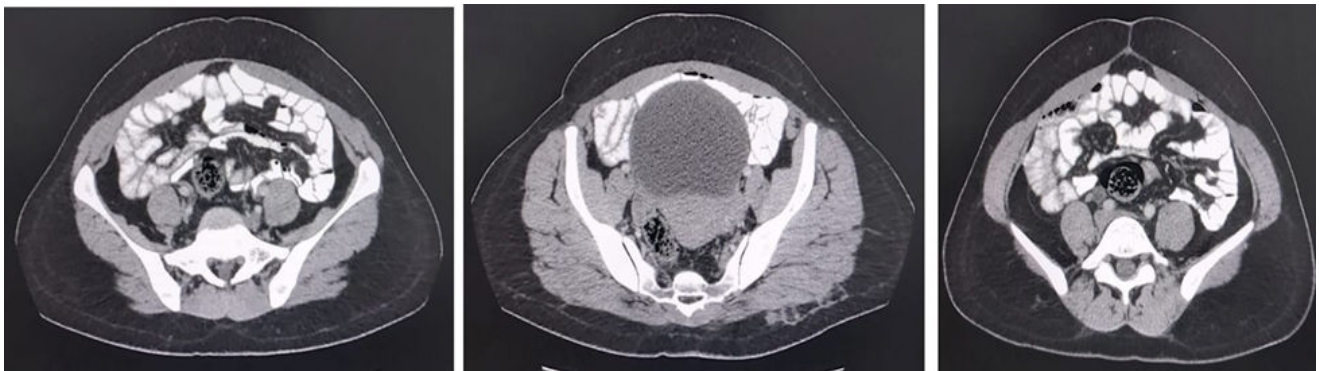


**Figure 1:** CT scan axial and coronal cuts with oral and IV contrast of middle aged female showing well defined rounded fluid density right iliac fossa lesion with marginal enhancement. It measured about 3 × 3 × 4 cm in diameter, and is seen associated with perifocal inflammatory reaction. However, the adjacent bowel loops are not dilated. In addition crescent air with few gas bubbles are seen which indicate the appendicular abscess lesion.





**Figure 2:** CT abdomen and pelvis axial views with oral and IV contrast of female aged 30 years showing well circumscribed rounded fairly non enhancing pelviabdominal cyst measuring about 6 × 7 × 8 cm (ovarian cyst).



**Figure 3:** unremarkable CT scan of abdomen and pelvis with oral and IV contrast of female patients aged 25 years, complaining from right iliac fossa pain and managed conservatively after CT.

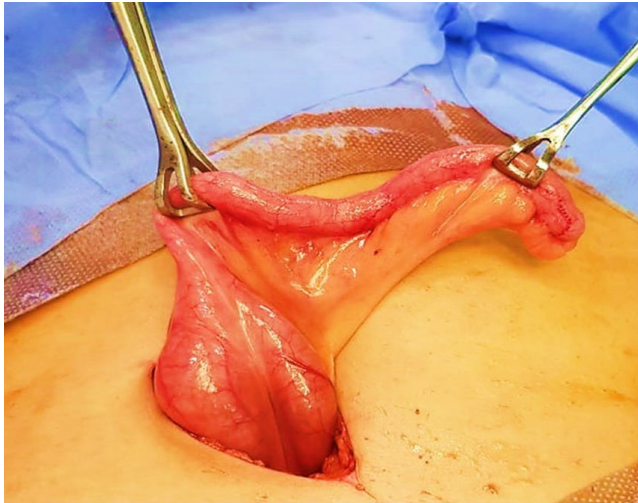
In group A, exclusion of 6 cases (20%) from the diagnosis of acute appendicitis after pelviabdominal US duo to diagnosis of other pathology or non-conclusive US and in group B, exclusion of 7 cases (23,3 ) from the ruling of acute appendicitis due to diagnosis of other pathology or normal CT finding. Two patients in group A ,from the 6 excluded cases and one patients in group B , from the 7 excluded cases with non-conclusive finding not respond to conservative management for 3 days with persistent rt lower abdominal pain and some signs and symptoms of acute appendicitis ,open appendectomy done for them and postoperative histopathology were positive diagnosis ,despite

of non-conclusive finding in US &CT abdomen and pelvis. Open appendectomy done for the 50 patients in the 2 groups (**Figure 4**) and postoperative histopathology done for all cases. The -ve appendectomy rate was 4 patients (16.6%) in group A, and was 2 patients (8.7) in group B, where the multislice-CT abdomen and pelvis was effective in primary ruling and postoperative reducing the negative appendectomy rate.

### Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 24.0 (released 2016), and MedCalc 2014

(MedCalc Software). The sensitivity, specificity, -ve predictive value (NPV), +ve predictive value (PPV), with their 95 confidence intervals (95 CIs) for Sonar and CT were estimated. Statistical significance was achieved if  $P < 0.05$  (Table 4).



**Figure 4:** Photograph of open appendectomy showing inflamed appendix.

**Table 4:** Diagnostic indices of Sonar and CT depending on using post-operative histopathology as gold standard.

Diagnostic index	CT Value	Sonar Value
Sensitivity (95 CI)	95.45% (77.16% to 99.88%)	83.33% (62.62% to 95.26%)
Specificity (95 CI)	75.00% (34.91% to 96.81%)	66.67% (22.28% to 95.67%)
Positive Predictive Value (precision) (95 CI)	91.3% (75.91% to 97.22%)	90.91% (76.80% to 96.92%)
Negative Predictive Value (95 CI)	85.71% (45.90% to 97.70%)	50.00% (25.76% to 74.24%)
Accuracy (95 CI)	90.00% (73.47% to 97.89%)	80.00% (61.43% to 92.29%)

- CT had higher sensitivity and specificity than Sonar, so it had lower false positive and false negative than Sonar.
- PPV of CT was elevated than that of Sonar. PPV were (91.30% and 90.91%) so CT leaves only 8.7% and 9.09% of false positive results for CT and Sonar respectively. This means that the proportion of people with +ve test result that really have the disease was higher in CT compared to that detected by Sonar. In other words, CT was more precise than Sonar.
- NPV of CT was higher (85.71%) than Sonar (50.00%) that means that the proportion of people with a negative test result who do not have disease was higher in CT than Sonar. The false negative results of CT were lower (14.29%) than that of Sonar (50.00%).
- CT was more accurate (90.00%) than Sonar (80.00%).

## Discussion

The sensitivity, specificity and ruling accuracy of the modified Alvarado and RIPASA scores in investigation were decrease than those of a CT scan [20]. A meta-analysis for 9330 patients clarified through 28 investigations and claimed a considerable variation in the -ve appendectomy rate (NAR), from 16.7 during applying clinical estimation without imaging compared to 8.7 with apply of CT [21]. Furthermore, the NAR lowered from the pre-to post-CT era (21.5% to 10%) [22].

This study including 60 female patients in reproductive age in which, only 50 patients were have underwent appendectomies. Group A, including 30 patients, the primary ruling depends on Alvarado score plus US abdomen and pelvis and group B, including 30 patients, the primary ruling of acute appendicitis depends on Alvarado score, plus CT abdomen and pelvis. Acute appendicitis is the commonest abdominal emergency and has a life time prevalence of about 7 [20]. Improving ruling accuracy and lowering the -ve appendectomy rate can be occurred through the applying of multiple diagnostic investigations, such as computed tomography (CT) and US, although these can elevate the overall healthcare costs. The CT scans have been clarified as having a high sensitivity (94%) and specificity (95%) for ruling acute appendicitis [21].

Comparison between the findings of the 2 groups of patients, the results was better in group B. The negative appendectomy rate was 4 patients (16.6%) in group A, and was 2 patients (8.7%) in group B, where the CT abdomen and pelvis was effective in reducing the -ve appendectomy rate.

The imaging is used mainly to increase the specificity of the diagnostic evaluation for appendicitis and to lower the -ve appendectomy average. In a contemporary worldwide observational study of over 4000 patients suspected of acute appendicitis, 21.2 percent underwent abdominal CT, 43.3 percent underwent abdominal ultrasound (US), 6.7 percent underwent both CT and US, and 28.8 percent did not undergo any radiological investigation [23].

## Conclusion

Pelviabdominal CT play an important role in ruling of acute appendicitis in female patients and it is more sensitive and specific than the US abdomen and pelvis. CT abdomen and pelvis more rule out other pelvic pathology, and thereby reducing the higher rates of negative appendectomy and increase accuracy of final diagnosis of acute appendicitis.

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