Original Article

Evaluation of Acute Pelvic Pain in Reproductive Aged Women with Abdominal Computed Tomography: Thammasat University Hospital study

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Abstract

Background: Acute pelvic pain is a common condition among reproductive-aged women. Some of them require surgery. Nowadays, abdominal computed tomography play important roles in diagnosis these patients.

Objective: To evaluate the accuracy, sensitivity and specificity of abdominal computed tomography for diagnosis of various causes of acute pelvic pain in women of reproductive age and to study the incidence and knowledge of radiographic abnormality acquired from abdominal computed tomography of acute pelvic pain in reproductive-aged woman.

Material and method: We compared 88 abdominal computed tomography results of reproductive female patient with acute pelvic pain with final diagnostic results. The sensitivity, specificity and accuracy of computed tomography for appendicitis, acute gynecologic condition and pelvic inflammatory disease (PID) were calculated.

Result: Seventy-two CT scans show radiographic abnormalities (positive). Overall accuracy of CT in diagnosis the cause of acute pelvic pain was 87.5%. The accuracy, sensitivity and specificity in diagnosis of acute appendicitis were 98.9%, 100% and 97.7%, respectively. The accuracy, sensitivity and specificity in diagnosis of pelvic inflammatory disease were 96.6%, 83.3% and 98.7%, respectively.

Conclusion: Abdominal CT has high accuracy in diagnosis of the cause of acute pelvic pain in reproductive-aged women. However, it should be rationally performed, considering radiation exposure to vulnerable female pelvic organs. Despite the main limitation, CT scan is useful in case clinical and initial ultrasound is inconclusive.

Keyword: acute pelvic pain, reproductive-aged women, abdominal computed tomography, acute appendicitis, pelvic inflammatory disease

Introduction

Acute pelvic pain is defined as sudden onset of lower abdominal or pelvic pain lasting less than 3 months and is common problem among reproductive-aged women.[1, 2, 3, 4]

Due to the nature of the female pelvic anatomy and physiology, this condition is somehow a diagnostic challenge due to non-specific clinical history and physical examination. The etiology of acute pelvic pain can vary from gastrointestinal, gynecologic and urologic conditions, which require different treatments.[3, 5, 6]

The treatments of the acute pelvic pain are categorized into surgical and non-surgical groups. The surgical group includes acute appendicitis, ovarian torsion or ruptured diverticulitis etc. Non-surgical group includes acute pyelonephritis or acute PID etc. Delayed diagnosis and treatment can lead to prolonged hospital stays, morbidity and mortality.

According to American College of Radiology (ACR) criteria, ultrasound is the primary choice of imaging techniques in acute pelvic pain patients, due to its ready availability, cost-effectiveness, noninvasive nature, and lack of ionizing radiation.[1, 7] However, there are increasing trends in use of abdominal computed tomography in acute pelvic pain patients, which attributes to its performance in identifying the gastrointestinal and urinary tract causes of acute pelvic pain.

The objective of this study is to evaluate the sensitivity, specificity and accuracy of computed tomography (CT) for diagnosis of various causes of acute pelvic pain in women of reproductive age.

Materials and methods

This study was approved by ethics committee in our institute.

Data collection

We collected data of female patients, aged 15-45 years, who presented at our emergency department or outpatient department with acute pelvic pain from electronic medical records during January 1, 2012 to December 31, 2016. One hundred and nineteen of these patients underwent abdominal CT scans. Thirty-one were excluded from the study due to incomplete medical records. Total eighty-eight were included in our study.

Abdominal CT scans were separately reviewed by two experienced radiologists. Both radiologists were blinded to clinical history and final diagnosis. Any discordant findings were discussed between two radiologists to make a final consensus. Final diagnoses for each patient were retrieved from surgical findings, pathological results and final clinical diagnosis from medical records.

The imaging criteria in diagnosis of appendicitis consist of main and additional imaging characteristics. The main imaging characteristics are dilated non-opacified appendix (>6mm) (Figure 1) and appendicolith (Figure 2). The additional imaging characteristics are fat stranding, fluid collection, abscess (Figure 2), extra-luminal air and adenopathy.[8, 9]
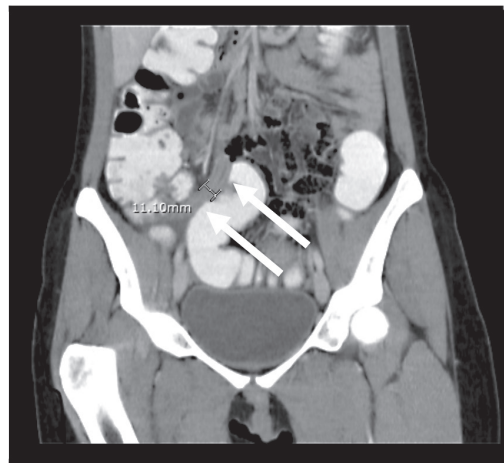
Figure 1 Coronal CECT abdomen of acute appendicitis showing dilated non-opacified appendix (>6mm) (arrow).
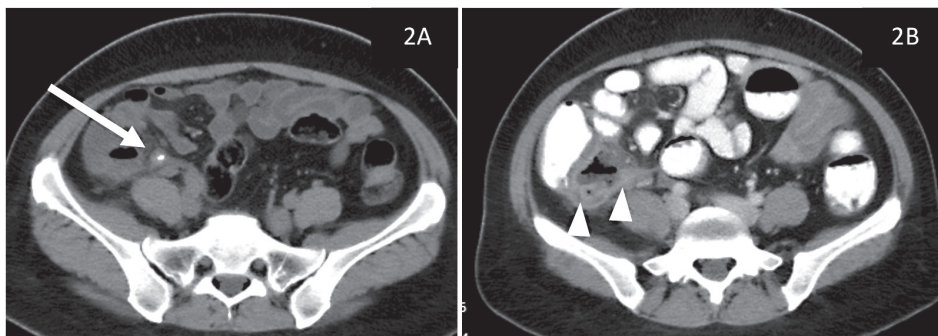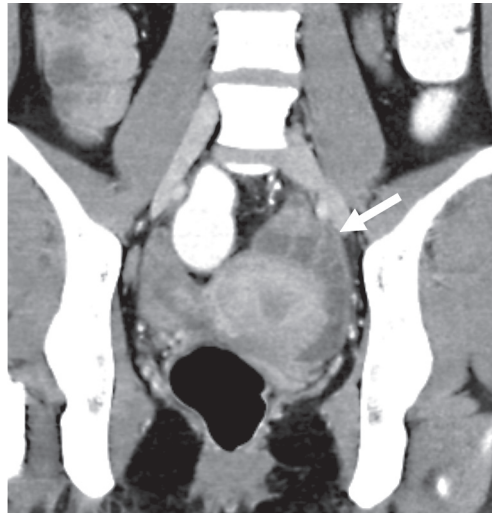

Figure 2 CT scan of appendiceal abscess, A: Appendicolith shown in axial pre-contrast image of patient with appendiceal abscess (arrow). B: Axial post-contrast showing appendiceal abscess which contains internal air-fluid level (arrowhead).

Major CT findings of acute pelvic inflammatory disease (PID) include thick-walled, low-attenuation adnexal masses with thick septations (Figure 3) and dilated, pus-filled fallopian tube (Figure 4). Minor CT findings consist of thickening of the uterosacral ligaments, increased attenuation of the presacral fat secondary to edema and indistinct margins of adjacent bowel loops.[10, 11, 12, 13]
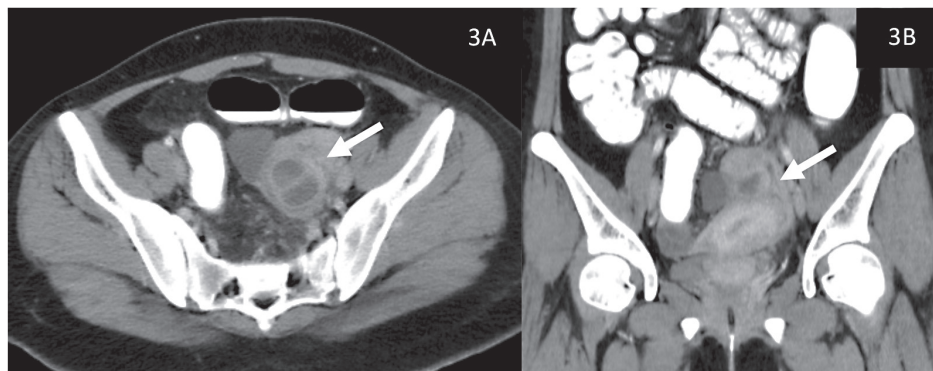
Figure 3 Axial (A) and coronal (B) CT scan of left tubo-ovarian abscess (arrow).

Figure 4 Coronal CT scan of left pyosalpinx (arrow).

And the other CT findings that may cause pelvic tenderness are also recorded such as urolithiasis, acute pyelonephritis, other gynecologic problems and non-periappendiceal abscess.

Final CT diagnoses were compared with final clinical diagnoses. The sensitivity, specificity and accuracy were calculated.

Computed tomographic techniques

CT examinations were performed using a Philips Brilliance ICT 256 slice helical scanner (Philips Healthcare Medical System) or a SOMATOM Definite AS 128 slice helical scanner (Siemens Healthineers) at our institution. Our standard CT protocol for abdominal pain includes non-contrast phase, late arterial phase and porto-venous phase (40s and 80s after start injection) using positive oral and rectal contrast administration. However, each abdominal CT scans were individually tailored depending on clinical information and discussion between referring physicians and on-duty residents or radiologist.

Results

Ages of our study population range from 15 years to 45 years (mean age and median ages are 29.3 years and 29 years, respectively). Durations of presenting symptoms range from 3 hours to 14 days (mean and median of durations are 3.12 days and 2 days, respectively).The most common location of abdominal pain is on the right side (72 patients) followed by bilateral lower abdomen (9 patients), left side (4 patients) and suprapubic area (3 patients). Thirteen of 88 patients have bedside transabdominal or transvaginal ultrasound before CT examinations. Three of 13 patients had normal sonographic examinations. The remaining sonographic results were inconclusive.

Whole abdominal CT scans were undergone in 20 patients. Others were performed lower abdominal CT scans. Details of various usages of contrast administrations are displayed in Table 1.

Table 1 Route of contrast material administrations

CT scan	Route of Contrast material (CM)	No. of patients
CT whole abdomen (20 patients)	Intravenous CM only	1
	Intravenous CM + positive oral and rectal CM	10
	Intravenous CM + positive rectal CM	8
	Intravenous CM + neutral rectal CM	1
CT lower abdomen (68 patients)	Intravenous CM + positive rectal CM	59
	Intravenous CM + neutral rectal CM	1
	Intravenous CM only	4
	Noncontrast	4

All clinical final diagnoses are tabulated as shown.

Table 2 Lists of clinical final diagnoses

Final diagnoses	No. of patients
Appendicitis and related complications	43
PID	12
Endometriosis	6
Enteritis	5
Urinary tract infection	4
Ovarian tumor without torsion	2
Ovarian tumor with torsion	1
Complicated ovarian cyst	1
Appendiceal mucocele	1
Ruptured corpus luteal cyst	1
Calyceal stone	1
Omphalitis	1
Appendiceal abscess and bilateral endometriotic cysts	1

There are 72 patients who had positive CT findings which are listed in Table 3.

Table 3 Lists of CT diagnoses

CT diagnoses	No. of patients
Appendicitis and related complications	44
PID	11
Colitis	4
Endometriosis	4
Urinary tract infection	3
Calyceal stone	1
Ruptured corpus luteal cyst	1
Ovarian tumor with torsion	1
Ovarian tumor without torsion	1
Hemorrhagic ovarian cyst	1
Appendiceal abscess and bilateral endometriotic cysts	1

Overall accuracy of CT in diagnosis the cause of acute pelvic pain is 87.5%. There are 11 cases which have discordance between CT and final diagnoses. 7 cases had normal CT scans and 4 cases had different CT diagnoses with final diagnoses. All 11 cases are listed in Table 4.

Table 4 Lists of discordance between CT and final diagnoses

CT diagnoses	Final diagnoses	No. of patients
	Enteritis	2
	Endometriosis	2
Normal	PID	1
	Cystitis	1
	Omphalitis	1
PID	Endometriosis	1
Enteritis	TOA	1
Endometriotic cyst	Struma ovarii	1
Appendiceal abscess	Appendiceal mucocele	1

Appendicitis and related complications are the most common CT diagnosis, accounting for forty five patients (51.1%).The sensitivity, specificity, positive predictive value, negative predictive value and accuracy in diagnosis of appendicitis of abdominal computed tomography are 100%, 97.7%, 97.8%, 100% and 98.9%, respectively.

Pelvic inflammatory disease is the second most common CT diagnosis, accounting for eleven patients (12.5%). The sensitivity, specificity, positive predictive value, negative predictive value and accuracy in diagnosis of PID of abdominal computed tomography are 83.3%, 98.7%, 90.9%, 97.4% and 96.6%, respectively.

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy in diagnosis of overall acute gynecologic conditions (PID and other gynecologic conditions) in our study are 81.8%, 97.0%, 90.0%, 94.1% and 93.2%, respectively.

Discussion

CT scans has high accuracy for identifying cause of acute pelvic pain, especially acute appendicitis and PID. The sensitivity, specificity and accuracy of abdominal computed tomography in diagnosis of appendicitis are high. This result is similar to prior study of Rao PM et al and Kamel IR et al[8, 9]. Outcomes of our study reach 100% sensitivity and 97.73% specificity. Only one false positive case that the CT diagnosis is abscess from ruptured appendicitis but pathological diagnosis is appendiceal mucocele (Figure 5). The abscess is possible a result of the inflamed appendiceal mucocele.
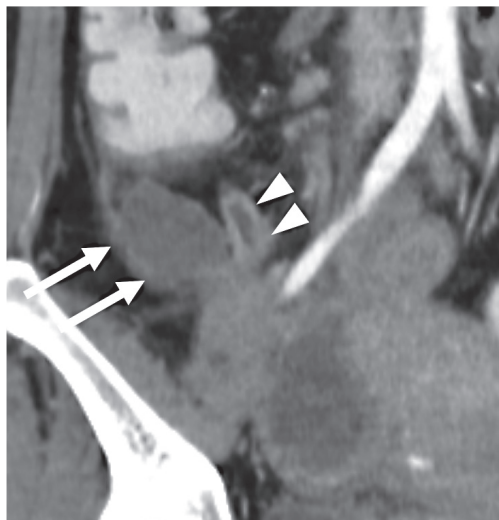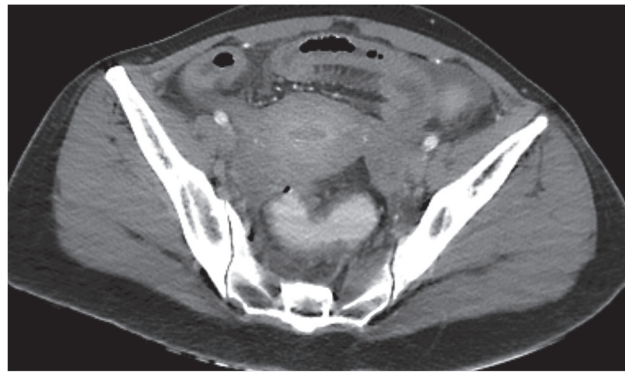

Figure 5 A 44-year-old female presented with RLQ pain for two days. Coronal CECT with positive rectal contrast administration showing dilated fluid filled and hyperenhancing walled appendix (arrowhead) and adjacent rim-enhancing fluid collection (arrow). CT diagnosis is ruptured appendicitis with abscess formation, but pathological result revealed appendiceal mucocele.

The sensitivity, specificity and accuracy in diagnosis of acute gynecologic conditions are slightly lower than prior study of Rao PM et al.[9] In our study, recruited populations were collected only reproductive age while in study of Rao PM et al collected data from wide-range-aged women. This may affect the disease prevalence and outcome of our study. Our sensitivity, specificity and accuracy of CT scan for diagnosis of PID are very high. Only three PID cases have false CT diagnosis. One of these cases had normal CT scan. In early course of PID, the disease may be subtle and can appear normal on CT scan[14]

as in our study. Another case had CT diagnosis of right TOA but intraoperative result was endometriotic cyst (Figure 6). Both lesions may have resembled CT findings of complex cystic pelvic mass with internal high attenuation.[15] Study of Wang Het al suggests that thick wall and multilayered appearance can help identifying TOA in CT.[16] The remaining case had CT diagnosis of enteritis but intraoperative result revealed ruptured tubo-ovarian abscess (Figure 7). Ruptured tubo-ovarian abscess may cause secondary inflammation of adjacent bowel loops.[17]
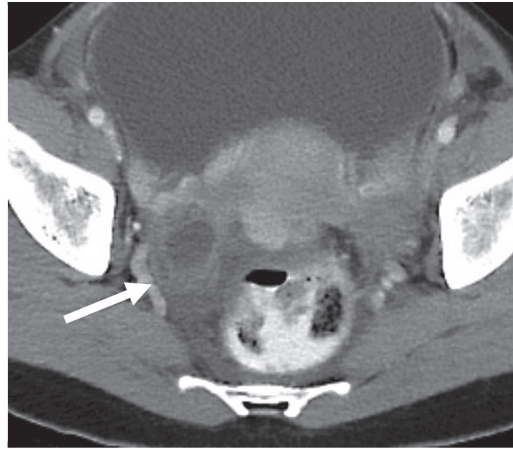
Figure 6   A 41-year-old female presented with suprapubic pain. Axial CECT with positive rectal contrast administration showing right complex cystic mass (arrow). CT diagnosis is right TOA. But pathological result revealed right endometriotic cyst.

Figure 7   A 34-year-old female presented with pelvic pain and vaginal discharge. Axial CECT with positive rectal contrast administration showing diffuse bowel wall thickening. CT diagnosis is enteritis. But pathological result revealed ruptured tubo-ovarian abscess.

Thirteen cases of pelvic pain performed sonography before CT scan. Final diagnoses of all cases were gynecologic conditions. The results of sonographies were normal in three cases. Only six sonographies can identify the possible causes of pelvic pain such as ovarian cyst or complex mass. Six cases underwent abdominal CT scans for further characterization and confirmation of the sonographic findings. Nine of 13 cases (69.23%) had correct CT diagnosis. Thus CT scans may add value in identifying the gynecologic cause of pelvic pain. Despite high accuracy of CT scan, the major disadvantage is radiation exposure. Because the reproductive-aged women are considered the vulnerable populations.[18] Ultrasound should be initially performed in patient with acute pelvic pain, according to American College of Radiology (ACR) criteria. Nowadays, there are increasing trends of low dose CT in clinical practice. Dose reduction often results in increased noise index which affects imaging quality. According to study of Xinlian W et al.[19] They suggest using low tube-voltage combined with automatic tube current modulation and 70% adaptive statistical iterative reconstruction (ASIR) technique which will allow the low CT radiation dose without losing image quality on female pelvic scan. Further study for optimizing protocols and capability of low dose CT scan in acute pelvic pain patients is needed.

Few limitations in our study; first, as mentioned above, the CT techniques were variable depending on clinical information and discussion between referring physicians and on-duty residents or radiologist. Second, there is no standard criterion in diagnosis of acute appendicitis and PID from CT scans.

Conclusion

CT has high accuracy in diagnosis of the cause of acute pelvic pain. However, CT scans should be performed reasonably due to its radiation exposure to vulnerable female pelvic organs. Despite the main limitation, CT scans are considered useful in case clinical and initial ultrasound is inconclusive

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บทคัดย่อ

การประเมินภาวะปวดอุ้งเชิงกรานเฉียบพลันในสตรีวัยเจริญพันธ์ด้วยเอกซเรย์คอมพิวเตอร์ส่วนช่องท้อง

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ที่มาและความสำคัญ: ภาวะปวดอุ้งเชิงกรานเฉียบพลันเป็นภาวะที่พบได้บ่อยในสตรีวัยเจริญพันธ์ ส่วนหนึ่งเป็นภาวะฉุกเฉินที่ต้องได้รับการรักษาด้วยการผ่าตัด ปัจจุบันการตรวจวินิจฉัยทางเอกซเรย์คอมพิวเตอร์ช่องท้องจึงเข้ามามีบทบาทสำคัญในการช่วยวินิจฉัยแยกโรคโดยอาศัยลักษณะความผิดปรกติทางรังสีที่ตรวจพบ

วัตถุประสงค์: ประเมินค่าความแม่นยำ ค่าความไว และค่าความจำเพาะของเอกซเรย์คอมพิวเตอร์ส่วนช่องท้องในการตรวจหาสาเหตุต่างๆ ที่ทำให้เกิดอาการปวดอุ้งเชิกรานเฉียบพลัน รวมทั้งศึกษาอุบัติการณ์ และองค์ความรู้ของลักษณะความผิดปรกติทางรังสีในสตรีวัยเจริญพันธ์

วิธีวิจัย: เปรียบเทียบผลภาพเอกซเรย์คอมพิวเตอร์ส่วนช่องท้องในผู้ป่วยหญิงวัยเจริญพันธ์ที่มาด้วยอาการปวดอุ้งเชิงกรานเฉียบพลัน 88 ราย กับผลการวินิจฉัยสุดท้ายและคำนวณค่าความไว ค่าความจำเพาะ และค่าความแม่นยำของการวินิจฉัยภาวะไส้ติ่งอักเสบ ภาวะฉุกเฉินทางนรีเวชและภาวะอุ้งเชิงกรานอักเสบเฉียบพลัน

ผลวิจัย: พบพยาธิสภาพจากการตรวจเอกซเรย์คอมพิวเตอร์ส่วนช่องท้องจำนวน 72 ราย ค่าความแม่นยำโดยรวมของเอกซเรย์คอมพิวเตอร์ส่วนช่องท้องในการวินิจฉัยหาสาเหตุอาการปวดอุ้งเชิงกรานเฉียบพลันในสตรีวัยเจริญพันธ์ เท่ากับ 87.5% ค่าความแม่นยำ ค่าความไว และค่าความจำเพาะ ในการวินิจฉัยภาวะไส้ติ่งอักเสบสูง เท่ากับ 98.9%, 100% และ 97.7% ตามลำดับ ค่าความแม่นยำ ค่าความไว และค่าความจำเพาะในการวินิจฉัยภาวะอุ้งเชิงกรานอักเสบเฉียบพลันสูง เท่ากับ 96.6%, 98.7% และ 83.3% ตามลำดับ

สรุปผลวิจัย: เอกซเรย์คอมพิวเตอร์ช่องท้องมีค่าความแม่นยำสูงในการวินิจฉัยสาเหตุของภาวะปวดอุ้งเชิงกรานเฉียบพลันในสตรีวัยเจริญพันธ์ แต่เนื่องจากผู้ป่วยต้องได้รับรังสี จึงควรพิจารณาอย่างสมเหตุสมผล โดยอาจพิจารณาส่งในกรณีประวัติอาการ รวมถึงอาการแสดงกับผลตรวจด้วยคลื่นเสียงความถี่สูงช่องท้องไม่สอดคล้องกันหรือไม่สามารถนำไปสู่วินิจฉัยได้

คำสำคัญ: ปวดอุ้งเชิงกรานเฉียบพลัน, สตรีวัยเจริญพันธ์, เอกซเรย์คอมพิวเตอร์ส่วนช่องท้อง, ภาวะไส้ติ่งอักเสบ, ภาวะอุ้งเชิงกรานอักเสบเฉียบพลัน