Multidetector Computed Tomographic Image Characteristics of Clinically Severe Pelvic Inflammatory Disease in an Emergency Department

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Purpose: Diagnosis of pelvic inflammatory disease (PID) is based on clinical history and examination; however, it may be difficult to distinguish from other disease entities. Multidetector computed tomography (MDCT) is a useful radiologic modality, which can be performed in an emergency department (ED). The aim of the current study was to clarify the MDCT characteristics of clinically severe PID by comparison of patients with clinically more severe and less severe forms of PID. In addition, we evaluated the independent predictors of MDCT findings in the severe PID group.

Methods: We conducted a retrospective study of female patients with symptoms and signs of PID who visited the ED at our institution during a five-year period. Patients who underwent abdominal MDCT and were diagnosed with PID were retrospectively enrolled in the study. For determination of CT characteristics, each patient was evaluated for pelvic edema, amount of ascites, Hounsfield units (HU) of ascites, salpingitis, oophoritis, intrauterine devices, peritoneal fat infiltration, cervicitis, abnormal endometrial enhancement, tubo-ovarian abscess, adjacent bowel wall thickening, localized ileus, and perihepatitis. Patients were divided into two groups: clinically more severe and less severe forms of PID. Patients having the clinically more severe form of PID were defined as follows: (1) initial body temperature over 38.3°C, (2) initial systolic blood pressure < 90 mmHg, (3) intractable abdominal pain, or (4) uncontrollable nausea or vomiting despite medication. We compared data between the two groups.

Results: A total of 136 patients were enrolled in this study. Thirty eight patients had the clinically more severe form (28%) and 98 patients had the less severe form (72%). In comparison with subjects in the group having the less severe form, the amount of ascites ($p<0.001$), salpingitis ($p<0.05$), and tubo-ovarian abscess ($p<0.01$) differed statistically between the groups. The HU value of ascites in the more severe group, 19.56 ± 11.14 HU, was significantly greater, compared with that of the group having the less severe form. Results of multivariate logistic regression analysis revealed an association of the amount of ascites, a high HU value, and atubo-ovarian abscess with increased odds of the more severe form (adjusted OR 3.25, 95% CI 1.01-10.45; adjusted OR 5.84, 95% CI 1.80-18.95; and adjusted OR 8.42, 95% CI 1.73-40.96, respectively).

Conclusion: Patients with clinically more severe PID show more clinically important findings on MDCT, such as a greater amount of ascites, higher HU value of ascites, and tubo-ovarian abscess. Leukocytosis, increased neutrophil percentage, and elevated CRP were observed in patients with severe PID.

Key Words: Pelvic inflammatory disease, Computed tomography, Pelvic pain, Female

Introduction

Pelvic inflammatory disease (PID) is defined as inflammation of the female upper reproductive tract. It is a serious disease, initiated by ascending infection from the cervix and vagina. The most important causes are sexually transmitted infections, such as gonorrhea and Chlamydia, which account for approximately one-half of PID infections. If PID is untreated or incompletely treated, there are serious long-term sequelae including chronic pelvic pain, increased risk of ectopic pregnancy, and tubal factor infertility. Prompt and correct diagnosis
of women suffering from PID is important to prevent serious sequelae.

PID comprises a spectrum of diseases, including endometritis, salpingitis, oophoritis, adnexitis, parametritis, tubo-ovarian abscess, pelvic peritonitis, and perihepatitis. Patients with PID also present with a broad range of clinical manifestations, from subclinical and asymptomatic presentations to acute severe infections requiring hospitalization. Although guidelines for the diagnosis of PID have been recommended by the Centers for Disease Control and Prevention, a clinically-based diagnosis is frequently subjective and thus there are some discrepancies between clinicians in making a diagnosis. The gold standard for diagnosis is laparoscopy; however, it is invasive and seldom used in an emergency department (ED). Relevant laboratory results, including elevated C-reactive protein (CRP), increased erythrocyte sedimentation rate (ESR), and leukocytosis may be helpful, but false-positive and false-negative diagnoses are common. A number of diagnostic imaging approaches can be performed to improve the accuracy of PID diagnosis. Ultrasound is rapid, low-cost, does not require ionizing radiation, and is readily available, but is highly observer dependent and lacks sensitivity for PID. The role of multidetector computed tomography (MDCT) in the evaluation of females with pelvic disease is of great value as a primary imaging modality in the ED as there is an advantage to differentiating between PID and other abdominal diseases, such as appendicitis, diverticulitis, urinary tract infection, irritable bowel syndrome, and other gynecologic diseases.

It is difficult to diagnose, assess severity, and determine the need for admission in PID patients using only a few criteria. Also, there is not a strong relationship between clinical severity and clinical presentation. An incorrect estimation of PID severity may lead to either overtreatment or undertreatment; therefore, imaging studies are necessary for proper diagnosis and classification. However, there have been few studies with statistical analysis of the clinical manifestations of severe PID and MDCT results. The purpose of the current study was to clarify the MDCT characteristics of clinically severe PID by comparing more severe and less severe form PID. Additionally, we identified independent predictors of MDCT findings in the severe PID group.

### Materials and Methods

#### 1. Study Design

We performed a retrospective study of women with symptoms and signs of PID, who visited the ED at our institution between January, 2007 and December, 2011. Those who underwent abdominal MDCT and were diagnosed with PID were retrospectively enrolled.

#### 2. Study Setting and Population

This study was conducted at a tertiary care hospital in Seoul, Korea, with 30,000 ED visits annually. Inclusion criteria were (1) women aged 15–45 years, (2) presentation to the ED with acute symptoms of PID (lower abdominal pain, fever, or purulent leucorrhoea), (3) leukocytosis, elevated C-reactive protein (CRP), or elevated erythrocyte sedimentation rate (ESR), and (4) diagnosis of PID based on MDCT and hospital admission. Two radiologists retrospectively reviewed three-phase abdominal CT scans for each patient and reached a final diagnosis.

To evaluate the CT manifestations of PID, the analysis of portal phase or delay phase images was used for detecting the presence of pelvic edema, amount of ascites, Hounsfield unit (HU) of ascites, salpingitis, oophoritis, intrauterine devices, peritoneal fat infiltration, cervicitis, abnormal endometrial enhancement, tubo-ovarian abscess, adjacent bowel wall thickening, localized ileus, and perihepatitis. Pelvic edema was defined as thickening of the uterosacral ligaments and haziness of the pelvic fat with obscured pelvic fascial planes. Cervicitis was defined as an enlarged and abnormally enhancing endocervical canal. Endometritis was defined as abnormal endometrial enhancement and fluid collection within the endometrial canal. Salpingitis was indicated by fluid-filled fallopian tubes exhibiting an even greater degree of wall thickening, and oophoritis was defined as enlarged and abnormally enhancing ovaries, which may demonstrate a polycystic appearance. Peritoneal fat infiltration was defined as a visually detectable area of increased...