

CT Imaging Findings of Ruptured Ovarian Endometriotic Cysts: Emphasis on the Differential Diagnosis with Ruptured Ovarian Functional Cysts

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Objective: The purpose of this study is to assess the prevalence of abnormal CT findings in patients with surgically proven ruptured endometriotic cysts, as compared with those abnormal CT findings of ruptured ovarian functional cysts.

Materials and Methods: This study included 13 retrospectively identified patients with surgically confirmed ruptured ovarian endometriotic cysts and who had also undergone preoperative CT scanning during the previous seven years. As a comparative group, 25 cases of surgically confirmed ruptured ovarian functional cysts were included. We assessed the morphologic features of the cysts and the ancillary findings based on CT.

Results: For the endometriotic cysts, the mean maximum cyst diameter was significantly larger than that of the functional cysts (70.1 mm versus 36.4 mm, respectively, $p < 0.05$). The endometriotic cysts frequently had a multilocular shape and a thicker cyst wall, as compared to that of functional cysts, and these differences were statistically significant. Among the ancillary findings, endometriotic cysts showed a significantly higher prevalence of loculated ascites, ascites confined to the pelvic cavity without extension to the upper abdomen, and peritoneal strandings and infiltrations ($p < 0.05$). Although 11 of the 25 cases of functional cysts showed active extravasation of contrast material at the ovarian bleeding site, only one of 13 cases of endometriotic cysts showed active extravasation.

Conclusion: The diagnosis of ruptured endometriotic cyst should be suspected for a woman in whom CT reveals the presence of multilocular or bilateral ovarian cysts with a thick wall and loculated ascites confined to the pelvic cavity with pelvic fat infiltrations.

Index terms: Endometriosis; Ovary; Cysts; Computed tomography (CT); Comparative studies; Pelvis

INTRODUCTION

The reproductive tract is the commonest source of spontaneous hemoperitoneum in women of childbearing age. After ruling out an ectopic pregnancy, rupture of an

ovarian cyst is the most common cause of spontaneous hemoperitoneum in nonpregnant patients (1–3). Ovarian cyst rupture and hemorrhage are basically physiological events that involve the follicle or corpus luteum, but when the hemorrhage is large or a considerable quantity of fluid is released from a cyst into the peritoneal cavity, this may result in acute abdominal pain and/or pelvic pain from peritoneal irritation (2, 4). While ovarian endometriosis is a very common condition in women of reproductive age, endometriotic cyst associated with rupture is an uncommon condition. Nevertheless, this condition is important because it may require emergency surgery due to the severe abdominal pain secondary to chemical peritonitis when the fluid contents flow out of the cysts (5).

Although the imaging findings of ovarian endometriotic cysts have been extensively described, less attention

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has been given to the imaging findings of ruptured endometriotic cysts. Although ultrasound (US) and magnetic resonance imaging (MRI) remain the primary imaging modalities for assessing women with suspected gynecologic pathology, computed tomography (CT) is frequently performed as the first imaging modality for the evaluation of abdominal and pelvic pain of an unknown etiology (6). The possibility of endometriosis is often overlooked as a cause when both ascites and a pelvic mass are found in the same patient, and this is because the majority of ovarian cysts presenting with rupture or hemorrhage are functional cysts. As patients with endometriotic cysts frequently have multiple associated peritoneal adhesions (7, 8), establishing the correct diagnosis of ovarian cyst is crucial to help guide the surgical planning. The purpose of this study is to assess the prevalence of abnormal CT findings of patients with surgically proven ruptured endometriotic cysts, as compared to the abnormal CT findings of patients with ruptured ovarian cysts.

MATERIALS AND METHODS

The study population consisted of 13 patients with surgically confirmed ovarian endometriotic cysts associated with rupture and who underwent preoperative CT from January 2003 to December 2009, and the patients were assessed through a retrospective review of the hospital records and the operation database at Kangbuk Samsung Hospital (Seoul, Korea). As a comparative group, we

retrospectively assessed 25 cases of surgically confirmed ruptured ovarian functional cysts during the same period, and these cases included 21 cases of corpus luteal cysts and four cases of follicular cysts. All these patients had undergone laparoscopic laparotomy or open oophorectomy within one week after CT scanning.

Ever since 2005, the CT scans were performed by a 40-slice Brilliance CT scanner (Philips Medical Systems, Cleveland, OH) using a 0.5 mm detector collimation with 3 mm reconstruction. For the contrast-enhanced scans, 120 mL of nonionic contrast medium was administered at a rate of 3 mL/s, with a scan delay of 60s. Prior to 2005, a GE HiSpeed Advantage CT (Milwaukee, WI) with helically acquired images at a collimation of 7 mm and a pitch of 1.0 was used.

The clinical and laboratory data for age, the presence of leukocytosis and an abnormal hemoglobin level and hematocrit was obtained by a retrospective review of the medical records: leukocytosis was a serum white cell blood count higher than $10.2 \times 10^3/\text{mm}^3$, an abnormal hemoglobin level was a serum hemoglobin level lower than the standard value (11.0 g/dL) and an abnormal hematocrit was a serum hematocrit level lower than 34%. A single attending radiologist who specialized in genitourinary radiology and who had more than 15 years of experience and who was without knowledge of the clinical and pathologic findings recorded the morphologic features of the cysts and the ancillary findings based on the CT: the maximum cyst diameter, bilaterality, multilocularity, the cyst

Table 1. Morphologic Characteristics of Ovarian Cysts and Prevalence of Ancillary Findings on CT Imaging of Women with Ruptured Endometriotic Cysts and Functional Cysts

CT Findings	Endometriotic Cysts (n = 13)	Functional Cysts (n = 25)	P value
Maximum diameter (mm)	70.1	36.4	0.007*
Cyst density on noncontrast scan (HU)	35.07	22.33	0.977
Maximum cyst wall thickness (mm ± SD)	2.92 (1.89)	2.14 (0.72)	0.002*
Bilaterality	4	2	0.07
Multilocularity	7	2	0.002*
Cyst wall enhancement	11	25	0.202
Disrupted cyst wall	4	16	0.07
Active extravasations	1	11	0.02*
Abdomen ascites	3	17	0.023*
Loculated ascites	10	1	0.000*
Peritoneal infiltrations	7	3	0.002*

Note.— *P values < 0.05 were considered statistically significant. HU = Hounsfield unit, SD = standard deviation

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density on the noncontrast scans, cyst wall enhancement, the maximum thickness of the cyst wall, discontinuity or disruption of the cyst wall, active extravasations of intravenous contrast media around the cyst, the extent of ascites, loculated ascites and the presence of peritoneal infiltrations.

Statistical analysis was performed to compare the differences of the CT findings. Differences in proportions were analyzed by Fisher's exact test, whereas continuous variables were assessed by the *t* test. A *p* value of < 0.05 was considered significant. All the analyses were performed using the SPSS program (SPSS version 17.0 software for Window; SPSS, Chicago, IL).

RESULTS

For the endometriotic cysts, the mean age of the patients with endometriotic cysts was older than that of the patients with functional cysts (32.7 ± 7.30 years and 26.8 ± 6.95 years, respectively), but the difference was not statistically significant. The prevalence of leukocytosis and a decreased hemoglobin or hematocrit level was not different between the two groups.

The morphologic characteristics of the ovarian cysts and the prevalence of the ancillary CT findings of the ruptured endometriotic cysts and functional cysts are listed on Table 1. For the endometriotic cysts, the mean maximum cyst diameter was significantly larger than that of the functional cysts (70.1 mm and 36.4 mm, respectively, $p = 0.007$). The

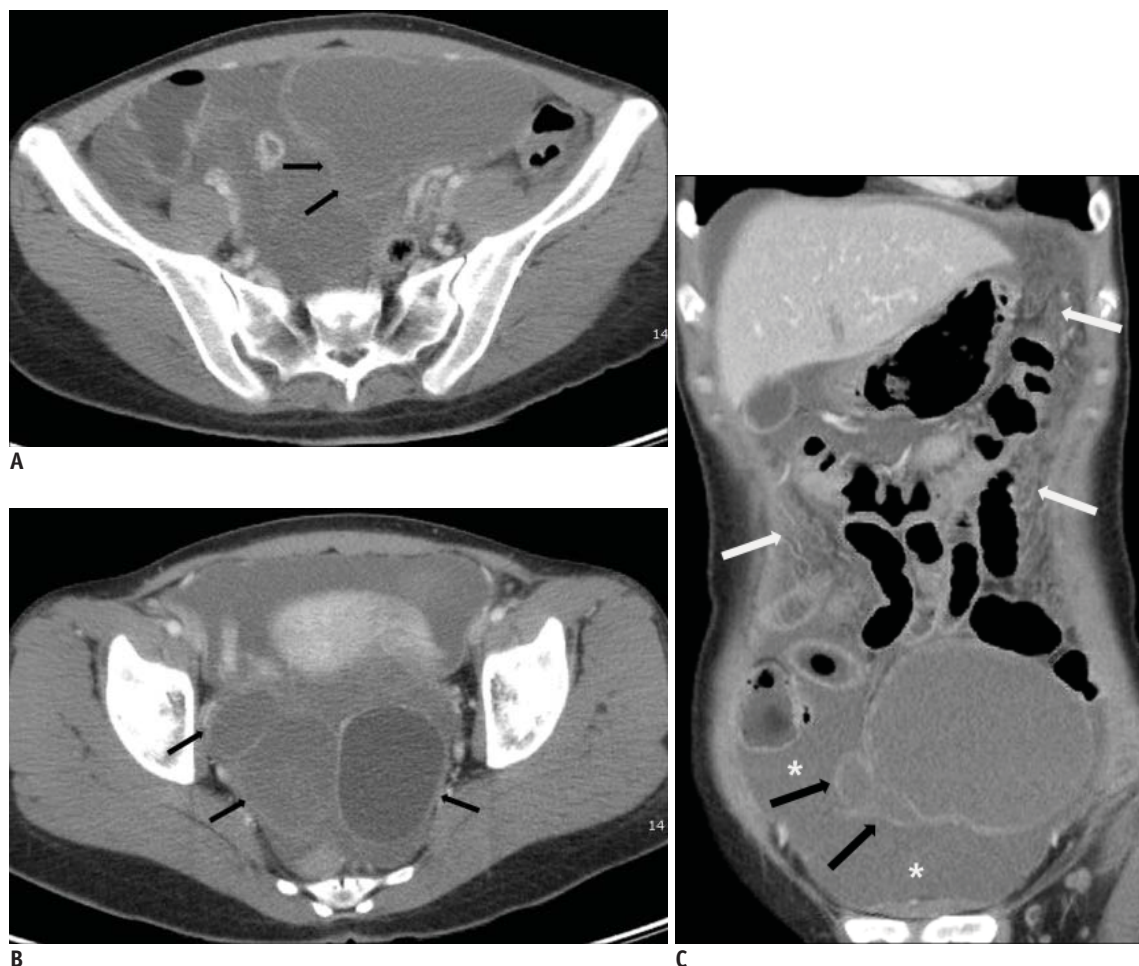


Fig. 1. Ruptured left ovarian endometriotic cysts in 30-year-old woman with sudden onset of abdominal pain. Laboratory tests detected serum CA-125 level that was elevated to 4034 IU/ml.

A. Enhanced CT image shows 13-cm-sized cystic lesion in left ovary with crenulated hyperdense cyst wall with focal disruption on right posterior wall (arrows), which all suggested rupture. **B.** Image more caudal to **A** shows other cystic lesions of both ovaries with "kissing ovary sign" (arrows). **C.** Coronal reformatted enhanced image shows large fluid collections in pelvic cavity (asterisks) and left ovarian cystic lesion with crenulated hyperdense cyst wall (arrows). Note haziness and strandings of mesenteric fat tissue suggesting associated inflammatory reactions (white arrows).

endometriotic cysts had a multilocular shape and a thicker cyst wall than did the functional cysts, and these differences were statistically significant. Seven of 11 patients with endometriotic cysts had bilateral endometriotic cysts (Fig. 1), and only two of the 25 patients with functional cysts had bilateral functional cysts, but this difference was not statistically significant ($p = 0.07$). Seventeen of 25 functional cysts (68%) had ruptures from the right adnexa, whereas five of 13 endometriotic cysts (38%) had a right sided rupture and one patient had bilateral rupture, but the difference was not statistically significant. Among the ancillary findings, there was a significantly different

prevalence of loculated ascites (Fig. 2), ascites confined to the pelvic cavity without extension to the upper abdomen, and peritoneal strandings and infiltrations in the patients with endometriotic cysts as compared to that of the patients with functional cysts (Fig. 1). Although 11 of 25 cases of functional cysts showed active extravasation of contrast material at an ovarian bleeding site, only one of 13 cases of endometriotic cysts showed active extravasation (Fig. 3). Focal discontinuity or a disrupted wall was more prevalent in the ruptured functional cysts than that of the endometriotic cysts, but this difference was not statistically significant.

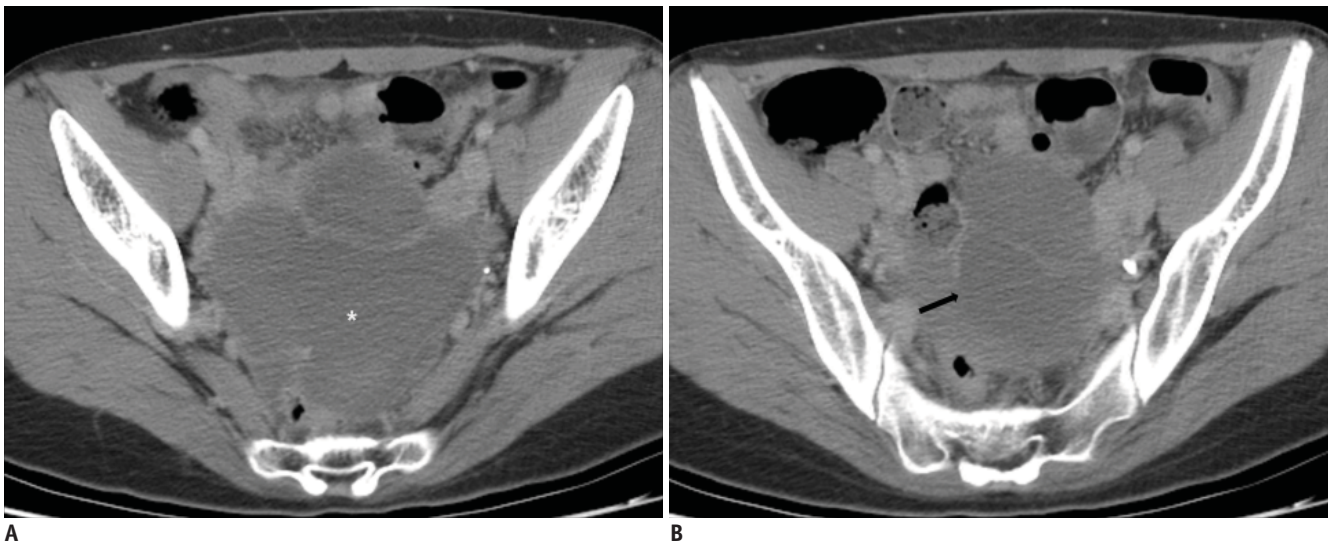


Fig. 2. Ruptured left ovarian endometriotic cysts in 27-year-old woman.

A. Enhanced CT image shows localized pelvic ascites in posterior cul de sac (asterisk). **B.** Image more cranial to **A** shows multiple cysts or multilocular cyst of left ovary with hyperdense wall and focal wall disruption (arrow). Laparoscopic wedge resection of left ovary was performed and lesion proved to endometriotic cyst.

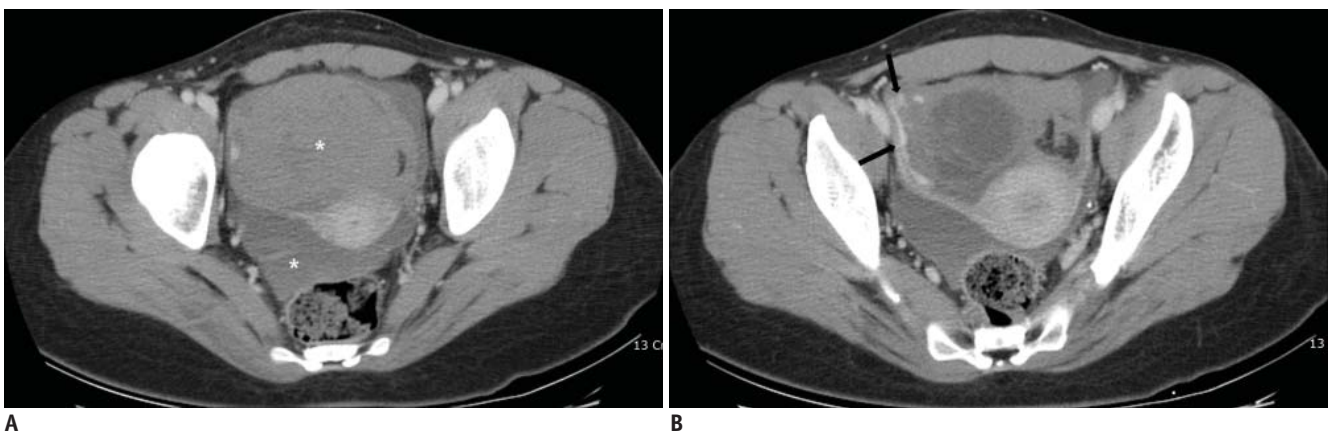


Fig. 3. 20-year-old woman presented with severe pelvic pain and negative β HCG test.

A. Enhanced CT image at level of uterus shows large amount of high-attenuation fluid in pelvis due to hemoperitoneum (asterisks). **B.** Enhanced scan more cephalad to **A** depicts jet of contrast material from right ovarian cyst wall (arrows), suggesting active bleeding site. Surgery confirmed ruptured corpus luteal cyst of right ovary.

DISCUSSION

Endometriosis corresponds to the ectopic endometrial glands and stroma outside the uterine cavity. The clinical symptoms include dysmenorrhea, dyspareunia, infertility, painful defecation or cyclic urinary symptoms (7). Endometriotic cysts generally occur within the ovaries and they are the result of repeated cyclic hemorrhage within a deep implant. These cysts can completely replace the normal ovarian tissue (8).

Focal leaks with inflammation, fibrosis and adhesion formation are characteristics of endometriosis, whereas acute cyst rupture is a relatively uncommon complication (8). Such cases of acute cyst rupture are rare, but they may be associated with severe peritonitis and systemic disturbance, followed by adhesion formation (9, 10). A theory on the formation of ascites in endometriosis was postulated by Bernstein et al. (11), who suggested that the blood and endometrial cells shed into the peritoneal cavity may irritate and stimulate the peritoneum, thereby resulting in ascites. Other authors have reported that rupture of endometriotic cysts with subsequent peritoneal irritation and the production of reactive exudates may provide an explanation (12). Ruptured endometriotic cysts sometimes present a diagnostic problem and surgical challenge because patients with a ruptured cyst present with symptoms of an acute abdomen associated with severe abdominal pain and unstable vital signs (8). Ruptured ovarian endometriotic cysts can sometimes mimic ovarian malignancy because of the extremely elevated serum CA 125 concentration (9, 13).

The US and MRI aspects of endometriosis, as reported in the literature, are variable depending on many structural and morphologic factors (8, 14–16). The CT appearance of endometriotic cysts is nonspecific and this includes a spectrum from simple cystic to complex cystic masses (8, 17, 18). Buy et al. (19) reported that the CT findings of a hyperdense focus inside an ovarian cyst are suggestive of endometriotic cysts. However, this is nonspecific because other hemorrhagic lesions, such as hemorrhagic cysts, may also demonstrate this finding (8). Multiple lesions increase the specificity for the diagnosis of endometriomas because endometriomas are often multiple (20).

Endometriotic cysts are more often multiple or bilateral, as opposed to other hemorrhagic cysts that are usually unilateral (8, 21); when associated with interovarian adhesions, endometriotic cysts are often described as “kissing” ovaries (22). In our study, seven of the 13 cases

of ruptured endometriotic cysts showed bilateral lesions, as compared to only two cases of bilateral functional cysts.

According to the results of this study, the endometriotic cysts are multilocular and they have a thicker cyst wall as compared to that of functional cysts. The multilocular-appearing endometriotic cyst may actually consist of multiple separate cysts (8). Thin or thick septations may be present between these loculi. One study showed that in the absence of wall nodularity and in the presence of diffuse low-level echoes, a multiloculated mass was 64 times more likely to be an endometriotic cyst (23). When using diagnostic MRI criteria such as T1 hyperintense cysts with T2 shading or multiple T1 hyperintense cysts regardless of the T2 signal intensity, the sensitivity and specificity for making a definitive diagnosis of endometriotic cysts have been reported to be as high as 90% and 98%, respectively (15).

The mean maximum diameter of the ruptured endometriotic cysts is 70.1 mm in this study, which is larger than that of the uncomplicated ovarian endometriotic cysts reported in the previous studies. Kinkel et al. (7) reported that 81% of ovarian endometriotic cysts ranged between 30 mm and 59 mm for the maximum diameter. If endometriotic cysts get large enough or if trauma occurs, then they can rupture and their contents spill into the pelvic cavity. Unruptured corpus luteal cysts are typically less than 3 cm in diameter (24).

The cyst walls in endometriotic cysts are generally thick and fibrotic, and they commonly have areas of discoloration and dense fibrous adhesions. The US appearance of the endometrial cyst wall can be variable, but this deserves special attention (8). Diffuse wall thickening, wall nodularity and echogenic foci within the cyst wall of endometriotic cysts have all been observed (23). Patel et al. (23) found no diagnostic value in assessing the wall thickness for differentiating between endometriotic cysts and other ovarian masses. On MR imaging, administration of gadolinium-based contrast material is not particularly useful for evaluating endometriotic cysts (8). When contrast material is used, the cyst wall demonstrates a nonspecific, variable pattern of enhancement that does not differentiate it from other benign and malignant processes (25). In our study, the relatively high incidence of enhancement of the cyst wall after intravenous contrast administration (11 of 13 cases) was suggestive of active inflammatory changes due to cyst rupture. In patients with ruptured corpus luteal cysts, CT typically reveals hemoperitoneum and an adnexal

cyst, with a ring of peripheral contrast enhancement (2). This ring of contrast enhancement may be due to the increased vascularity during the luteal phase, which predisposes the cyst to rupture (26).

In a patient suffering from hemoperitoneum, active bleeding as depicted at CT by the active arterial extravasation of intravenous contrast with a measured attenuation value higher than that of free or clotted blood is indicative of the need for prompt surgical intervention (4). A focus of active bleeding may appear as a serpiginous or amorphous high attenuation area that is intermixed with or surrounded by a large hematoma (1). The wall of an endometriotic cyst is mostly fibrotic tissue with a paucity of vascularity; therefore, only one of the 13 cases of endometriotic cysts in our study showed active extravasation, while 11 of the 25 cases of functional cysts showed this finding.

In patients with ruptured endometriotic cysts, the ascites is usually confined to the pelvic cavity with a loculated contour, and this suggests associated pelvic adhesion, which is an extremely common and important complication of endometriosis (8). After a corpus luteal cyst ruptures, hemoperitoneum will be present within the pelvis and possibly throughout the abdomen, as was shown in this study. Higher attenuation blood is typically present within the pelvis, as compared with being present the abdomen, and blood may be present adjacent to the cystic lesion, indicating that the source of the hemoperitoneum is cyst rupture (2).

Several limitations of our present study must be considered. First, it was a retrospective evaluation with a relatively small number of patients. Second, the present study was confined to patients with functional cysts as a comparative group, and we did not include any patients with conditions such as tuboovarian abscess or ovarian tumor that might potentially overlap with ovarian endometriotic cysts on CT. Third, the patients with ruptured corpus luteal cysts and who had a small amount of hemoperitoneum confined to the pelvic cavity were managed conservatively, and this may have caused a selection bias. Fourth, the CT protocol was not identical for all the enrolled patients. Finally, in this study, the images were reviewed and analyzed by only a single reader.

That being said, the CT appearance of ruptured endometriotic cysts is relatively distinctive compared to that of ruptured functional cysts, and the accurate preoperative characterization of ovarian cyst via CT will

help the surgical planning. In conclusion, the diagnosis of ruptured endometriotic cyst should be suspected for a woman in whom CT reveals the presence of multilocular or bilateral ovarian cysts with a thick wall and loculated ascites confined to pelvic cavity with pelvic fat infiltrations.

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