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CT Differentiation of Ovarian Mucinous and Serous Cystadenocarcinoma[1]

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Purpose : To assess the differences between imaging findings of mucinous and serous cystadenocarcinomas of the ovary, as seen on computed tomography (CT).

Materials and Methods : The CT findings of 24 patients with mucinous cystadenocarcinoma (25 tumors) and 26 with serous cystadenocarcinoma (47 tumors) of the ovary were retrospectively analysed. Images were evaluated for tumor size, contour, CT attenuation of locules within the mass, the presence of septal vegetation, the proportion of solid portion within the mass, the presence of calcification, and carcinomatosis peritonei.

Results : Mucinous cystadenocarcinomas tend to have a smooth contour (96%), variable CT attenuation of locules (80%), and even size of locules within the mass (88.0%). Serous cystadenocarcinomas, on the other hand, tend to have an irregular lobulated contour (89.4%), unevenly sized locules (76.6%), septal vegetation (57.4%), and a prominent solid portion (59.6%). Bilaterality and carcinomatosis peritonei were more common in serous than in mucinous cystadenocarcinoma.

Conclusion : Features which are valuable for the differentiation of mucinous and serous cystadenocarcinomas of the ovary, as seen on CT, are tumor size, contour, varying locule attenuation and size, septal vegetation, a solid portion, bilaterality and peritoneal seeding.

Index words : Ovary, neoplasms
Ovary, CT

Epithelial cancers are the most common type of ovarian malignancy, and may be serous (75%), mucinous (20%) or a mixture of other histologic types (5%). In terms of their pathology, tumor behavior and prognosis, serous and mucinous ovarian cancers are different, and their clinical differentiation is not easy. In order to determine the basis on which these two diseases may be differentiated, we have therefore evaluated their respective imaging features.

Materials and Methods

During a recent six-year period, CT images were obtained from 50 consecutive ovarian cystadenocarcinoma patients. Pathologic examination revealed 25 mucinous cystadenocarcinomas (one bilateral) in 24 patients aged 45 to 72 (mean, 59) years, and 47 serous cystadenocarcinomas (21 bilateral) in 26 patients aged 16 to 71 (mean, 43) years. In all patients, CT images were ob-

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tained one week before surgery, and retrospectively evaluated.

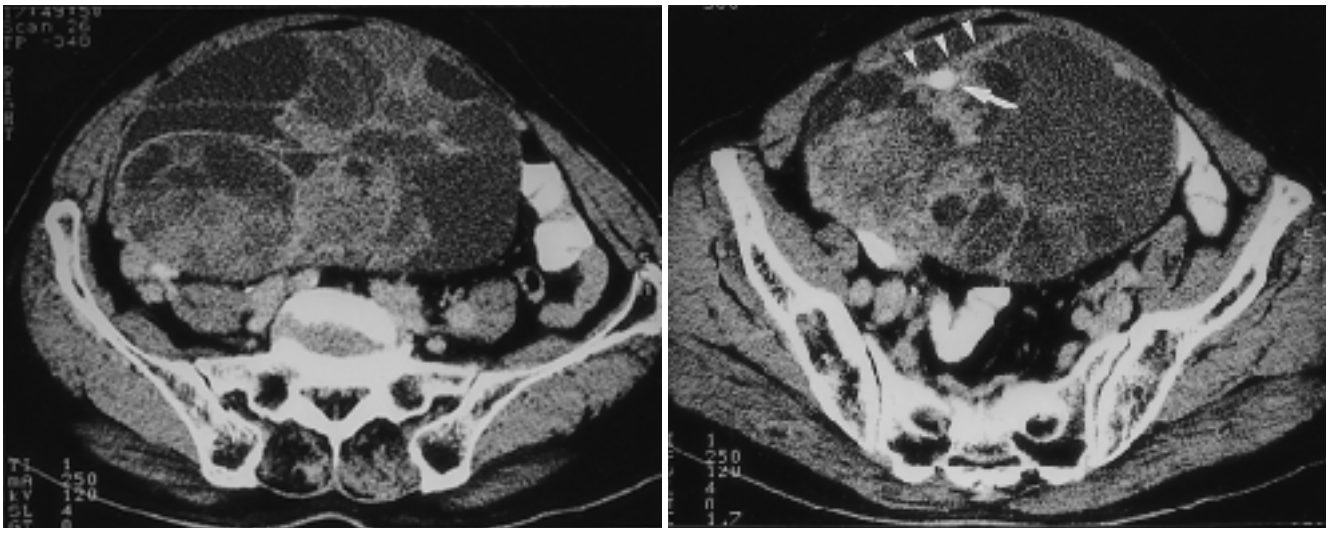
For CT, a Somatom Plus (Siemens, Erlangen, Germany), with 8-10 mm slice thickness and interval was used. Six hundred ml diluted diatrizoate meglumine (gastrografin 2 %; Schering, Berlin, Germany) was orally administered 30-120 minutes before scanning. A total of 100 ml iopromide 62.3 % (Ultravist 300; Schering, Berlin, Germany) was injected as a bolus at a rate of 2-3 ml/sec using a mechanical injector. Incremental or spiral scanning began 45 seconds after the start of intravenous injection of contrast media from the diaphragm to the symphysis.

CT images were analyzed independently by two radiologists without knowledge of the ultrasonographic or pathologic results. The imaging features of ovarian epithelial tumors were assessed with regard to tumor size, contour, difference in CT attenuation of locules within the mass, variation in the size of these locules, the presence of septal vegetation, the proportion of solid component within the mass, the presence of calcification, bilaterality and the frequency of carcinomatosis peritonei. Tumor size was compared between two groups of ovarian carcinomas by measuring the greatest diameter of the masses. Tumor contour was defined as either smooth or lobulated. Variations in the size of locules within the mass was subjectively defined as even or uneven. Septal vegetation was considered to be present when lobulated endocystic or exocystic septal growth with a microlobulated contour was found. The proportion of solid portion of the mass was determined by the percentage of solid portion in relation to the entire mass, as seen on two dimensional images. The tumor was considered mainly cystic when the solid portion comprised 0-20 %, mixed solid and cystic when 20-50 %, and mainly solid when >50 %. Ascites, peritoneal nodule and omental cake were considered indicative of carcinomatosis peritonei.

After comparing the CT imaging findings of mucinous and serous cystadenocarcinomas, analyses using the chi-square test, unpaired Student's *t* test, and Mann-Whitney U test were performed. The chi-square test was used to compare the two groups in terms of statistically significant differences in tomor contour and CT attenuation of locules, variation in the size of locules within the mass, the presence of septal vegetation, the proportion of solid portion within the mass, the presence of calcification, and the frequency of carcinomatosis peritonei. An unpaired Student's *t* test was used to assess the statistical significance of difference in tumor size between the two groups. The Mann-Whitney U test was used when one factor such as CA125 level was measured on at least an ordinal scale. A *p* value of less than 0.05 was considered staticstically significant.

Results

The clinical symptoms of patients with serous and



A B

Fig. 1. 71-year-old woman with left mucinous cystadenocarcinoma.
A. Contrast enhanced pelvic CT shows a huge multiocular cystic mass with smooth contour, honeycombing appearance, and different attenuation of locules.
B. Lower level CT scan shows calcification (arrow) in the thickened septum (arrowheads).

mucinous cystadenocarcinomas were abdominal mass, bloating or mild abdominal pain. The differential imaging features of serous and mucinous cystadenocarcinomas are summarized in Table 1.

The diameter of mucinous tumors was 8-27 (average, 15) cm and that of serous tumors was 3-18 (average, 8) cm ($p < .001$). Contour was smooth in 24 of 25 mucinous cystadenocarcinomas (96 %) and lobulated in 42 of 47 serous cystadenocarcinomas (89.4 % ; $p = .0001$). CT attenuation of the locules varied in 20 of 25 mucinous tumors (Fig. 1), but in all but one serous cystadenocarcinoma ($p = .0001$). The size of locules within the mass was even in 22 of 25 mucinous cystadenocarcinomas (88 % ; Fig 1), and uneven in 36 of 47 serous cystadenocarcinomas (76.6 % ; $p = .0001$). Septal vegetation was seen in 27 serous cystadenocarcinomas (Fig. 2), but in only two mucinous cystadenocarcinomas ($p = .0001$).

The proportion of intratumoral solid portion is summarized in Table 2. This was larger in cystadenocarcinomas (Fig. 2, 3) than in mucinous cystadenocarcinomas ($p = .003$). Calcifications within the tumor were seen in 5 of 25 mucinous cystadenocarcinomas (20 %) and 12 of 47 serous cystadenocarcinomas (25.5 %), with no statistically significant difference between the two groups ($p = 0.773$).

Bilateral tumors were more common in the serous cystadenocarcinoma group than in the mucinous cystadenocarcinoma group ($p = .0001$). Carcinomatosis peritonei were found in only 12 serous cystadenocarcinoma patients (Fig. 4 ; $p = .0001$). Two cases of mucinous cystadenocarcinoma showed pseudomyxoma peritonei.

Discussion

Common epithelial tumors of the ovary include serous, mucinous, endometrioid, clear cell, and other-

Table 1. CT Features of Mucinous and Serous Cystadenocarcinoma of the Ovary

Findings	Cystadenocarcinoma	
	Mucinous (n = 25)	Serous (n = 47)
Size	8-27 (mean,15) cm*	3-18 (mean, 8) cm*
Lobulated contour	1 (4.0%)	42 (89.4%)*
Difference in cham. atten.	20 (80.0%)*	1 (2.2%)
Honeycombing appearance	22 (88.0%)	11 (23.4 %)*
Vegetation of septa	2 (8.0%)	27 (57.4%)*
Calcification	5 (20.0%)	12 (25.5%)
Bilaterality	1 patient	21 patients*
Carcinomatosis peritonei	0 patient	12 patients*

* $p < 0.001$
cham. : locule; atten. : CT attenuation

Table 2. Proportion of Solid Portion within the Mass in Mucinous and Serous Cystadenocarcinoma

Solid portion	Mucinous	Serous
0 - 20 %	20 (80.0%)	9 (19.1%)
20 - 50 %	4 (16.0%)	10 (21.3%)
> 50 %	1 (4.0%)	28 (59.6%)*

* $p < 0.05$

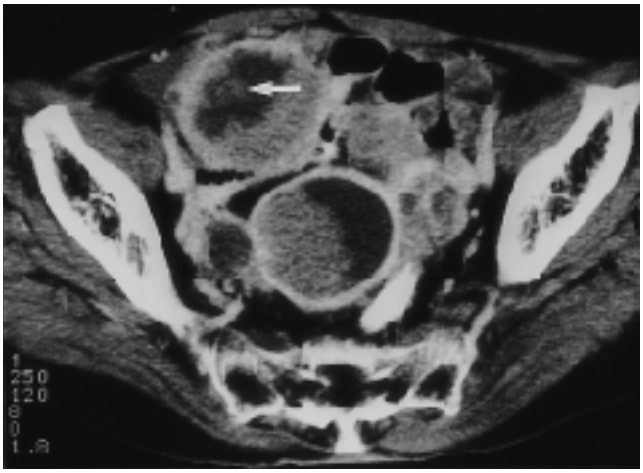


Fig. 2. 42-year-old woman with bilateral, mainly cystic masses with large solid portions and vegetations (arrow) on postcontrast pelvic CT. Ehnancement of solid portion and intense enhancement of cystic and tumor wall can be visualized. Surgery and subsequent tissue pathology revealed that these were bilateral ovarian serous cystadenocarcinomas.

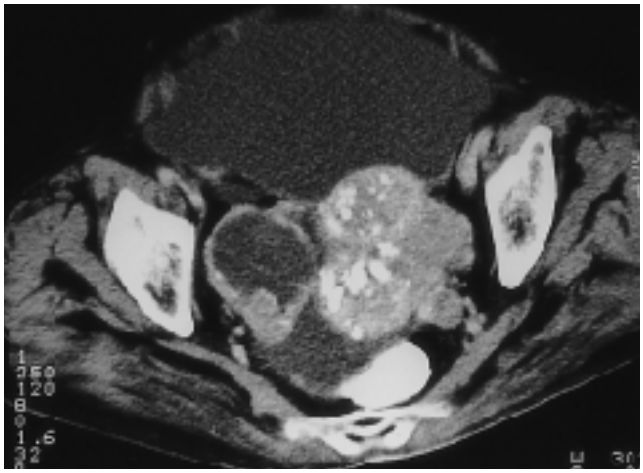
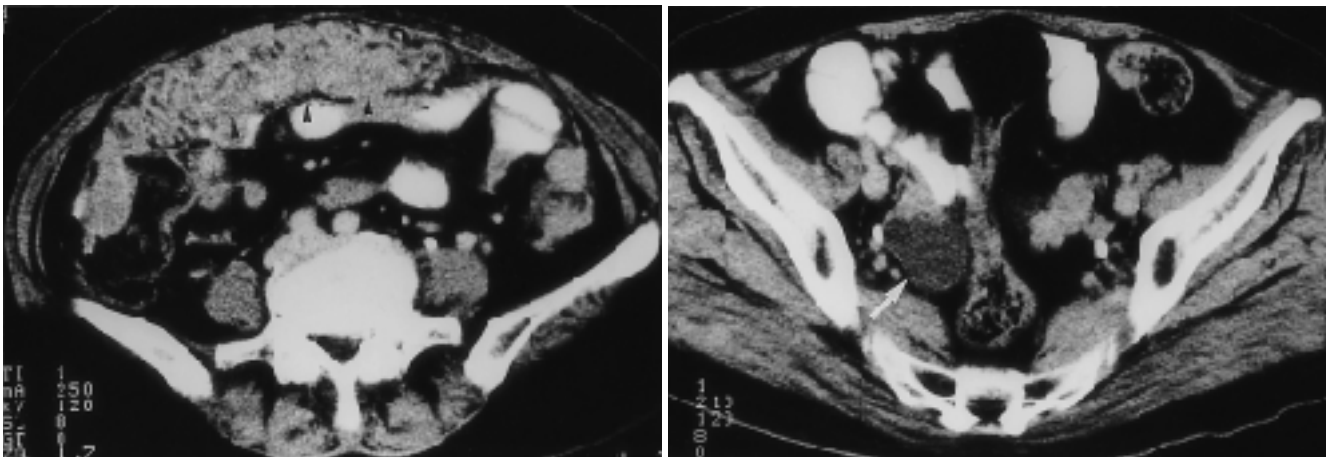


Fig. 3. 72-year-old woman with bilateral serous cystadenocarcinoma. Contrast enhanced pelvic CT scan shows bilateral ovarian masses, mainly solid on the left and solid and cystic on the right, with lobulated contour and calcification. Massive ascites is also noted.



A B

Fig. 4. 59-year-old woman with right serous cystadenocarcinoma
A. Contrast enhanced CT at the level of the common iliac arteries reveals large confluent soft-tissue masses separating the small bowel from the anterior abdominal wall representing the omental cake (arrowheads).
B. CT scan at the level of the pelvis demonstrates a small ovoid cystic mass (arrow) with focal solid portion in the right adnexal area.

wise unspecified adenocarcinomas (1). All of these originate from coelomic epithelium or peritoneum (mesothelium). Pathologically serous and mucinous tumors have different microscopic features. Microscopically, in benign serous tumors, the epithelium is similar to that of the fallopian tube with both ciliated and nonciliated secretory elements.

Mucinous tumors have characteristic tall columnar epithelial cells with a clear refractile cytoplasm and basally placed nucleus resembling an endocervical cell (2).

The prognosis of serous cystadenocarcinoma is poor with an overall 5-year survival rate of 20 %, compared with 40-60 % in the case of mucinous cystadenocarcinoma (3). Because early diagnosis of ovarian cancer may offer a significant opportunity to improve survival rates in this deadly disease, investigation of the serum level of CA 125, a tumor-associated antigen, and transvaginal sonography remain the foremost diagnostic modalities for screening patients with adnexal lesions (4-7). In addition to sonography, CT and magnetic resonance (MR) imaging can provide significant information with which to characterize epithelial tumors of the ovary. It has been said that because subsequent treatment is determined by the surgical staging of an ovarian tumor, abdominal or pelvic CT and MR imaging is of no value for patients with a definitive pelvic mass (2). In patients with ovarian tumors, however, CT and MR imaging may permit differentiation between benign and malignant ovarian tumors, as well as indicating the preoperative staging (8). Differentiation between serous and mucinous cystadenocarcinomas, the pathology of which is different, may provide a fuller understanding of the pathophysiology of ovarian carcinomas. CT and MR imaging can provide significant information and on the basis of this, epithelial tumors of the ovary may be characterized (8). CT permits better evaluation of the intraperitoneal organs and lymph nodes, while MR imaging has advantages over CT in terms of tissue characterization, including the depiction of internal septations, papillary and other solid elements, necrosis, and debris (9-13).

Several reports of different imaging features have compared mucinous with serous cystadenoma, and benign with malignant tumors (8,9). A tumor which is a unilocular or bilocular cystic mass showing homogenous CT attenuation or MR signal intensity of locules, and which has a thin regular wall and/or a thin regular septum without any endocystic or exocystic vegetation, is classified as a benign serous cystadenoma. One which is a multilocular cystic mass with a thin regular wall and septa, or contains liquids of different attenuation or signal intensity without endocystic or exocystic vegetation, is classified as a benign mucinous cystadenoma (8,9). In contrast to benign ovarian tumors, borderline or malignant ovarian tumors present as large lobulated masses with a larger solid portion, a thick and irregular wall, and septa of the masses. In patients with malignant ovarian tumors, lymphadenopathies and metastasis to other organs may occur. To the best of our knowledge, no imaging study of differentiation between mucinous and serous cystadenocarcinoma has previously been published.

In our study, most mucinous tumors were smooth

contoured, multilocular cystic masses with even locule size, and demonstrated different CT attenuations of intratumoral locules. Mucinous tumors usually contain proteinaceous or hemorrhagic mucinous material secreted from endocervical cells, and on CT, differing high densities are revealed (9,10). It is for this reason, we believe, that mucinous tumors are enormous. Mucinous cystadenocarcinomas were of homogenous appearance with uniformly sized and evenly distributed locules. In a previous study, the appearance of most mucinous cystadenocarcinomas was more benign than that of serous cystadenocarcinomas (14), and in our study this was also the case.

Compared with mucinous cystadenocarcinomas, serous cystadenocarcinomas were irregular and lobulated, with locules of uneven size and homogenous attenuation. Vegetation was also present, as well as a large solid portion within the tumor. Psammoma bodies, more correctly foci of foreign material, are frequently associated with invagination of surface epithelium, and it has been reported that laminated and calcified psammoma bodies were found in 80 % of serous cystadenocarcinomas (2,15). In our study, however, calcification within the tumor was seen in 21 % of serous cystadenocarcinomas, and it was only in this type that omental cake with or without ascites was found. As reported in a previous study, the appearance of serous cystadenocarcinomas were more aggressive than that of mucinous tumors (14).

In our study, serous cystadenocarcinomas were very frequently bilateral, though in previous reports this was not the case. There might be a selection or recruitment bias, though we did not recognize this. For further evaluation of the democratic features of ovarian cystadenocarcinomas, we believe that a larger study group is necessary.

The greatest limitation of this study, however, is that the pathologic results of ovarian cystadenocarcinomas were not graded in terms of malignancy. The evaluation of imaging features of each ovarian cystadenocarcinoma was thus not based on pathologic grade of malignancy.

Ovarian cystadenocarcinomas, which have a smooth contour, variable CT attenuation of locules, and small, cystic, honeycomb-like locules within the mass, were diagnosed as mucinous tumors. Most serous cystadenocarcinomas had an irregular lobulated contour, locules, of unequal size, septal vegetation, and a solid portion comprising more than 50% of the whole mass. Bilaterality and carcinomatosis peritonei are more common in serous that in mucinous cystadenocarcinoma.

In conclusion, tumor size, contour, differences in locule attenuation, locules of various sizes, septal vegetation, a solid portion, bilaterality and peritoneal seeding are important features for the differentiation of mucinous and serous cystadenocarcinomas of the ovary, as seen on CT.

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난소 점액성 낭선종암종과 장액성 낭선종암종의 전산화단층촬영에서의 감별점[1]

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목적: 전산화단층촬영 (CT) 영상에서 난소 점액성 낭선종암종과 장액성 낭선종암종의 차이점을 알아보고자 하였다.

대상 및 방법: 점액성 낭선종암종 환자 24명 (25종양)과 장액성 낭선종암종 환자 26명 (47종양)을 대상으로 CT 소견의 차이를 후향적 분석을 시행하였다. CT 영상을 종양의 크기, 외연, 종양 내 방의 CT 감쇠 계수의 차이, 종양내 방의 크기 차이, 중격 증식증의 유무, 종괴내 고형 부분의 비율, 석회화의 유무, 복강 내 암종증 등으로 구분하여 확인하였다.

결과: 점액성 낭선종암종은 매끈한 외연 (96%), 다양한 종양 내 방의 CT 감쇠계수 (80%), 종괴 내 균일한 크기의 작은 낭종성 방 (88%)의 소견을 보이는 경향이 있었고 장액성 낭선종암종에서는 불규칙한 분엽 모양의 외연(89.4%), 불규칙한 방크기 (76.6%), 중격의 증식증 (57.4%), 고형 부분이 풍부한 (59.6%) 경향을 보였다. 양측성과 복강내 암종증은 점액성 낭선종암종 보다는 장액성 낭선종암종에서 더 흔한 소견이었다.

결론: 종양의 크기, 외연, 종양 내 방의 감쇠계수 차이, 종양내 방 크기의 차이, 중격 증식증의 유무, 종괴에서 고형부분이 차지하는 비율, 양측성, 복강 내 전이 등의 소견이 CT 영상에서 난소 점액성 낭선종암종과 장액성 낭선종암종을 감별하는데 가치있는 소견이라고 생각한다.