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Calcifications in Mucinous and Serous Cystic Ovarian Tumors

Susumu Okada[1], Yoshiharu Ohaki[2], Kohei Inoue[1], Takashi Kawamura[3], Toshihiko Hayashi[4], Tomoyasu Kato[5] and Tatsuo Kumazaki[6]

[1]Department of Radiology, Nippon Medical School Chiba-Hokuso Hospital
[2]Department of Pathology, Nippon Medical School Chiba-Hokuso Hospital
[3]Department of Obstetrics and Gynecology, Nippon Medical School Chiba-Hokuso Hospital
[4]Department of Radiology, Teikyo University Mizonokuchi Hospital
[5]Department of Gynecology, Cancer Institute Hospital
[6]Department of Radiology, Nippon Medical School

Abstract

Mucinous cystic ovarian tumors sometimes contain calcifications, but the frequency and significance of such calcifications in diagnostic radiology are not well understood. We therefore retrospectively investigated the radiological and histopathological evidence of calcifications in 44 cases of ovarian mucinous cystic tumors (22 benign, 13 borderline, and 9 malignant) and 21 cases of ovarian serous cystic tumors (6 benign and 15 malignant) in which a non-contrast CT scan was performed. The shape and distribution of the calcifications in the mass lesion were assessed both radiologically and histopathologically.

Calcifications were noted in 34.1% of mucinous cystic tumors on CT scans and 56.8% in histopathological studies, and they were found in two locations, intramural and intra-cystic, according to the histopathological findings. Intramural calcifications were frequent in benign tumors, and intra-cystic calcifications were frequent in proliferating tumors. Calcifications (psammoma bodies) were noted in 4.7% of serous cystic tumors on CT scans and 14.3% in histopathological studies. CT was not sufficiently sensitive in the detection of intra-cystic calcification in mucinous tumors and psammoma bodies in serous tumors. However, the presence of intramural calcifications may be a good indicator of mucinous tumors. Understanding the frequency and morphology of the calcifications in these neoplasms is one of the keys to making a correct diagnosis.
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Key words: ovary, calcification, neoplasms, CT

Introduction

The radiological importance of psammoma bodies in the diagnosis of serous ovarian tumors has been reported[1–3]. However, few reports have presented radiological or pathological evidence of calcifications in mucinous ovarian tumors, even though they sometimes contain calcifications[4]. Since the frequency and significance of calcifications in mucinous tumors in diagnostic radiology are not well understood, we investigated the radiological and histopathological evidence and characteristics of calcifications in serous and mucinous ovarian tumors.

Correspondence to Susumu Okada, Department of Radiology, Nippon Medical School Chiba-Hokuso Hospital, 1715 Kamagari, Inba-mura, Inba-gun, Chiba 270–1694, Japan
E-mail: okada@nms.ac.jp
Journal Website (http://www.nms.ac.jp/jnms/)

Materials and Methods

This retrospective study was approved by our institutional review board, and the board waived the requirement for informed consent.

We reviewed all cases of histopathologically diagnosed ovarian mucinous and serous cystic tumors in which the patient had undergone a non-contrast CT scan between February 1994 and July 2002. Cases in which only a post-contrast CT scan was performed were excluded. About 5% of dermoid cysts coexist with mucinous cystic tumors[5], so these coexisting tumors were excluded. We also excluded patients who undergone chemotherapy for ovarian malignancy before the CT examination, because the calcified material may have been produced after chemotherapy. Thus, 44 cases of ovarian mucinous cystic tumors (22 benign, 13 borderline and 9 malignant, mean age: 48, S.D.: 15.7) and 21 cases of ovarian serous cystic tumors (6 benign and 15 malignant, mean age: 49, S.D.: 15.4) were included in this study.

CT images were obtained with a helical CT unit (W3000, Hitachi, Hitachi-shi, Japan, or High Speed Advantage, General Electric Medical Systems, Milwaukee, WI, USA). Slice thickness was 7 mm.

The radiographic criterion used for the diagnosis of a calcification in this study was a sharp-margined high-density structure. Areas of increased density with unclear margins were excluded because highly concentrated mucinous products can result such findings. The CT diagnoses were made by consensus among three radiologists (S.O., K.I. and T. H.) who had no information on the histopathological diagnosis. The histopathological diagnosis was made by a pathologist (Y.O.) who reviewed all preparations for each case stored in the department of pathology. The shape and distribution of calcifications in the mass lesions were recorded in both the radiological and histopathological studies. The tumor size, tumor marker data, and number of CT detected calcifications were also recorded.

Statistical analysis was performed by chi square test with Yates' correlation for 2×2 tables, and results were considered significantly different if the P value was less than 0.05.

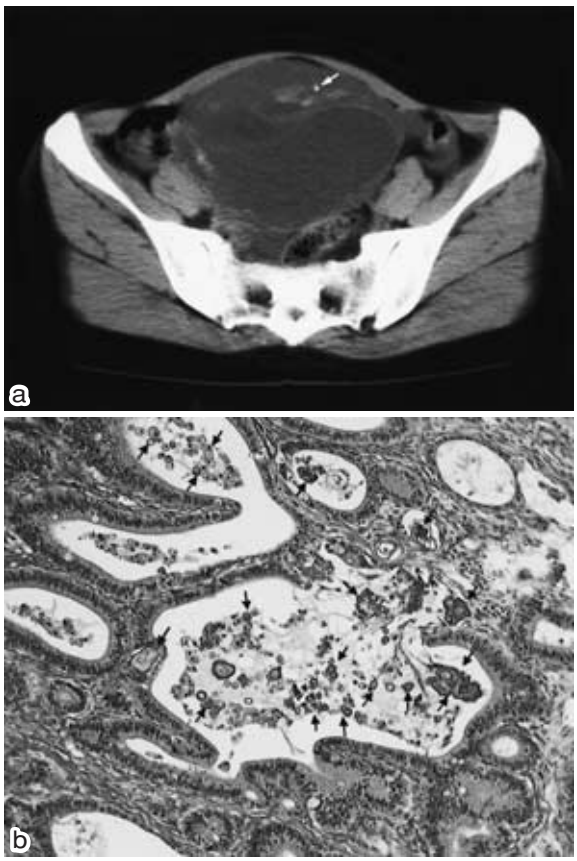

Fig. 1 Mucinous cystadenocarcinoma in a 35-year-old woman. (a) Non-contrast CT scan, (b) photomicrograph (hematoxylin and eosin, ×10). Histopathological study shows intra-cystic (psammoma body-like calcifications, **arrows** in a) and intramural (not shown) calcifications. CT scan shows a calcification in the septum (**arrow** in b). Intra-cystic calcifications were not detected on CT.

Results

(1) CT Scan Findings:

Calcifications were noted in 15 (34.1%) mucinous cystic tumors (8 benign, 3 borderline, and 4 malignant). They were detected in the cyst wall and/or the septum in each case, and were punctate in 11 cases (**Fig. 1, 2**) and curvilinear in 2 cases (**Fig. 3**), and both morphological types were present in 2 cases. Calcification was not detected within the cyst. The number of calcifications was one in 6 cases, more than one but less than 5 in 4 cases, more than 6 but less than 10 in 4 cases, and 10 in one case.

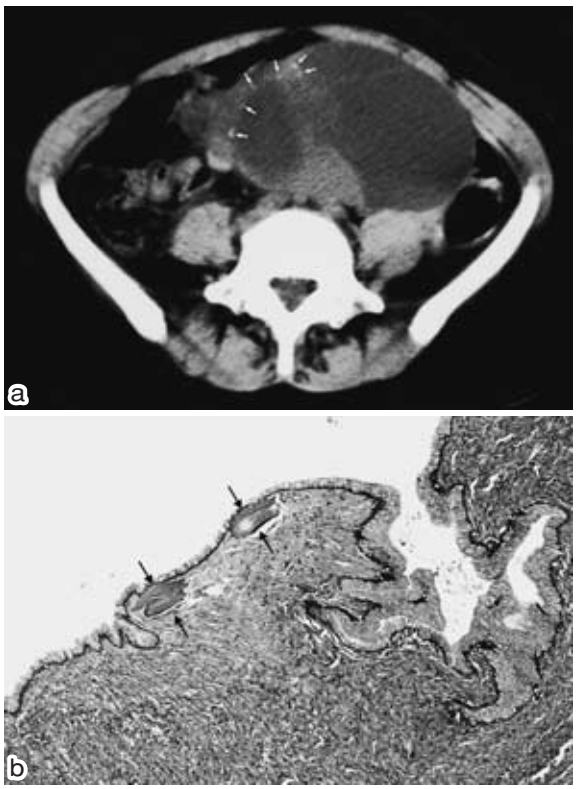

Fig. 2 Mucinous cystadenoma in a 31-year-old woman. (a) Non-contrast CT scan, (b) photomicrograph (hematoxylin and eosin, ×10). The CT scan shows punctate calcifications in the cyst wall and the septum (**arrows**). The photomicrograph shows calcifications in the cyst wall (**arrows**).

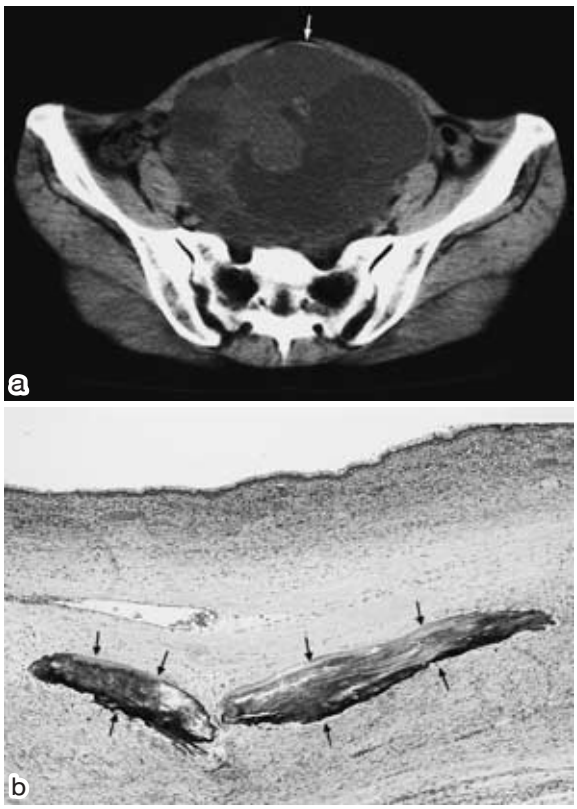

Fig. 3 Mucinous cystadenoma in a 48-year-old woman. (a) Non-contrast CT scan, (b) photomicrograph (hematoxylin and eosin, ×10). The CT scan shows a curvilinear shape calcification in the cyst wall (**arrow**). The photomicrograph shows laminar shape large calcifications in the cyst wall (**arrows**).

Calcification was noted in only one case (carcinoma) of serous cystic tumors (4.7%). It was detected in the cyst wall and was punctate in shape.

(2) Histopathological Findings:

Calcifications were noted in 25 (56.8%) mucinous cystic tumors (13 benign, 5 borderline, and 7 malignant). The largest dimensions of the tumor were 19.4 cm (S.D.: 7.5) in calcification positive cases and 17.16 cm (S.D.: 8.8) in calcification negative cases. Mean age was 48 (S.D.: 7.5) in calcification positive cases, and 45.1 (S.D.: 16) in calcification negative cases. There was no statistically significant difference in tumor size or mean age between the calcification positive and negative cases. The rate of carcinoma was greater in calcification positive cases than in calcification negative cases (56.8% to 43.2%). However, the differences were not statistically significant. Also, there was no difference in tumor staging or tumor marker data between the calcification positive and negative cases.

We classified the calcifications into two patterns according to their distribution: a fine-sand-like calcification pattern, located in the necrotic material within cystic structures (intra-cystic type, **Fig. 1**) and a solid and laminar calcification pattern, located in the wall or the septum (intramural type, **Fig. 2, 3**). The intramural type not associated with intra-cystic type was noted in 16 cases (11 benign, 3 borderline, and 2 malignant), the intra-cystic type not associated with intramural type was noted in 6 cases (2 benign, 1 borderline, and 3 malignant), and mixed pattern in 3 cases (1 borderline and 2 malignant) (**Table 1**). Intramural type calcification not associated with intra-cystic type calcification tended to be more frequent in benign tumors, and intra-cystic type calcifications with or without associated

Table 1 Number of cases in which calcifications are detected in the histopathological studies. Intramural type tended to be more frequent in benign tumors, and intra-cystic and both type tended to be more frequent in malignant or borderline tumors.

	Intramural	Intra-cystic	Both	Total
Benign	11	2	0	13
Borderline	3	1	1	5
Malignant	2	3	2	7
Total	16	6	3	25

intramural type calcification tended to be more frequent in malignant or borderline tumors. However, the differences were not statistically significant (P = 0.069).

Calcifications (psammoma bodies) were noted in 3 serous carcinomas (14.3%). The largest dimensions of the tumor were 11.2 cm (S.D.: 4.0) in positive calcification cases and 10.5 cm (S.D.: 3.2) in negative calcification cases. Mean age was 64.3 (S.D.: 13) in calcification positive cases, and 52.8 (S.D.: 13) in calcification negative cases. There was no statistically significant difference in tumor size or mean age between the calcification positive and negative cases.

(3) Comparison of CT with Histopathological Findings:

Calcifications in mucinous cystic tumors were detected by both CT scan and histopathological studies in 11 cases, only by CT scan in 4 cases, only by histopathological study in 14 cases, and by neither in 15 cases. In the four cases in which calcifications were detected only by CT, only one calcification was demonstrated. Histopathological study failed to detect it in each case.

In the 16 cases in which only intramural calcifications were detected histopathologically, CT findings were positive in 6 cases. In the 6 cases in which only intra-cystic type calcifications were detected, CT findings were positive in 3 cases. In the 3 cases in which both types of calcification were detected, the CT findings were positive in 2 cases. There were no histopathological differences, except in calcification size, between punctuate and curvilinear calcifications detected on CT.

In cases in which intra-cystic type calcifications with or without intramural calcifications were detected histopathologically, CT demonstrated calcifications in the wall and/or the septum, and intra-cystic calcifications were not detected.

CT scans failed to detect the calcifications in 2 cases of serous cystic tumors that contained psammoma bodies (**Fig. 4**).

Discussion

In their textbook, Russel and Farnsworth state that simple mucinous cysts sometimes contain large spiculate deposits of dystrophic calcifications[4]. Russel also reported that such calcifications are relatively commonly found in areas of acellular connective tissue, that they are unrelated to the epithelial component, and that they differ markedly from typical psammoma bodies[6]. Brandt et al. detected curvilinear calcifications in mucinous cystadenoma by ultrasonics examination[7]. However, there have been few reports concerning calcifications in mucinous cystic tumors other than these. Because such calcifications are a nonspecific and common finding, they may not have been investigated in detail. Our study showed that calcifications were detected on CT scans in 34.1% of mucinous cystic tumors and by histopathological study in 56.8%. The calcifications were found in two locations: intramural and intra-cystic. The former are laminar and coarse dystrophic deposits located in fibrotic and hyalinized dense connective tissue, and they are frequently found in the wall or the septum of the benign portion of mucinous cystic tumors. These findings are consistent with Russel's description[6] and are not observed in serous cystic tumors. The latter are psammoma body-like calcifications that are noted in

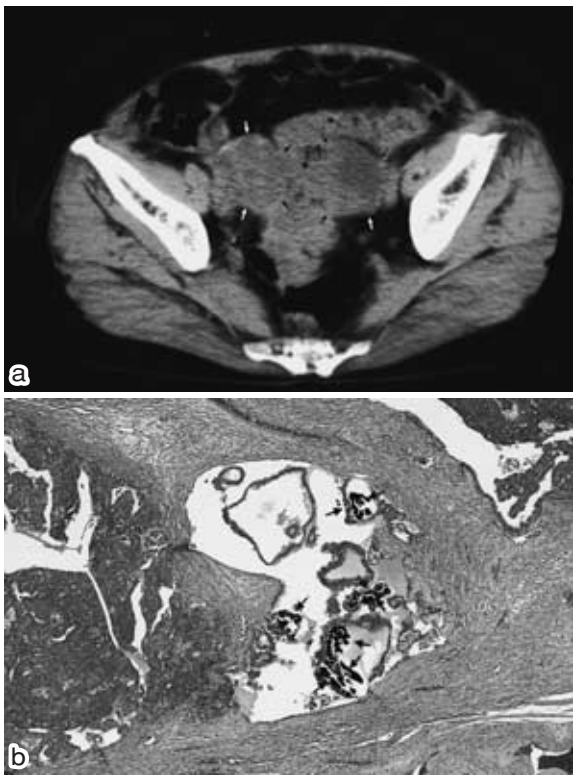

Fig. 4 Serous cystadenocarcinoma in a 67-year-old woman. (a) Non-contrast CT scans, (b) photomicrograph (hematoxylin and eosin, ×10). Bilateral ovarian tumors noted on the CT scan (**arrows**). The photomicrograph shows psammoma bodies (**arrows**), but no calcifications are seen in the CT scan.

the necrotic material frequently present in the proliferating tumors.

Psammoma bodies are typically found in serous cystic tumors and can be detected in both primary tumors[1] and metastatic lesions[2,3] on CT scan or X-ray films. Michel et al.[2] reported that searching for calcifications should improve the sensitivity of CT scans for diagnosing metastases of ovarian serous carcinoma, but few reports have concerned the frequency of calcifications in the non-treated primary tumors. Our data showed that calcification detectable by CT was more frequent in mucinous cystic tumors than in serous cystic tumors.

The presence of calcifications in the cyst wall may be an important indicator of a mucinous cystic tumor. MRI has recently come to be widely used to diagnose gynecological lesions, but CT scans can easily detect calcifications and fat, and CT is still an important diagnostic modality for ovarian lesions. Differentiation between adenoma and carcinoma was, however, not possible based on the presence of calcifications and their morphology.

There were differences in the detectability of calcifications by CT scans and histopathological study. CT scans often failed to detect very small calcifications, and intra-cystic type calcifications are difficult to distinguish from dense mucinous fluid by CT. Histopathological examination may miss calcifications because the entire specimen is not examined. If the latest multidetector row CT unit were used, the frequency of detectable calcifications would increase.

In conclusion, calcifications are common in mucinous cystic ovarian tumors. CT was not sufficiently sensitive in the detection of intra-cystic calcification in mucinous tumors or psammoma bodies in serous tumors. However, the presence of intramural calcifications may be a good indicator of mucinous tumors. Understanding the frequency and morphology of calcifications in these neoplasms is one of the keys to making a correct diagnosis.

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