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Variations in radiological features between primary and secondary ovarian malignancies

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ABSTRACT

Objectives: To describe the patient characteristics, imaging features, biomarkers raising the possibility of secondary ovarian tumors. How imaging features of secondary ovarian tumors vary according to the origin of the primary tumor.

Methods: Between January 2012 and September 2016, we conducted a retrospective study of 50 pathologically confirmed ovarian metastasis. We reviewed patient's medical records and retrieved their clinicopathological characteristics and reviewed their radiological images to evaluate discrepancies in the imaging features between ovarian metastasis and the primary tumor.

Results: The majority of our patients were younger than 50y (72%), had bilateral ovarian metastasis (64%), elevated CA-125 (64%), lesion less than 9 cm (68%), and have mixed solid and cystic lesion (82%). 70% of lesions with solid component has a moderate pattern of enhancement. While, 90% of ovarian metastasis derived from cancer stomach, breast, lymphoma was solid; 81% of metastases arising from the primary tumor in the small intestine, colon, rectum or biliary tract was mixed ($P < 0.0001$). Also, Metastases from the primary tumor in the stomach, breast, and lymphoma were significantly smaller than those from colorectal or biliary tract cancers ($P = 0.02$).

Conclusion: possibility of secondary ovarian tumors should be considered in cases with bilateral relatively small solid ovarian tumors in a woman with age < 50 years old with normal or mild elevated CA 125 level. Imaging features may differ according to the primary tumor.

1. Introduction

Ovarian metastasis is relatively uncommon and about 5–20% of ovarian masses are metastases from primary tumors in other organs [1–3]. Ovarian metastasis my come from multiple primary sites including cancer colon, breast, stomach, pancreas, melanoma and carcinoid. Gastrointestinal tract and breast cancer give about 50–90% of ovarian metastases and prognosis varies according to the type of the primary tumor [4,5].

benign and malignant adnexal masses can be differentiated accurately by greyscale ultrasound which is highly sensitive and has high negative predictive value, and also addition of color and spectral Doppler may increase the specificity of ultrasound in this task [2].

However, primary and metastatic ovarian tumors discrimination may be a more difficult job and it affect the treatment options.

Many authors studied the difference of imaging features between primary and secondary ovarian tumor.

ultrasound findings of metastases commonly show well defined tumor outlines with an irregular echogenic soft tissue pattern with areas of cystic degeneration seen within, but primary ovarian cancers, shows ill-defined border, with an irregular hypoechoic soft tissue pattern and soft tissue papillae may be seen. Differentiation can be easier if done early in the disease when the metastasis is predominantly solid but later on it becomes more difficult because metastases develop cystic degeneration and necrosis simulating primary ovarian malignancy [2].

In the study of Alcazar et al. [2], there is no significant difference regarding bilateralism, although metastatic tumors were more common to be solid. Also, color Doppler ultrasound showed no significant difference in vascular features due to similarity in the angiogenic phenomena between primary and secondary tumors and they conclude that imaging feature of primary and secondary malignancy may unfortunately overlap.

Ovarian metastases may exhibit variable sized solid or complex masses, but it is commonly described by the pathologist and radiologist as bilateral and predominantly solid [2].

Brown et al. [3] studied discrimination of primary and secondary

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ovarian neoplasms using ultrasound, computed tomography, and magnetic resonance imaging, they reported no significant difference between them regarding solidity and bilateralism although ovarian metastasis was more common to be bilateral than primary one, but the statistically significant feature reported was multilocularity which is more common in primary tumors but they concluded no single method was accurate in discrimination between primary and metastatic ovarian tumors.

The explanation of these conflicting results may be due to the different types of the primary tumors they included in their studies. Primary tumors from stomach, breast, lymphoma and carcinoid commonly give solid metastases, but primary cancer colon commonly give cystic metastases resembling primary ovarian tumors [2].

Many authors acknowledged difficult discrimination between ovarian metastasis and primary tumors. Practically, bilateral, predominantly solid tumors should raise the possibility of ovarian metastasis [3].

In a patient with a known primary malignancy we cannot easily consider ovarian masses as metastatic, because synchronous or metachronous primary cancer ovary may exist in patients with another primary malignancy [6].

Cytoreductive surgery and systemic therapy are essential in primary ovarian cancers management. So, discrimination from ovarian metastasis should be done preoperatively. Although imaging discrimination is difficult and specific imaging features are not common, sometimes, certain imaging features may raise the possibility of ovarian metastasis [7,8].

Laurent et al. [9] agreed with the algorithm suggested by Anna et al. [10] for differentiation between primary and secondary mucinous ovarian tumors. They reported that if we use the following criteria (unilateral tumor more than 10 cm suggest primary tumor and bilateral tumors of any size, or unilateral tumor less than 10 cm suggest metastasis) this can correctly classified 84% of all tumors, including 100% of primary tumors and 77% of metastatic tumors and diagnosis of metastasis can be improved to 80% if the size was adjusted to 12 cm, and if we optimize the size criterion to 13 cm, we can correctly classified 87% of all tumors, and improve the diagnosis of metastasis to 82% and maintain the diagnostic performance of primary tumors at 98%.

2. Patients and methods

This retrospective study was approved by the local institutional review board of south Egypt cancer institute. The informed consent requirement was waived.

Between January 2012 and September 2016, we reviewed all our institution database and screened records of 421 ovarian malignancies and then we reviewed the pathology reports to identify ovarian metastasis pathologically confirmed by histological, immunological stains. clinical and pathological confirmation of the primary tumor were obtained.

Inclusion criteria was pathology proved ovarian metastasis, with pathology report confirmed the primary tumor. 35 patients underwent CT and 15 patients underwent MRI were included in this study. Data of patients with ovarian metastasis from primary genital tract tumor except ovary was included. We excluded 5 cases with: pelvic metastatic mass with normal ovaries (n = 2), mucinous papillary peritoneal cancer (n = 3).

A total of 50 histologically confirmed metastatic ovarian tumors were selected. We recorded patient data including age, patient presenting symptoms, type of the primary malignancy if known, level of CA 125 (the cut-off level was 35 IU/mL).

35 CT examinations were performed using 16-slice multi-detector CT scanner (GE Healthcare Bright Speed 16). in an antecubital vein, 140 mL of IV contrast material (iopromide; Ultravist 300, Schering) with rate 2.3 mL/s was administer via mechanical injector; 70 or 80 s after the start of IV injection of contrast material then scanning began from the diaphragm to the lower pelvis. Scanning parameters were: kV120; mA 250, 1.25 mm slice thickness, 1 mm detector collimation; and table speed 7–10 mm/sec.

Table 1
MRI parameters used in the study.

Sequence	TR (ms)	TE (ms)	FOV (mm)	Matrix	Slice thickness (mm)
T2 sagittal	3000	90	290 × 290	208 × 205	4
T2 axial	3700	100	288 × 350	292 × 180	5
T1 axial	500	10	260 × 216	263 × 171	5
T1 SPAIR axial	530	8	240 × 240	240 × 190	5
T2 coronal	5000	90	300 × 300	272 × 200	45

Slice gap is 1 mm and flip angle 90°.
Abbreviations: FOV = field of view; SPAIR = spectral adiabatic inversion recovery.

15 MRI examination were performed by 1.5-T magnet (Gyroscan INTERA and ACHIEVA, Philips medical systems, the Netherland). pelvic phased-array coil with eight channels was used to images patient in the supine position. Contrast media was injected and post contrast images was obtained among sagittal, coronal and axial planes.

Table 1 shows present study MRI protocol.

Images of 50 patients (35 underwent CT and 15 underwent MRI), radiologists who had four years of experience in gynecologic imaging, retrospectively interpreted images by consensus. we analyzed the imaging findings regarding the following characteristics: 1) ovarian mass size: the maximum diameter of lesion; 2) laterality;3) character of the mass: cystic (if more than half of cystic component), solid (if more than half of solid component), mixed (if both components are seen equally);4) enhancement of solid portion (either moderate or prominent enhancement in relation to myometrial enhancement); 5) pre and post contrast T1WIs andT2WIs, the signal intensity was classified regarding the normal skeletal muscle as homogeneously hyperintense, homogeneously isointense, homogeneously hypointense, heterogeneously hyperintense heterogeneously hypointense. Tissue nature was classified depending on the signal intensity of the largest component of the mass in pre and post contrast images as: soft tissue, clear fluid, protein or blood, lipid and degenerated tissue, 6) ascites, 7) presence of peritoneal deposits, categorization of peritoneal deposits extension was classified by deviding the peritoneal cavity into 13 anatomical regions inlding: central, right upper quadrnt, epigasium, left upper quadrant, left flank, left lower quadrant, pelvis, right lower quadrant, right flak, proximal jejunum, dial jejunum, proximl ileum and distal ileum. In each region, size of the largest tumor nodule is measured and classified as either: < 0.5 cm, between 0.5 and 5 cm, or > 5 cm, (8) abdominal and retroperitoneal lymph node enlargement (short axis diameter more than 1 cm).

Surgical treatment was classified as: (A) cytoreduction: complete if no visible disease grossly detected; optimal cytoreduction if tumor remaining is ≤ 0.5 cm in maximal tumor diameter; suboptimal cytoreduction if residual tumor nodule more than 0.5 cm (B) total abdominal hysterectomy, bilateral salpingo-oophorectomy with or without omentectomy, (C) unilateral or bilateral salpingo-oophorectomy.

31 women of the 50 cases underwent surgery and 19 patients underwent US guided true cut biopsy (13 of them had advanced Pelvic tumors, the origin of the tumor was unclear in (6)

3. Statistical analyses

Histopathologically confirmed secondary ovarian tumors were statistically analyzed: categorical data was assessed by fisher's exact test and numerical data by Mann–Whitney test T with 5% as the level of significance. SPSS 9.0 was used for statistical analysis (SPSS Inc, Chicago, IL, USA).