American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Staging and Follow-up of Ovarian Cancer**

Variant 1: **Pretreatment staging of ovarian cancer. (See narrative for comments regarding CA-125.)**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with IV contrast	9		☢☢☢☢
MRI abdomen and pelvis without and with IV contrast	7	If CT with IV contrast cannot be performed (due to renal insufficiency or severe allergy) or if CT findings are indeterminate.	O
CT chest abdomen pelvis with IV contrast	7	Indicated with abnormal chest radiograph.	☢☢☢☢
CT abdomen and pelvis without IV contrast	6		☢☢☢☢
MRI abdomen and pelvis without IV contrast	5		O
CT chest abdomen pelvis without IV contrast	4		☢☢☢☢
FDG-PET/CT skull base to mid-thigh	4		☢☢☢☢
US pelvis transvaginal	3		O
US abdomen and pelvis transabdominal and US pelvis transvaginal	3		O
CT chest abdomen pelvis without and with IV contrast	3		☢☢☢☢
CT abdomen and pelvis without and with IV contrast	3		☢☢☢☢
X-ray IV contrast enema	2		☢☢☢
X-ray intravenous urography	2		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Clinical Condition: **Staging and Follow-up of Ovarian Cancer**

Variant 2: **Rule out recurrent ovarian cancer. (See narrative for comments regarding CA-125.)**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with IV contrast	9		☢☢☢☢
FDG-PET/CT skull base to mid-thigh	8		☢☢☢☢
CT chest abdomen pelvis with IV contrast	7	Indicated with abnormal chest radiograph.	☢☢☢☢
MRI abdomen and pelvis without and with IV contrast	7	If CT with IV contrast cannot be performed (due to renal insufficiency or severe allergy) or if CT findings are indeterminate.	O
CT abdomen and pelvis without IV contrast	6		☢☢☢☢
MRI abdomen and pelvis without IV contrast	4		O
CT chest abdomen pelvis without IV contrast	4		☢☢☢☢
US pelvis transvaginal	3		O
US abdomen and pelvis transabdominal and US pelvis transvaginal	3		O
CT abdomen and pelvis without and with IV contrast	3		☢☢☢☢
CT chest abdomen pelvis without and with IV contrast	3		☢☢☢☢
X-ray IV contrast enema	2		☢☢☢
X-ray intravenous urography	2		☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

STAGING AND FOLLOW-UP OF OVARIAN CANCER

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Summary of Literature Review

Introduction/Background

Ovarian cancer is the fifth most common cause of cancer death in women in the United States behind lung, breast, colorectal, and pancreatic cancers, accounting for more than 3% of all cancers in women and causing more deaths than any other gynecologic malignancy [1,2]. Most ovarian cancer typically presents late, stage III-IV, after the disease has spread widely out of the pelvis [2-4]. The roles of diagnostic imaging have been to characterize the ovarian mass, determine the extent of preoperative disease, predict tumor resectability, and evaluate response to treatment [4-10]. Surgical staging is both diagnostic and therapeutic, and an experienced gynecologic surgeon is critical in optimum debulking of this tumor [9,11,12]. However, up to 40% of patients may be understaged at laparotomy [13].

Overview of Imaging Modalities

Imaging is used to detect and characterize adnexal masses and to stage ovarian cancer both prior to and following initial treatment. Thus far, no imaging method has achieved a sufficiently high positive predictive value to be recommended for screening women of average risk.[4]. In patients at increased risk for ovarian carcinoma based either on their genetic profile or on serum markers, transvaginal ultrasound (US) may be used for ovarian cancer screening, although determinations of outcome-based benefits are still preliminary at best [4,14-19]. Transvaginal US is also useful for determining the site of origin of a pelvic mass and to characterize the lesion [20]. A combination of morphology on transvaginal US and Doppler waveform analysis may provide an accurate risk assessment for adnexal lesions. [8,14]. Magnetic resonance imaging (MRI) is excellent for characterizing adnexal masses that are indeterminate by US [6-8,21-23]. Positron emission tomography (PET), particularly when combined with computed tomography (CT), has improved the accuracy of staging ovarian carcinoma [10,22,24-27].

The proper choice of treatment for ovarian cancer depends on accurate staging. CT and MRI have been used to determine the resectability of tumors, the candidacy of patients for effective cytoreductive surgery, the need for postoperative chemotherapy if debulking is suboptimal, and the need for referral to a gynecologic oncologist [5,24-26,28-34]. Stage I disease is limited to one or both ovaries, stage II disease has spread to the surface of other pelvic organs, stage III indicates spread to lymph nodes or abdominal peritoneal surfaces, and stage IV is advanced disease with distant metastases to solid organs or outside the abdomen [5,6].

Cytoreductive surgery is the standard treatment for ovarian cancer. Imaging is used to define the extent of disease, assess the likelihood of optimal primary cytoreduction [13], and select patients who may benefit from neoadjuvant chemotherapy [35,36]. The radiographic techniques for preoperative staging of ovarian cancer called for by the International Federation of Gynecology and Obstetrics — such as chest radiograph, barium enema and excretory urography — have been replaced by more advanced cross-sectional imaging techniques such as CT [37-39] in the United States and many other countries.

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Computed Tomography

CT is the current imaging modality of choice in the preoperative evaluation of ovarian cancer and has been validated as an accurate method to predict successful surgical cytoreduction. CT has been useful for detecting local tumor involvement of the pelvic ureter and uterine serosa, as well as metastases to the peritoneum, omentum, mesentery, liver, spleen, lymph nodes, and lung parenchyma [5,28,29,38]. CT has a reported accuracy for ovarian cancer staging of up to 94% [13]. The most important limitation of CT in staging ovarian cancer is its inability to reliably detect bowel surface, mesenteric, or peritoneal tumor implants <5 mm, especially in the absence of ascites [5,32,40]. CT is also useful for guiding biopsy of the omentum, a procedure that can increase the accuracy of preoperative staging [41-44].

CT of the chest is useful for detecting pleural and pulmonary metastases during primary staging. Although CT is not sensitive for detecting pleural metastases, these can be verified by video-assisted thoracoscopy (VATS) if needed [45]. Preoperative detection by CT of a moderate-to-large pleural effusion helps predict poor post-treatment outcome [46]. For postsurgical surveillance, the yield of chest CT is low if the chest radiograph shows no abnormalities, CT shows no abdominal or pelvic disease, and there is no rising serum CA-125 [47,48]. If PET using tracer fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG-PET) and including chest, abdomen and pelvis is obtained, the added value of diagnostic-quality chest CT is probably even lower.

Magnetic Resonance Imaging

MRI is an excellent problem-solving technique by virtue of its ability to define common conditions such as fibroids, dermoid cysts, endometriomas, and other benign lesions [6-8,21,33]. A multivariate analysis showed that the accuracy of MRI with gadolinium enhancement in diagnosing ovarian malignancy was 93% [49]. Gadolinium enhancement and diffusion-weighted imaging offer improved diagnostic confidence and tissue characterization [21,49]. However, the role of MRI has been limited because 1) the use of intraluminal gastrointestinal contrast agents with MRI is not routine as it is with CT, 2) MRI generally costs more than CT, 3) there are fewer experienced radiologists to interpret MRI, and 4) patient motion is a greater problem for MRI than for CT. Thus, CT is currently the first modality recommended for staging ovarian cancer. MRI is recommended for patients with a contraindication to the use of iodinated contrast agents (eg, allergy, mild-to-moderate renal insufficiency), patients who are pregnant, patients of childbearing age with borderline tumors (to minimize ionizing radiation exposure), those for whom CT findings are inconclusive [50,51]. Higher-field MRI scans may improve the accuracy of MRI for staging ovarian cancer pending further investigation [52].

Predicting Resectability

For predicting the nonresectability of ovarian cancer, cross-sectional imaging (CT or MRI) plays a critically important role in finding significant lesions (>2 cm) at the root of the mesentery, gastrosplenic ligament, omentum of the lesser sac, porta hepatis, intersegmental fissure of the liver, diaphragm, liver dome, and lung parenchyma, and also in detecting lymphadenopathy at or above the celiac axis, presacral extraperitoneal disease, and pelvic sidewall invasion [5,13,29,38,51,53-56]. Unresectable disease can be managed by needle or laparoscopic biopsy, by chemotherapy, and possibly by a later attempt at optimal debulking, resulting in improved survival by virtue of optimal response to chemotherapy [9,24,41-44].

Positron Emission Tomography

The use of FDG-PET imaging in the primary diagnosis and tissue characterization of ovarian cancer is unsupported to date. Specificity has been reported as low as 54% and moderate sensitivity as high as 86% [23,57,58]. Also, false-negative results have been reported with borderline tumors, early carcinomas, and adenocarcinomas. False-positive results have been reported with dermoid cysts, hydrosalpinges, and endometriosis [51,58].

However, FDG-PET, especially when combined with CT, is a valuable tool for diagnosing and staging advanced disease and detecting recurrent tumor [22,24-27,57,59]. The use of FDG-PET combined with serum tumor marker CA-125 has a reported sensitivity as high as 98%, and PET alone has a sensitivity of 85% [60]. For primary staging of ovarian carcinoma, best performances have been reported with fusion PET/CT, which has higher accuracy than either CT or FDG-PET alone [22,25,26,57,61].

Recurrent Disease

Imaging of the chest, abdomen, and pelvis plays a key role in detecting recurrence and the extent of disease. The latter in turn will determine the choice(s) of treatments from among surgery, chemotherapy, and radiation therapy.

CT is 58% sensitive and 100% specific in predicting unsuccessful debulking [38]. The reported accuracy of MRI for detecting lesions >2 cm is comparable to that of CT at 93%-95% [13]. However, CT remains the most widely used imaging method for detecting recurrence for the same reasons as those that are discussed above for primary staging. For detecting recurrent ovarian cancer, fusion PET/CT has recently shown higher accuracy than CT or PET alone [10,24,59,60,62], with a sensitivity of 95%-97% and specificity of 80%-100% [59,63]. Second-look laparotomy is no longer routinely performed because the noninvasive diagnosis of recurrence obviates the need for unnecessary surgery.

CA-125 Levels

The preoperative evaluation of patients with suspected ovarian carcinoma usually includes a serum CA-125 determination. Only about 50% of all patients with stage I ovarian cancer have a true-positive result [4,64-66]. Thus, this test alone is inadequate when used in isolation as a screening tool. This is especially true in menstruating females, since false-positive results have been reported with endometriosis, benign ovarian cysts, pregnancy, and pelvic inflammatory disease. However, with stage II or greater ovarian cancer, the true-positive rate is as high as 80% [66]. There is a very high correlation between CA-125 levels and the clinical course of the patient during chemotherapy. Pancreatic cancer and cirrhosis have caused elevated CA-125 levels. CA-125 levels also can be used to predict tumor recurrence in patients who are clinically tumor free [60].

Summary

- CT of the abdomen and pelvis with contrast is the procedure of choice for staging ovarian cancer, both pretreatment and for post-treatment surveillance.
- CT of the chest is usually not appropriate in the absence of an abnormal chest radiograph, except if there is abdominal or pelvic post-treatment recurrence or rising serum CA-125.
- MRI without and with contrast may be useful following equivocal CT, but is usually not the best initial procedure for ovarian cancer staging.
- FDG-PET/CT is appropriate for detecting and defining post-treatment recurrence, but may not be needed for initial pretreatment evaluation.
- Ultrasound is useful for evaluating adnexal disease, but has limited utility for staging ovarian cancer.
- Radiographic studies such as contrast enema and urography have been replaced by CT for staging ovarian cancer.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations		
Relative Radiation Level*	**Adult Effective Dose Estimate Range**	**Pediatric Effective Dose Estimate Range**
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢ ☢	0.1-1 mSv	0.03-0.3 mSv
☢ ☢ ☢	1-10 mSv	0.3-3 mSv
☢ ☢ ☢ ☢	10-30 mSv	3-10 mSv
☢ ☢ ☢ ☢ ☢	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".		

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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