Imaging Modalities for Granulosa Cell Tumor Imaging

Alan K Klitzke, MD, FACNM

ROSWELL PARK CANCER INSTITUTE
Alan K. Klitzke, MD, FACNM  
Staff Radiologist and Nuclear Physician  
Roswell Park Cancer Institute

- General Surgery Internship –  
  *The University of Chicago Hospitals-Pritzker School of Medicine*

- 2 years Additional Residency Training in Surgery and Urology –  
  *Albert Einstein College of Medicine-Long Island Jewish Hospital*

- Residency in Diagnostic Radiology –  
  *University of Missouri at Kansas City*

- Residency in Nuclear Medicine –  
  *State University of New York at Buffalo*

- Fellowship in Abdominal Imaging Radiology–  
  *The Cleveland Clinic*

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**Assistant Professor of Oncology,**  
Roswell Park Cancer Institute  
**Assistant Professor of Radiology**  
Jacobs School of Medicine & Biomedical Sciences, State University of New York at Buffalo  
**Assistant Professor of Nuclear Medicine**  
Jacobs School of Medicine & Biomedical Sciences, State University of New York at Buffalo  
**Distinguished Fellow of The American College of Nuclear Medicine**

**Certifications**  
American Board of Radiology  
American Board of Nuclear Medicine

**National/ International Service:**  
President, Society of Nuclear Medicine and Molecular Imaging-Eastern Great Lakes Chapter  
Treasurer, American College of Nuclear Medicine  
Society of Nuclear Medicine and Molecular Imaging-Correlative Imaging Council Board of Directors  
American College of Radiology Council  
New York State Radiological Society  
Delegate, American Medical Association Organized Medical Staff Section

**Disclosures:**  None
Tumor Imaging

... Well, how about an introduction to some of the technologies and how they are used...
• Enough information to be informed

• …or just enough knowledge …to be … misinformation

• Lets hope for the former
Granulosa Cell Tumors

Rare ovarian neoplasms that constitute 2% to 5% of ovarian cancer.

A GCT is derived from the granulosa cell, which is responsible for estradiol production in ovarian stroma.

Clinical symptoms and signs of GCTs are caused by exposure of the endometrium to tumor-derived increased estradiol and include postmenopausal bleeding, endometrial hyperplasia, and endometrial adenocarcinoma.
Multiple Imaging Modalities for Assessment of Pelvis and Tumors

- Ultrasound
- CT
- MRI
- PET/CT
Ultrasound (AKA Sonography)

• Safe and painless
• Produces pictures of the inside of the body using sound waves
• Involves the use of
  • a small transducer (probe)
  • Ultrasound gel placed directly on the skin
High-frequency sound waves are transmitted from the probe through the gel into the body. The transducer collects the sounds that bounce back. A computer uses those "echoed" sound waves to create an image.
Benefits of Ultrasound

- Pelvic ultrasound scanning is noninvasive (no needles, no injections, no preps)
- May be temporarily uncomfortable, almost never painful
- Less expensive than CT and MRI
- Does not use any ionizing radiation
- Provides real-time imaging
  - Can show structure and movement of the body's internal organs
  - Blood flowing through blood vessels
Doppler Ultrasound Exam

Special ultrasound technique that allows the physician to see and evaluate blood flow through arteries and veins or within various body organs.

The use of Doppler technology allows determination of the speed and direction of blood flow by utilizing the Doppler effect.
Doppler effect (or the Doppler shift)

- The change in frequency of a wave (or other periodic event) for an observer moving relative to its source.
- Named after the Austrian physicist Christian Doppler, who proposed it in 1842 in Prague.
- Commonly heard when a vehicle sounding a siren or horn approaches, passes, and recedes from an observer.
  - Compared to the emitted frequency, the received frequency is:
    - Higher during the approach.
    - Identical at the instant of passing by, and
    - Lower during the recession.
Doppler effect (or the Doppler shift)
Doppler effect (or the Doppler shift)
Color Doppler Weather Radar Map
Ultrasound Probes come in Different Varieties
Granulosa cell tumor in a 46-year-old woman

Transvaginal ultrasonography reveals a multilocular solid mass

This tumor has mainly solid components, some with and some without a multilocular cystic appearance
Diagnosis is Combination of Clinical and Imaging Findings

1) Ultrasound Imaging of a large solid mass with heterogeneous echogenicity of the solid tissue or a multilocular – solid mass with many (small) locules, high color content on color or power Doppler examination, and hemorrhagic components in girls and women
   • With

2) Signs of hyperestrogenism
   • Isosexual pseudoprecocity
     • Isosexual precocious puberty refers to the appearance of phenotypically appropriate secondary sexual characteristics before age 8 years in girls
     • Pseudo-isosexual precocity is due to sex steroid production which is independent of hypothalamic-pituitary regulation
   • Bleeding disorders

3) Should raise the suspicion of a GCT
Granulosa cell tumor in 44-year-old woman. Transvaginal ultrasound image reveals 13-cm predominantly solid-appearing mass. Uterus and left ovary were unremarkable (not shown). Normal right ovary was not seen.
Computed tomography, more commonly known as a CT or CAT scan, is a diagnostic medical test that, like traditional x-rays, produces multiple images or pictures of the inside of the body.

The cross-sectional images generated during a CT scan can be reformatted in multiple planes, and can even generate three-dimensional images. These images can be viewed on a computer monitor, printed on film or transferred to a CD or DVD.

CT images of internal organs, bones, soft tissue and blood vessels typically provide greater detail than traditional x-rays, particularly of soft tissues and blood vessels.
Patient undergoing computed tomography (CT) scan
Sir Godfrey Newbold Hounsfield
(28 August 1919 – 12 August 2004)

Godfrey Hounsfield with an early version of the CT scanner, then called the EMI Scanner

English electrical engineer

Shared the 1979 Nobel Prize for Physiology or Medicine with Allan McLeod Cormack for his part in developing the diagnostic technique of X-ray computed tomography (CT)
The CT scanner uses a set of software algorithms to determine the amount of x-radiation absorbed by every element in a plane of tissue.

Each of these elements is represented by a pixel on the video display, and the density (amount of x-radiation absorbed) is measured in Hounsfield units.
If $mw$, $ma$, and $m$ are the linear attenuation coefficients of water, air and a substance of interest, the CT number of the substance of interest is:

$$H = 1000 \ (m - mw) / (mw - ma)$$

Thus, a change of one Hounsfield unit (HU) corresponds to 0.1% of the attenuation coefficient difference between water and air, or approximately 0.1% of the attenuation coefficient of water since the attenuation coefficient of air is nearly zero.
Substance Densities in Hounsfield Units

Air: -1000
Fat: -50
Water: 0
Soft tissue such as muscle: +40
Calculus: +100 to +400
Bone: +1000 to +3000

From his Nobel Award Address:
General Clinical Guide

- Fatty Tissue: -130 to -10
- Simple Fluid: ~0 to +18 (20)
- Soft Tissue: +20 to ~+70
- Complex Fluid: +18 to +80+ (heme)

The scale extends in the positive direction to about +4000, which represents very dense metals.
The First Scans were Brain Imaging
Early CT Scans
Basic Structures in Head CT

- Anterior horn of lateral ventricle
- 3rd Ventricle
- Frontal lobe
- Septum pellucidum
- Fornix
- Occipital lobe
CT Artifacts

- Metal
- Motion
- Beam Hardening
- Partial Volume

Images showing artifacts in CT scans:

- Metal artifact
- Motion artifact
- Beam hardening artifact
- Partial volume artifact

Soft Tissue

Bone
Artifacts

Beam hardening artifact:
- Corrected by processing during the reconstruction process.

Partial volume artifact:
- Occurs when a voxel contains two very different materials, like bone and soft tissue.
- The resulting CT number will be somewhere between the correct values for the different materials.
- Depending on the window setting, a structure such as bone, can appear thinner or thicker than it's actual dimension.
Coronal CT Through Paranasal Sinuses
Major Anatomical Structures Within the Thorax
Major Anatomical Structures Within the Thorax

- Descending aorta
- Ascending aorta
- SVC
- Right pulmonary artery
- Main pulmonary artery
- Left pulmonary artery
- Left main bronchus
Major Anatomical Structures Within the Thorax
Major Anatomical Structures Within the Thorax

- Right ventricle
- Interventricular septum
- Left ventricle
- IVC
- Azygous vein
Descending Aorta filled with intravenousous contrast
Right, Middle and Left Hepatic Veins draining into the Inferior Vena Cava
Portal Vein Branching into the Liver

Liver

Stomach
IVC, Aorta, Esophagus, Portal Veins
Upper Abdomen

- Liver
- Stomach
- Rib
- Spleen
- Chondral Cartilage (calcified here)
Proper Hepatic Artery, Splenic Vein, Portal vein, Adrenal Glands, Pancreas
1. Celiac Artery originates from the Aorta
2. Proper Hepatic Artery
3. Splenic Vein
4. Splenic Artery
Proper Hepatic Artery & Splenic Artery
(Splenic Artery is the circle)

Splenic Vein
Here the Splenic Vein joins the Superior Mesenteric Vein (below slice level) to form origin of the Portal Vein.
Superior Mesenteric Artery originating from the Aorta

Common Bile Duct
Transverse Colon

Small Bowel
Aorta bifurcates into Common Iliac Arteries
There is always a slight chance of cancer from excessive exposure to radiation. However, the benefit of an accurate diagnosis far outweighs the risk.

The effective radiation dose for this procedure varies.

Women should always inform their physician and x-ray or CT technologist if there is any possibility that they are pregnant.
## Radiation Dose to Patients From Common Imaging Examinations

<table>
<thead>
<tr>
<th>Procedure</th>
<th>**Approximate effective radiation dose</th>
<th>Comparable to natural background radiation for</th>
<th>* Estimated lifetime risk of fatal cancer from examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMEN'S IMAGING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bone Densitometry (DEXA)</td>
<td>0.001 mSv</td>
<td>3 hours</td>
<td>Negligible</td>
</tr>
<tr>
<td>Mammography</td>
<td>0.4 mSv</td>
<td>7 weeks</td>
<td>Very Low</td>
</tr>
<tr>
<td>CHEST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computed Tomography (CT) — Chest</td>
<td>7 mSv</td>
<td>2 years</td>
<td>Low</td>
</tr>
<tr>
<td>Computed Tomography (CT) — Lung Cancer Screening</td>
<td>1.5 mSv</td>
<td>6 months</td>
<td>Very Low</td>
</tr>
<tr>
<td>Radiography — Chest</td>
<td>0.1 mSv</td>
<td>10 days</td>
<td>Minimal</td>
</tr>
</tbody>
</table>

### Risk Level

<table>
<thead>
<tr>
<th>*Risk Level</th>
<th>Negligible</th>
<th>Minimal</th>
<th>Very Low</th>
<th>Low</th>
<th>Moderate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated additional risk of fatal cancer for an adult from examination</td>
<td>Less than 1 in 1,000,000</td>
<td>1 in 1,000,000 to 1 in 100,000</td>
<td>1 in 100,000 to 1 in 10,000</td>
<td>1 in 10,000 to 1 in 1,000</td>
<td>1 in 1,000 to 1 in 500</td>
</tr>
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**Note:** These risk levels represent very small additions to the 1 in 5 chance we all have of dying from cancer.
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<td><strong>ABDOMINAL REGION</strong></td>
<td></td>
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<tr>
<td>Computed Tomography (CT) — Abdomen and Pelvis</td>
<td>10 mSv</td>
<td>3 years</td>
<td>Low</td>
</tr>
<tr>
<td>Computed Tomography (CT) — Abdomen and Pelvis, repeated with and without contrast material</td>
<td>20 mSv</td>
<td>7 years</td>
<td>Moderate</td>
</tr>
<tr>
<td>Computed Tomography (CT) — Colonography</td>
<td>10 mSv</td>
<td>3 years</td>
<td>Low</td>
</tr>
<tr>
<td>Intravenous Pyelogram (IVP)</td>
<td>3 mSv</td>
<td>1 year</td>
<td>Low</td>
</tr>
<tr>
<td>Radiography (X-ray) — Lower GI Tract</td>
<td>8 mSv</td>
<td>3 years</td>
<td>Low</td>
</tr>
<tr>
<td>Radiography (X-ray) — Upper GI Tract</td>
<td>6 mSv</td>
<td>2 years</td>
<td>Low</td>
</tr>
<tr>
<td><strong>NUCLEAR MEDICINE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positron Emission Tomography — Computed Tomography (PET/CT)</td>
<td>25 mSv</td>
<td>8 years</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

*Estimated lifetime risk of fatal cancer from examination:
- Negligible: Less than 1 in 1,000,000
- Minimal: 1 in 1,000,000 to 1 in 100,000
- Very Low: 1 in 100,000 to 1 in 10,000
- Low: 1 in 10,000 to 1 in 1,000
- Moderate: 1 in 1,000 to 1 in 500

**Note:** These risk levels represent very small additions to the 1 in 5 chance we all have of dying from cancer.
Alternative assumptions for the extrapolation of the cancer risk vs. radiation dose to low-dose levels, given a known risk at a high dose: (A) supra-linearity, (B) linear (C) linear-quadratic, (D) hormesis
Hormesis Theory
Radiation Hormesis Theory (AKA radiation homeostasis)

- Hypothesis that low doses of ionizing radiation (within the region of and just above natural background levels) are beneficial
  - Stimulate the activation of repair mechanisms that protect against disease, that are not activated in absence of ionizing radiation.
  - Reserve repair mechanisms are hypothesized to be sufficiently effective when stimulated as to *not only* cancel the detrimental effects of ionizing radiation but to also inhibit disease not related to radiation exposure.
Effects of high and acute doses of ionizing radiation are easily observed and understood in humans (e.g. Japanese Atomic Bomb survivors).

Effects of low-level radiation are very difficult to observe and highly controversial.

This is because the baseline cancer rate is already very high and the risk of developing cancer fluctuates 40% because of individual lifestyle and environmental effects obscuring the subtle effects of low-level radiation.
CONSISTENCY

It’s Only a Virtue if You’re Not a Screwup.
Magnetic Resonance Imaging (MRI)

- Magnetic resonance imaging (MRI) uses
  - Powerful magnetic field
  - Radio waves
  - Computer
- Produces detailed pictures of the body's internal structures that can be clearer or more detailed than those obtained by other imaging methods
- MRI is noninvasive
- Does not use ionizing radiation (x-rays)
Granulosa cell tumor in a 55-year-old woman. Contrast-enhanced CT scan shows a large, complex mass with a lobular contour, multiple cysts with a “bunch of grapes” appearance on the right (arrows), and an irregularly enhancing solid portion on the left (*). $U =$ uterus.
Figure 21a. Granulosa cell tumor in a 71-year-old woman. (a) Sagittal turbo spin-echo T2-weighted MR image (4,275/138) shows a lobulated multilocular cystic mass that resembles a cystadenocarcinoma. However, no evidence of a papillary projection is noted. The endometrial cavity (arrows) is unusually prominent for a patient this age, a finding that is consistent with endometrial hyperplasia. (b) Gadolinium-enhanced fat-suppressed FLASH T1-weighted MR image (148/4.8) demonstrates multiple well-enhanced septa, with numerous large cystic spaces lined by granulosa cells. These findings represent an extreme example of the macrofollicular pattern.
18F-FDG PET/CT

- Useful tool for evaluating the recurrence of ovarian cancer after first-line therapy in patients with a high risk of relapse, equivocal radiologic findings, increased or normal levels of serum CA-125

- It can more accurately diagnose and localize recurrence, hence decreasing the rate of second look surgery and changing treatment plan
PET scanning with the tracer fluorine-18 (F-18) fluorodeoxyglucose (FDG), called FDG-PET, is widely used in clinical oncology.

- This tracer is a glucose analog that is taken up by glucose-using cells and phosphorylated by hexokinase – and gets trapped in the cells (ideal for identification of these cells)

- Uses the natural effect of Positrons for imaging
What is a Positron?

- The positron or antielectron is the antiparticle or the antimatter counterpart of the electron.
- The positron has an electric charge of +1 e, a spin of $\frac{1}{2}$, and has the same mass as an electron.
- When a low-energy positron collides with a low-energy electron, annihilation occurs, resulting in the production of two or more gamma ray photons.
- Positrons may be generated by positron emission radioactive decay.
Electron–positron Annihilation

• Electron–positron annihilation occurs when an electron (e−) and a positron (e+, the electron's antiparticle) collide.

• The result of the collision at low energies is the annihilation of the electron and positron, and the creation of gamma ray photons.

• All Matter is Destroyed!
• … and changed into energy

• As per Einstein’s Theory of Relativity – E=MC²
Uses emissions from small amounts of injected radioactive material

- PET imaging uses the process of Electron–positron annihilation to produce high quality nuclear medicine images of injected materials labeled with radioactive isotopes which degrade by positron emission

- Florine-18 (F18) is a useful positron emitting isotope which a half-life of 110 minutes

- Needs to be made with a cyclotron

- F18FDG looks like normal sugar glucose to your cells (at the cell surface) and are taken up by energy hungry cells
THE STEAKS HAVE BEEN RAISED
Recurrent ovarian cancer in 49 y/o female with bilateral ovarian granulosa cell carcinoma underwent TAH&BSO, received chemotherapy

(a and d) Axial contrast-enhanced CT, (b and e) FDG PET, and (c and f) fused PET/CT fused images

Show multiple confluent soft tissue masses (a–c) posterior and superior to the urinary bladder with low grade FDG uptake

Left lateral rectal (d–f) wall thickening

Findings suggestive of local pelvic recurrence
Volume PET (only) Image
• Two classification organizations
  • The tumor-node-metastasis (TNM)
  • International Federation of Gynecology and Obstetrics (FIGO)
• Distinctions nearly identical – with different designations
## Primary tumor (T)

<table>
<thead>
<tr>
<th>TNM</th>
<th>FIGO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX</td>
<td>FIGO</td>
<td>Primary tumor cannot be assessed</td>
</tr>
<tr>
<td>T0</td>
<td>FIGO</td>
<td>No evidence of primary tumor</td>
</tr>
<tr>
<td>T1</td>
<td>I</td>
<td>Tumor limited to the ovaries (one or both)</td>
</tr>
<tr>
<td>T1a</td>
<td>IA</td>
<td>Tumor limited to one ovary; capsule intact, no tumor on ovarian surface; no malignant cells in ascites or peritoneal washings</td>
</tr>
<tr>
<td>T1b</td>
<td>IB</td>
<td>Tumor limited to both ovaries; capsules intact, no tumor on ovarian surface; no malignant cells in ascites or peritoneal washings</td>
</tr>
<tr>
<td>T1c</td>
<td>IC*</td>
<td>Tumor limited to one or both ovaries with any of the following: capsule ruptured, tumor on ovarian surface, malignant cells in ascites or peritoneal washings</td>
</tr>
<tr>
<td>T2</td>
<td>II</td>
<td>Tumor involves one or both ovaries with pelvic extension</td>
</tr>
<tr>
<td>T2a</td>
<td>IIA</td>
<td>Extension and/or implants on the uterus and/or tube(s); no malignant cells in ascites or peritoneal washings</td>
</tr>
<tr>
<td>T2b</td>
<td>IIB</td>
<td>Extension to and/or implants in other pelvic tissues; no malignant cells in ascites or peritoneal washings</td>
</tr>
<tr>
<td>T2c</td>
<td>IIC*</td>
<td>Pelvic extension and/or implants (T2a or T2b) with malignant cells in ascites or peritoneal washings</td>
</tr>
<tr>
<td>T3</td>
<td>III*</td>
<td>Tumor involves one or both ovaries with microscopically confirmed peritoneal metastasis outside the pelvis</td>
</tr>
<tr>
<td>T3a</td>
<td>IIIA*</td>
<td>Microscopic peritoneal metastasis beyond the pelvis (no macroscopic tumor)</td>
</tr>
<tr>
<td>T3b</td>
<td>IIIB*</td>
<td>Macroscopic peritoneal metastasis beyond the pelvis 2 cm or less in greatest dimension</td>
</tr>
<tr>
<td>T3c</td>
<td>IIIC*</td>
<td>Macroscopic peritoneal metastasis beyond the pelvis &gt;2 cm in greatest dimension and/or regional lymph node metastasis</td>
</tr>
</tbody>
</table>
### Tumor Staging – TNM / FIGO

#### Regional lymph nodes (N)

<table>
<thead>
<tr>
<th>TNM FIGO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX</td>
<td>Regional lymph nodes cannot be assessed</td>
</tr>
<tr>
<td>N0</td>
<td>No regional lymph node metastasis</td>
</tr>
<tr>
<td>N1</td>
<td>Regional lymph node metastasis, IIIC</td>
</tr>
</tbody>
</table>

#### Distant metastasis (M)

<table>
<thead>
<tr>
<th>TNM FIGO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>No distant metastasis</td>
</tr>
<tr>
<td>M1</td>
<td>Distant metastasis (excludes peritoneal metastasis)</td>
</tr>
</tbody>
</table>
American College of Radiology (ACR) Appropriateness Criteria

Clinical Condition: Staging and Follow-up of Ovarian Cancer
Variant 1: Pretreatment staging of ovarian cancer

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT abdomen and pelvis with contrast</td>
<td>9</td>
<td>If CT with contrast cannot be performed (due to renal insufficiency or severe allergy) or if CT findings are indeterminate. See statement regarding contrast in text under “Anticipated Exceptions.”</td>
<td>5</td>
</tr>
<tr>
<td>MRI abdomen and pelvis without and with contrast</td>
<td>7</td>
<td>Indicated with abnormal chest radiograph.</td>
<td>0</td>
</tr>
<tr>
<td>CT chest abdomen pelvis with contrast</td>
<td>7</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>CT abdomen and pelvis without contrast</td>
<td>6</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>MRI abdomen and pelvis without contrast</td>
<td>5</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>CT chest abdomen pelvis without contrast</td>
<td>4</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>FDG-PET/CT skull base to mid-thigh</td>
<td>4</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>US pelvis transvaginal</td>
<td>3</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>US abdomen and pelvis transabdominal and US pelvis transvaginal</td>
<td>3</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>CT chest abdomen pelvis without and with contrast</td>
<td>3</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>CT abdomen and pelvis without and with contrast</td>
<td>3</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>X-ray contrast enema</td>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>X-ray intravenous urography</td>
<td>2</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level
## Variant 2: Rule out recurrent ovarian cancer

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<td>4</td>
<td></td>
<td>★★★★★★</td>
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<td>O</td>
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<td></td>
<td>O</td>
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<td>2</td>
<td></td>
<td>★★★★★★</td>
</tr>
<tr>
<td>X-ray intravenous urography</td>
<td>2</td>
<td></td>
<td>★★★★★★</td>
</tr>
</tbody>
</table>

**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level*
TRADITION

JUST BECAUSE YOU’VE ALWAYS DONE IT THAT WAY DOESN’T MEAN IT’S NOT INCREDIBLY STUPID.
• **Ultrasound and MRI are the best imaging modalities for imaging the PRIMARY TUMOR**

• The overall best Imaging Modality for preoperative grading of the Primary Tumor is Magnetic Resonance (MR or MRI)
  - Best Tissue Differentiation
  - Can detect fat content of soft tissue structures—a feature which can help with differential diagnosis (narrowing the diagnostic possibilities of a given imaging finding)
  - Can tailor the exam for the body region of interest
### Accuracy measures of PET/CT in lesion localization (Lesion-based)

<table>
<thead>
<tr>
<th>Localization</th>
<th>Number of lesions</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvic recurrence</td>
<td>24</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Pelvic lymph node</td>
<td>5</td>
<td>80</td>
<td>99</td>
<td>97</td>
</tr>
<tr>
<td>Para-aortic lymph node</td>
<td>10</td>
<td>78</td>
<td>96</td>
<td>94</td>
</tr>
<tr>
<td>Peritoneal metastasis</td>
<td>22</td>
<td>77</td>
<td>96</td>
<td>90</td>
</tr>
<tr>
<td>Distant lymph node</td>
<td>8</td>
<td>89</td>
<td>100</td>
<td>99</td>
</tr>
<tr>
<td>Distant organ metastasis</td>
<td>4</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Assessment of Nodal Stage and Metastatic Disease

• This can be done with CT, PET/CT and MRI

• MRI is not useful for complete staging, but is relatively sensitive for the immediate pelvic region

• **Complete Staging is best accomplished with PET/CT**

• Diagnostic CT with oral and IV Contrast is nearly equal. In recent years, PET/CT shown to be superior
Thank you for Listening

This Lecture was brought to you with the cooperation of Roswell Park Cancer Institute Division of Diagnostic Imaging

Zachary D. Grossman, MD, FACR, Professor and Chairman