

## CT Incidentalomas

Bruce Lehnert, MD

---

---

---

---

---

---

---

---

## Objectives

- Understand the scope of the incidentaloma problem.
- Review important imaging features and follow-up recommendations for several CT incidentalomas.
- Understand rational behind imaging recommendations for incidental findings.

---

---

---

---

---

---

---

---

## Incidentalomas

- Total body CT has a reported incidental findings rate of 45% with the majority of these findings being located in the abdomen.
- The prevalence of incidental findings increases with age
  - 20% in patients under 40 years .
  - 46% in those over 40 years of age.

Sierink JC, et al. 2014;45(5):840-844.  
Paluska TR, et al. J Trauma 2007;62(1):157-161.

---

---

---

---

---

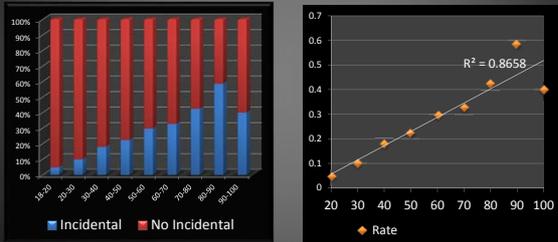
---

---

---

## Incidentalomas

The prevalence of incidental findings increases with age



2014: RSNA. "Major Incidental Findings on Trauma CT: Rate and Impact of Patient Age." Gunn, M et al.

---

---

---

---

---

---

---

---

---

---

---

---

## Incidentalomas

- Ekeh et al. found a large majority (up to 75%) of trauma patients with incidental findings had no traumatic injury at imaging.

CT Scan	Trauma%	Incidental %
Brain	18.1	6.1
Chest	26.6	18.6
Abdomen	16.5	29.8
Pelvis	11.8	8.0
Spine	16.7	7.9
Total	26.8	14.8

15% of incidental findings highly likely to be clinically significant

Ekeh AP, et al. J Emerg Med 2010;38(4):484-489.  
Munk MD, et al. J Emerg Med 2010;38(3):346-350.

---

---

---

---

---

---

---

---

---

---

---

---

### Incidental findings on routine thoracoabdominal computed tomography in blunt trauma patients

- 1047 CTs reviewed
- 35% had one or more incidental finding .
- Further investigation or therapy in 19%.
  - 5% underwent surgery.
- Malignancy in 2%.

J Trauma. 2012. Volume 72, Number 2

---

---

---

---

---

---

---

---

---

---

---

---

**Recommendations for Additional Imaging in Radiology Reports: Multifactorial Analysis of 5.9 Million Examinations**

- The likelihood to recommend further imaging more than doubled from 1995 to 2008 (OR 2.16).
- Radiologists with increasing levels of experience made fewer recommendations for additional imaging
  - 15% decrease in the odds of recommendation per decade of experience.

*Radiology*: Volume 253: Number 2—November 2009

---

---

---

---

---

---

---

---

**Common Incidental Findings on MDCT: Survey of Radiologist Recommendations for Patient Management**

- Surveyed radiologists about how to manage 12 incidental findings on body CT including:
  - thyroid nodule,
  - lung nodule
  - coronary artery calcification
  - adrenal nodule
  - pancreatic cyst,
  - enhancing liver lesion
  - high-density renal cyst
- $\geq 70\%$  agreement on management recommendations for only 6/12 types of incidentalomas.

*J Am Coll Radiol* 2011;8:762-767.

---

---

---

---

---

---

---

---

**Incidentaloma follow up**

- Documentation and follow-up rates for incidental findings on ED CT scans are alarmingly low:
  - 20-49%

Munk MD, et al. *J Emerg Med* 2010;38(3):346-350.

---

---

---

---

---

---

---

---

### Incidentaloma follow-up: Communication

- Causes of radiology malpractice lawsuits in USA (Ranked):
  1. Failure to diagnose.
  - 2. Failure to communicate results.**
- Communication problems present in 80% of malpractice cases.

J Am Med Inform Assoc. 2007;14:459-466  
Applied Radiology, Jan 2010, 17

---

---

---

---

---

---

---

---

### Incidentaloma follow-up at HMC

Imaging study performed and interpreted  
-ED  
-IP  
-OP

---

---

---

---

---

---

---

---

### Incidentaloma follow-up at HMC

Imaging study performed and interpreted  
-ED  
-IP  
-OP

Non-emergent result reported and verbally communicated to ordering provider.

---

---

---

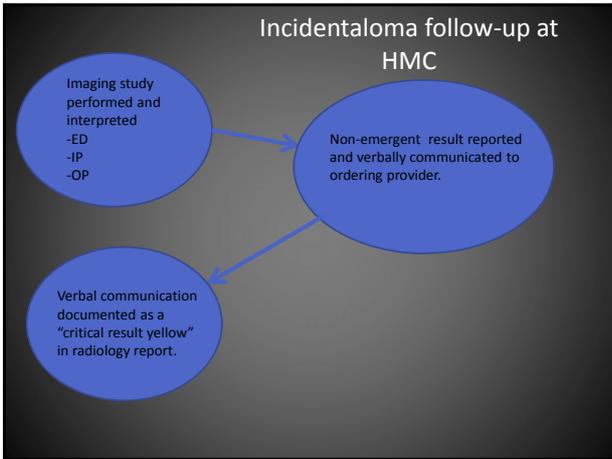
---

---

---

---

---



---

---

---

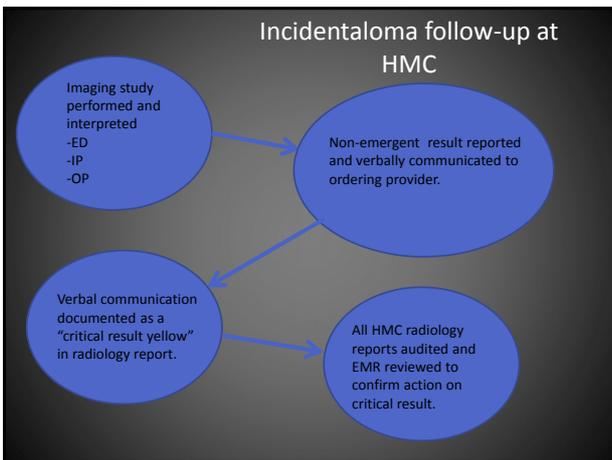
---

---

---

---

---



---

---

---

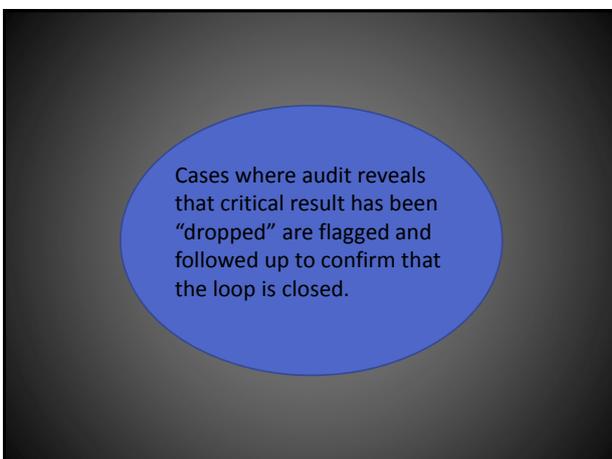
---

---

---

---

---



---

---

---

---

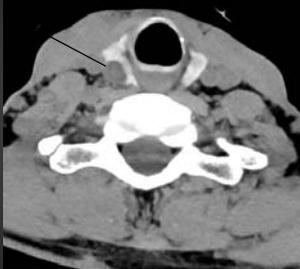
---

---

---

---

### Imaging



**Management in a 30 year old?**  
A: Non emergent ultrasound  
B: Clinical correlation  
C: Thyroid function testing  
D: Flip coin. If heads recommend ultrasound follow-up. If tails recommend no follow-up  
E: Window/level until not visible and ignore.

---

---

---

---

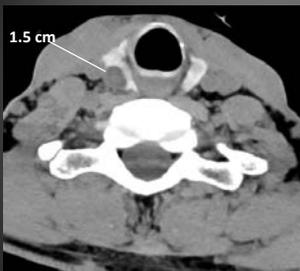
---

---

---

---

### Imaging



**Management in a 30 year old?**  
A: Non emergent ultrasound  
B: Clinical correlation  
C: Thyroid function testing  
D: Flip coin. If heads recommend ultrasound follow-up. If tails recommend no follow-up  
E: Window/level until not visible and ignore.

---

---

---

---

---

---

---

---

### Thyroid

---

---

---

---

---

---

---

---

## Thyroid

- Apparent prevalence of thyroid nodules depends on the tool of interrogation:
  - Palpation: 4%–7%
  - Autopsy: 50%–60%
  - US: Up to 67%
  - CT: 12-16%
- Crude estimation: 50% prevalence= 150 million people with thyroid nodules in US.
- Current imaging guidelines for management (FNA) are based on ultrasound features.
- Management of nodules identified at CT is not well established.

---

---

---

---

---

---

---

---

---

---

## Thyroid

### Increasing Incidence of Thyroid Cancer in the United States, 1973-2002

- The apparent incidence of thyroid cancer increased 2.4 fold from 1972-2002.
- No change in the incidence of follicular, medullary, or anaplastic types.
- Increase is attributable to 2.9 fold increase in incidence of papillary thyroid cancer
- 49% of the increase consisted of cancers measuring 1 cm or smaller;
- Mortality from thyroid cancer was stable between 1973 and 2002

**Conclusions:**

“The increasing incidence of thyroid cancer in the United States is predominantly due to the increased detection of small papillary cancers.”

“The increasing incidence reflects increased detection of subclinical disease, not an increase in the true occurrence of thyroid cancer.”

JAMA, May 10, 2006—Vol 295, No. 18

---

---

---

---

---

---

---

---

---

---

## Thyroid

### Occult Papillary Carcinoma of the Thyroid

- Sectioned 101 thyroid glands in 3-mm slices.
- 36% of those not known to have thyroid cancer during their lifetime had 1 or more foci of thyroid cancer.
  - 67% were 1mm or less.
- Calculated that they missed the majority of cancer foci due to the thickness of the tissue blocks.
- Estimated that most, if not all, had one or more focus of papillary Ca.

CANCER August | 1985 Vol. 56

---

---

---

---

---

---

---

---

---

---

## Thyroid

How do we currently manage incidental CT thyroid nodules?

---

---

---

---

---

---

---

---

## Thyroid

Variability in management recommendations for incidental thyroid nodules detected on computed tomography of the cervical spine in the Emergency Department.

- Reviewed 315 CT cervical spine radiology reports describing thyroid nodule(s).
- Management recommendations made in approximately 50% of cases with nodules <15mm
- Type of management recommended was variable: US, clinical correlation, thyroid serology, FNA, nuclear scintigraphy, do not follow up.

Lehnert BE et al. 2014. JACR.

---

---

---

---

---

---

---

---

## Thyroid

What should we recommend for the incidental thyroid nodule detected at CT?

---

---

---

---

---

---

---

---

## Thyroid

### Significance of Incidental Thyroid Lesions Detected on CT: Correlation Among CT, Sonography, and Pathology

- 230 patients with abnormal findings in the thyroid gland on CT subsequently underwent thyroid US/FNA/Resection.

**CONCLUSION.**

- 11.3% prevalence of malignant or potentially malignant lesions among incidental thyroid lesions on CT.
- No CT feature reliably distinguishes benign from malignant lesions .
- CT underestimates the number of nodules relative to sonography, which suggests that sonography is a useful adjunctive test after the incidental detection of a thyroid abnormality on CT.

AJR:187, November 2006

---

---

---

---

---

---

---

---

## Thyroid

### The Prevalence and Significance of Incidental Thyroid Nodules Identified on Computed Tomography

- Reviewed CT scans in 734 patients without known thyroid disease.
- The CT findings were correlated with ultrasonographic (US) findings and tissue sample.
- 9.4% prevalence of malignancy among incidental thyroid nodules detected on CT.

J Comput Assist Tomogr. Vol32, No 5, Sept/Oct2008

---

---

---

---

---

---

---

---

## Thyroid

- Incidental Thyroid Nodule Detected on CT or MRI
- No suspicious features
  - Age <35
    - <1cm= No further evaluation
    - ≥ 1cm= Ultrasound
  - Age ≥ 35
    - <1.5cm= No further evaluation
    - ≥1.5cm= Ultrasound

Hoang et al. JACR 2014

---

---

---

---

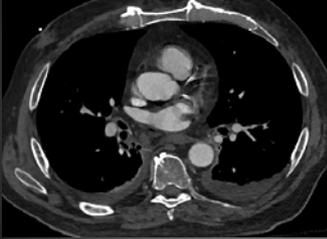
---

---

---

---

## Imaging



- Management?**  
A: Do not report  
B: Include in body of report only.  
C: Include in impression without recommendation  
D: Include in impression with recommendation for follow-up with coronary artery calcium scoring.  
E: Include in impression and recommend blood pressure control.

---

---

---

---

---

---

---

---

## Imaging



- Management?**  
A: Do not report  
B: Include in body of report only.  
C: Include in impression without recommendation  
D: Include in impression with recommendation for follow-up with coronary artery calcium scoring.  
E: Include in impression and recommend blood pressure control.

---

---

---

---

---

---

---

---

## Cardiac

---

---

---

---

---

---

---

---

## Cardiac

### Coronary Artery Calcification Is Often Not Reported in Pulmonary CT Angiography in Patients With Suspected Pulmonary Embolism: An Opportunity to Improve Diagnosis of Acute Coronary Syndrome

- 11.1% of patients had PE
- 43.8% had coronary calcs (CAC).
- Strong positive association between CAC and ACS
  - younger patients (OR =3.5)
  - patients without PTE (OR = 2)
- CAC present but not reported in 45%
- ACS final diagnosis in 32% with unreported CAC

Johnson et al. AJR 2014; 202:725–72

---

---

---

---

---

---

---

---

## Cardiac

### Visually scored calcifications in thoracic arteries predict death: follow-up study after lung cancer CT screening

- 504 men (aged 39–81 years, mean 63 years) were previously screened for lung cancer were visually scored for atherosclerotic calcifications in the aorta, great branches, and in coronary arteries.
- Their mortality was later checked in the national register, at a mean follow-up time of 10.4 years.
- Calcifications at several sites significantly predicted cardiovascular deaths
  - brachiocephalic origin
  - left anterior descending artery
- Conclusion: Incidental arterial calcifications should be actively reported to aid the recognition, preventive measures and medication of early atherosclerosis.

---

---

---

---

---

---

---

---

## Adrenal

---

---

---

---

---

---

---

---

## Adrenal Mass

**The Incidental Adrenal Mass on CT: Prevalence of Adrenal Disease in 1,049 Consecutive Adrenal Masses in Patients with No Known Malignancy**

- 65,231 studies evaluated
- Adrenal mass was identified in 3,307 (5%)
  - 973 with an incidental adrenal mass and no history of cancer or suspicion of hyperfunctioning lesion
  - No malignant lesions were identified.



AJR Am J Roentgenol 2008; 190:1163-8..

---

---

---

---

---

---

---

---

## Adrenal Adenoma

**Differentiation of Adrenal Adenomas from Nonadenomas Using CT Attenuation Values**

- Reviewed non-contrast CT scans of 135 adrenal masses.
- The lowest unenhanced CT attenuation value of a non-adenoma was 18 HU.
- This threshold for adrenal adenoma results in:
  - Sensitivity 85%
  - Specificity 100%
  - PPV 100%
  - NPV 77%

AJR:166, March 1996

---

---

---

---

---

---

---

---

## Imaging



**Management recommendations?**  
A: Side branch IPMN. No follow-up.

B: Indeterminate. Contemporaneous characterization with pancreatic CT or MRI.

C: Indeterminate. Follow-up in 1 year with MRI

D: Indeterminate. Follow-up in 2 years with MRI

---

---

---

---

---

---

---

---

## Imaging



**Management recommendations?**  
A: Side branch IPMN. No follow-up.  
B: Indeterminate. Contemporaneous characterization with pancreatic CT or MRI.  
C: Indeterminate. Follow-up in 1 year with MRI  
D: Indeterminate. Follow-up in 2 years with MRI

---

---

---

---

---

---

---

---

## Pancreas

---

---

---

---

---

---

---

---

## Pancreas

### Prevalence of Unsuspected Pancreatic Cysts on MDCT

- 2832 CT scans of the abdomen
- Prevalence of unsuspected pancreatic cysts was 2.6%.
- Cyst presence strongly correlated with increasing age and the Asian race.



AJR:191, September 2008

---

---

---

---

---

---

---

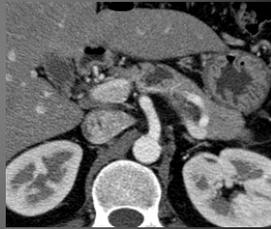
---

### Pancreatic Cystic Mass

#### Incidental Pancreatic Cysts: Clinicopathologic Characteristics and Comparison with Symptomatic Patients

78 asymptomatic patients with pancreatic cystic lesions

- 17% serous cystadenomas
- 28% mucinous cystic neoplasms
- 27% intraductal papillary mucinous neoplasms
- 2.5% ductal adenocarcinomas.
- 3.8% pseudocysts



Arch Surg. 2003;138:427-434

---

---

---

---

---

---

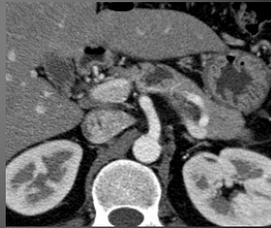
---

---

### Pancreatic Cystic Mass

#### “Risk of malignancy in resected cystic tumors of the pancreas ≤ 3 cm in size: is it safe to observe asymptomatic patients? A multi-institutional report.”- J Gastrointest Surg. 2008

- Resections performed for cystic neoplasms ≤ 3 cm from 1998-2006.
- Pathology and imaging features reviewed.
- Asymptomatic patients with no radiographic features of malignancy
  - 3.3% incidence of occult malignancy.



J Gastrointest Surg. 2008 Feb;12(2):234-42

---

---

---

---

---

---

---

---

### Pancreatic Cystic Mass

#### Managing Incidental Findings on Abdominal CT: White Paper of the ACR Incidental Findings Committee

- Asymptomatic Patient with Incidental Pancreatic Cystic Mass
  - < 2cm= Single follow-up in 1 year
  - 2-3cm= Contemporaneous characterization with MRI/MRCP
    - Follow-up every 1 for indeterminate lesion
    - Follow-up every 2 years for IPMN, Serious cystadenoma
- >3cm= aspiration and/or resection

J Am Coll Radiol 2010;7:754-773.

---

---

---

---

---

---

---

---

## Pancreatic Cystic Mass

### Focal Cystic Pancreatic Lesions: Assessing Variation in Radiologists' Management Recommendations

- 1067 Focal cystic pancreatic lesions.
- Prevalence : 2.2% at CT
- Radiologists recommended a follow-up imaging study in 23.7% of cases
- A 2.8-fold difference in the rate of recommendation for further imaging across radiologists

*Radiology*; Volume 259: Number 1—April 2011

---

---

---

---

---

---

---

---

## Imaging



### Management recommendations?

- A: Hyperdense cyst. No follow-up recommended.
- B: Bosniak 2F. Follow-up in 1 year.
- C: Bosniak 2F. Follow-up in 6 months.
- D: Indeterminate. Perform dedicated renal imaging (CT, MR, or US)

---

---

---

---

---

---

---

---

## Imaging



### Management recommendations?

- A: Hyperdense cyst. No follow-up recommended.
- B: Bosniak 2F. Follow-up in 1 year.
- C: Bosniak 2F. Follow-up in 6 months.
- D: Indeterminate. Perform dedicated renal imaging (CT, MR, or US)

---

---

---

---

---

---

---

---

# Kidney

---

---

---

---

---

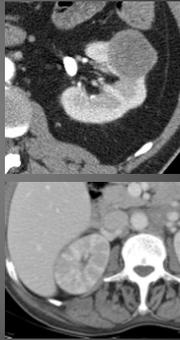
---

---

---

## Kidney: Solid Lesions

- What are the key players?
- "Ball" type lesion:
  - RCC
  - Angiomyolipoma (AML)
  - Oncocytoma
  - Metastasis
  - Lymphoma
- "Bean" type lesion:
  - Transitional Cell Carcinoma (TCC)
  - Medullary carcinoma
  - Collecting duct carcinoma
  - Lymphoma
  - Metastasis



---

---

---

---

---

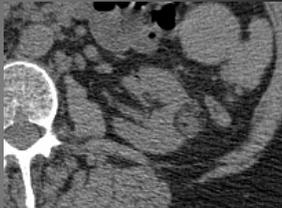
---

---

---

## Kidney: Solid Lesion

- How do we define macroscopic fat?
- 20 pixels with attenuation less than -20 HU and/or > 5 pixels with attenuation less than -30 HU
  - 100% PPV for detection of AML.
- $ROI \leq -10$  HU or 4 adjacent pixels of  $\leq -10$  HU
  - specificity of 100% and sensitivity of 97% for AML.



AJR 2009 vol. 192(2) 438-443  
Clin Radiol.2006 May;61(5):410-6

---

---

---

---

---

---

---

---

## Kidney: The Hyperdense Lesion

### Can High-Attenuation Renal Cysts Be Differentiated from Renal Cell Carcinoma at Unenhanced CT?

- 54 RCCs, 56 high attenuation renal cysts were retrospectively evaluated:
- A homogeneous mass measuring  $\geq 70$  HU at **unenhanced** CT has a greater than 99.9% chance of representing a benign high-attenuation renal cyst.
  - Bosniak 2: No follow-up.

*Radiology*: Volume 243: Number 2—May 2007

---

---

---

---

---

---

---

---

## Kidney: Lesion Attenuation

### Incidental Findings of Renal Masses at Unenhanced CT: Prevalence and Analysis of Features for Guiding Management

- 433 incidental renal masses were reviewed:
- Attenuation values alone used to classify lesions as benign ( $<20$ ,  $>70$ HU) or indeterminate (20-70HU).
- 4/41 indeterminate masses were RCC.
- No RCCs in the benign category

- **Conclusions: Mean attenuation alone appears reliable for determining which renal masses need evaluation.**

*AJR*:197, July 2011

---

---

---

---

---

---

---

---

## Kidney: Lesion Attenuation

### Distinction of Renal Cell Carcinomas from High Attenuation Renal Cysts at Portal Venous Phase Contrast-enhanced CT

- 57 RCCs and 37 high attenuation renal cysts on **portal venous contrast enhanced CT** were reviewed.
- Based on cyst and tumor attenuation values and lesion heterogeneity:
  - Attenuation  $\geq 70$  HU or internal heterogeneity favor RCC
  - All lesions  $\geq 110$ HU were RCC

Suh et al *Radiology*, August 2003

---

---

---

---

---

---

---

---

## Kidney: Cystic Lesions

- **Bosniak Classification**
- **Category I**
  - Benign simple cyst with thin wall without septa, calcifications, or solid components. It does not enhance with contrast, and has a density equal to that of water.
- **Category II**
  - Benign cyst with a few thin septa, which may contain fine calcifications or a small segment of mildly thickened calcification. This includes homogenous, high-attenuation lesions less than 3 cm with sharp margins but without enhancement.
- **Category III**
  - Well marginated cysts with a number of thin septa, with or without mild enhancement or thickening of septa. Calcifications may be present; these may be thick and nodular. There are no enhancing soft tissue components. This also includes non-enhancing high-attenuation lesions that are completely contained within the kidney and are 3 cm or larger.
- **Category III**
  - Indeterminate cystic masses with thickened irregular septa with enhancement.
- **Category IV**
  - Malignant cystic masses with all the characteristics of category III lesions but also with enhancing soft tissue components independent of but adjacent to the septa.

---

---

---

---

---

---

---

---

---

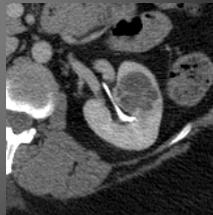
---

## Kidney: Cystic Lesions

Is the Bosniak system objective?

**Interpersonal variability and present diagnostic dilemmas in Bosniak classification system.**

- 113 complex renal cystic masses scored by a group of radiologists
- Reviewed by blinded radiologist and a urologist
- Score changed 20-54% of cases



Scand J Urol Nephrol 2011 Sep;45(4):239-44

---

---

---

---

---

---

---

---

---

---

## Kidney: Cystic Lesions

- **Managing Incidental Findings on Abdominal CT: White Paper of the ACR Incidental Findings Committee**
  - Bosniak 1 or 2= No follow-up
  - Bosniak 2F= CT or MRI at 6 months, then yearly for 5 years
  - Bosniak 3 or 4= Surgical lesions

J Am Coll Radiol 2010;7:754-773.

---

---

---

---

---

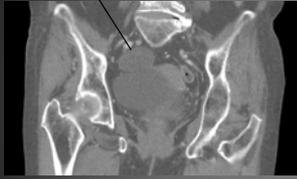
---

---

---

---

---



2.5cm

Management recommendations in 60 y/o female?

- A: MRI
- B: Contemporaneous ultrasound
- C: No follow-up
- D: Follow-up US in 1 year
- E: Follow-up US in 6-12 weeks

---

---

---

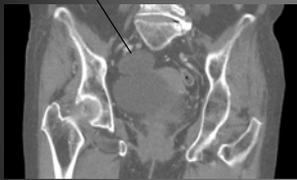
---

---

---

---

---



2.5cm

Management recommendations in 60 y/o female?

- A: MRI
- B: Contemporaneous ultrasound
- C: No follow-up
- D: Follow-up US in 1 year
- E: Follow-up US in 6-12 weeks

---

---

---

---

---

---

---

---

### Ovary

#### Risk of Malignancy in Unilocular Ovarian Cystic Tumors Less Than 10 Centimeters in Diameter

- 1987-2002: 15,000 asymptomatic women screened
  - 3259 unilocular cysts identified
    - 69% resolved
    - 22% became more complex
    - 6.8% persisted unchanged
  - **No woman with isolated unilocular cyst developed ovarian cancer in this population**

ACOG, Sept 2003; 102(3)

---

---

---

---

---

---

---

---

## Ovary

“Managing Incidental Findings on Abdominal and Pelvic CT and MRI, Part 1: White Paper of the ACR Incidental Findings Committee on Adnexal Findings”

---

---

---

---

---

---

---

---

## Ovary

• **Definitions:**

- When the patient's last menstrual period is unknown,
  - 50 years can be used as an arbitrary designation for the age of menopause,
  - <50 years of age= premenopausal
  - ≥50 years of age being postmenopausal.
- early postmenopausal period is defined as within 5 years of the final menstrual period or ages 50 to 55.
- Late post menopause is >5 years from the final menstrual period or age >55 years.

---

---

---

---

---

---

---

---

## Ovary

- “Benign appearing cyst”:
  - (1) an oval or round
  - (2) unilocular mass of uniform fluid signal and attenuation,
  - (3) with a regular or imperceptible wall
  - (4) without solid areas or mural nodules
  - (5) <10 cm in maximum diameter.
  - In premenopausal patient, the cyst can contain layering hemorrhage and still fall into the benign-appearing cyst category.
- Using above definition, endometrioma, hydrosalpinx, cystadenoma or cystadenocarcinoma are unlikely to meet these requirements.

---

---

---

---

---

---

---

---

## Ovary

- “Probably benign cyst” refers to an adnexal cyst that would have met the criteria for a benign-appearing cyst but does not because of one or more of the following observations:
  - (1) it has angulated margins,
  - (2) it is not round or oval in shape
  - (3) a portion of the cyst is poorly imaged (eg, a portion of the cyst might be obscured by metal streak artifact from hip prosthesis on CT of the pelvis)
  - (4) the image has reduced signal-to-noise ratio, usually because of technical parameters or in some cases because the study was performed without intravenous contrast.

---

---

---

---

---

---

---

---

## Ovary

- **Managing Incidental Findings on Abdominal and Pelvic CT and MRI, Part 1: White Paper of the ACR Incidental Findings Committee on Adnexal Findings**
- Benign appearing cyst
  - Pre-menopausal
    - >5cm = US follow-up in 6-12 weeks
  - Early post menopausal
    - ≤ 3cm = No follow-up
    - >3cm, ≤ 5cm = US follow-up in 6-12 weeks
    - >5cm = Ultrasound
  - Late post menopausal
    - ≤ 3cm = No follow-up
    - >3cm = Ultrasound

JACR 2013; 10:675-681  
Radiology 2010; 256(3)

---

---

---

---

---

---

---

---

## Summary

- Demonstrated the scope of the incidentaloma problem
- Reviewed important imaging features and follow-up recommendations for several CT incidentalomas
- Discussed the rational behind imaging recommendations for incidental findings

---

---

---

---

---

---

---

---



Thank you!  
*blehnert@u.washington.edu*

---

---

---

---

---

---

---

---