RENAL CYSTS

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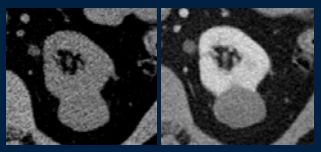
Disclosures

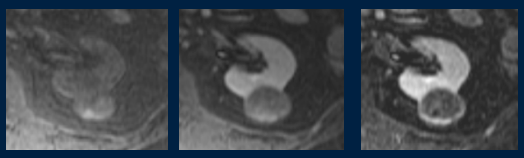
- None

Introduction

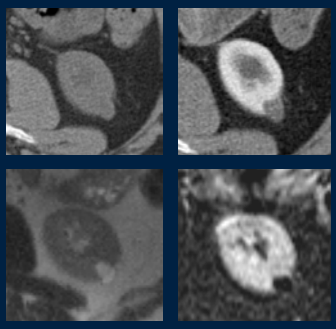
- Renal cysts are extremely common.
- Present in >50% of individuals after age 50
  - Often multiple
- Leads to extensive surveillance cross-sectional imaging and possible renal surgery
- Large majority are benign
- Key role for radiologists to indicate level of concern for given lesion and guide clinical management

CT vs. MRI for Cystic vs. Solid

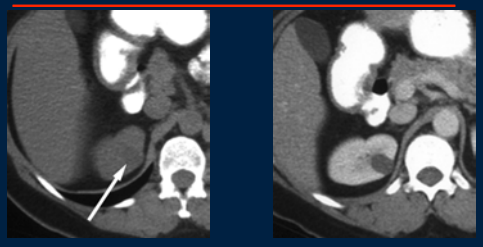




CT vs. MRI for Cystic vs. Solid



Pseudoenhancement?



15 HU 32 HU

17 HU increase

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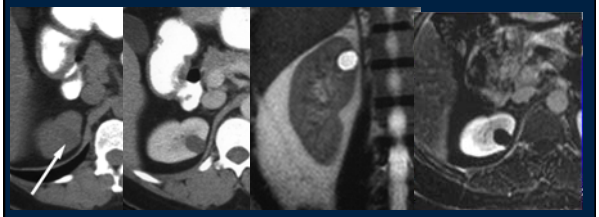
Problem solving with MRI



- **MRI helpful for problem-solving:**
  - "Too small to characterize" on CT
  - Borderline HU increase
  - Hyperdense/calcified lesion

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Determining Enhancement on MRI

- **Subjective visual assessment**
- **SI using ROI**
  - % enhancement = $(SI_{post} - SI_{pre}) / SI_{pre}$
  - % enhancement > 15%
  - Reported high sensitivity and specificity
- **Subtraction images**
  - Post contrast - Pre contrast

Ho VB et al. Radiology 2002
Hecht EM et al Radiology 2004

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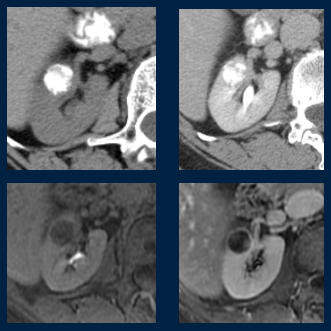
Coursely calcified mass on CT



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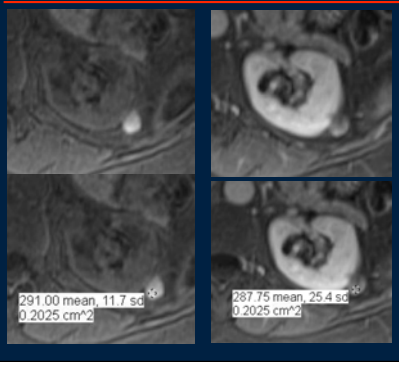
Pre and post ROIs



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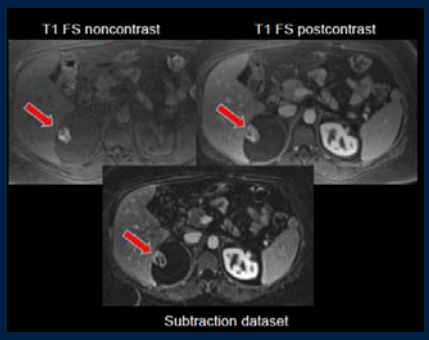
Subtraction Images



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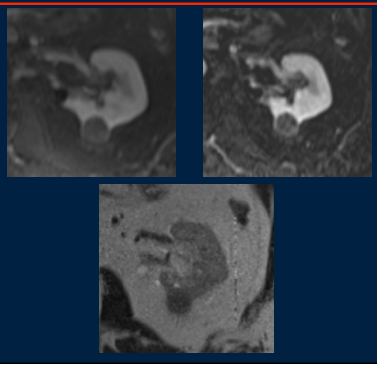
Subtraction: Low-level enhancement



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MRI Enhancement Pitfalls

- Subtraction misregistration:
  - Rind adjacent to liver
- Subtraction:
  - Noise additive

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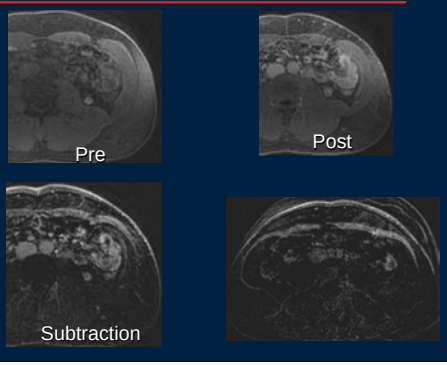
Subtraction misregistration



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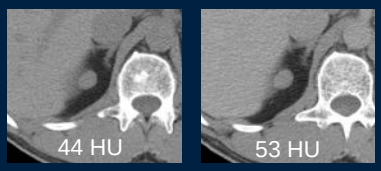
Right Upper Pole Mass



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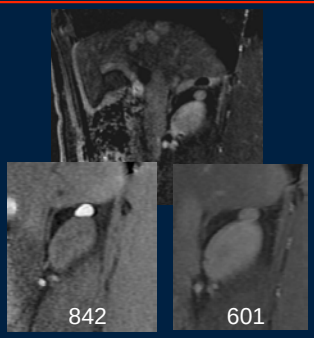
MRI with Subtraction



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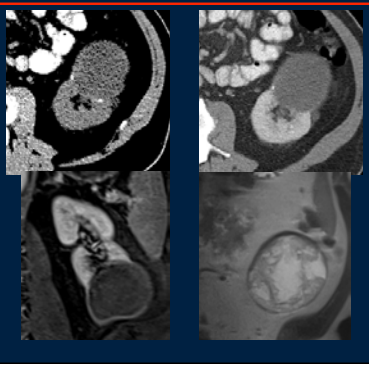
Left Renal Mass



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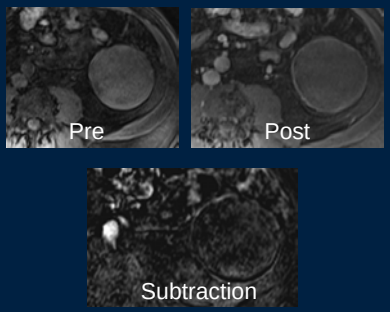
Noise on Subtraction Images



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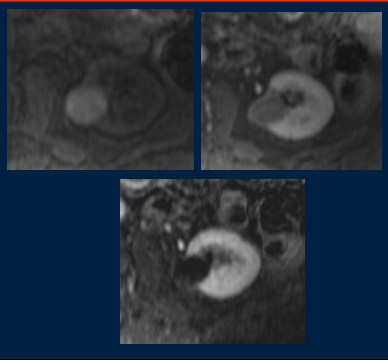
Noise on Subtraction Image



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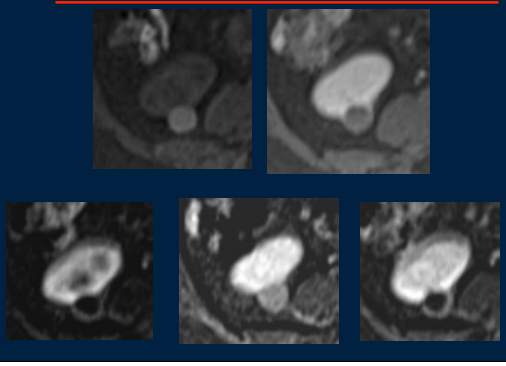
Persist on all subtracted phases?



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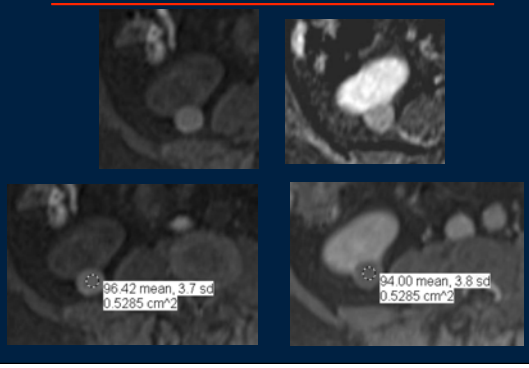
Pre- and Post-Contrast ROI's



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MRI vs. CT for Cystic Lesions

- **Israel, Hindman, Bosniak (Radiology 2004)**
  - Appreciate greater mural and septal thickening, nodularity, and enhancement on MRI
  - Occasionally leads to upgrading of Bosniak classification on MRI
- **Hindman, Hecht, Bosniak (Radiology 2014)**
  - No significant difference in progression to malignancy (p=0.456)
  - Suggest that "CT and MRI may be used interchangeably, although more research needed"

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Cystic-Appearing Mass Under 1 cm

- Very common
- Often remains difficult to definitively evaluate with multi-phase CT or MRI
- Overwhelmingly likely to be benign
  - Majority of population has renal cyst after age 50
- In general, if <1cm lesion looks like simple cyst:
  - Presume it to be clinically unimportant
  - Do not suggest any further evaluation

Silverman SG et al. Radiology 2008

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"Simple cyst-appearing" Lesions on CT

- Retrospective review of 15,695 unenhanced CT reports
- 1,159 patients with simple cyst-appearing renal lesion and at least 5 years follow-up
  - 6 developed renal cancer; all separate from the cyst
- No difference in rate of renal cancer between patients with and without simple cyst-appearing lesion (p=0.54)
- Suggest foregoing further imaging for such lesions

O'Connor SD et al. Radiology 2013

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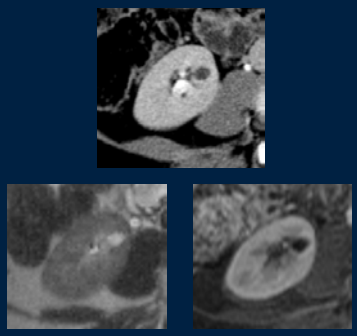
Cystic-Appearing Lesion Under 1 cm



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Cystic Lesion Over 1 cm

- If lesion entirely <20 or >70 HU on non-contrast CT:
  - Benign cyst; no further work-up warranted
- Enhancement:
  - >20 HU increase considered definitive enhancement
  - 10-20 HU increase equivocal
- MRI useful for further characterization of indeterminate lesions:
  - Confirm cystic nature
  - Assessment of internal complexity
  - Enhancement is key!

Pooler BD et al. AJR 2012.
O´Connor SD et al. AJR 2011.

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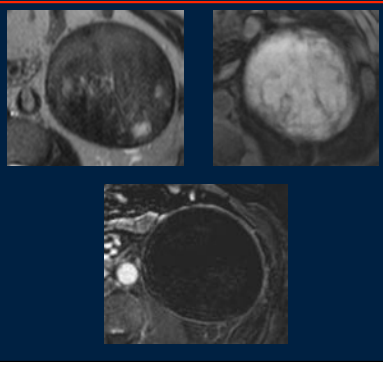
Cystic Lesion Over 1 cm



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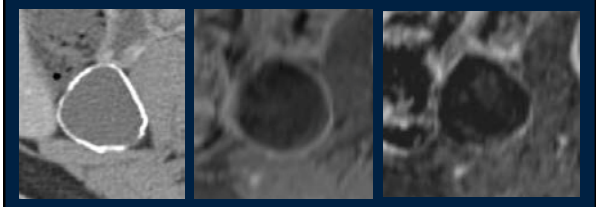
Cystic Lesion Over 1 cm



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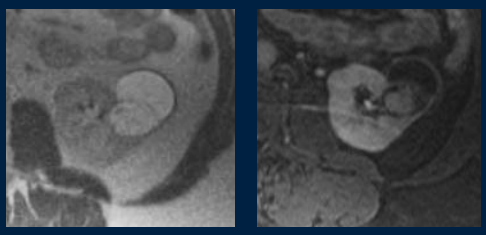
Cystic Lesion Over 1 cm



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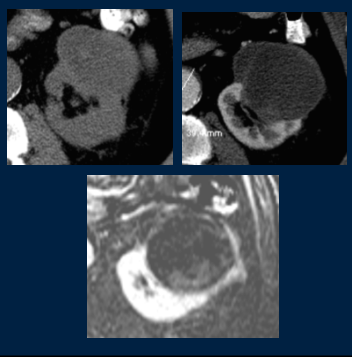
Cystic Lesion Over 1 cm



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Indeterminate Cystic Renal Lesions

- Use Bosniak cystic classification to stratify probability of malignancy
- Based on internal complexity of lesion
  - Neither size, nor change in size, a factor
- **I/II:** Benign, ignore
- **IIF**: Likely benign, but still observe
- **III/IV**: Surgery (in healthy patients)

Bosniak MA. Radiology 2012.

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Bosniak Category and Malignancy

Bosniak Category	Malignancy Rate
I	0%
II	Exceptionally rare
IIF	5-15%
III	50%
IV	80%

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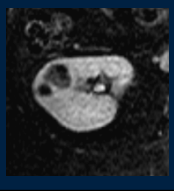
Surveillance Using Bosniak System



Follow-up study:
Stable size, increased complexity

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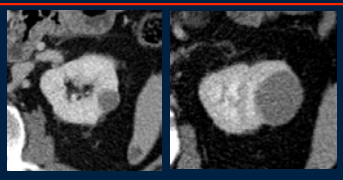
Surveillance Using Bosniak System



Follow-up study:
-Increased size
-No increase in internal complexity

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Indolent Nature of Cystic Lesions

- **Even when cystic cancer, still excellent prognosis**
- Study of >200 Bosniak IIF/III lesions
  - No patient developed locally advanced or metastatic disease from renal lesion
- Study of 23 cases of multilocular cystic RCC
  - Ranged from IIF-IV in appearance
  - No patient developed recurrence/metastasis
- Study of 43 cystic RCCs with follow-up
  - No local recurrence
  - 1 patient with metastasis at presentation

Smith AD et al. Radiology 2012.
Hindman N et al. AJR 2012.
Jhaveri K et al. AJR 2013.

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Indolent Nature of Cystic Lesions

- Study of 61 patients with cystic RCC and moderate follow-up
- No patient recurred or progressed regardless of RCC size, histologic subtype, or grade.
- Suggest malignant potential of cystic RCC << solid RCC that such lesions perhaps warrant independent approach for classification and management
- **Use of category IIF for equivocal cases may safely provide patient an opportunity to avoid surgery.**

Donin NM et al. Clin Genitourin Cancer 2014.

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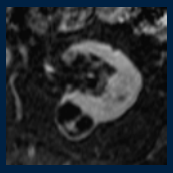
Indolent Nature of Cystic Lesions



79 year-old male.
Nodularity of septation.
Bosniak IIF or III?

Lesion stable after 8 years

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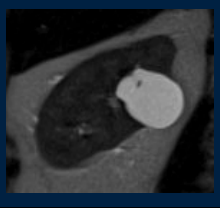
Follow-up of IIF Cystic Lesions

- Suggested follow-up MRI initially at six months, and then yearly
- Modify timing and duration of follow-up based on level of concern and clinical aspects of given case



Israel GM and Bosniak MA. AJR 2003.
Silverman SG et al. Radiology 2008.

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Follow-up of IIF Cystic Lesions

- Study of 156 Bosniak IIF lesions with up to 13 years follow-up
- 12% progressed to category 3 or 4 lesions in follow-up ranging from 6 months to 3.2 years
- 90% of those that progressed and 11% of initial IIF lesions were malignant
- None with recurrence or metastasis
- **Suggest 4 year follow-up for Bosniak IIF lesions as sufficient interval to identify progression on imaging**

Hindman NM et al. Radiology 2014.

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Diffusion Weighted Imaging

- Studies consistently show differences on average between benign and malignant renal lesions
- Nonetheless, substantial overlap for individual cases
- Given excellent performance of conventional imaging for this purpose, incremental value of DWI in current practice for cystic renal lesions remains to be established
- May be useful for problem-solving in challenging cases

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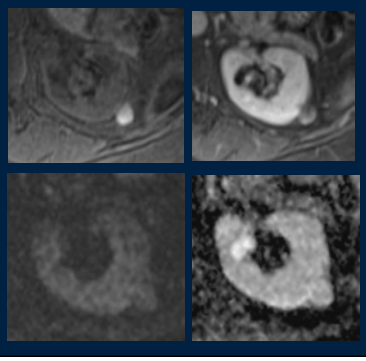
DWI of Hemorrhagic Cyst



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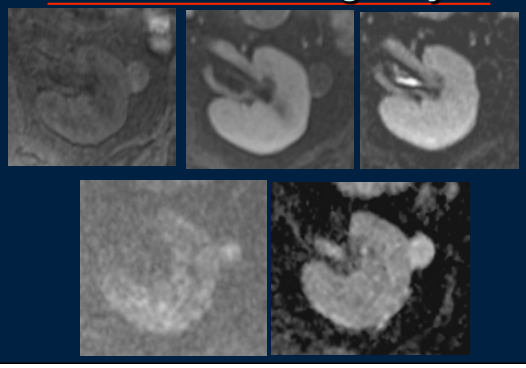
DWI of Hemorrhagic Cyst



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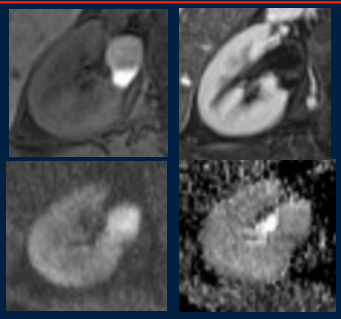
"Restricted Diffusion" in Hemorrhagic Cyst



Conventional sequences vs. DWI/ADC findings

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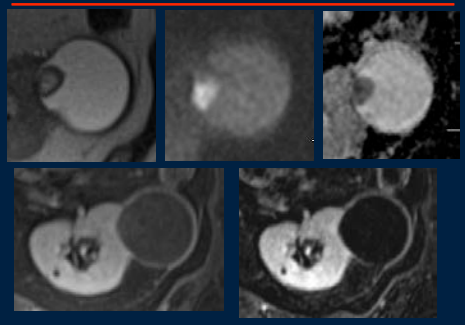
DWI vs. Enhancement



Conventional sequences vs. DWI/ADC findings

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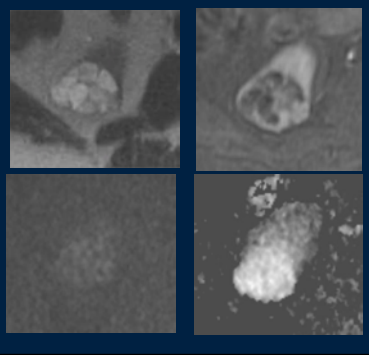
High ADC in Cystic RCC



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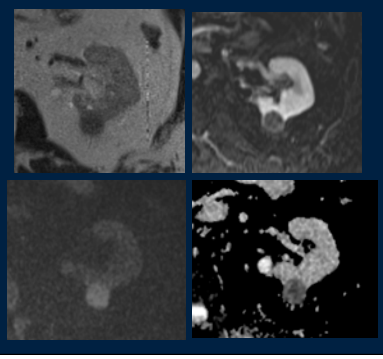
Low ADC of Papillary RCC



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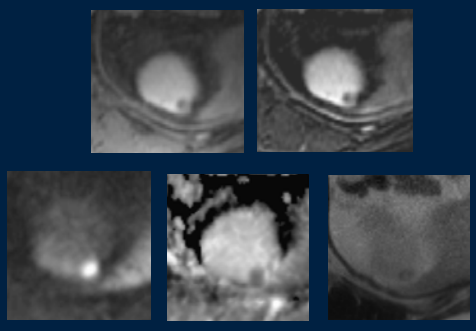
DWI for Lesion Detection



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Conclusion

- If under 1 cm and looks like simple cyst, may presume it to be unimportant
- For lesions detected on CT, MRI useful for further characterization of cystic vs. solid nature of internal complexity of cystic lesions
- Bosniak classification system to stratify and guide management of cystic lesions
- System based on internal complexity, not size
- Excellent prognosis, even for cystic cancers