Renal Mass Evaluation with MRI

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Menu of Tests

- **US**
  - **Dx of Simple cyst**: anechoic, sharply defined back wall and enhancement of through sound transmission. One or two septations may be visible sonographically.
  - **79% sensitivity in detecting renal masses**
  - **80% of detected renal masses are characterized as simple cysts and require no further study.**
  - **Atypical findings** such as calcifications, more than two septations, and septal thickening or nodularity and presence of solid components must be followed up with CT or MRI.

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Warshauer, 1988
Davidson, 1997
Einstein, 1995
Zagoria, 1998
Menu of tests-cont…

- **CT**
  - 94% sensitivity in detecting renal masses
  - Widespread availability
  - More rapid evaluation time in comparison with CT
  - More cost effective than CT.

Warshauer, 1988
Dunnick, 1992
Menu of tests-cont…

• **MRI**

  • *Studies indicate that MR imaging is comparable with optimal CT for detection, diagnosis, and staging of renal masses.*

What is Magnetic Resonance Imaging?

- T1 recovery - Longitudinal remagnetization
- T2 decay - Transverse magnetization decline
- Repetition Time (TR) - Time between RF
- Echo Time (TE) - Time between RF and first echo
- Radio Frequency (RF)
Why MRI?

- Multiplanar/Vascular imaging
  - Diagnosis
  - Surgical planning
- Excellent soft tissue contrast
- Safety

References:
- Roubidouz, 1992
- Horan, 1989
- Choyke, 1997
- Rofsky
MRI Contrast

- T1
- T2
- Proton Density
- Flow
- Gadolinium
Gadolinium (Gd) = contrast

- **Pharmacokinetics** = to I contrast
- Excretion by glomerular filtration
- **No Δ serum creatinine**
- Eliminated by dialysis
- **Adverse rxn**: 7/5,000,000

Rofsky, Radiology 1991
Haustein Radiology, 1992
Prince JMRI 1996
Indications

- Mass characterization
- Surgical planning
  - Venous extension
Mass Characterization

Cystic
Benign
Malignant
Determining Enhancement

- Always compare pre and post Gd
- ROI’s (Region of Interest)
  - Receiver gain/attenuation
- Subtraction
Complex mass at US

Pre
Post
Post - pre

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CT Exam

Does this enhance??

26 HU

38 HU

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Subtraction MR!

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Precontrast T1-Papillary RCC and Hemorrhagic Cyst
Postcontrast T1- Papillary RCC and Hemorrhagic Cyst

Note-Lesions look equivalent.

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Subtraction!

Enhancing Mass

Cysts are black

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BIDMC
T1 Precontrast with Fat Suppression in High Grade Cystic Papillary RCC

Note-T1 bright fat, hemorrhage, proteinaceous fluid, and melanin.

Heterogeneous mass
T1 Postcontrast-High Grade Papillary RCC

Note-Post contrast image becoming more homogeneous compared to precontrast lesion hemorrhagic cyst.
Subtraction!

Note-Subtraction lesion enhances and hemorrhagic cyst does not.
T2-High Grade Cystic Papillary RCC

Note-T2 cysts simple homogeneous white lesion with thin wall.
Polycystic Renal Dz

Pre Gd
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Post Gd

BIDMC-Rofsky
Subtraction

Renal sarcoma

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Increased Contrast = Increased Confidence

CT

Heterogeneous?
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T1 BH; Subtraction (Post - Pre Gd)

Papillary RCC
Looking for Fat

- Chemical shift imaging (IP/OP)
  - In Phase (IP)
  - Out of Phase (OP)
- Chemically selective fat suppression
In Phase-Angiomyolipoma

Note: In phase = bright lesion = fat

AML
Out of Phase-Angiomyolipoma

Note-Out of phase has black ink pattern around angiomyolipoma and organs.
Selective Fat Suppression-Angiomyolipoma

Note- Selective fat suppression results in black lesion=fat=AML
Surgical Intervention

Surgical teams
Robson staging
Incision site

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Tumor Extension to Vein

- **Right atrium**
  - CV surgery
- **IVC**
  - Vascular surgeon
- **Left tumor**
  - Crosses midline?
    - Incision location
Robson Staging Scheme

- **I** = Confined to renal capsule
- **II** = Extension into Gerota’s fascia; ipsilateral adrenal gland
- **IIIA** = Renal Vein or IVC
- **IIIB** = Adjacent nodes
- **IIIC** = A + B
- **IVA** = Adjacent organs (not adrenal)
- **IVB** = Distant metastases
Loss of normal kidney architecture
Late Postcontrast-Renal Vein Invasion Extending to IVC (Clear Cell RCC)

Late stage post contrast with both IVC and aorta equal enhancement showing tumor growing along renal vein.
T1 Post Contrast-Renal Vein Invasion Extending to IVC (Clear Cell RCC)

Post contrast- IVC thrombus with enhancement to show tumor presence.
Renal Mass – 3D Gd

Mass

Accessory renal artery
References

• Beth Israel Deaconess Hospital-Images.
• Dr. Neil Rofsky-Images.
• Hornak P. http://www.cis.rit.edu/htbooks/mri
• Margaret M. King, RT http://www.erads.com/mrimod.htm

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