"Incidentalomas" of Kidney Imaging

Dr. Richard Braun
Chief Medical Director
Generali USA Life Reassurance

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Case Studies

- # 1 – A 62 year-old Man applies for Life insurance. He has blood in his HOS with 25 RBCs/HPF. His APS reveals that he c/o hematuria for about 6 months. A urologist report shows a consistent low to moderate amount of hematuria. He has had a negative cystoscopy, IVP, and renal ultrasound.

- # 2 – A 45 year-old woman applies for Life insurance. She appears healthy with routine OB/Gyn visits. Her family history reveals that her father had a renal transplant, but died of Polycystic Kidney Disease at the age of 65. Her gynecologist ordered a renal ultrasound when she was 42 years-old. It revealed 3 "simple" cysts bilaterally, all less than 2 CM. Her current insurance labs are normal.

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Imaging the Kidney

- **Review the Anatomy and Function**
- **Renal Mass**
  - **Cysts**
  - **Solid Mass**
- **Renal Parenchymal Disease**
- **Renovascular Disease**

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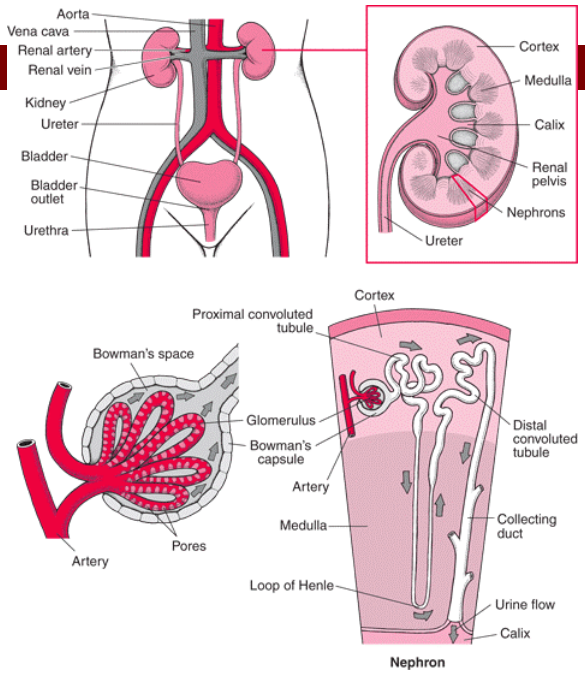

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Imaging the Kidney

- **Plain X-ray Kidneys, ureters, and bladder (KUB)**
  - **Can detect calcifications, may detect renal outline if visible**
  - **Should be only the starting point**
- **Intravenous Urography (IVU) a.k.a. Intravenous Pyelography (IVP)**
  - **25-40 mg of iodine (75-150 ml) injected IV as a bolus**

60 seconds after contrast injection

CT

KUB

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Imaging the Kidney

- **Renal Mass**
  - **IVP is not a sensitive test for renal Mass**
  - **Ultrasound is a little better**
  - **Compared to Computed Tomography (CT)**

Mass Size	IVP detects	Ultrasonography
< 1 cm	10%	26%
1-2 cm	21%	60%
2-3 cm	52%	82%
>3 cm	85%	85%

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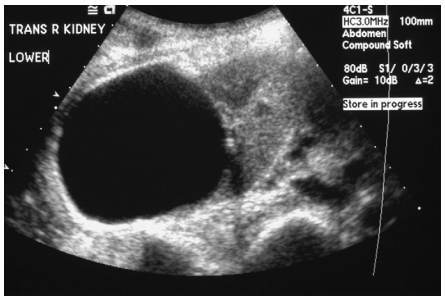
Imaging the Kidney – Renal Cysts

- **Renal cysts – found incidentally**
  - **Quite common – Most persons age 60+ will have one or more, found in 50% of people over age 50**
  - **Rare in those under age 25**
  - **Usually cortical in location**
  - **If seen on IVP, Ultrasound (US) is a good follow-up test to characterize**
  - **If a cyst has septa or internal echoes, a CT or MRI is warranted to evaluate**



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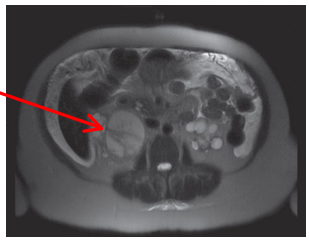
Imaging the Kidney – Renal Cysts

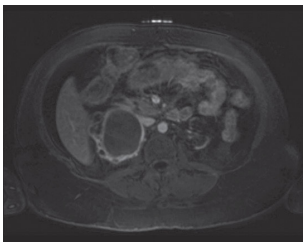
Classification	Description	Risk of malignancy
Bosniak I	Round or oval, thin walled, no septations, 0-20 Hounsfield CT Units, no enhancement with IV contrast	Benign
Bosniak II	As above with a few septations and/or a few calcifications	Very low risk, f/u 6-12 months
Bosniak III	Thick wall, calcifications, Hounsfield density 0-20, no enhancement or nodules	60% chance
Bosniak IV	Thick wall, thick septations, coarse calcifications, Hounsfield Units >20, enhance with contrast	Consider malignant, proceed with work-up

Imaging the Kidney – Renal Cysts

- **Complex cysts contain blood or proteinaceous material, may have density of 50-80, still have thin walls and no nodules**
- **Magnetic Resonance Imaging (MRI) may be superior to CT, especially with subtraction techniques, in differentiating complex cysts from cystic neoplasm**



Complex structure with Septations
T1 weighted



Gadolinium, does not enhance
Needle aspirated – hemorrhagic cyst

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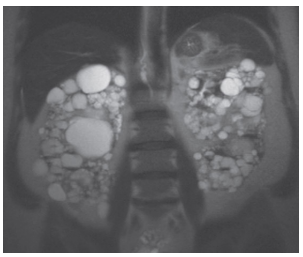
- **Autosomal dominant polycystic kidney disease (APCKD)**
  - **Accounts for 6-10% of patients on dialysis in the US**
  - **Begins in the 3rd or 4th decade**
  - **Pain in the flank, back, or abdomen is the most common complaint**
  - **If no change in the kidneys or early cysts by age of 19 – unlikely affected**
  - **If no findings by age 40 – extremely unlikely to be affected**

Sonography



CT T2 weighted

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Polycystic Kidney Disease

	Family Genotype	Unknown		PKD1		PKD2	
AGE (YR)	**REVISED CRITERIA FOR POSITIVE DIAGNOSIS**	**PPV**	**SEN**	**PPV**	**SEN**	**PPV**	**SEN**
15-29	≥3 cysts, unilateral or bilateral	100	81.7	100	94.3	100	69.5
30-39	≥3 cysts, unilateral or bilateral	100	95.5	100	96.6	100	94.9
40-59	≥2 cysts in each kidney	100	90.0	100	92.6	100	88.8
≥60	≥4 cysts in each kidney	100	100	100	100	100	100
	REVISED CRITERIA FOR DIAGNOSIS EXCLUSION	**NPV**	**SPEC**	**NPV**	**SPEC**	**NPV**	**SPEC**
15-29	≥1 cyst	90.8	97.1	99.1	97.6	83.5	96.6
30-39	≥1 cyst	98.3	94.8	100	96.0	96.8	93.8
40-59	≥2 cysts	100	98.2	100	98.4	100	97.8

Taal: Brenner and Rector's The Kidney, 9th Edition. 2011 Saunders

J Am Soc Nephrol 2009; 20(1):205-212.

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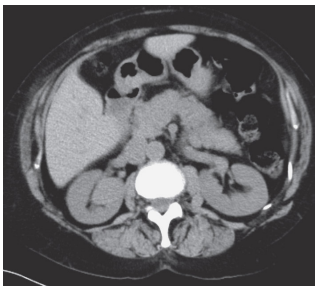
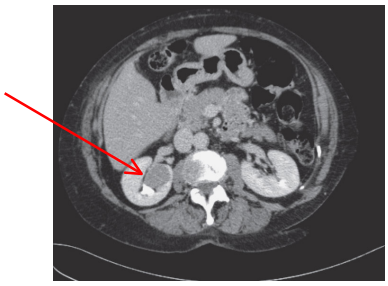
- **Benign Solid Renal Mass**
  - **Renal adenoma is the most common benign neoplasm**
    - **Corticomedullary in location**
    - **Almost always < 2-3 cm in size**
    - **Demonstrate uniform enhancement on CT**
  - **Hamartomas (angiomyolipomas)**
    - **Solitary unilateral in women aged 30-50, often painful**
    - **Multiple, bilateral in those with tuberous sclerosis**
    - **The presence of Fat in the lesion ensures the diagnosis**
    - **< 4cm can be monitored, with surgery for symptoms or hemorrhage**
  - **Oncocytoma**
    - **Uncommon, benign tumor originating from the epithelium in the proximal collecting tubule**
    - **Oncocytic renal cell carcinomas occur, and surgery is usually needed to make the diagnosis**
  - **Fibromas, Myomas, Lipomas, and Hemangiomas are other uncommon, benign tumors of the kidney**

Imaging the Kidney

- **Renal Malignancy**
  - **Renal Cell Carcinoma**
    - **85% of primary renal malignancies**
    - **Usually occurs in the 6th decade, male: female ~ 2:1**
    - **Flank pain, hematuria and flank mass seen in ~ 10%**
    - **Persistent, painless hematuria with negative cystoscopy and IVP needs to have a CT or MRI of the kidneys**



Non-Contrast CT



Nephrographic Phase

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DIFFERENTIAL DIAGNOSIS OF CHRONIC RENAL PARENCHYMAL DISEASE

•No papillary/calyceal abnormality

•Diffuse parenchymal loss	*Focal parenchymal loss*
•A. Bilateral	
– Chronic glomerulonephritis	Infarct
– Diffuse small-vessel disease	Previous trauma
– Hereditary nephropathies	
•B. Unilateral	
– Renal artery stenosis	
– Post irradiation	
– Rare:	
• Hypoplastic kidney	
• Postobstructive atrophy	

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- **Papillary/calyceal abnormality**
- *Diffuse parenchymal loss*
  - Obstructive nephropathy
  - Generalized reflux nephropathy
- *No Parenchymal Loss*
  - Papillary necrosis
  - Tuberculosis
  - Medullary sponge kidney
  - Megacalyces
  - Pelvicalyceal cyst
- *Focal Parenchymal Loss*
  - Focal reflux nephropathy (chronic atrophic pyelonephritis)
  - Tuberculosis
  - Calculus disease

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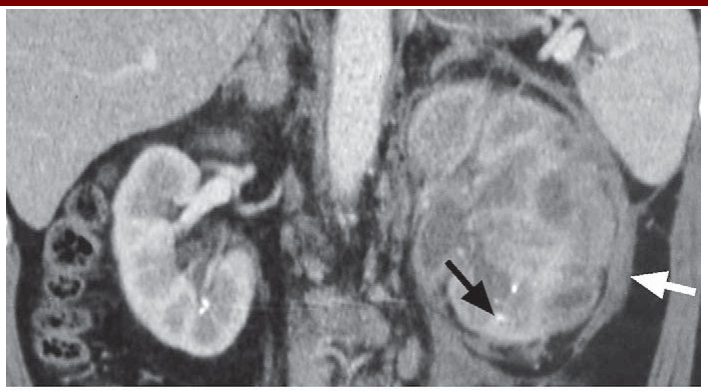

B

Chronic pyelonephritis, dilated calyces, thinned cortex, calcifications,
And surrounding inflammation

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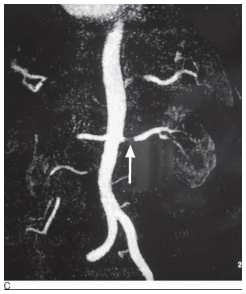
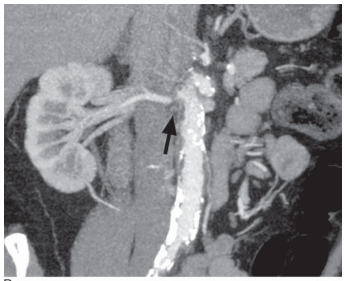
Imaging the Kidney – Vascular disease

- The most common cause of renal artery stenosis is atherosclerosis (70–80%)
- It occurs most often in men over the age of 50 with risk factors for vascular disease
- It usually involves the origin (ostial) or the proximal third of the renal artery
- Plaques within the aorta often cause ostial lesions
- Eccentrically placed atheromatous plaques in the proximal renal artery may also be seen
- If the kidney is small or there are distal plaques, there may be little benefit to intervention

MRA



CTA



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- Fibromuscular dysplasia (FMD) is the 2nd most common cause of renal artery stenosis (15-20%)
- FMD typically occurs in young women, and should be investigated in a young person with hypertension
- It is a heterogeneous group of conditions, with medial fibroplasia the commonest form
- There are multiple short stenoses and is seen as a 'string of beads' in the distal main artery and major branches, and may be bilateral
- Medial fibroplasia dilates easily at lower pressures with excellent long-term results, while the other types, characterized by smooth stenoses, do not always dilate satisfactorily.

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- **Renal artery aneurysms are rare**
  - They can be congenital, mycotic, post-traumatic, atherosclerotic, vasculitic or associated with FMD
  - Treat if causing hypertension or if there is a risk of rupture
  - Risk of rupture
    - aneurysm size (> 2.5 cm)
    - the absence of calcification
    - an association with pregnancy.
  - If the aneurysm is at risk of rupture, selective renal arteriography will be necessary to plan the appropriate treatment
- Renal infarction is usually due to thromboembolic occlusion of a renal artery
  - Principal source is atrial fibrillation
  - Others: aortic aneurysm, atheroma, vasculitis or trauma.
  - Clinical presentation: with pain and hematuria
  - Over time, the infarcted area decreases in size, with cortical scar formation
  - In vasculitis there are multiple small infarcts with patchy or wedge-shaped areas of altered perfusion

Case Studies

- # 1 – A 62 year-old Man applies for Life insurance. He has blood in his HOS with 25 RBCs/HPF. His APS reveals that he c/o hematuria for about 6 months. A urologist report shows a consistent low to moderate amount of hematuria. He has had a negative cystoscopy, IVP, and renal ultrasound.

Small Renal carcinomas may only be detectable by MRI or CT.

- # 2 – A 45 year-old woman applies for Life insurance. She appears healthy with routine OB/Gyn visits. Her family history reveals that her father had a renal transplant, but died of Polycystic Kidney Disease at the age of 65. Her gynecologist ordered a renal ultrasound when she was 42 years-old. It revealed 3 “simple” cysts, 2 in the left, 1 in the right, all less than 2 CM. Her current insurance labs are normal.

Consider a current renal US as cysts tend to increase in size and number over a period of years.

An early finding in APCKD is the inability to concentrate urine. Consider a urine specimen after a night of fasting/NPO – Specific Gravity < 1.015?