Kidney Biopsy

- First percutaneous renal biopsies
  - Iversen and Brun 1951
- First use of cutting needle with patients in the prone position
  - Kark and Muehrcke 1954
- First electron microscopy studies
  - Farquhar et al. 1957
- First immunofluorescence studies
  - Freedman et al. 1960
Background and rationale

• Kidney biopsy remains the gold standard for establishing a diagnosis (etiology), and for determining prognosis (risk of disease progression), in many patients with renal disease

• Blood tests, urine tests and radiographic studies are frequently unable to identify the etiology of a patient’s renal disease in a reliable fashion

• Because treatments may be associated with serious side effects (opportunistic infection, malignancy, and death), it is essential to establish a tissue diagnosis in selected patients before administering potentially toxic therapy
CONTRAINDICATIONS

- Solitary native kidney
- Uncorrectable bleeding diathesis
- Severe hypertension, which cannot be controlled with antihypertensive medications
- An uncooperative patient
- Small hyperechoic kidneys (less than 9 cm), which are generally indicative of chronic irreversible disease
- Multiple, bilateral cysts or a renal tumor
- Hydronephrosis
- Active renal or perirenal infection
- Anatomic abnormalities of the kidney which may increase risk (see above)
- Skin infection over the biopsy site

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Techniques

• Percutaneous
  – Real time (USG or CT)
  – Non-real time
• Transjugular
• Open/laparoscopic
RENAL BIOPSY NEEDLES

Monopty®

BIO-CUT Single-handed needle
“Open” versus percutaneous renal biopsy

• Open renal biopsy
  – Local control of bleeding, but:
  – Dedicated OR procedure
  – General anesthesia
  – Reserved for unusual space-occupying lesions not easily amenable to percutaneous biopsy (r/o malignancy)
Transjugular versus Percutaneous Renal Biopsy

Modified Colapinto needle

Percutaneous renal biopsy (n=400)
  • Success: 95.5%
  • Complications 1%

Transjugular renal biopsy (n=400)
  • Success: 95.8%
  • Complications 0.75%
Technique of the renal biopsy

• Primary objectives:
  – Obtaining adequate specimen for pathologic diagnosis with minimum discomfort and risk to the patient
  – Patient comfort and safety
    • Platelet count and clotting parameters; timely cessation of aspirin, heparin, coumadin, etc
    • Blood pressure control
    • Local anesthesia
    • Positioning; patient cooperation; slow comfortable breathing
    • Prn analgesics
  – Physician comfort and safety
    • Proper patient positioning facilitating physician comfort helps ensure safety, and increases likelihood of obtaining adequate pathologic specimen
Renal anatomic relationships

Liver
L adrenal gland
Spleen
L kidney
Superior Mesenteric Artery
L ureter
Aorta
R kidney
Vena cava
Psoas muscle
Renal transplant anatomy – right iliac fossa
Preferred site of biopsy
Positioning: Prone
Supine antero-lateral position

Nephrology Dialysis Transplantation 2008 23(3):971-976
Depth Measurement

Longitudinal view

Transverse view – lower pole
Patient preparation

• Full discussion of the medical indication for biopsy – with interpreter if necessary

• Full discussion of potential risks

• Informed signed consent – with interpreter if necessary

• Timely notification of staff nurse before the procedure (minimum 30-60 minutes) so that she/he will be ready to institute vital sign monitoring protocol immediately after the biopsy

• Time-out form
Patient preparation, continued

- Positioning
- USG localization – generally not done “real time” at CUMC
- Skin prep
- Local anesthesia (5-10 cc of 1%-2% lidocaine) – to the level of the renal capsule
- Rarely patients will require low dose narcotic or benzodiazepine to facilitate the procedure
The biopsy

- Goal is to obtain 2 or 3 pieces of renal cortex for full histological examination (light microscopy, immunofluorescence, electron microscopy)
- 18 gauge biopsy needle
- Patient holds breath during the actual needle insertion (native kidney biopsy only)
- Multiple passes may be required (shallow/conservative needle placement leading to connective tissue sampling)
- Avoid deep penetration into the kidney, which may lead to sampling of medulla instead of cortex, and risk of urinary bleed
Post-biopsy

• Clean skin around biopsy site
• Sterile dressing
• Bed rest x 4-5 hours
• Vital sign monitoring – alert physician for BP/HR deviations according to patient-specific parameters
  – q 15 min x 1 hr; q 30 min x 2 hr; q 60 min x 2 hr
  – Maintain clear & accessible record of vitals for MD review
• Serial urine examination – alert physician for gross hematuria
• PRN analgesic
• CBC check after 4-5 hours
• Eclypsis order set
COMPLICATIONS

• Minor complications:
  – Gross hematuria and/or perinephric hematoma but spontaneously resolving without the need for further intervention.

• Major complications: need for an intervention
  – transfusion
  – invasive procedure (radiographic or surgical)
  – acute renal obstruction or failure
  – Septicemia
  – death
Complications – risk of bleeding

• The kidney is a highly vascular organ and receives approximately 20% of the cardiac output each minute.
• A drop in hemoglobin by 1 g/dl after biopsy is common and has been reported to occur in almost 50% of cases.
• 0.7% biopsies resulted in the need for an invasive procedure, no patient required emergent surgery or nephrectomy, and a death attributed to the procedure occurred in only one (0.1%) patient.
• Predictive risk factors:
  – Serum creatinine $\geq 5.0$ mg/dl (OR 2.3; CI 1.3 to 4.1; $P$ 0.005).
<table>
<thead>
<tr>
<th>Minor complication</th>
<th>n</th>
<th>%</th>
<th>% of All Biopsies</th>
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<tr>
<td>gross hematuria</td>
<td>23</td>
<td>46%</td>
<td>3.1%</td>
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<tr>
<td>hematoma</td>
<td>16</td>
<td>32%</td>
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<td>8</td>
<td>16%</td>
<td>1.1%</td>
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<tr>
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<tr>
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<tr>
<td>Major complication</td>
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<td>%</td>
<td>% of All Biopsies</td>
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<td>gross hematuria</td>
<td>12</td>
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<tr>
<td>hematoma</td>
<td>14b</td>
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<tr>
<td>both</td>
<td>13</td>
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<td>1.7%</td>
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<tr>
<td>no. with AV fistula</td>
<td>3</td>
<td>6.3%</td>
<td>0.4%</td>
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<tr>
<td>no. with Obst/ARF</td>
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<td>0.3%</td>
</tr>
<tr>
<td>drop in Hgb</td>
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<td>4.2%</td>
<td>0.3%</td>
</tr>
<tr>
<td>other</td>
<td>2b</td>
<td>4.2%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>100%</td>
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Table 3. Cumulative timing of post-biopsy complication

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<tr>
<th></th>
<th>n</th>
<th>≤ 4</th>
<th>≤ 8</th>
<th>≤ 12</th>
<th>≤ 24</th>
<th>&gt; 24</th>
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<tbody>
<tr>
<td>Total</td>
<td>91</td>
<td>42%</td>
<td>67%</td>
<td>85%</td>
<td>89%</td>
<td>11%</td>
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<tr>
<td>Minor complication</td>
<td>46</td>
<td>46%</td>
<td>67%</td>
<td>80%</td>
<td>87%</td>
<td>13%</td>
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<tr>
<td>Major complication</td>
<td>45</td>
<td>38%</td>
<td>67%</td>
<td>89%</td>
<td>91%</td>
<td>9%</td>
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Bleeding, continued

- Most biopsy-related bleeds are due to perinephric (retroperitoneal) bleeding, outside of the kidney

- Occasionally, bleeding may be into the urinary collecting system, causing gross hematuria and possibly bladder clot with urinary retention

- Most clinically-significant bleeding becomes evident within the first few hours after a biopsy

- Most clinically-significant bleeding is self-limiting (resolves spontaneously with bed rest alone)
Bleeding, continued

• Diagnosis of biopsy-related retroperitoneal bleeding: non-contrast abdominal & pelvic CT scan

• Treatment of RP bleed
  – Ongoing bed rest
  – Confirm normal coagulation parameters
    • FFP, platelet, cryoprecipitate, DDAVP infusion if appropriate
  – Rare cases: angiographic embolization of the bleeding vessel

• Refractory urinary bleeding may require foley catheter placement, irrigation, forced diuresis, angiographic embolization
AV Fistulæ

- Hematuria is the commonest presenting manifestation
Angioembolization

Kidney International (2006) 69, 1101
Conclusions

• Percutaneous renal biopsy remains an essential tool in the management of certain patients with medical disease of the kidneys
• The risk of serious bleeding complications is small but not trivial
• Patient safety, comfort and reassurance need to remain paramount concerns at all times
• The physician needs to properly identify risk factors for serious bleeding and correct them where possible
• Clear and timely communication between physician and nurse are essential to facilitate appropriate monitoring procedures and thereby maximize patient safety and reassurance