Diagnosis of kidney and urinary tract diseases

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Kidney injuries

Prerenal

Glomerular disease
  - Glomerulonephritis
  - Glomerular sclerosis

Tubular disease
  - Acute tubular necrosis

Interstitial nephritis

Renoparenchimal

Tubulopathies

Vascular lesions
  - Vasculitis
  - Vascular occlusion

Postrenal
Signs and symptoms

Meeting the patient – review of the systems

Questions related to the kidney and urinary tract

- Urine: color (blood)
  quantity: 500-3000 ml/day

- Pain (loin pain, dysuria)

- Edema

- Blood pressure
Signs and symptoms

Urine color

orange: rifampicin
pink: urate crystals
red: macroscopic hematuria, hemoglobin, myoglobin, beets
brown: bilirubin, chloroquin, nitrofurantoin
green: methylene blue, propofol
darkens upon standing: porphyria
Signs and symptoms

Hematuria

• Stone
• Infection
• Tumor
• Trauma
• Polycystic kidneys
• Benign prostate hypertrophy
• Papillary necrosis (sickle cell anemia)
• Glomerulonephritis (IgA nephropathy)
Signs and symptoms

Decreased urine output

- Oliguria < 500 ml/day
- Anuria < 50-100 ml/day

Acute kidney injury (AKI):
- acute nephritis syndrome
- rapidly progressive glomerulonephritis syndrome
- prerenal AKI
- postrenal AKI – urethral or bilateral ureteral obstruction
- vascular occlusion – if bilateral

!! Acute tubular necrosis and chronic kidney disease may or may not be associated with decreased urine output !!
Signs and symptoms

Increased urine output

Polyuria > 3000 ml/day
with renal injury
  Acute kidney injury (AKI):
    recovery – polyuric phase
  Tubulopathies (hypokalemia, hypercalcemia)
  Renal diabetes insipidus – lack of ADH effect

without renal injury
  Primary polydipsia
  Diabetes mellitus – osmotically active glucose
  Central diabetes insipidus – no ADH
  Diuretic abuse + adequate hydration
Signs and symptoms

Pain

Colicky: **acute obstruction** of the urinary tract – stone / clot

Dysuria: burning pain during voiding + urgency: **infection**

Stong and dull loin pain + fever: **pyelonephritis**

Weaker pain: acute **interstitial nephritis**

!! Acute glomerulonephritis, acute kidney injury, chronic kidney disease (including chronic obstruction) are painless!!
Signs and symptoms

Blood pressure

Normal: 100-140/50-90 mmHg

- Hypertension (> 140/90 mmHg) – volume /salt expansion
  - RAAS activation
    - acute nephritic syndrome
    - renal artery stenosis
    - chronic kidney disease

- Hypotension (< 90/50 mmHg) – volume / salt loss
  - prerenal acute kidney injury
  - nephrotic syndrome (not always)
Signs and symptoms

Edema

Glomerular diseases:
- Nephrotic syndrome – hypoproteinemia
- Acute nephritic syndrome – volume and salt retention

Chronic kidney disease – volume retention
Past medical history

• Previous renal diseases

• Diseases with possible renal involvement
  hypertension, atherosclerosis
  diabetes mellitus
  autoimmune disorders (SLE, vasculitis)
  tumors (multiple myeloma)
  infections (chronic hepatitis, tuberculosis, HIV)

• Previous laboratory results:
  estimated GFR
  urinalysis: sediment / proteinuria

• Previous imaging: ultrasound
Family history

- Polycystic kidneys – AD
  end-stage renal disease
  intracranial aneurysms

- Alport syndrome - mostly X-linked
  deafness
  ocular changes
  chronic kidney disease

- Tubulopathies – AR
  Bartter syndrome - growth retardation, laboratory abnormalities
  Gitelman syndrome - laboratory abnormalities
Medications

• NSAIDs – prerenal injury, „acut on chronic” kidney disease

• nephrotoxic agents (platina, aminoglycosides) – tubular toxicity, acute tubular necrosis

• herbal products – acut / chronic interstitial nephritis caused by aristolochic acid - „Chinese herb nephropathy”

• radiocontrast material – tubular toxicity, acut tubular necrosis
Physical examination
Laboratory - glomerular function

Creat = 100 μmol/l

GFR 52 ml/min

GFR 147 ml/min

CKD-EPI formula to estimate GFR:

- online calculators
- gender, age, ethnicity, creatinine are considered
Laboratory – urine dipstick

**Dipstick:**

- pH: 4.5-8
- Hemoglobin
- Protein: Dipstick detects albumin
- Nitrite
- Leukocyte
- Glucose
- Ketones
## Laboratory – assessment of proteinuria

<table>
<thead>
<tr>
<th>Dipstick</th>
<th>Urinary albumin excretion (mg/24h)</th>
<th>Alb/creat ratio (mg/mmol)</th>
<th>Urinary protein excretion (mg/24h)</th>
<th>Protein/creat ratio (mg/mmol)</th>
</tr>
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<tbody>
<tr>
<td>Healthy</td>
<td>–</td>
<td>&lt; 30</td>
<td>&lt; 3</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>Microalbuminuria</td>
<td>trace</td>
<td>30 - 300</td>
<td>3 - 30</td>
<td>150 - 450</td>
</tr>
<tr>
<td>Proteinuria</td>
<td>+</td>
<td>&gt; 300</td>
<td>&gt; 30</td>
<td>&gt; 450</td>
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<tr>
<td>significant</td>
<td>++</td>
<td>&gt; 700</td>
<td>&gt; 70</td>
<td>&gt; 1000</td>
</tr>
<tr>
<td>nephrotic</td>
<td>+++</td>
<td></td>
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</table>

Laboratory – microscopic hematuria

- **Non-glomerular: isomorph**
  - Strenuous exercise (marathon running)
  - Urolithiasis
  - Infection
  - Tumor
  - Trauma
  - Polycystic kidney disease
  - Benign prostate hyperplasia
  - Endometriosis
  - Sickle cell anemia (papillary necrosis)
  - Hypercalciuria, hyperuricosuria
  - Coagulopathy

- **Glomerular: dysmorph**
  - Glomerulonephritis
Laboratory – urine sediment

Structures embedded in Tamm-Horsfall glycoprotein matrix

- Hyalin cast
- Lipid cast
- Tubule cell cast
- RBC cast
- ATN cast
- WBC cast
Laboratory – urine sediment

Ca-ox dihydrate

Ca-ox monohydrate

Ca-carbonate

Struvite (Mg-amm-phosphate)

Cystine

Urate
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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<tr>
<td>Size?</td>
<td>9-13cm</td>
</tr>
<tr>
<td>Thickness of the parenchyma?</td>
<td>&gt; 10mm</td>
</tr>
<tr>
<td>Echogenicity of the parenchyma?</td>
<td>same as the healthy liver</td>
</tr>
<tr>
<td>Surface?</td>
<td>smooth</td>
</tr>
<tr>
<td>Pyelon?</td>
<td>without dilation</td>
</tr>
<tr>
<td>Cyst? Stone? Tumor?</td>
<td>absent</td>
</tr>
</tbody>
</table>

Renal ultrasound
Renal biopsy
Renal biopsy
Differential diagnosis – renal syndromes

Reason for admission: edema

Physical examination:
- pitting edema
- xanthelasma
- white lines of the nails
- pleural fluid /ascites

Laboratory:
- Normal GFR
- Large proteinuria (>3.5g/day)
- Hypalbuminaemia
- Hyperlipidemia
- No hematuria

» Nephrotic syndrome
Differential diagnosis – renal syndromes

Reason for admission: oliguria
dark urine
hypertension

Physical examination:
moderate edema
hypertension

Laboratory:
Decreased GFR
Mild proteinuria (300mg-3.5g/day)
Dysmorphic hematuria
Red blood cell casts

» Nephritic syndrome
Differential diagnosis – renal syndromes

Reason for admission:
progressive weakness
nausea, vomiting, weight loss
itching
delirium, seizures

Physical examination:
dry, dyscolored skin with excoriations
uremic foetor
signs of pleuritis / pericarditis
signs of volume overload

Laboratory:
markedly decreased GFR (< 10ml/min/1.73m2)
anemia
hyperkalemia, hypocalcemia, hyperphosphatemia
metabolic acidosis
secondary hyperparathyroidism

» Uremia syndrome