Approach to the patient with renal disease III.

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Complaints, which are directly referable to the urinary tract.

- **Dysuria** - difficulty or pain associated with voiding. Causes: inflammation, stones, tumor.

- **Incontinence** - uncontrollable voiding. Paradoxic incontinence - bladder distension caused by mechanical or functional obstruction - small, frequent, involuntary "overflow" voiding.

- **Enuresis** - unintentional voiding of urine, usually at night - no gross urologic abnormality.
Complaints/2

• **Oliguria**- low urin flow < 400ml/day
  Dehydration, reduced effective plasma volumen (heart failure, cirrhosis), renal insuff., obstruction of the urinary tract

• **Polyuria**- high urin output > 1500ml/day
  Diabetes- mellitus, insipidus, hyperaldosteronism, hyperCa, chr. ren. insuff. salt losing type

• **Nocturia**- excessive night time passage of urine.
  Edema, renal insuff., partial obstruction of the bladder
Important features of the history in the patients with renal disease (RD)

- **Familial RD**: polycystic kidney, hereditary nephritis, renal calculi
- **Systemic D**: SLE, diab. mell. hypertension, sickle cell anaemia
- **Toxic exposure**: heavy metals, radiographic contrasts, drugs (analgetics, NSAID, antibiotics)
Associated symptoms

- **General**: fever, weight loss, fatigue, skin rash, pruritus, sore throat
- **Cardiovascular**: dyspnea, chest pain, edema
- **Gastrointestinal**: anorexia, nausea, vomiting
- **Genitourinary**: polyuria, dysuria, flank pain, hematuria, passage of renal stones
Physical examination

- **Cardiovascular**: hypertension, cardiac failure, percardial rub, edema
- **Genitourinary**: palpable kidneys or bladder, prostatic enlargement
- **Neurological**: peripheral neuropathy, encephalopathy, asterixis
- **Fundoscopic**: diabetic retinopathy, hypertensive retinopathy
Urinalysis/1-color

- Colorless: dilute urine (diabetes mellitus, diuretics)
- Yellow: normal, riboflavin
- Amber: concentrated urine, sulfasalazine
- Blue-green: biliverdin, methylene blue, triamterene
- Red: hemat-hemoglobin-myoglobinuria, phenolphthalein, adriamycin
- Red-brown: porphyria, urobilinogen, bilirubin, metronidazole, nitrofurantoin
- Brown-black: melanin, acid of Hbg, alkaptonuria, senna
- Milky white: chyluria, pyuria
Urinalysis/2 Chemical assessment

Detect protein, occult blood, glucose, ketones

• Semiquantitative (estimate the degree of urine concentration)
• Sensitive to albumin but not to immunoglobulin, tubular proteins
• The finding of occult blood indicate the presence of either red blood cells or free Hbg or myoglobin
## Urinalysis/3. Microscopic examination - Casts

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red blood cell</td>
<td>GN, vasculitis</td>
</tr>
<tr>
<td>White blood cell</td>
<td>interstitialN, pyeloN</td>
</tr>
<tr>
<td>Epithelial cell</td>
<td>Acute tub.necrosis interstitialN, GN</td>
</tr>
<tr>
<td>Waxy, broad</td>
<td>Advanced renal failure</td>
</tr>
<tr>
<td>Fatty</td>
<td>Heavy proteinuria</td>
</tr>
<tr>
<td>Hyaline</td>
<td>Normal finding in concentrated urine</td>
</tr>
</tbody>
</table>
Leukocyta cast in the tubulus
Cast in the urin sediment
Urin sediment-Casts
# Urinalysis/3. Microscopic examination - Cells

| Red blood cell | Urinary tract infection, inflammation |
| White blood cell | Urinary tract infection, inflammation |
| Eosinophil | Drug induced interstitial nephritis |
| Squamous epithelial cell | contaminants |
Urinalysis/3. Microscopic
Leukocyta
Urin sediment in interstitial nephritis
Urin sediment-Cells
### Microscopic examination/3. Crystals

<table>
<thead>
<tr>
<th>Crystals</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uric acid</td>
<td>Acid urine, acute uric acid nephropathy, hyperuricosuria</td>
</tr>
<tr>
<td>Calcium phosphate</td>
<td>Alkaline urine</td>
</tr>
<tr>
<td>Calcium oxalate</td>
<td>Acid urine, hyperoxaluria, ethylene glycol poisoning</td>
</tr>
<tr>
<td>Cystine</td>
<td>Cystinuria</td>
</tr>
<tr>
<td>Sulfur</td>
<td>Sulfadiazine antibiotics</td>
</tr>
</tbody>
</table>
Urin sediment-Crystals
Investigation of renal function

1. Functional integrity of glom. ultrafiltr. barrier

**Proteinuria**

- Normal excretion is < 150mg/24 hours
- Highly selective proteinuria - albumin
- Poorly selective proteinuria - higher mol. weight proteins
- Microalbuminuria - increase in albumin excretion, that are detectable by sensitive immunoassay (predict diabetic nephropath.)
## Types of proteinuria

<table>
<thead>
<tr>
<th>Types</th>
<th>Description</th>
<th>Quantity</th>
<th>Molecular Weight</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overflow</td>
<td>Abnormal plasma proteins across normal G</td>
<td>≥ 0.2-10g</td>
<td>Low &lt;40,000</td>
<td>Bence Jones myoglobin</td>
</tr>
<tr>
<td>Glomerular</td>
<td>Defective G. retention of norm.prot.</td>
<td>&gt; 3-5g</td>
<td>High &gt;68,000</td>
<td>G. nephritis, nephrotic sy</td>
</tr>
<tr>
<td>Tubular</td>
<td>Defective reabsorption of norm.prot.</td>
<td>&lt; 2g</td>
<td>Low &lt;40,000</td>
<td>Interstitial nephritis, heavy metal antibiotic injury</td>
</tr>
<tr>
<td>Hemodynamic</td>
<td>Increased filtration, decreased reabs.</td>
<td>&lt; 2g</td>
<td>Variable 20,000-68,000</td>
<td>Fever, CHF, Exercise</td>
</tr>
</tbody>
</table>
Investigation of renal function

2. The presence of urogenital inflammation

**Leukocyturia**

- Abnormal > 5 leukocytes per high power field - Urinary tract infection
- Steril pyuria - tbc
- Steril pyuria + urgency, frequency - nongonococcal urethritis
- + eosinophils - acute allergic interstitial nephritis
- **Leukocyta casts = parenchymal disease**
Investigation of renal function
2. The presence of urogenital inflammation

**Hematuria**

- Abnormal > 2 red blood cell/ high power field
- **Red blood cell casts**+
  **proteinuria**=glomerular lesion
Causes of hematuria isolated from other urine abnormalities

- **Urologic** - urogen., tu, renal cyst or tu nephrolithiasis or urolith (usually painful)
- **Hematologic** – coagulopathies, hemoglobinopathies, sickle trait
- **Nephrologic** – Glom. pathies, especially IgA nephropathy, benign essential hematuria
- **Menstruation**
Investigation of renal function
3. Glomerular filtration rate

Estimates of the mass of functional renal tissue

- **Creat. clearance**(ml/min) = Urine creat(mg/dl) x volume of urine/plasma creat(mg/dl)
  Normal range 95-105 ml/min/ 1.75 sqm

- **BUN** - imperfect quantitative indicator of renal filtration. The liver synthesizes it from ammonia derived from the protein catabolism. The kidney filtered, reabsorbed and secreted it.
  Normal range 2-8.3 mM/l
Investigation of renal function

4. Tubular function

- Renal concentrating and diluting ability
  The total solute concentration of urine assessed by measurement of urine specific gravity, which relates the weight of a unit volume of urine to an equal volume of water. It is only a rough indication of urine osmolality (higher density solute (glucose, protein, contrasts) have relative higher specific grav. to their osmolality.

- Normal max. urine osmolality 1000+/−200mOsm= 1030 spec grav
  Test: Stop fluid intake for 16 hours-til three consecutive urine specimen show no further increase in osmolality.
  Administer sc.5 U vasopressin, and measure the urine osm.

- Maxc diluting capacity 80 mOsm-1002 spec .grav
  Test: 1200ml water p.os to a fasting patient.
  Three hourly measurement of urine specific grav.
  Diuretics, and glucosuria impaired the diluting, and conc. capacity.
Investigation of renal function

5. Acidification capacity

- Urine is more acidic than body fluids because of endogenous production of nonvolatile acids.
- In the presence of arterial acidosis pH < 7, the urine pH should be < 5.3.
- Test for acid capacity (susp. of distal tub. dysf): 0.1g/kg ammoniumchlorid by mouth—urinary pH must achieve 5, or less.
Investigation of renal function
6. Urinary electrolytes

- Measure the urinary excretion of solute relative to the exr. of creatinin
- The fract. excr. of Na is useful in the diff. dg. of acute renal failure (>20-40mEq/l)
- The fract. excr. of Ca, Ph, uric acid, amino acids for renal stones and tubular diseases
## Imaging studies of the urinary tract

<table>
<thead>
<tr>
<th>Study</th>
<th>Information</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain radiography</td>
<td>Renal size, calculi</td>
<td>Inexpensive</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>Size, cysts, tubal/venous flow Doppl.</td>
<td>Noninvasive</td>
</tr>
<tr>
<td>Scan</td>
<td>Blood flow, tubular func.</td>
<td>Functional study</td>
</tr>
<tr>
<td>Iv urogram</td>
<td>Size, shape, tu, stones, obstruction</td>
<td>Requires iv contrast</td>
</tr>
<tr>
<td>CT</td>
<td>+retroperitoneal space</td>
<td>Requires iv contrast</td>
</tr>
<tr>
<td>Retrograde urography</td>
<td>Ureteral obstruction</td>
<td>Invasive</td>
</tr>
<tr>
<td>Renal arteriography</td>
<td>Renal vasculature, tu.</td>
<td>Invasive</td>
</tr>
<tr>
<td>Renal venography</td>
<td>Thrombosis,. Blood sampling</td>
<td>Invasive</td>
</tr>
</tbody>
</table>
Kidney tu rtg
Kidney tu US
Multiplex tu of kidney CT
Kidney tu MR
Vesicourethral reflux –iv. pyelo
Stone in the urether –iv pyelo
Arteriovenousus malformation-angio
Indications for renal biopsy

- Presumptive presence of glom. disease
  - Heavy proteinuria >3- to 5 grams/24h
  - Nephrotic syndrome
  - Acute nephritic syndrome
- Proteinuria with hematuria
- Renal involv. by systemic disease
- Unexplained acute renal failure
- Persistent acute renal failure (beyond 2-4 weeks)
- Renal transplantation - rejection, reccurence of original disease
Membranoproliferative GN - histology
Interstitial nephritis - histology
Small vessel vasculitis - histology
The major renal syndromes

• Nonspecific manifestations: hematuria, azotaemia, hypertonia

• Group of findings (history, physical, laboratory examinations) may be used to describe some more common syndromes
The major renal syndromes

- Acute renal failure
- The nephritic syndrome
- The nephrotic syndrome
- Nephritic/nephrotic syndrome
- The interstitial nephritic syndrome
- Renal tubule defects
- Renal cystic diseases
- Chr. renal failure
- Asymptomatic urinary tract abnormalities
Acute renal failure

**Clues:** anuria, oliguria, documented recent decline (some days) in GFR

**Prerenal** (the underperfusion syndrome)
- reduced effective volume
- circ. collapse, congestive heart failure,
- cirrhosis with ascites
- occlusive renal art. dis.-fibrin musc. hyperplasia, arteriosclerosis, embolia
- vasoconstriction of renal microvasc
- acute transplant rejection
- cyclosporin, amphotericin nephrotoxic

**Postrenal** (urinary tract obstruction)
- from renal papillae to the urethral meatus

**Renal** (generally evident from the findings which characterises the acute glomerulonephritic syndrome)
The nephritic syndrome
(glomerular disorder)

Inflammatory and/or necrotizing lesions in the glomeruli

**Clues:** hypertonia, hematuria, RBC casts, azotaemia, proteinuria, edema

- **Primary renal disorders:** postinfectious GN, idiopathic rapidly progr. GN, Goodpasture sy, hemolitic uremic sy.
- **Systemic disorders:** vasculitis (SLE, Wegener, Schönlein-Henoch)
The nephrotic syndrome
(glomelural disorder)

Predominantly noninflammatory derangement of the
glomeruly, abnormal leakiness of the glom. to albumin and
other macromolecules

Clues: proteinuria greater than 3,5g/24h/1,73m2,
hypoalbuminaemia, hyperlipideaemia, lipiduria, edema

Primary renal disorders: idiopathic nil dis., membranous
nephropathy, focal sclerosis

Systemic disorders: Nil dis. in Hodgkin, membranous
nephropathy in SLE, drugs, neoplasms, focal sclerosis in
heroin abuse, essential cryoglob., diabetic nephropathy.
Nephritic/nephrotic syndrome
(Glomerular disorder)

Clues: hematuria, massive proteinuria/azotemia, hypertension, edema

Primary renal disorders: membranoproliferative GN type I, type II, mesangio proliferative GN (IgA/IgG nephropathy)

Systemic disorders: vasculitis partially SLE, diabetic nephropathy
The interstitial nephritic syndrome

The primary abnormality is damage to the tubulointerstitial system of the kidney, with secondary glomerular damage.

Clues: hyporeninaemia, hypoaldosteronism, modest salt wasting, hyperkalaemia, hyperchloremic metabolic acidosis.

Urinary abnormalities: hematuria, proteinuria usually but not always.
The interstitial nephritic syndrome

Three classes

1. Chronic tubulointerstitial disease: (proteinuria, casts, azotemia) hypertension, gout, drugs (NSAID), sickle cell

2. Acute allergic interstitial disease: (eosinophils in the urine, may be marked hematuria, proteinuria, oliguria): penicillin, NSAID

3. Acute pyelonephritis: (bacterial invasion of the kidney: fever, bacteriuria, pyuria, leukocyte casts, hematuria, mild proteinuria)
Renale tubule defects

1. Prox. tub. defects: glucosuria, aminoaciduria, phosphaturia, bicarbonate wasting

2. Possible loop of Henle (reduced NaCl reabsorption—hypovolaemia—hyperaldosteron-hypokalaemia) (Bartter sy)

3. Distal tub. defects: permeable to protons, cannot maintain acid urine

4. Collecting duct defect: nephrogenic diabetes insipidus
Renal cystic diseases
(hereditary tubular disorders)

- 1. Isolated simple cysts, or multiple: ren size normal, calyceal system only minimally distorted
- 2. Adult polycystic kidney: positive family history (autosomal dominant), kidney enlargement, calyceal distorsion. Hematuria, stones, hypertension, flank pain,
- 3. Microcystic kidney of medulla: children, recessive trait, high requirement for salt intake
Chr. Renal failure

- Clues: azotemia for > 3 month, prolonged symptoms and signs of uremia, renal osteodystrophy, bilateral kidney size reduction, broad casts in urinary sediment.
- Other findings: hematuria, proteinuria, casts, oliguria, polyuria, edema, hypertension, electrolyt disorders
Asymptomatic urinary tract abnormalities

- Isolated hematuria
- Isolated proteinuria
- Pyuria
Summary

- Take a good history
- Do a correct physical examination
- Check the urine characteristics (color, specific gravity, protein, sugar content, sediment)
- Estimate 24h protein content, do a urine protein ELFO
- If necessary, do a urine culture
- Check the GFR
- Use appropriate imaging methods
- If necessary, do a renal biopsy