Examination in Nephrology

MUDr. Zuzana Lichá
MUDr. Petra Divácká

The University Hospital Brno

April 20, 2020

Structure of the presentation

Medical History

- Family history: do you have any of kidney disease in the family? - eg. polycystic disease of kidney (her, autoimmune disease – eg. SLE, familiar haematuria, has anyone in the family been treated for renal failure by renal replacement therapy (RRT)?
- Personal history: do you have any metabolic disease? – eg. diabetes? or vascular disease: hypertension?, chronic hearth failure?, autoimmune disease, oncological disease, urological disease – prostatic hyperplasia, nephro- or urolithiasis, vesicourethral reflux?
- Gynecological anamnesis: gestational hypertension? preeclampsia?
- Pharmacological history: using any of nephrotoxic drugs? – eg. analgetics (mainly NSAIDs), antibiotics, chemotherapy, high osmolar contrast agents i.v.
- Physiological functions: urological problems – dysuria, pollakiuria, renal colic, haematuria, nycturia, stools - regular, irregular, pathological substances in the faeces – blood, mucus, melena, diarrhoea
- Nefrological history: infectious focuses (sinusitis, tonsilitis) in connection with renal injury, frequent inflammations of urotract, recurrent lithiasis, haematuria, proteinuria (during pregnancy, after angina. . .)

The most common problems of a patients with kidney disease

- swelling – permanent/temporary
- headache, vertigo, problems of vision (eg. because of hypertension)
- lumbal pain/in kidney area/ hypogastric area
- dysuria (burning or cutting during urine), pollakiuria (painful dysuria and frequency), haematuria (change color of urine- red/brown), problems with holding urine
- fatigue, weakness (anemia?)
- dyspepsia, nausea, vomiting (kidney failure)
- fever, shivers during of inflammation of urotract

Physical Examination

Basics

Including height, weight, body mass, blood pressure and pulse

- General examination: conscious, lucid, oriented, without icterus or cyanosis. Pallor? – anemia with erythropoietin deficiency. Skin turgor? – reduced for dehydration, skin clean? With numerous excoriations? Rush? Breathing odor of urea (uremic syndrome), Anasarca?
- Head: percussively painless, output of cranial nerves V a VII intact, isocoric pupils, without nystagmus, sclera anicteric, swelling of eyelids? – for autoimmune inflammation of the kidneys or with a decrease in diuresis with kidney damage?, nose and ears and mouth without secretion, sick mucous membranes during dehydration
- Neck: free movement in all directions, normal filling of cervical veins, thyroid non-enlarged, elastic, lymph nodes not palpable
- Chest: alveolar and clean breathing, without pathological phenomena, Kussmaul's faster and deeper breathing in acidotic uremia (blood pH below 7,2 = acidosis in renal failure and high serum urea)? Cardiac regular action (bradycardia / tachycardia in case of potassium metabolic disorders), echoes intact, no murmur (pericardial murmur in uremia)

Physical Examination

- Belly: in niveau (ascites?), soft, palpable, painless, without palpable resistance, peristalsis +, any scars? (after nephrectomy?), liver and spleen not palpable, tappotment bilaterally negative, kidney palpation – palpable? Enlarged? (polycystic of kidney)
- Extremities: Upper limbs: no swelling, no inflammation, free movement, palpable pulsations on the periphery
- Lower limbs: no swelling, no signs of inflammation, free movement, varices?, signs of chronic venous insufficiency? Lymphedema? palpable pulsations on the periphery

Examination of kidneys and urinary system

- Tappotment - hitting the lumbar region by the edge of the hand just below the rib arch - the pain of kidney´s inflammation
- Bimanual palpation of the kidneys (Israeli´s touch) – the patient lies on his back with knees bent, when examining the right kidney, the examiner stands on the right side of the bed, his left hand examines the kidney by pressure in lumbar region, „lifts“ against the palpating right hand (palpation of enlarged kidney eg. polycystic kidney)
- Palpation and tapping of the bladder – just above the symphysis, to detect pain or greater residue (= residual urine) in the bladder after urination

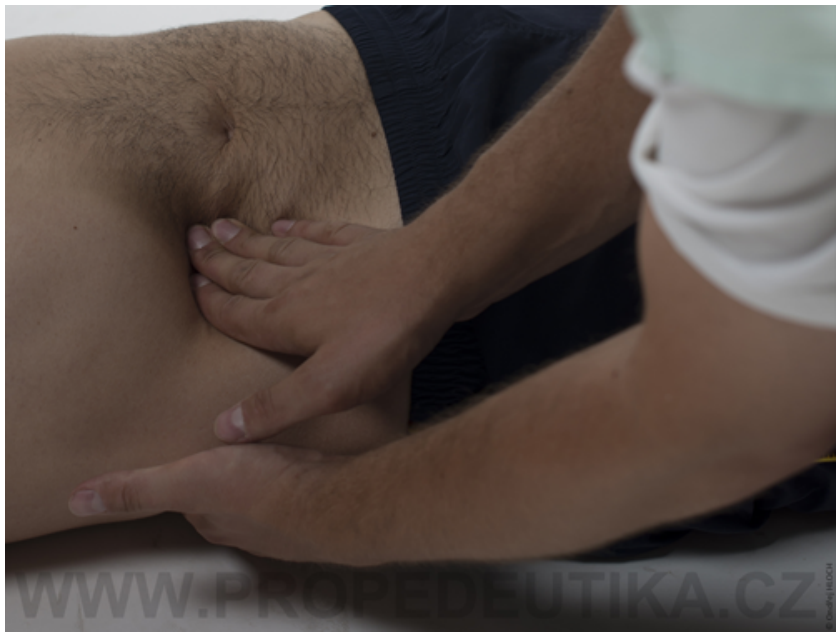


Figure: Kidneys examination

Urine assessment

Color

- light - decreased urine concentration (patient drinks a lot)
- orange – sign of dehydration and fever
- dark - with bilirubin for jaundice = obstructive icterus
- pink - weaker admixture of blood in urine
- dark brown - massively blood in urine = macrohematuria

Turbidity

Pus in the urine

Odor

e.g. after rotten apples - in diabetic ketoacidosis, after medication - endiaron, antibiotics

Urine assessment

Foam

Foam with higher content of bilirubin or protein

Amount

Oliguria (urine amount below 500ml / day), anuria (urine amount below 100ml / day), polyuria (more than 3l urine / day)

Urine examination

Proteinuria examination

- Orientation test with strips
- Quantitative proteinuria in 24 hours – urine collection (possibly morning urine sample or from second micturition)
- In adults physiologically max. 0.15g/24 hours (pregnant 0.3g/24h)

Proteinuria levels

- Small (up to 1g/day)
- Medium (1-3g/day)
- Large - nephrotic syndrom (more than 3g/day)

Albuminurie

- Standard up to 30mg/24h, albumin/creatinine ratio in urine = ACR standard up to 3mg/mmol
- albuminuria over 30mg/24h - is an early symptom in diabetic and hypertensive nephropathy, is a bad predictor of cardiovascular risk

Urine examination

Urine & sediment

- 10ml morning urine (medium flow, watch out for menses and discharge)

Biochemical examination

- Density, pH, protein, sugar, ketones, blood, leukocytes, nitrites, bilirubin, urobilinogen

Microscopic examination

Rating:

- Erythrocytes - norm 0-10/µl, glomerular (acanthocytes) x from outlet pathways
- Leukocytes - norm 1-15/µl, inflammation, sterile pyuria in TB
- Rollers - hyaline, granulated, cellular, waxy, fat, bacteria, epithelium (flat, round),
- Crystals (urates, oxalates)

Diagnostics

- Protein, erythrocytes, urine cylinders in immune non-infectious inflammations (glomerulonephritis)
- Leukocytes, bacteria and erythrocytes in urine due to infectious bacterial inflammation (pyelonephritis)

Examination of microerytrocyturia

Examination of erythrocytes in phase contrast

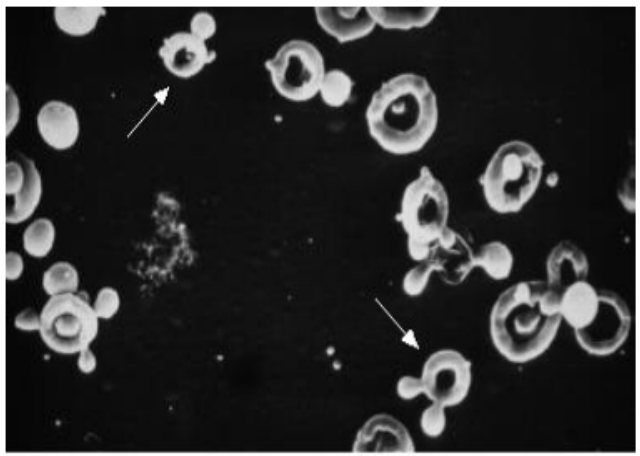
Glomerular hematuria suggests:

Dysmorphic red cells $\geq 80\%$

Acantocytes („budding erythrocytes“) $\geq 5\%$

Presence of erythrocyte cylinders

- The evaluation requires experience, is always subjective
- Between glomerular and nonglomerular findings there is a wide gray zone
- Diagnostic sensitivity for glomerular hematuria in phase contrast is $53 - 74\%$, specificity 50-98%.



Dysmorphic red cells Scanning microscopy showing dysmorphic red cells in a patient with glomerular bleeding. Acanthocytes can be recognized as ring forms with vesicle-shaped protrusions (arrows). Courtesy of Hans Köhler, MD.

Laboratory examination

Biochemistry:
urea, creatinine (high retention of nitrogen catabolites?), CKD EPI – is laboratory calculated value of renal function, sodium, potassium (hyperkalemia?), chloride, calcium, phosphorus, parathyroid hormone (hypercalcemia, hyperphosphatemia, secondary hyperparathyroidism), proteinemia, albumin - hypoproteinemia in nephrotic syndrome, liver test + bilirubin - hepatitis? hepatorenal syndrome?, glycemia (diabetes?), lipidogram, anemic group – metabolism of iron, vitamin B12 and folate
Blood count:
normocytic normochromic anemia?, microcytic sideropenic anemia? Urine + sediment: micro erythrocyturia?, proteinuria?, leukocyturia?, cylinduria? epithelium in urine? crystalluria? Albuminuria and proteinuria from a single urine sample.
Urine collection for 24 hours for renal function:
creatine clearance, tubular reabsorption, urine and protein waste.
Urine for cultivation
Immunological examination:
suspected glomerulonephritis or systemic autoimmune disease, inflammatory parameters (CRP, FW, procalcitonin), serum immunoglobulins, complement components, cryoglobulins, antistreptolysin O (ASLO), autoantibody collection (e.g. ANA, ENA, ANCA, antiGBM), antiPLA2R. . .)

Laboratory Examination

1.examination of serum urea concentration

- standard up to 8mmol/l
- a poorly accurate indicator of kidney function, influenced by the intensity of protein metabolism and protein intake
- increases with dehydration
- Urea is synthesized in the urea cycle in the liver, it is a waste substance that removes excess nitrogen from the body

2. examination of serum creatinine concentration

- standard for women up to 84 μmol/l for men up to 104 μmol/l
- final product of creatine phosphate degradation (it is an energy reserve for muscle contraction)
- in addition to endogenous synthesis, creatinine is also fed into the body through food

Laboratory Examination

3. examination of glomerular filtration

- creatinine clearance C (clearance = amount of plasma that is completely cleaned from the substance of interest per time unit)

$$C = \frac{U \times V}{P} \tag{1}$$

P = blood concentration of the substance
V = urine volume over 24 hours
U = concentration of the substance in the urine

- standard 1.5-2ml/sec, determination of glomerular filtration by calculation from serum creatinine (MDRD or CKD-EPI formula)

Laboratory Examination

4. examination of kidney concentration ability

- examination of tubular function
- monitoring of urine osmolality in:
  a) adiuretine test – the patient does not drink at night, in the morning apply 2 drops of ADH in the nose, urine collection at 1-hour intervals, osmolality at least 900mosmol/kg
  b) fluid withdrawal test - stopping water and fruit intake for 36 hours, similar evaluation – sensitive examination (glomerular filtration rate may still be normal)

5. examination of renal dilution ability

- we observe the reaction to increased water supply (20ml/kg b.w.), standard - elimination of $\frac{3}{4}$ of the fluid within 4 hours and decrease of urine osmolality below 100mosmol/kg

6. examination of kidney acidification ability

- after administration of an acidic substance (ammonium chloride) we monitor the ability to eliminate hydrogen ions and reduce the urine pH to 5.4-5.5.

Factors influencing examination of glomerular filtration

- Stage of chronic kidney disease ↓
- Pregnancy ↑
- Decreased renal perfusion ↓
- Increase and decrease in volume ECF ↑ ↓
- Drugs (NSAIDs, cyclosporin A, ACE-I, sartans. . .) ↓
- Protein or amino acid intake ↑
- Hyper- and hypoglycemia ↑ ↓
- Hypertension / hypotension ↑ ↓

Imaging methods

Ultrasonography of kidneys, Doppler´s sonography of renal vessels

Native radiograph of kidneys

Dynamic renal scintigraphy

Excretory urography

Cystography of micturition

CT or MR of kidneys

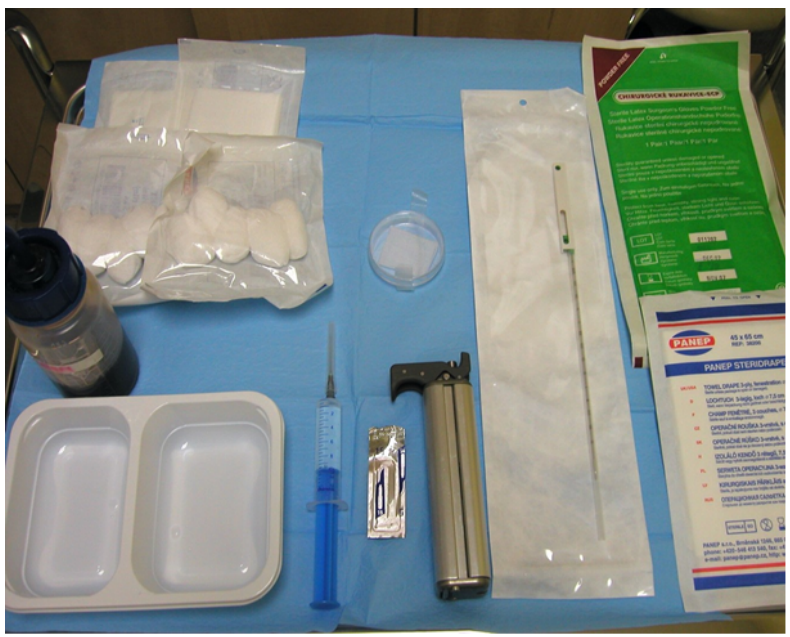
Angiography

Sonography in nephrology

- First choice method - easy availability, non-invasiveness, relatively low price
- Assessment of the shape, size and placement of the kidneys, breadth, echogenicity and homogeneity of the parenchyma, delineation and echogenicity of the renal sinus, filling of the pelvis and calyx
- Assessment of adrenal size, including possible bearing changes
- Assessment of the bladder, prostate and vascular supply of the kidney
- Basic examination method in transplantation nephrology
- Biopsy of autologous and transplanted kidneys, or other interventional procedures under ultrasonographic control

Renal Biopsy

- sampling of kidney tissue
- indications: protein in urine over 3g/day = nephrotic syndrome (CVP>3g/day, ↓ albuminemia, ↑ cholesterol), unclear renal deterioration, unclear acute renal failure, erythrocyturia, suspected nephropathy in systemic diseases
- contraindications: bleeding state, non-cooperating patient, morbid obesity, polycystic kidney disease, uncorrected hypertension, acute infectious kidney inflammation (pyelonephritis)
- design: patient lies on the abdomen, local anesthesia with 1% mesocaine, ultrasound measurement and control, biopsy needle sampling
- after surgery: the patient is lying on his back for 24 hours, with a sandbag compression, blood pressure checks, blood count control, coagulation after 3-4 hours, urine color control, ultrasound kidney control 2nd day to exclude hematoma



Possibilities of renal replacement therapy

1. **Kidney transplantation:** living donor, deceased donor
2. **Dialysis treatment:** hemodialysis (HD), home hemodialysis, peritoneal dialysis (PD), assisted peritoneal dialysis (APD);
3. **conservative treatment:** "non-dialysis treatment", "maximum conservative management" (MCM);

- indications: decrease in renal function to the terminal stage of chronic kidney disease, uncontrollable hypertension, uncontrollable hyperhydration, uremic syndrome (pericarditis, encephalopathy, bleeding, gastritis, anorexia, pruritus), conservatively uncontrollable acid-base imbalance and severe hyperkalaemia
- the most optimal replacement therapy for kidney function is transplantation (better survival and quality of life in most patients with chronic kidney disease than dialysis treatment). However, due to the lack of donor organs, most patients are treated with dialysis.

Renal replacement therapy

Kidney transplantation – placement of a kidney (from a living or cadaverous donor) to the hip pit. Transplants have a 70% lower risk of death than dialysis patients. Pre-emptive kidney transplantation before commencing regular dialysis therapy is the best and most natural replacement for renal function.
Hemodialysis/hemodiafiltration – in dialysis centers is the most widespread method of treatment of the terminal stage of chronic kidney disease in the Czech Republic (over 90% of patients). Chronic hemodialysis program – individual 3 times a week, 4-5 hours. Blood purification through semipermeable membrane (diffusion principle, convection, filtration through capillary dialyser). Chronic vascular input – AV shunt, central permanent catheter.
Peritoneal dialysis – CAPD (continuous ambulatory peritoneal dialysis), APD (automated peritoneal dialysis). Blood purification via peritoneum (diffusion, filtration, peritoneal pores filtration – according to solute concentration in dialysis solution) via peritoneal catheter inserted in the abdominal cavity.

- Advantages: greater patient autonomy, more flexible time scheduling, travel options, home-based method, dialysis center independence, the ability to combine dialysis with work responsibilities, lower fluctuations in body fluid volume and longer persistence of residual renal function, less cardiovascular stress – no vascular access required blood purification is smooth).
- Disadvantages: possible use only in cooperating patients with sufficient family background, other contraindications are severe obesity, stoma and adhesions after abdominal surgery.

Renal replacement therapy

Conservative therapy of chronic kidney disease - treatment of basic disease (eg diabetes, glomerulonephritis), good blood pressure control (blood pressure target values below 130-139 / 80-85 mm Hg), avoid nephrotoxic substances - high osmolar contrast agent, drugs (eg. aminoglycoside antibiotics, non-steroidal anti-inflammatory drugs), adjustment of the internal environment - adjustment of fluid intake, titration of diuretic therapy, risk of hyperkalaemia (diet, education of the patient, adjustment of medication). Cardiovascular risk factors, a reduced protein diet (e.g 0.8 g/kg body weight) should be identified and influenced.

Where to send the patient?

Urology

- retention of N-substances-postrenal etiology (urinary retention, according to sonography of kidney)
- dysuria, frequent urination, urge to urinate...
- recurrence of uroinfects (cystoscopic exam.)
- macroscopic / microscopic haematuria (<80% of dysmorphic red cells)

Nephrology

- N-retention
- proteinuria – swelling of legs, eyelids, foamed urine
- hematuria (>80% of dysmorphic era, acantocytes)

Have a nice day!

References:

Prof. Zadražil: Vyšetřovací postupy v nefrologii
Prof. Tesař, prof. Viklický: Klinická nefrologie
MUDr. Jitka Řehořová: Diagnostika onemocnění ledvin