

10. Hematuria

Hematuria means the presence of erythrocytes in the urine (the pathological condition is the capture of > 5 erythrocytes on the one field of view of the microscope). Hematuria is divided into **microscopic** and **macroscopic** (it is visible to the naked eye).

Possible causes of hematuria include:

- **inflammation** of the urinary tract - cystitis (burning, cutting, urgency, pain), pyelonephritis (flank pain, fever, sometimes together with symptoms of cystitis)
- **urinary stones** (acute renal colic or its history)
- **tumors** – of the urinary tract or advanced kidney tumors
- **trauma** (kidneys, ureters, urinary bladder)
- glomerulonephritis (together with high proteinuria)
- spontaneous bleeding (e.g. in case of overdose of anticoagulants)

Only in 15-45% is the origin of hematuria urological. The intensity and nature of haematuria do not correlate with the severity of the condition. The risk of malignancy in patients with haematuria increases with age, smoking, analgesic abuse, treatment with alkylating cytostatics, radiotherapy for the pelvis and other chronic conditions of the urogenital tract. In intermittent hematuria, the risk of cancer reaches 3-9%, in permanent hematuria it is between 5 and 20%.

The basic examination is ultrasonography of the urinary tract (kidneys and bladder).

CT urography for the detection of urothelial carcinoma (especially of the upper urinary tract) is now the method of choice in patients with hematuria. Cystoscopy is necessary to rule out a bladder tumor.

Radiological imaging methods in hematuria:

Ultrasound:

- available method (performed by urologists), non-invasive, cheap.

Excludes dilatation of the kidney collecting system (may be caused by urothelial carcinoma, ureterolithiasis,...).

Excludes large renal cell carcinoma (small is usually not the cause of haematuria).

High sensitivity for the detection of bladder tumors (when the bladder is full).

Low sensitivity for detection of small nephrolithiasis, ureterolithiasis, upper urinary tract tumors.

Non-contrast CT (without intravenous contrast administration)

is the method of choice for imaging urolithiasis (sensitivity is almost 100%, it also displays uric acid stones).

CT urography (= with intravenous administration of contrast agent including excretory phase)

it is used to detect tumors of the upper urinary tract and staging of bladder tumors (most bladder tumors are already found on ultrasound or cystoscopy).

Note - in many patients with hematuria this examination is negative, so the effort is to adjust the protocol to reduce radiation exposure (smaller number of postcontrast phases, split bolus protocol –

i.e. with gradual application of the contrast in 3 boluses allows to visualise enhancing cortex, medulla and renal drainage system on one postcontrast CT scan). Thus, the examination may not be optimal for other indications - for example, for staging of renal cell carcinoma or investigation of unclear kidney deposits, because dynamics of enhancement is not evident (just one postcontrast phase). Therefore, two or three postcontrast phases are usually performed for staging of renal cancer.

MR urography:

- examination to show urinary tract (tumors, congenital anomaly)

- 2 basic types:

Excretory MR urography - with intravenous contrast administration

- includes an excretory phase similar to a CT scan

- compared to CT, there may be a problem with movement artifacts and with too high concentration of gadolinium contrast agent in the urinary tract (susceptible artifacts)

Static MR urography (or MR hydrography) - only non-contrast with a special hydrographic sequence

- ureters are displayed, but enhancement of tumors cannot be evaluated

- it is performed mainly in patients with severe renal insufficiency and in children in the search for congenital anomalies.

Performed especially if CT urography cannot be performed (allergy to iodine., renal insufficiency)

CAVE! In CKD 4 and 5 (chronic kidney disease) there is a higher risk of nephrogenic systemic fibrosis, therefore only low-risk gadoline contrast agents can be administered with caution.

Kidney tumors

- incidence: 30 / 100,000 inhabitants

- more histological subtypes differing in radiological image, the most common and most vascularized is the clear-cell renal cell carcinoma (Grawitz's tumor)

- these are typically accidental findings on ultrasound / CT performed for another reason

- tendency to tumor thrombosis of the renal vein resp. inferior vena cava (direct spread through the lumen of the veins)

- metastases - lungs, lymph nodes, skeleton, liver, brain, pancreas,...

Tumors of the urinary tract

- incidence: urinary bladder - 20 / 100,000, renal pelvis - 2 / 100,000, ureter - 0.8 / 100,000

- histologically - urothelial carcinoma (90%), squamous cell carcinoma, adenocarcinoma

- the main symptom is haematuria

- urological possibilities of examination - cystoscopy (biopsy, resection), ureterorenoscopy, cytology of the ureter, retrograde pyelography (direct application of a contrast agent into the ureter + visualisation under fluoroscopy)

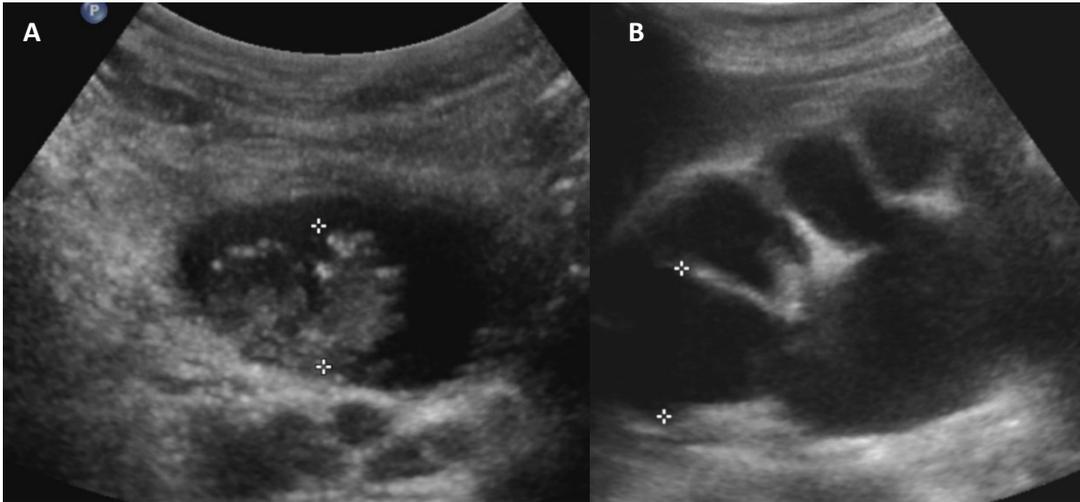


Fig. A - Ultrasound - urinary bladder tumor

Fig. B - Ultrasound - dilation of renal pelvis and renal cortex atrophy due to the urinary bladder tumor

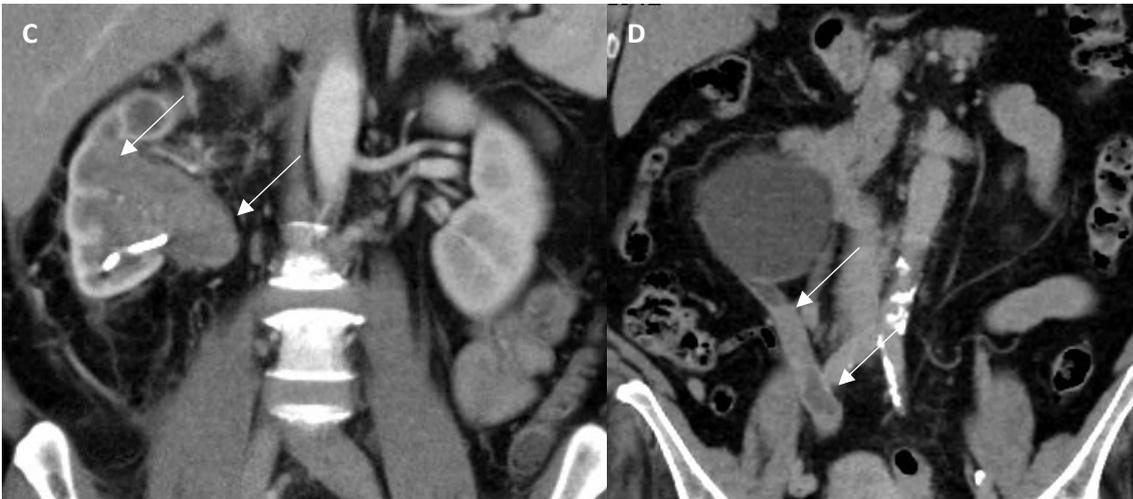


Fig. C - Contrast-enhanced CT – urotelial carcinoma of the renal pelvis (**white arrows**)

Fig. D - Contrast-enhanced CT – urotelial carcinoma of the ureter (**white arrows**)



Fig. E - MR hydrography – well visualised is renal collecting systém, bile ducts and cerebral fluid

