Urogenital imaging

Imaging methods

Plain abdominal film

A properly performed plain abdominal film requires the last two ribs and the pubic symphysis to be visualized on the film. It is a radiological technique useful in the evaluation of renal morphology, as it can evaluate the renal shadows (contour, size, position) or regarding the presence of calcifications (stones, parenchymal calcifications or overlapping calcifications).

Imaging methods

Intravenous urography (IVU)

IVU is performed after a plain abdominal film and involves intravenous administration of a iodinated contrast agent, followed by repeated exposures at predefined time intervals. Any contrast agent administered intravenously has a functional time, a morphological time and an excretory time.

About 5-7 minutes from the moment of injection, the first image acquisition is made and the images corresponding to the functional phase are obtained. In this phase, the nephrogram must be present and symmetrical. The functional phase allows to appreciate the secretory function of the kidneys, as well as to appreciate the kidney changes regarding size, contour and position.

Imaging methods

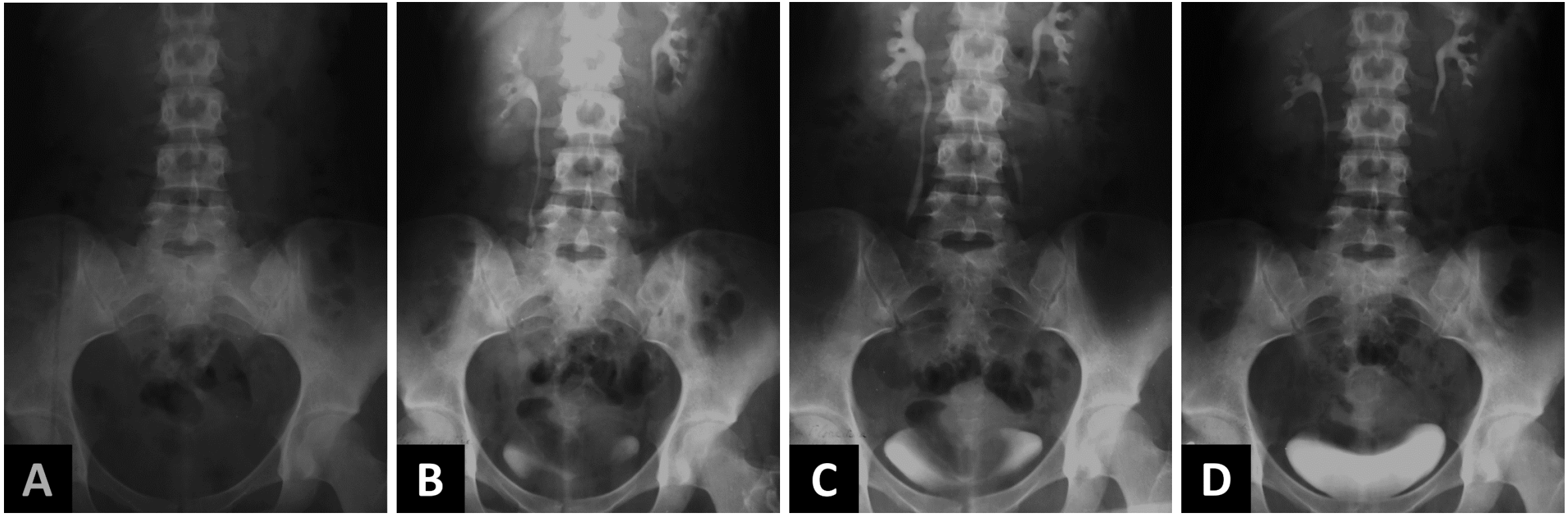
Intravenous urography (IVU)

The next image acquisition is at about 15-20 minutes from the moment of injection and corresponds to the morphological phase. In this phase, the renal excretion is highest. The morphological phase allows a proper assessment of the morphology of the calyces, renal pelvis and ureter (not on its entire length), as well as the excretory function of the kidneys.

The last image acquisition is at about 30 minutes from the moment of injection and corresponds to the phase of elimination (excretion) of the contrast agent in the bladder. Using this phase, it is possible to evaluate changes in shape and size of the bladder.

Imaging methods

Intravenous urography (IVU)



Imaging methods

Intravenous urography (IVU)

IVU requires careful preparation of the patient in order to evacuate the gas and solid content from the colon, as it may interfere with the examined structures. This can be achieved by adopting an adequate food regime and an enema for content evacuation. In addition, the preparation of the patient also involves maintaining a certain level of dehydration of the patient, in order to obtain an increased intravenous concentration of contrast substance.

The utility of the IVU has now decreased due to the development of superior imaging techniques. Some of the indications for IVU include: renal secretion / excretion disorders, detecting stones inside the urinary tract, detecting renal abnormalities.

IVU contraindications include: iodine allergy, pregnancy, severe kidney failure, recent myocardial infarction.

Imaging methods

Renal angiography

Angiography of the renal vessels is indicated for suspected lesions that affect the renal artery: aneurysms or stenosis. Using the newly developed techniques of angio-CT and angio-MRI, it is possible to simultaneously explore the kidneys, the urinary tract and the renal vascularization in a non-invasive manner.

Imaging methods

Pielography, cystography, uretrography

Pielography can be performed anterograde (percutaneous) or retrograde (cystoscopic). Similarly, cystography can be performed anterograde (suprapubian catheter/as a last phase of UIV) or retrograde (by introducing the contrast substance through the urethral probe). Uretrography can be performed anterograde (after cystography) or retrograde.

Imaging methods

Ultrasonography

US is preferred as the initial imaging method for evaluating parenchymal organs due to its non-invasive nature, rapidity, increased availability and reduced costs. An ultrasonographic examination can be performed natively (without contrast agent) or using a contrast agent based on gas bubbles. In addition to the pathological changes in the kidneys, the US can detect ascites.

Imaging methods

Ultrasonography

Imaging methods

Ultrasonography

US allows evaluation of any region of the urinary tract, except the iliac portion of the ureters. The US can be successfully used as an initial imaging diagnostic method in the evaluation of renal pathology. US allows real-time guidance for interventional maneuvers such as nephrostomy or abscess drainage.

Some of the disadvantages of this technique are represented by the difficult examination of the region of interest in case of rich subcutaneous fat tissue or in the event of an increased amount of air inside the bowel.

Imaging methods

Computed Tomography

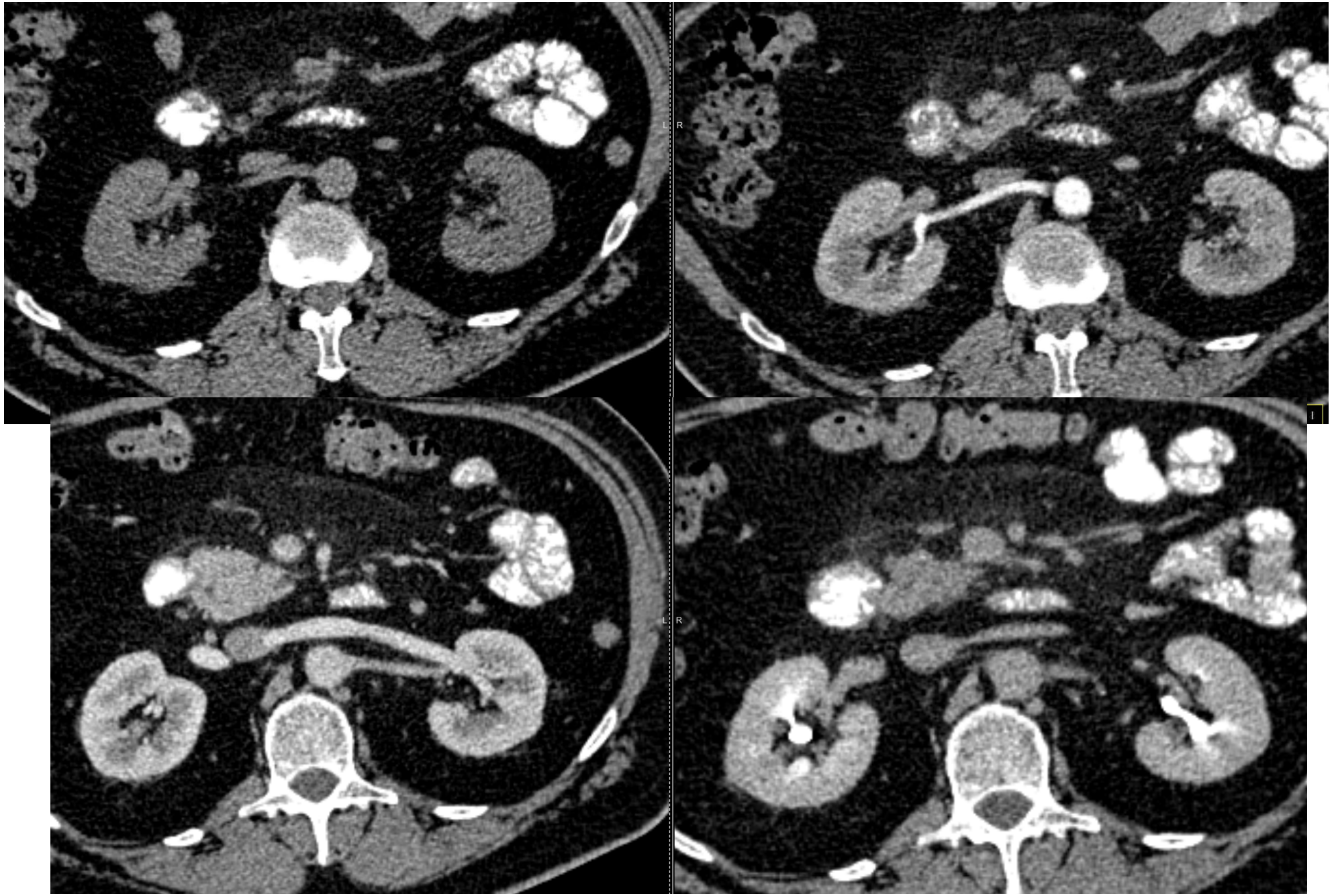
The protocol of a CT examination with iodinated contrast agent begins by obtaining native images, acquired before administering the contrast. Subsequently, the iodinated contrast agent is administered intravenously and successive scans are performed at predefined time intervals. Reported at the time the injection began, the images obtained at approximately 25-30 seconds correspond to the arterial phase, those obtained at 60-70 seconds correspond to the venous phase and those obtained at approximately 5-10 minutes correspond to the late phase, when the contrast agent is eliminated through the renal pathway.

Imaging methods

Computed Tomography

The advantages of CT examination include fast image acquisition (which is why it is preferred as a diagnostic imaging method in emergency), the possibility to store the acquired images in an online database that can be accessed anywhere and anytime an Internet connection is available, as well as the possibility to carry out multi-planar reconstructions in all 3 planes (axial, coronal, sagittal). However, the method is limited by the relatively high costs of examinations, but also by the harmful effects of X-rays in case of repeated scans.

Due to the irradiating nature of this imaging diagnostic method, pregnancy is a contraindication to both native and postcontrast CT. Other contraindications are renal failure, iodine allergy or other medications.



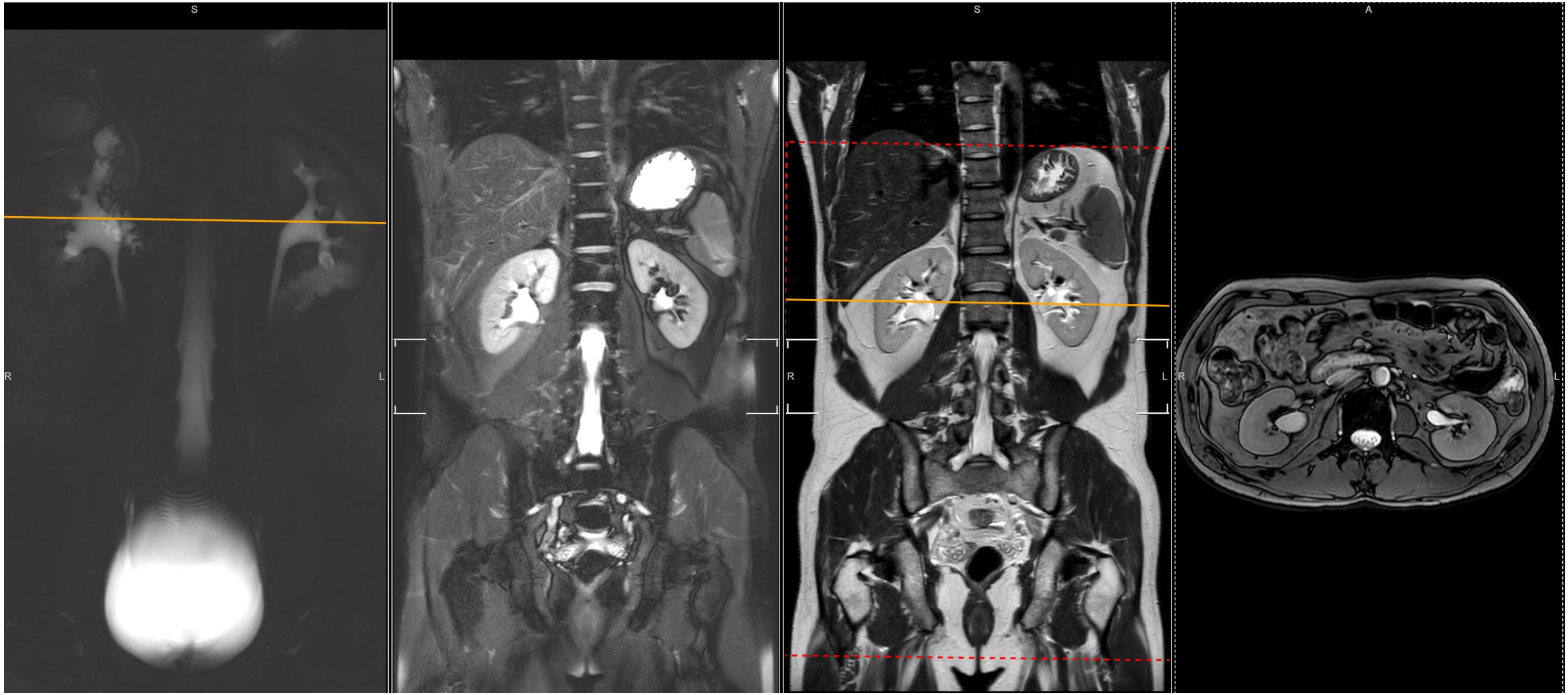
Imaging methods

Magnetic Resonance Imaging

MRI examination can be done natively (without contrast agent) or using a gadolinium—based contrast agent.

In the case of the native MRI scan, the basic sequences are T1 IP (in-phase), T1 OP (out-of-phase), T2, T2 SPAIR (with fat suppression), DWI (diffusion weighted imaging).

The contrast agents behave similar to those used in CT and offer the possibility of acquiring images in the three phases (arterial, venous and late).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Imaging methods

Magnetic Resonance Imaging

The advantages of using MRI include the non-radiating character and the possibility of storing the images in an online database. Regarding disadvantages, the MRI technique involves an increased image acquisition time (which is why it is not used in emergency like the CT) and significantly higher costs.

Pregnancy in the first trimester, allergy to the contrast agent, the presence of metal rods or prostheses, cardiac valve prostheses and claustrophobia are contraindications to perform an MRI examination.

Imaging methods

Hybrid imaging – PET/CT, PET/MR

PET-CT and PET-MRI are modern imaging techniques that involve the use of a radioactive tracer. Most commonly, 18F-fluorodeoxyglucose (18F-FDG) is used as a radiotracer. The imaging methods described above can detect lesions that exhibit intense radiotracer concentration due to the intense metabolic activity at this level.

Congenital disorders

Number anomalies

a. Renal agenesis - frequently occurs unilaterally, rarely bilaterally. Unilateral renal agenesis implies the existence of a single congenital, enlarged compensatory kidney. Bilateral renal agenesis is incompatible with life.

b. Renal aplasia - fetal buds do not develop into a normal functioning kidney. Bilateral renal aplasia is incompatible with life.

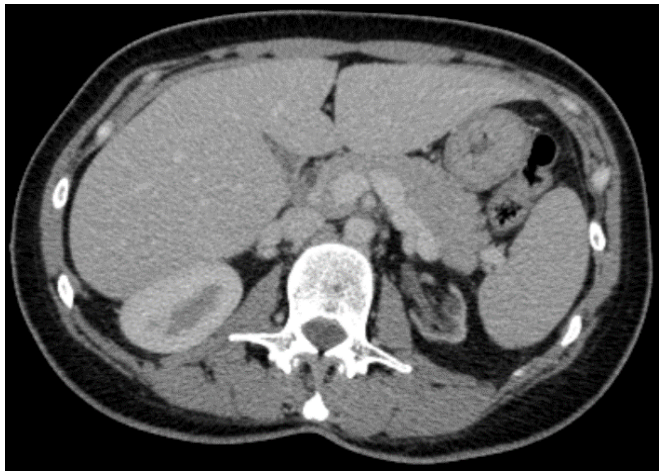
c. Supranumerary kidney – a rarely encountered renal malformation which implies the existence of a third kidney that has its own vascularization and urinary tract.

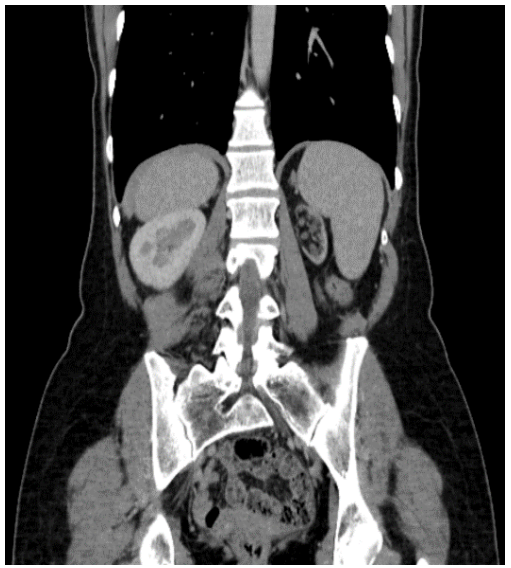
Congenital disorders

Size anomalies

a. Renal hypoplasia - the kidney appears small in size, with poorly represented renal vascularization and excretory urinary tract. Renal function may be impaired.

b. Renal hyperplasia - the kidney appears increased in size, with well-represented renal vascularization and excretory urinary tract. Renal functions appear to be normal. It is important to mention that congenital renal hyperplasia is different than the enlargement of the kidney following an acquired pathology.





Congenital disorders

Shape anomalies

a. Persistence of fetal lobulation - the kidney has a lobulary appearance, characteristic for a fetal configuration that usually disappears before the age of 4.

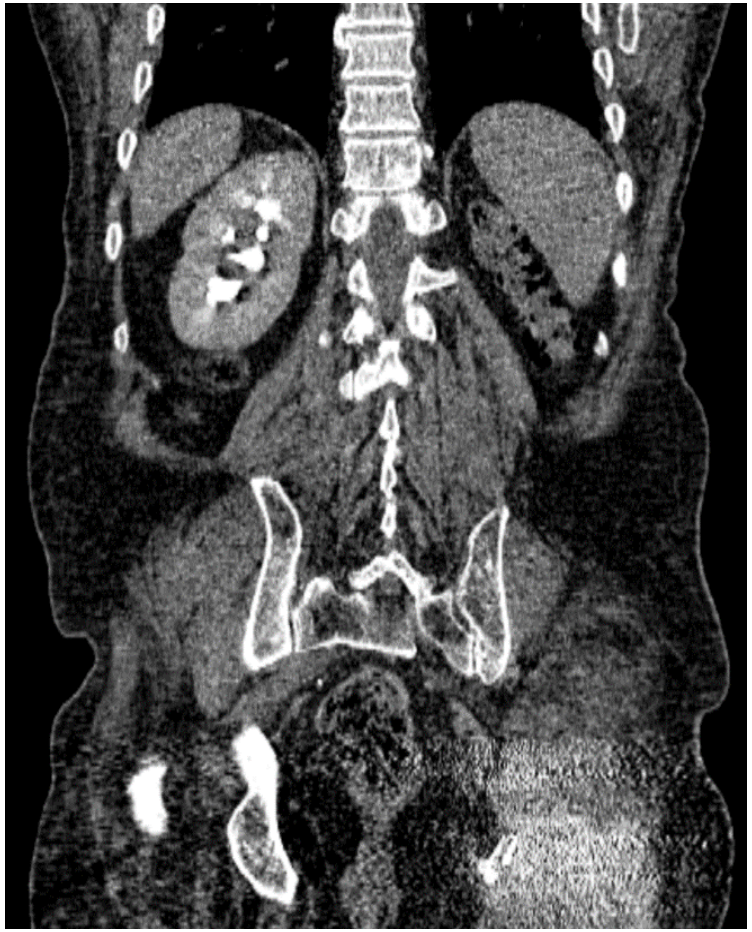
b. Renal fusion - the kidney in the horseshoe - the fusion of the two kidneys at the lower anterior pole, anterior to the aorta and the inferior vena cava. In addition, the two kidneys seem to have a lower position than normal.

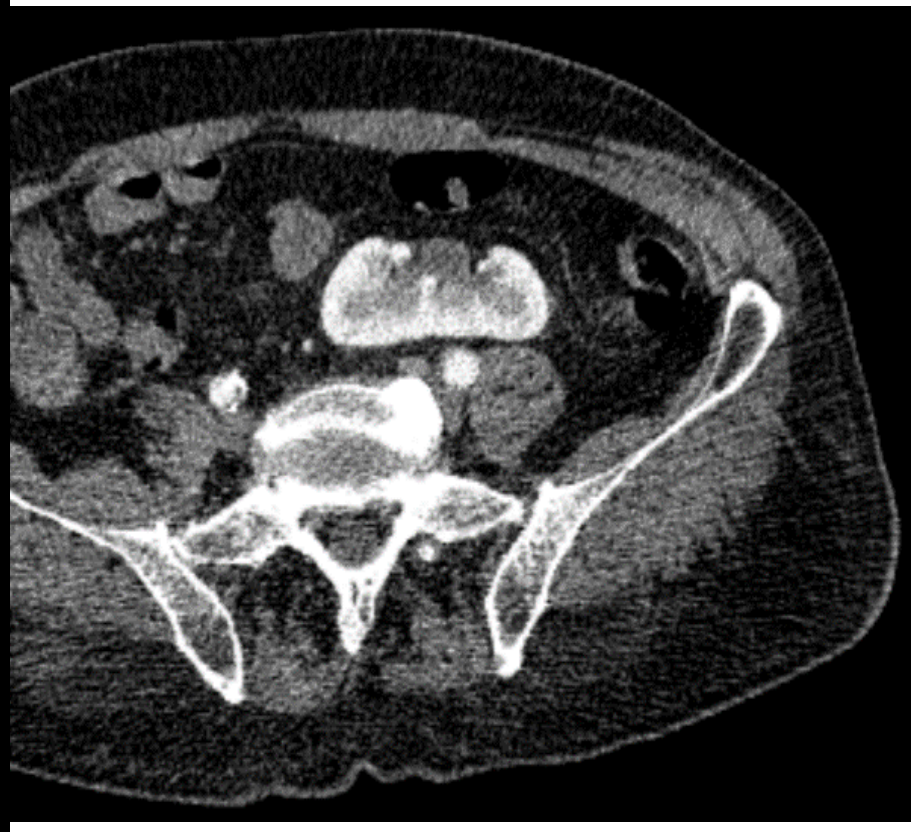
Congenital disorders

Position anomalies

a. **Ectopic kidney** - the kidney has an abnormal position. It can be uni- or bilateral. In case of renal ectopia, this can be done in a both cranial or caudal (lumbar, iliac, pelvic) way. Also, crossed renal ectopia may be present. The ectopic kidney has a rectilinear ureter, as opposed to renal ptosis which has a sinuous, normodimensional ureter.
b. **Kidney malrotation -** lack or exaggeration of the normal rotation of the renal pelvis around the longitudinal axis.

Congenital disorders

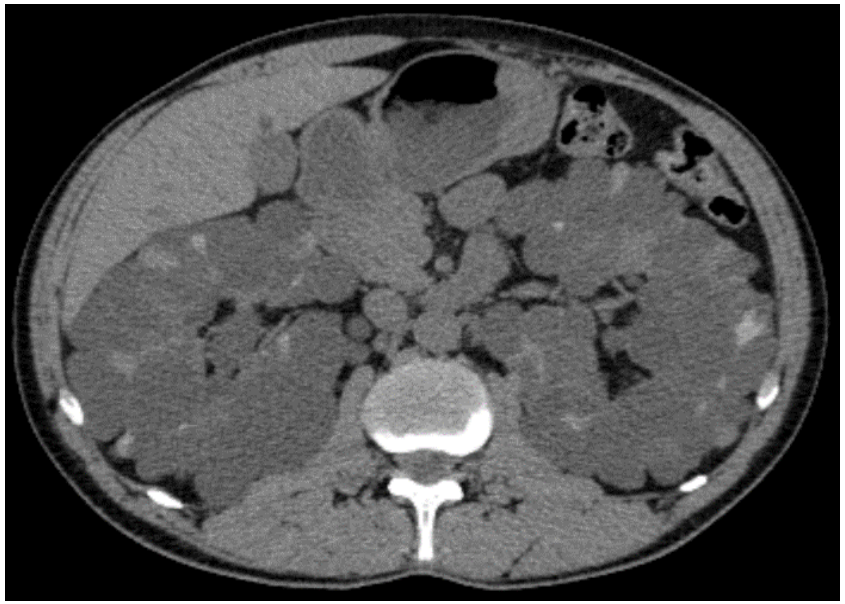




Congenital disorders

Renal parenchymal anomalies

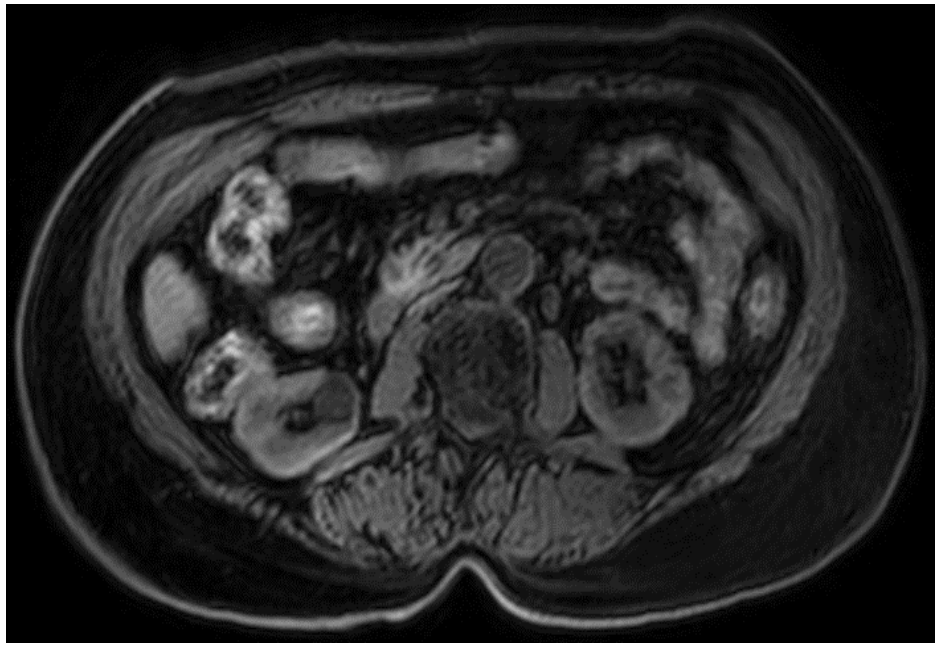
a. Polycystic kidney - unilateral (rare) or bilateral (frequent) congenital renal disease, characterised by a disorganised kidney and urinary tract architecture of the kidney due to multiple cystic areas that protrude from the renal outline. These cysts determine mass effect on the functional renal parenchyma and on the excretory urinary tract, with important consequences on the renal function.

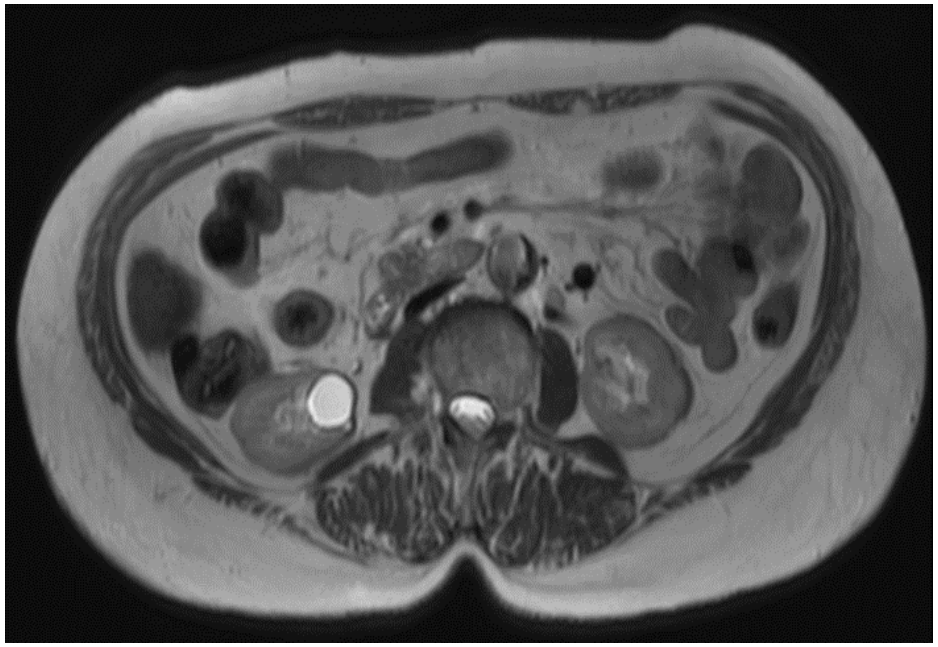


Congenital disorders

Renal parenchymal anomalies

b. Cystic kidney - the presence of single or multiple renal cysts. On the CT examination, the cystic areas have densities similar to fluids (0-10 UH) and do not enhance contrast. At the MRI examination, the cystic areas appear hypointense on T1 and hyperintense on T2 and do not show contrast enhancement.



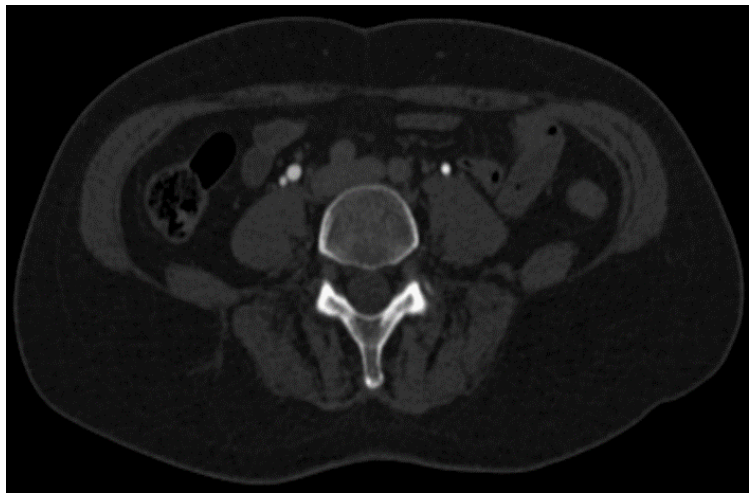


Congenital disorders

Urinary tract anomalies

a. Megacalyces - marked dilation of the calyces, without being accompanied by the dilatation of the renal pelvis or ureter, as in acquired hydronephrosis.

b. Calyces and renal pelvis duplicity +/- ureteral duplicity - this type of anomaly refers to the presence of a double renal pelvis and / or a double ureter that either opens individually in the bladder or joins the other ipsilateral ureter and the two of them open together in the bladder.



Congenital disorders

Urinary tract anomalies

c. Blind ureter - at the proximal end, the ureter is connected to a dysfunctional kidney, and at the distal end, the ureter ends in a sac before reaching the bladder.

d. Renal pelvis-ureter junction syndrome – the urine flow is blocked at the renal pelvis-ureteral junction.

e. Ureteral strictures - narrowing of the ureteral lumen frequently at the renal pelvis-ureteral junction and the the ureter-bladder junction.

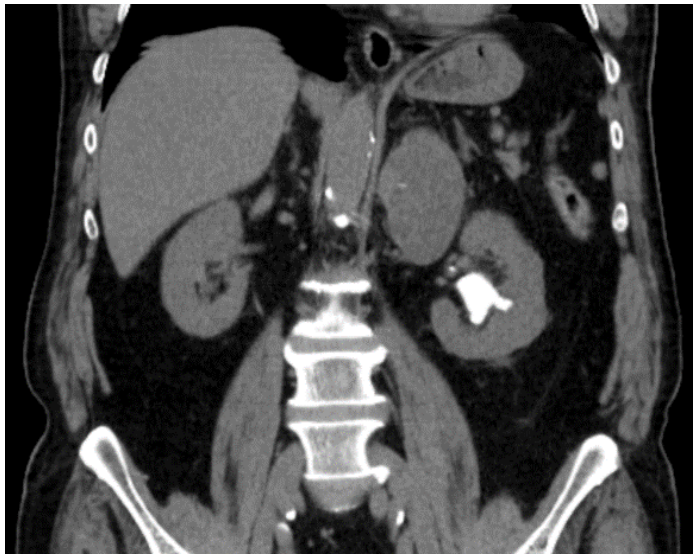
f. Megadolicoureter - the ureter has increased length, sinuous path and increased calibre.

g. Ureterocele - saccular dilatation of the ureter in the intramural portion.

Acquired renal disorders

Urinary lithiasis

Urinary lithiasis frequently affects males and involves the formation of stones in the calyces and renal pelvis, after which they can migrate to the ureter and bladder. It is important to note that the shape of the stones is similar to the cavities in which they are formed in (oval, triangular, etc.). Coraliform stones represent a special type of stones that develop simultaneously in the calyx and renal pelvis, with possible extension to the ureter.



Acquired renal disorders

Urinary lithiasis

On a plain abdominal film, the appearance of the stones varies depending on their composition:

- radioopaque stones: calcium phosphate, calcium oxalate;

- hardly visible stones: cystine;

- radiolucent stones: uric acid, xanthine.

UIV is useful for evaluating renal secretory and excretory functions, as well as for evaluating obstruction. In case of an obstruction caused by the presence of a stone, superjacent dilatation of the urinary tract is observed (for example, a stone located in the ureter determines superjacent dilatation of the calyces, renal pelvis and ureter located above of the stone).

US may be useful in evaluating renal stones as hyperechoic focal areas with posterior acoustic shadow, as well as highlighting the overlying hydronephrosis in case of ureteral stones. It should be noted that the ultrasound does not detect very small stones, nor the renal sand.

Acquired renal disorders

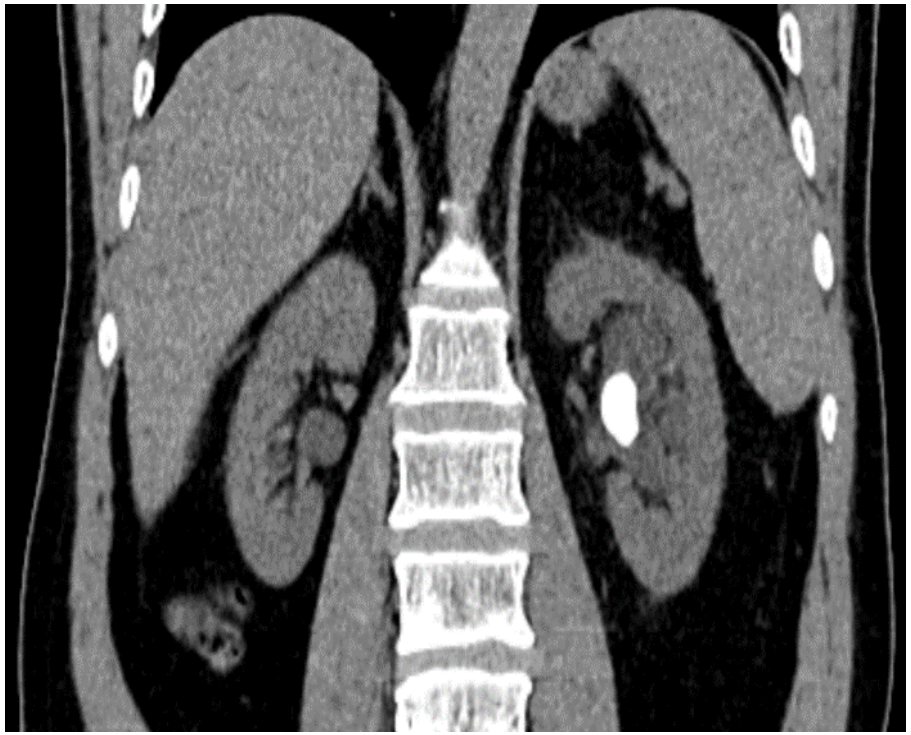
Urinary lithiasis

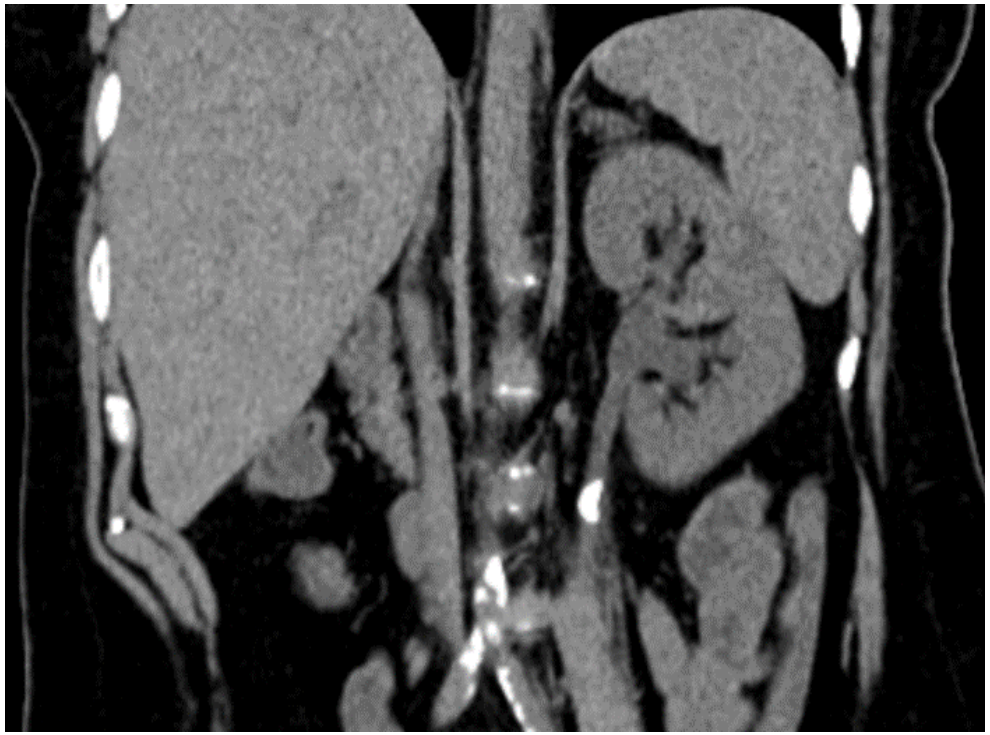
Native CT is currently used in emergency imaging in case of suspected renal colic because **it can detect most of the stones inside the urinary tract (>99%).** This examination can detect stones as hyperdense images, located in the urinary tract (calyx, renal pelvis, ureter, bladder). For the evaluation of the renal secretory and excretory functions, as well as for the evaluation of the urinary obstruction, uro-CT is performed, combined with intravenous administration of a contrast agent and image acquisition at predefined times. In case of an obstruction caused by the presence of a stone, overlying hydronephrosis of the urinary tract is observed.

Uro-MRI is not indicated for the evaluation of renal lithiasis. Exceptionally, it can be used in pregnant patients, children or patients in whom the administration of the iodinated contrast agent is contraindicated.

Acquired renal disorders

Urinary lithiasis





Acquired renal disorders

Hydronephrosis

Hydronephrosis represents the dilatation of the renal pelvis and calyces, as a result of an obstruction of mechanical (stones, intrinsic tumor mass, extrinsic compressive tumor mass) or inflammatory causes.

For evaluation of hydronephrosis, US, UIV or CT can be used.

Acquired renal disorders

Hydronephrosis

Hydronephrosis is classified as follows:

grade 0: no dilatations of the urinary tract, normal parenchymatous index (IP);

grade I: minimum dilatation of the renal pelvis, no dilatations of the calyces, normal IP;

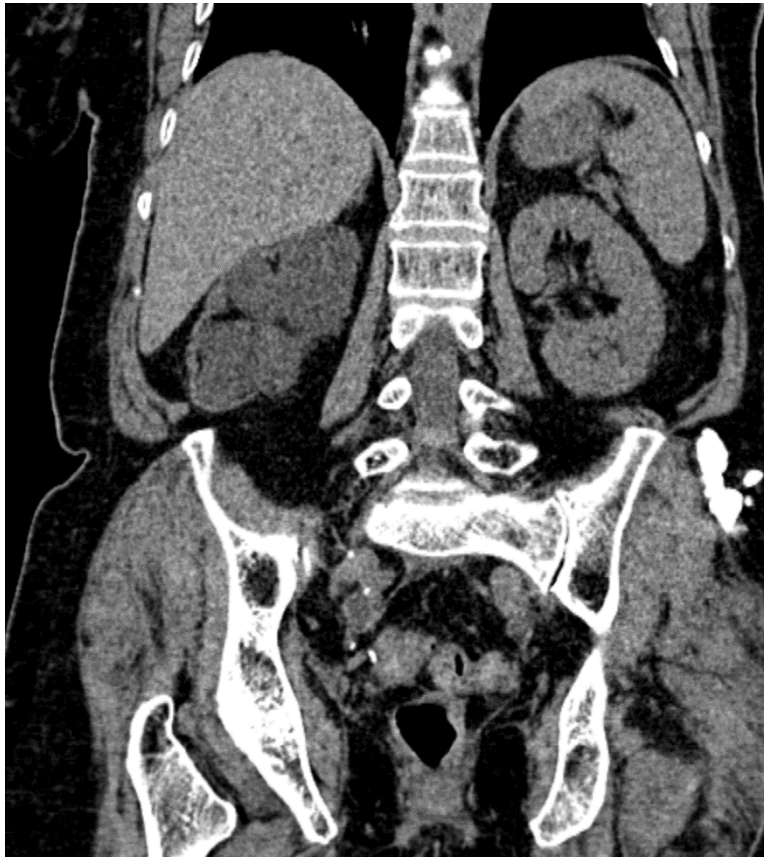
grade II: minimum dilatation of the calyces and renal pelvis, normal IP;

grade III: moderate dilatation of the calyces and renal pelvis, minimum decrease of IP;

grade IV: marked dilatation of the calyces and renal pelvis, atrophy of the cortical area, no delineation between calyces and renal pelvis.

Acquired renal disorders

Hydronephrosis



Acquired renal disorders

Renal cysts

Kidney cysts are the most common adult focal kidney lesions.

US: round-oval lesion, transonic content, well delimited by a fine wall, located in the cortical or parapyelic area.

CT: round-oval lesion with fluid densities, well delimited, non-enhancing.

MRI: round-oval lesion seen as hypo T1, hyper T2, homogeneous, non-enhancing.

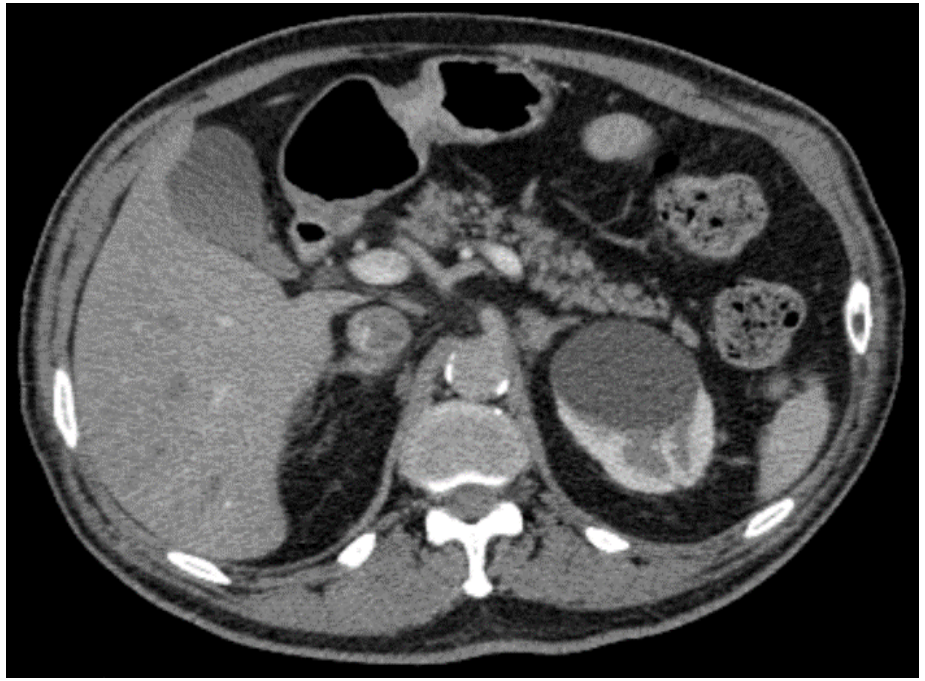
Acquired renal disorders

Renal cysts

Kidney cysts are classified based on Bosniak classification system:

Bosniak I

- fluid echogenicity / density / signal;
- homogeneous;
- well delimited by a fine wall;
- no contrast enhancement;
- no septations, calcifications or solid components;
- ~ 0% are malignant lesions.



Acquired renal disorders

Renal cysts

Kidney cysts are classified based on Bosniak classification system:

Bosniak II

- fine intralesional septations that do not enhance contrast;
- peripheral or septae calcifications;
- homogeneous;
- well delimited by a fine wall;
- size <3 cm;
- no contrast enhancement;
- ~ 0% are malignant lesions.

Acquired renal disorders

Renal cysts

Kidney cysts are classified based on Bosniak classification system:

Bosniak IIF

- multiple fine intralesional septations that do not enhance contrast;
- minimal parietal or septae thickening with possible nodular calcifications;
- increased native densities on CT;
- no tisular components;
- size >3 cm;
- no contrast enhancement;
- ~ 5% are malignant lesions.

Acquired renal disorders

Renal cysts

Kidney cysts are classified based on Bosniak classification system:

Bosniak III

- irregular thickening of the lesion wall and/or intralesional septations – contrast enhancement at this level;
- ~50% are malignant lesions.

Acquired renal disorders

Renal cysts

Kidney cysts are classified based on Bosniak classification system:

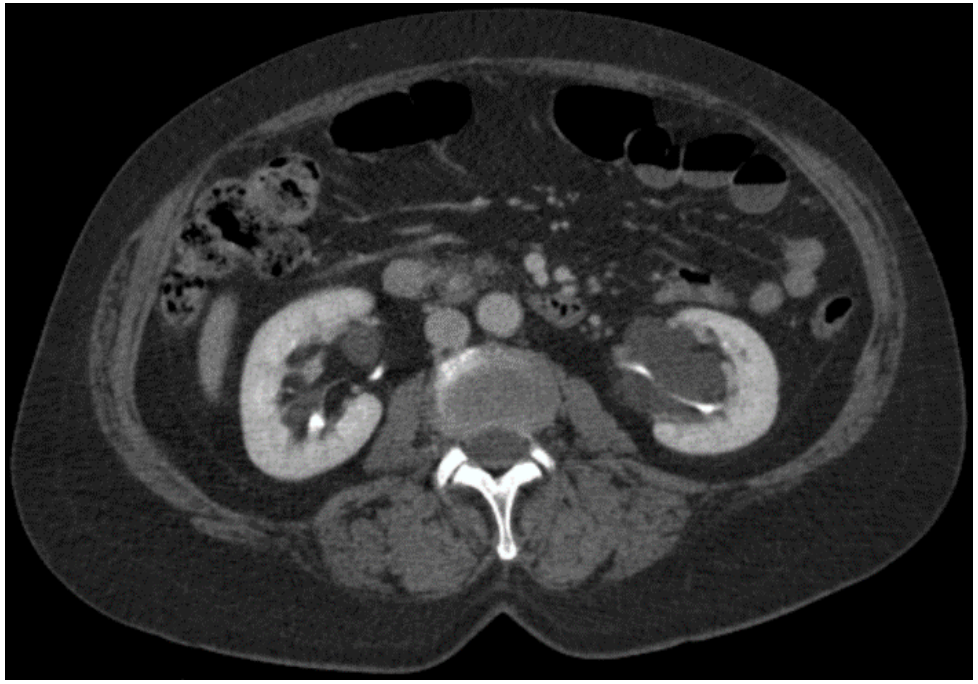
Bosniak IV

- cystic masses with malignant traits that accomplish the criteria described at Bosniak III, but additionaly present distinct tisular components that enhance contrast;
- ~100% are malignant lesions.

Acquired renal disorders

Renal cysts

Parapyelic cysts – simple renal cysts that develop and extens around the renal pelvis and the calyces and determine mass effect over them – it can lead to hydronephrosis.



Acquired renal disorders

Benign renal tumors

Angiomyolipoma is a benign renal tumor that has arterial vessels (angio), smooth muscle fibers (myo) and mature adipose tissue (lipoma).

US: a hyperechoic mass with a regular contour is visualized and the color Doppler mode highlights the presence of vascularization inside the lesion.

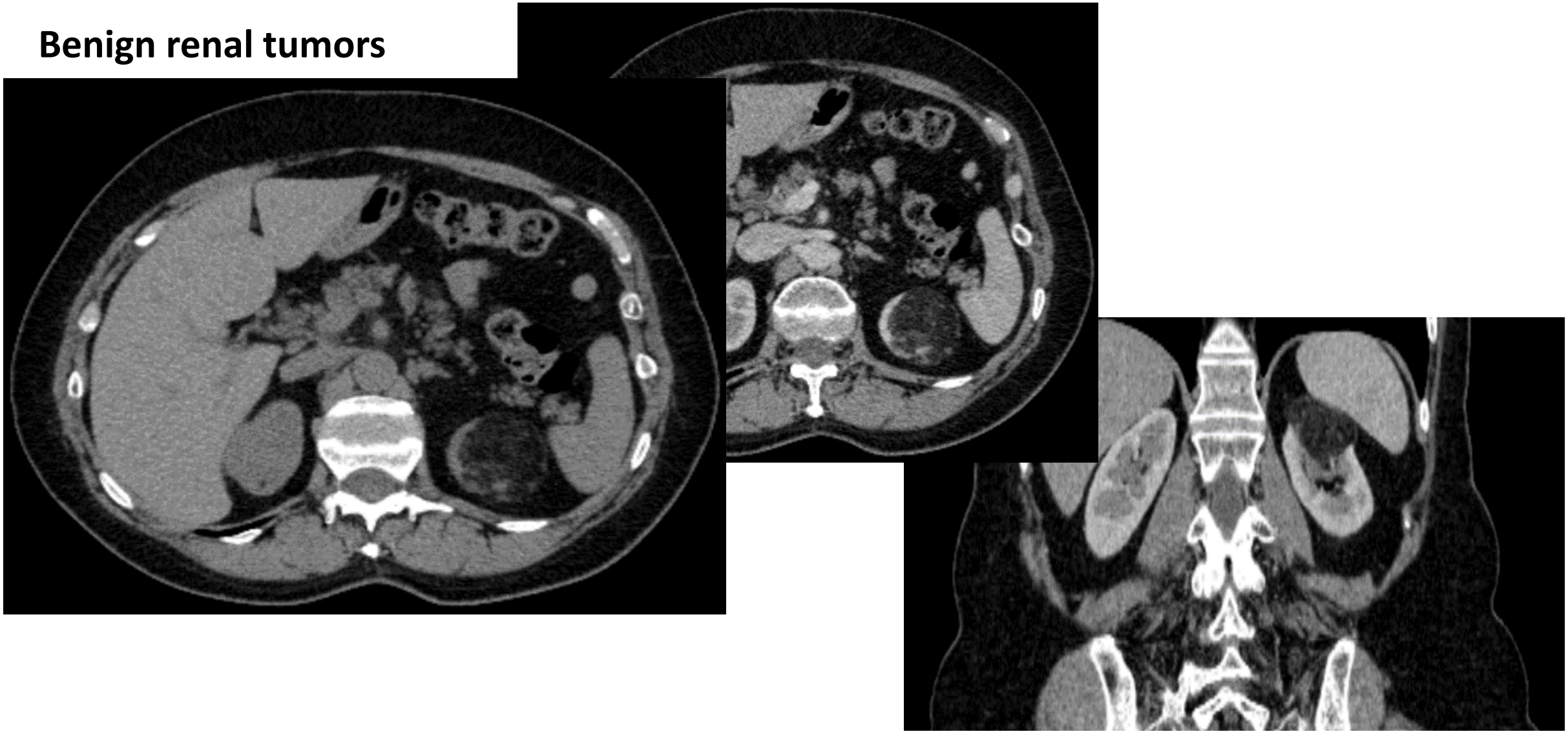
IVU: the mass protrudes from the renal contour and generates mass effect over the urinary tract (calyces, renal pelvis).

CT: the vascular and muscular components show significant increases in density after contrast administration. The fatty component is characterized by the negative values of the densities (-20 to -120 UH) and it does not enhance after contrast administration.

MRI: angiomyolipoma appears hyper T1 and T2 (mainly due to the fatty component), with loss of signal intensity in the fat suppression sequences (T1 in-phase: hyperintense; T1 out-of-phase: hypointense).

Acquired renal disorders

Benign renal tumors



Acquired renal disorders

Benign renal tumors

The oncocytoma is a rare benign renal tumor, difficult to differentiate from malignant tumor masses.

US: iso / hypoechoic mass, with a hyperechoic central scar.

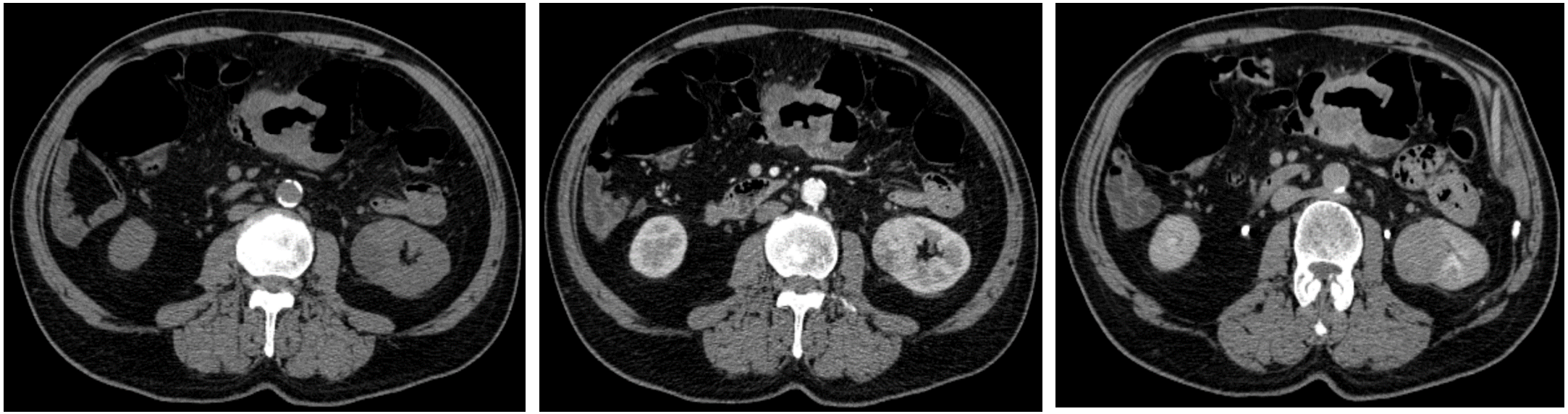
CT: tumor mass is single or multiple, homogeneous, well delimited, iso- / hyperdense natively. Postcontrast, the lesion may enhance slightly. In the center of the lesion, a hypodense non-enhancing scar can be seen sometimes.

MRI: the tumor appears as iso T1 and iso-/ hyper T2 and is well delimited. In the center of the lesion, a scar can be visualized as hypoT2, non-enhancing.

Acquired renal disorders

Benign renal tumors

Oncocytoma



Acquired renal disorders

Malignant renal tumors

Renal carcinoma

Renal carcinoma is the most common malignant renal tumor that develops more frequently in men than in women

IVU: deformation of the renal contour and compression / amputation of the calyces/renal pelvis.

US: can highlight renal tumor mass in the form of a hypo- / hyperechoic solid mass, with an intensely heterogeneous structure, with calcifications and areas of necrosis; Doppler can reveal the tumor neovascularization.

CT: the native examination reveals an iso / hypodense tumoral mass, with possible calcifications at this level. After administration of the intravenous contrast substance, renal carcinomas present as tumor masses that protrude from the renal contour and disrupt the renal and urinary tract architecture and present a heterogeneous with hypervascular or hypovascular areas and areas of necrosis.

Acquired renal disorders

Malignant renal tumors

Renal carcinoma

CT examination allows evaluation of local tumor extension, lymphatic extension, as well as the presence of secondary lesions. In order to assess the local tumor extension, the integrity of the renal capsule, the invasion of perirenal fat, renal vessels (artery and renal vein) and adjacent structures are evaluated. In order to assess the lymphatic extension, the regional lymph nodes are evaluated. Last but not least, CT examination is particularly useful in the evaluation of distant metastases.

MRI: The characteristics of the tumor mass are variable depending on the tumor vascularization, as well as the presence or absence of hemorrhagic, necrotic areas or calcifications. The enhancement pattern of the tumor is similar to the one described on the CT examination. MRI examination is commonly indicated for evaluation of renal intravascular tumor thrombosis.

Acquired renal disorders

Malignant renal tumors

Renal carcinoma

Acquired renal disorders

Malignant renal tumors

Urothelial carcinoma

Urothelial carcinoma develops in the urinary excretory pathways (calyx, renal pelvis, ureter).

US: iso / hypoechoic mass compared to the renal cortex.

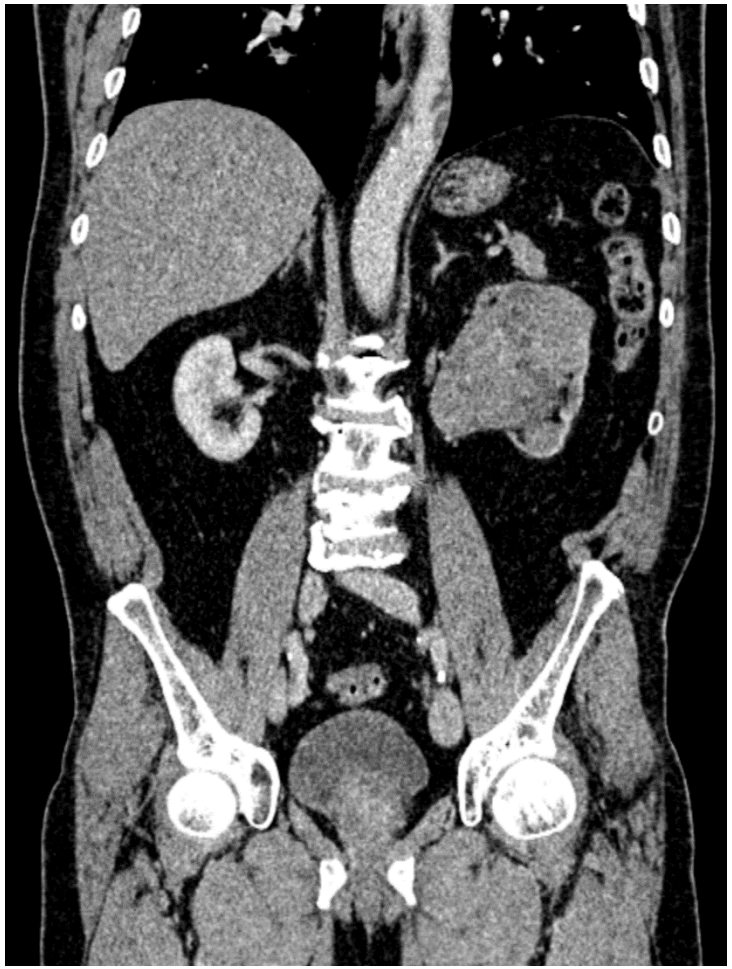
CT: visualized in the form of an intraluminal contrast-enhancing mass or as an enhancing circumferential or eccentric thickening of the urinary tract walls. In case of large tumors, obstruction of the urinary flow is possible and it can generate appearance of hydronephrosis upstream. Also, large tumor formations can cause invasion of renal parenchyma and renal vessels (artery and renal vein).

MRI: visualized in the form of an intraluminal contrast-enhancing mass or as an enhancing circumferential or eccentric thickening of the urinary tract walls. The tumoral mass appears as iso/hypo T1 and iso/hyper T2.

Acquired renal disorders

Malignant renal tumors

Urothelial carcinoma



Acquired renal disorders

Malignant renal tumors

Renal lymphoma

Primary renal lymphoma is rarely encountered. However, renal impairment is often considered in the case of secondary lymphoma, with systemic interest.

Frequently, secondary renal lymphoma is visualized in the form of multiple tumoral masses developed inside the kidneys, weakly vascularized, with a size below 3 cm, accompanied by retroperitoneal adenomegaly in more than half of the cases. Occasionally, secondary renal lymphoma may manifest as a single renal tumor that can reach dimensions up to 15 cm and may have calcifications, hemorrhagic areas or necrosis. Another form of manifestation of secondary renal lymphoma is the presence of a retroperitoneal tumoral mass that can exceed 10 cm in size and can extend to the entire kidney, kidney vessels or ureter, and can lead to overlying hydronephrosis. Postcontrast, the tumoral masses in secondary renal lymphoma enhance poorly.

Acquired renal disorders

Malignant renal tumors

Renal metastases

Primary malignancies that can give secondary determinations in the kidney include breast, gastric, pulmonary, colon carcinomas, as well as leukemias, lymphomas and melanomas.

CT: can not make a differential diagnosis between renal metastases and a primary renal tumor. Renal secondary lesions may be single or multiple most often, appear as iso- / hypodense lesions natively and exhibit iodophilia after administration of the contrast agent.

MRI: faces the same limitations as described in the CT exam.

Acquired renal disorders

Malignant renal tumors

Renal metastases

Acquired renal disorders

Renal infections

Pyelonephritis

Acute pyelonephritis is a bacterial infection of the renal parenchyma and pelvis commonly encountered in young women.

UIV: highlights the increased volume of the affected kidney and the presence of the striated nephrogram.

US: low inhomogeneous echogenicity.

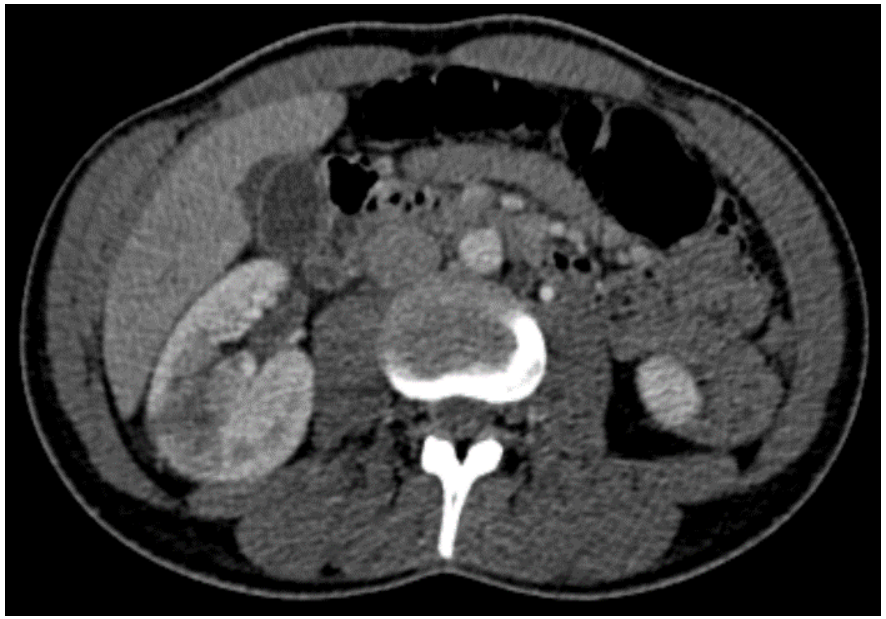
CT: highlights one or more diffusely delimited areas located cortical-medullary, isodense, hypodense (in case of necrosis or edema) or hyperdense (in case of hemorrhage), which show a reduced contrast enhancement. In the late phase, the presence of the striated nephrogram can be highlighted. The term striated nephrogram refers to the appearance of high intensity linear bands that alternate with low intensity linear bands arranged in a radial cortical-medullary pattern. It is important to note that acute pyelonephritis affects the kidney from the medullary area up until the renal capsule.

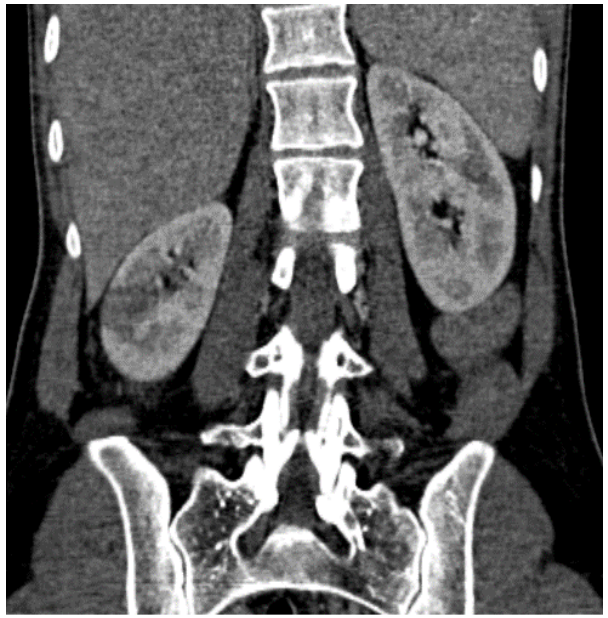
Acquired renal disorders

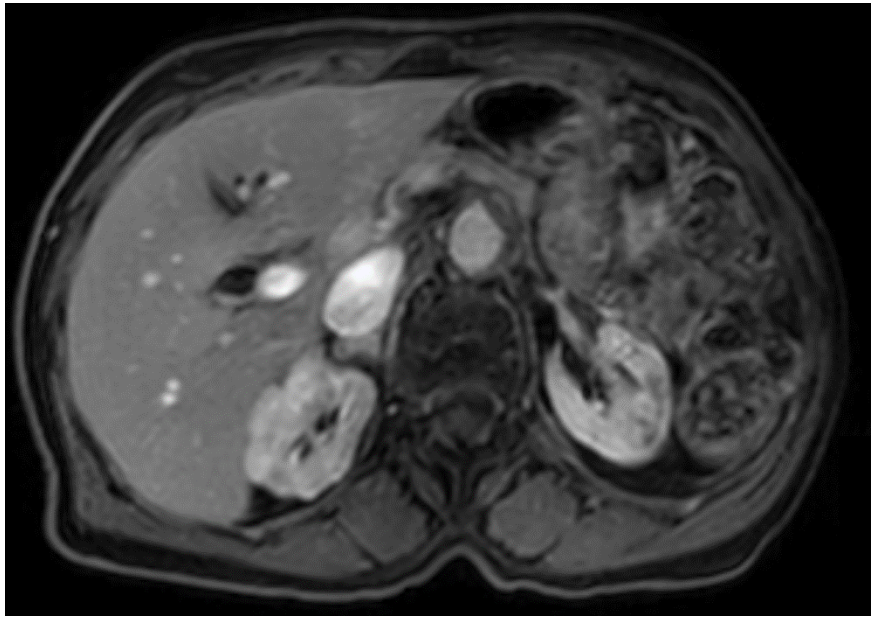
Renal infections

Pyelonephritis

MRI: regions affected by acute pyelonephritis appear as hypo T1 and hyper T2 compared to the healthy renal parenchyma. After contrast administration, the affected areas show reduced uptake of the contrast agent compared to the healthy renal parenchyma.







Acquired renal disorders

Renal infections

Renal abscess

The CT examination is the investigation of choice in case of a suspected renal abscess. It can be visualized as a hypodense zone with fluid densities, delineated by an irregular thick wall that enhances contrast. The adjacent renal parenchyma appears diffusely hypodense natively, due to the edematous changes at this level. The presence of gas bubbles inside the lesion is an evocative sign for abscess.

MRI: renal abscess is visualized as hypo T1 and hyper T2. In the postcontrast T1 sequence, peripheral gadophilia is found in the renal abscess.

Acquired renal disorders

Renal trauma

For the evaluation of renal trauma, the primary examination is CT.

In case of patients with renal trauma, the classification of AAST (The American Association for the Surgery of Trauma) is used:

- **grade I:** contusion / subcapsular hematoma, without laceration;
- **grade II:** superficial laceration <1 cm in depth, without involvement of the urinary system;
- **grade III:** superficial laceration> 1 cm in depth, without involvement of the urinary system;
- **grade IV:** laceration affects the urinary system and extravasation of urine and contrast agent is present;
- **grade V:** avulsion of the renal hilum or significant destruction of the renal parenchyma.

Acquired renal disorders

Renal trauma

Acquired renal disorders

Renal trauma

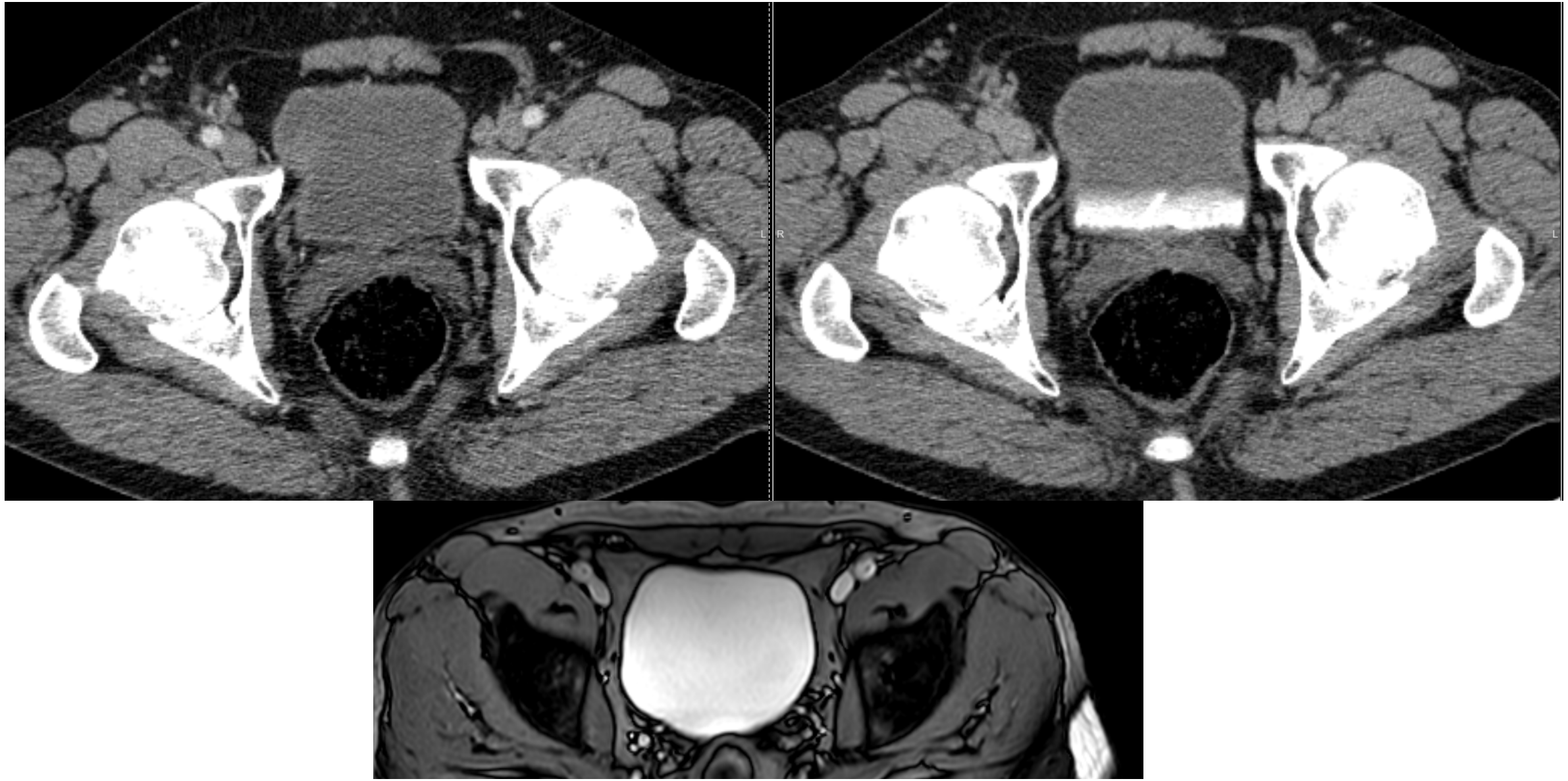
a. The renal contusion is visualized in the form of post-contrast hypoenhancing regions.
b. Acute subcapsular hematoma appears as a semi-lunar collection, located under the renal capsule, with native densities higher than the adjacent renal parenchyma. The subacute subcapsular hematoma appears similar to the adjacent renal parenchyma. Chronic subcapsular hematoma has lower native densities compared to adjacent renal parenchyma.
c. Renal laceration can be visualized as a hypodense linear area that crosses the renal parenchyma. In the case of ureteral trauma, the IVU and CT examinations highlight the extravasation of contrast agent.
d. The urinoma may appear as a result of a trauma or as a result of spontaneous rupture of the calyces installed after an acute obstruction. On native CT examination, the urinoma is visualized as a collection with fluid densities. After administration of the contrast substance, in the late phase the communication between the excretory urinary tract and the fluid collection can be highlighted. Moreover, in this phase the extravasation of the contrast agent excreted by the kidneys can be seen.

Acquired renal disorders

Renal infarction

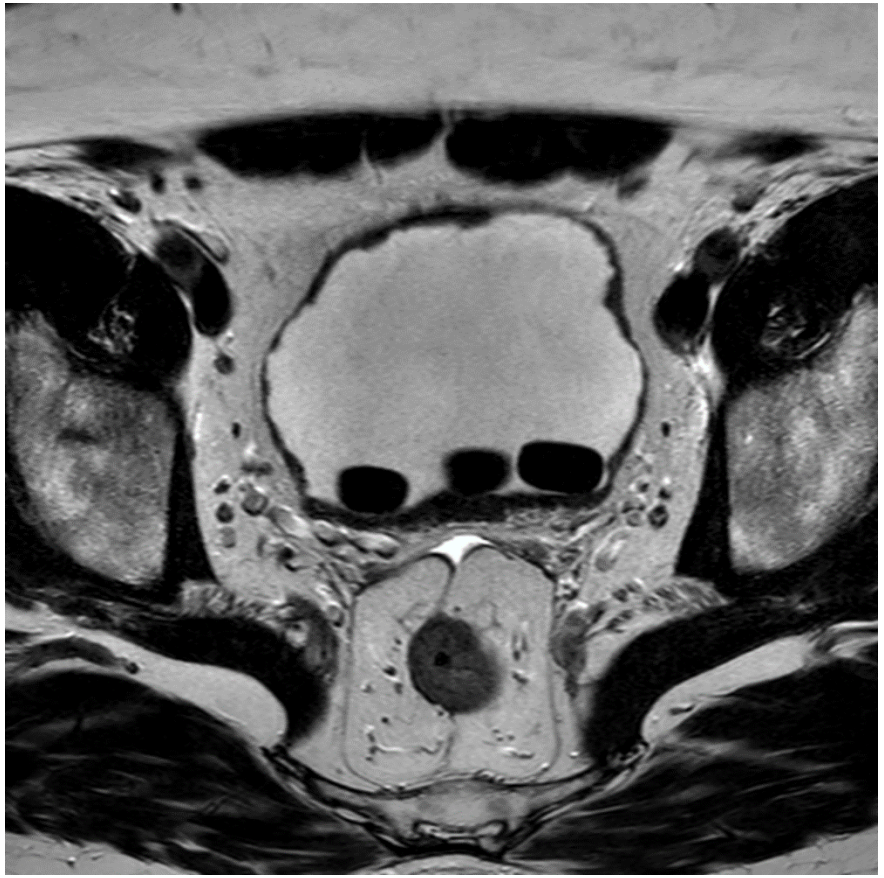
Renal infarction occurs in the case of impaired renal vascularization either due to intravascular thrombus or due to avulsion of the renal hilum. At intravenous post-contrast CT examination, the area of renal infarction appears hypodense, triangular, with the tip towards the hilum and the base towards the periphery and does not enhance contrast. On MRI examination, it appears as a hypo T1 and T2 area.

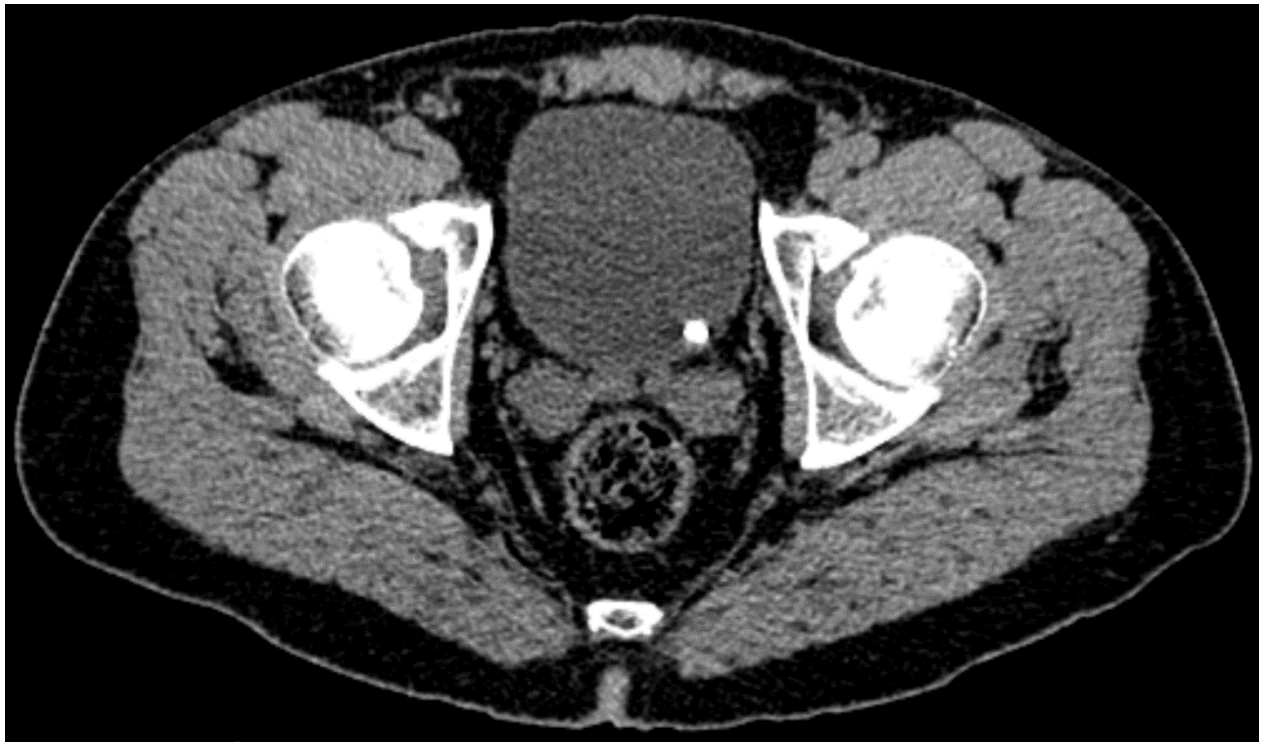
Bladder – normal anatomy



Bladder disorders

Urinary lithiasis

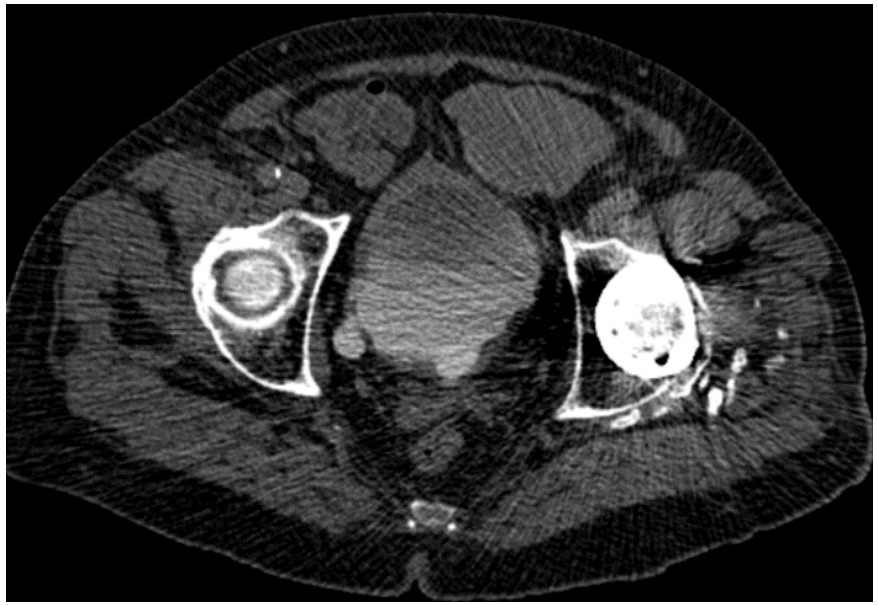


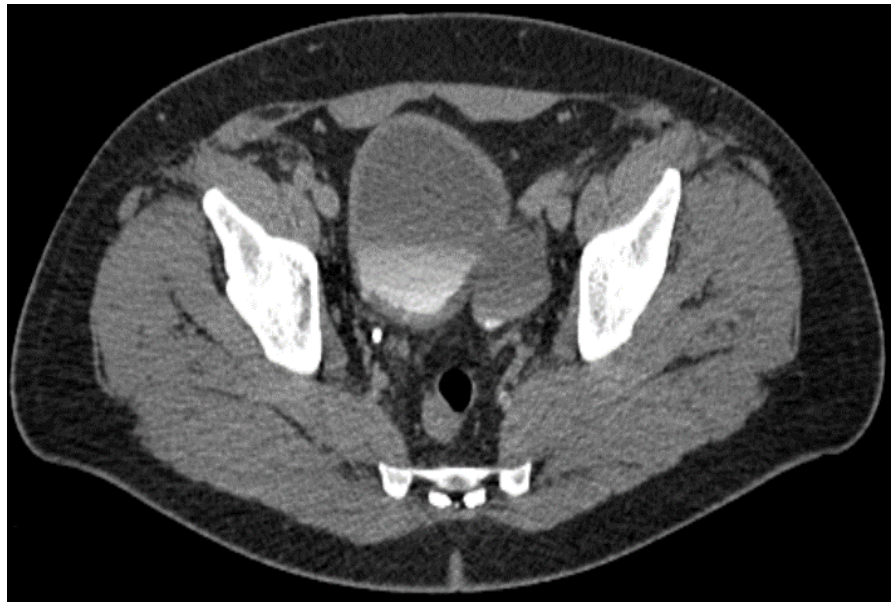


Bladder disorders

Bladder diverticulum

A bladder diverticulum represents the herniation of the bladder mucosa through the wall of the bladder. It may appear as a single or multiple lesion. From a medical imaging point of view, the bladder diverticula appears as a saccular communication with the bladder; the contrast agent accumulates in the bladder diverticulum.

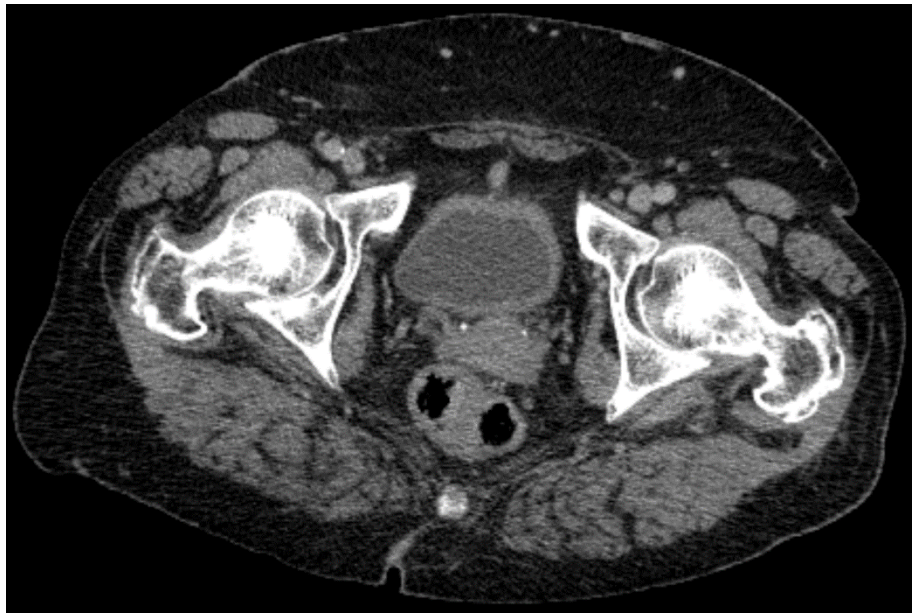




Bladder disorders

Cystitis

Cystitis is an inflammatory condition commonly found in women. The imaging diagnosis can be established through IVU, US and CT. From a medical imaging point of view, changes affecting the volume of the bladder can be identified (hypertonia of the bladder in acute cystitis), and thickening of the bladder walls.



Bladder disorders

Bladder carcinoma

Carcinoma of the bladder is a primary malignant tumor that mainly affects men. The imaging diagnosis of bladder carcinoma can be made by UIV, US, CT and MRI.

From a macroscopic point of view, the bladder carcinoma can be represented as a vegetant tumor or as an infiltrative tumor.

IVU: in case of a vegetant tumor there is a filling defect with irregular edges located inside the bladder. In case of an infiltrative tumor, the increased rigidity of the bladder wall can be highlighted.

US: vegetant tumors appear as a mass with variable echogenicity that protrudes inside the lumen of the bladder. Infiltrative tumors developed in the bladder cause thickening of the bladder wall.

Bladder disorders

Bladder carcinoma

CT: Native CT examination can reveal the thickening of the bladder wall which enhances contrast agent in case of an infiltrative bladder tumor. In case of a vegetant bladder tumor, post-contrast CT examination in the arterial phase reveals an enhancing tumoral mass that protrudes inside the lumen of the bladder and / or presents extension outside the bladder with lymphanitic changes near the bladder. Postcontrast, in the late phase, the CT reveals an irregular filling defect inside the bladder due to a vegetant tumor mass at this level. Also, with the help of CT, it is possible to highlight the obstruction of the urinary tract with overlying hydronephrosis.

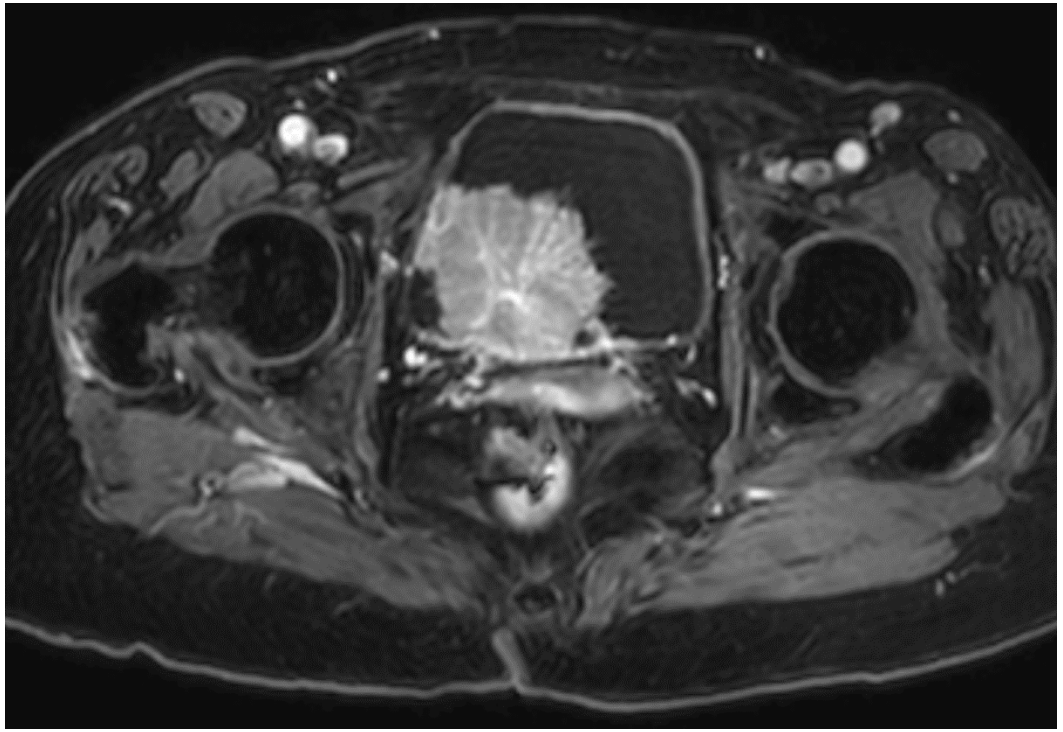
MRI: the tumor formation developed in the bladder appears as iso T1 and hyper T2 in relation to the bladder wall.

Bladder disorders

Bladder carcinoma

Bladder disorders

Bladder carcinoma

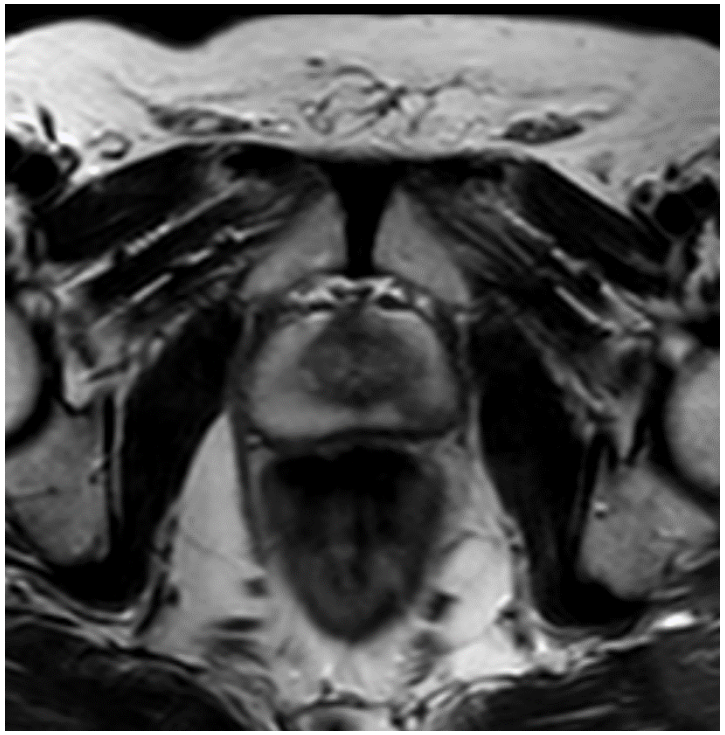


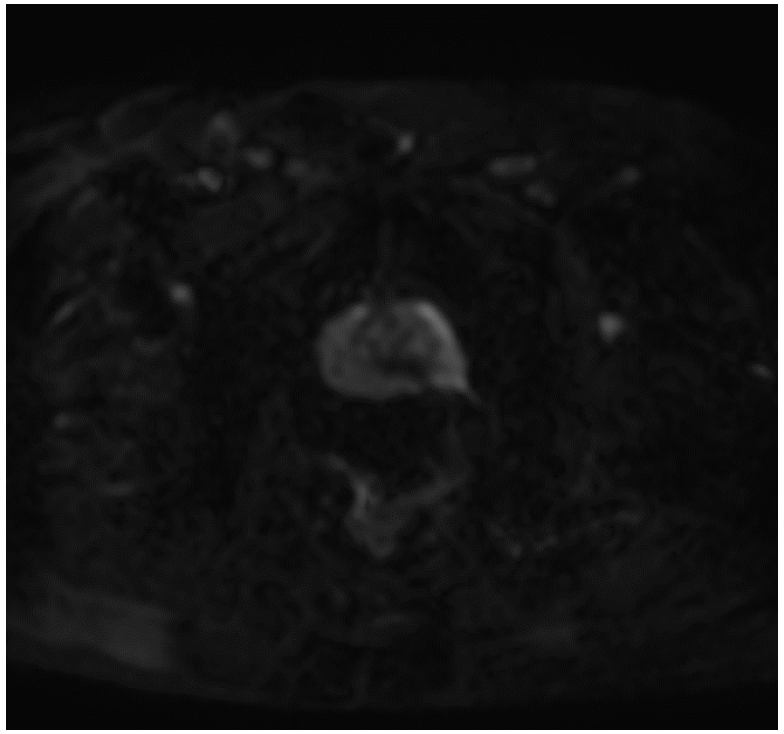
Prostate disorders

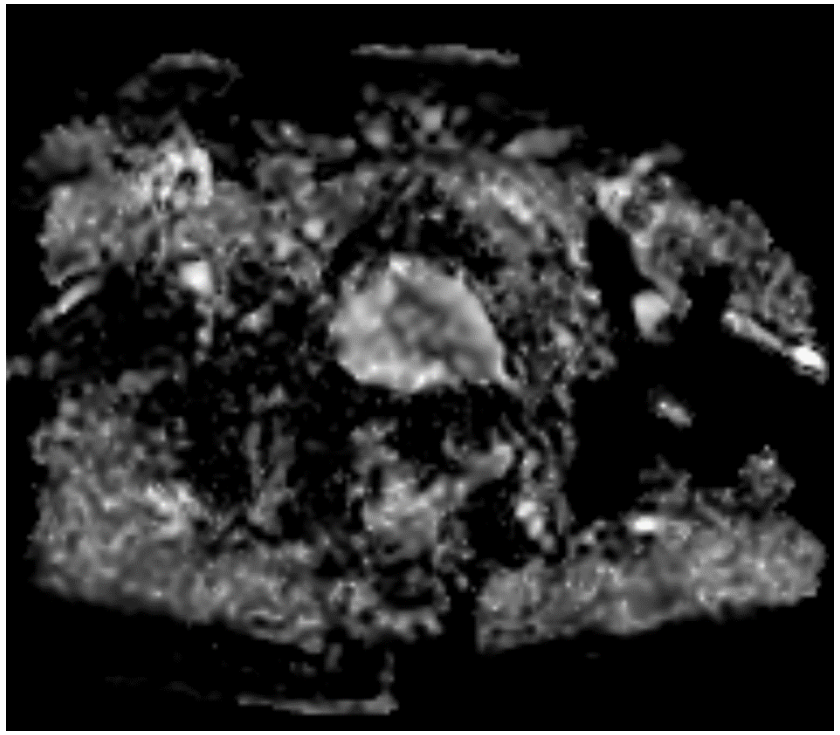
General information

At the moment, MRI + PI-RADS v2 is used for the evaluation of the prostate pathology and to establish the probability of prostate carcinoma (+staging). According to this staging system, one can assess the probability of a malignant process in the prostate on a scale of 1 to 5. The prostate contains a central area (called ***transitional area***) and a ***peripheral area***. Malignant processes developed at the prostate level are usually located in the peripheral area. The T2 sequence, the Diffusion Weighted Imaging (DWI) and the ADC (Apparent Diffusion Coefficient) map are used to investigate the two zones. In the transition area the T2 sequence is mainly used, while in the peripheral area, the diffusion sequence and the ADC map are extremely useful in the investigation of prostatic pathology.

Prostate disorders







Adrenal – normal anatomy

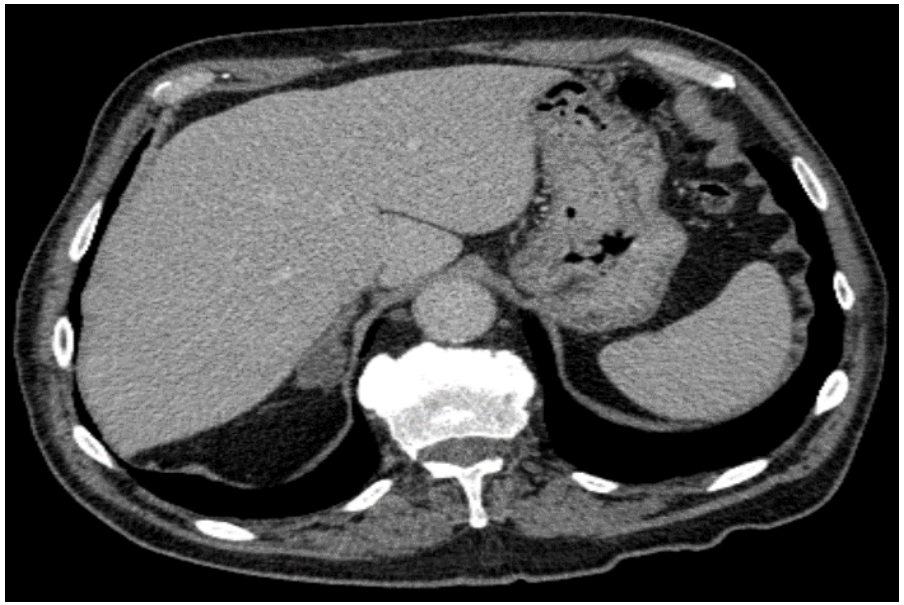
Adrenal glands disorders

Adrenal cyst

Adrenal cyst is a benign lesion most commonly seen in women.

CT: round-oval lesion with fluid densities (0-10 HU), homogeneous, well delimited by a thin, non-contrast enhancing wall.

MRI: adrenal cyst is visualized as hypo T1 and hyper T2. In the event of hemorrhagic complication, intralesional T1 hypersignal is highlighted.



Adrenal glands disorders

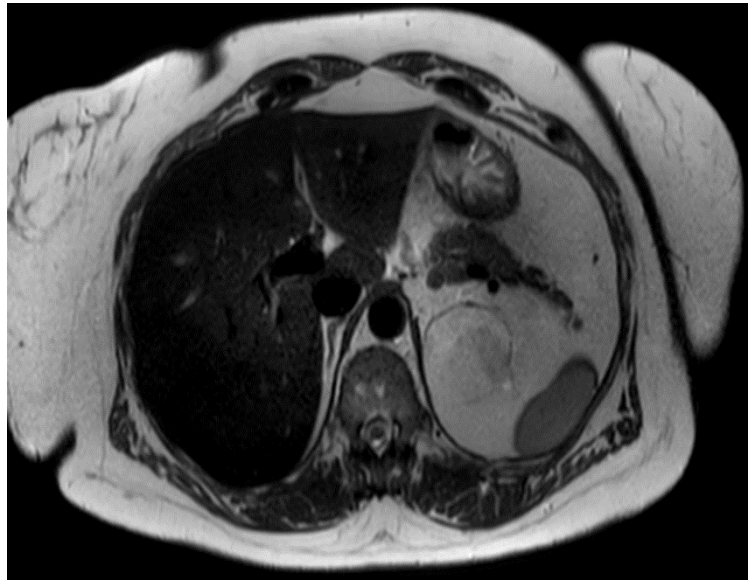
Adrenal myelolipoma

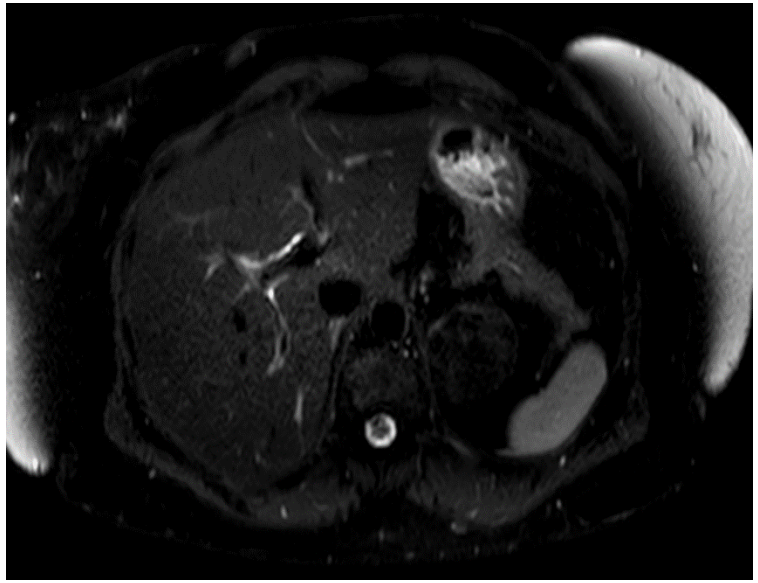
The adrenal myelolipoma has a hematopoietic and lipomatous component and can be identified using US, CT and MRI.

US: hyperechoic nodular lesion.

CT: well delimited round-oval lesion with fat densities (-20 UH to -120 UH).

MRI: the lesion appears in hyper T1, hyper T2, hypo on fat suppression sequences.

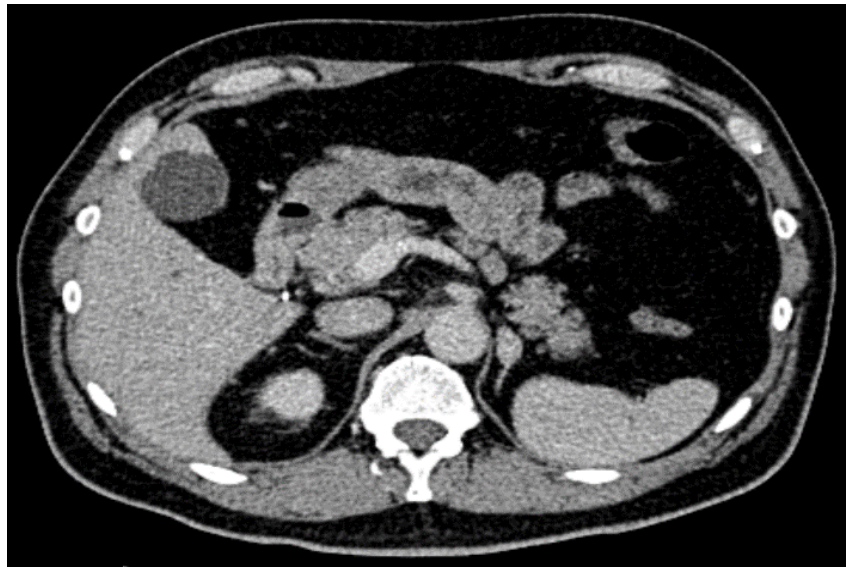




Adrenal glands disorders

Adrenal adenoma

On the CT examination, the adrenal adenoma appears to be a well-delimited, homogeneous, contrast enhancing round-oval lesion. In order to be able to make a differential diagnosis between an adenoma and a malignant lesion of the adrenal glands, it is necessary to obtain a new acquisition 15 minutes after the injection of the contrast substance. The adrenal adenoma is characterized by a rapid wash-out (rapid contrast washing), whereas malignant lesions show slower wash-out.



Adrenal glands disorders

Adrenal adenoma

At MRI, the signal of the lesion is variable. In case of an adenoma with rich lipid content, hyperT1 in-phase signal is noted, with significant decrease of signal in T1 out-of-phase sequence. Intravenous postcontrast T1 shows intense gadophilia inside the lesion.

Adrenal glands disorders

Pheochromocytoma

Pheochromocytoma is a tumor mass that develops in the adrenal glands and is associated, from a clinical point of view, with paroxysmal hypertension. The imaging diagnosis is made through US, CT and MRI.

CT: highlights a well-delimited tumor mass of over 3 cm, with intensely heterogeneous structure and iodophilia due to the areas of intralesional hemorrhage and necrosis.

MRI: the lesion appears as iso T1 and hyper T2 compared to the muscle signal. The "salt and pepper" aspect is present in the intravenous postcontrast T1 sequence.

Adrenal glands disorders

Adrenal metastases

Primary malignancies that can give secondary lesions in the adrenal glands include breast cancer, bronchopulmonary cancer, kidney cancer, thyroid cancer and melanoma.

On the CT examination, the metastases located in the adrenal glands appear uni- or bilaterally in the form of tissue masses of varying size and shape. The intralesional presence of hemorrhagic foci and necrotic areas confers heterogeneity to these lesions both natively and postcontrast.

On the MRI examination, adrenal metastases can be uni- or bilateral and show similar signal to the primary tumor. Postcontrast, adrenal metastases are intensely gadophilic and may exhibit heterogeneous structure due to necrosis zones and hemorrhagic foci at their level.

Adrenal glands disorders

Adrenal metastases