Pyeloureonal backflow seen on CT urography: everything you need to know

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Learning objectives

Pyelorenal backflow refers to the retrograde flow of contrast material out of the intrarenal collecting system during the acute phase of urinary obstruction.

The aim of this educational poster is to:

- Learn about the significance of pyelorenal backflow.
- Discuss the mechanisms of pyelorenal backflow to improve its diagnosis.
- Describe and illustrate the CT appearances of the various forms of backflow.

Background

In acute ureteral obstruction the kidney resorbs urine as a compensatory mechanism to allow continued excretion. This resorption of urine occurs due to the increasing pressure in the renal pelvis during the acute phase of urinary obstruction and we will see it on CT as a retrograde flow of contrast material out of the intrarenal collecting system. This retrograde flow of contrast material is termed "pyelorenal backflow", and occurs via one of five pathway: pyelovenous, pyelolymphatic, pyelotubular, pyelointerstitial or pyelosinus. Fig. 1 on page 3

Among all of these phenomena, only pyelocanalicular or pyelotubular backflow does not require the rupture of the fornix and thus can be interpreted as a genuine backflow in the fullest sense of the word. Unlike pyelotubular, the rest of the refluxes can only occur after the rupture of the renal fornix.

Clinical findings: patients usually present with acute ureteral obstruction symptoms and they may report relief when the rupture of renal fornix occurs.

Examination by microscopy shows the presence of tears in the fornix of the pelvic cavity that extend into the kidney parenchyma.
Treatment: none is usually required. If required, the goal of treatment is the same for all types: to decrease the intrarenal pelvic pressure. There are different ways to do so: nephrostomy, ureteral access sheath etc.

Possible complications of this entity are urinoma and secondary retroperitoneal fibrosis.

**Images for this section:**

**Fig. 1:** Pyelorenal backflow types

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Findings and procedure details

Findings on urography: All five types of renal backflow are well depicted on retrograde urography and result from the force of injection. Pyelolymphatic and pyelosinus backflow may also be seen on excretory urography, but neither pyelovenous nor pyelotubular can be diagnosed using this technique.

Findings on CT urography:

- **Pyelotubular**: it is usually considered a normal phenomenon. We can see the contrast backflow running into the terminal collecting ducts (papillary ducts). It produces a wedge-shaped striated area or blush extending from a calyx. Fig. 2 on page 5 Fig. 3 on page 6 Fig. 4 on page 7

- **Pyelointerstitial backflow**: in this case the contrast enters the interstitium of the kidney. Like pyelotubular, it produces a wedge-shaped striated area or blush extending from a calyx that in this case reaches out to the edge of the renal cortex. Fig. 5 on page 8 Fig. 6 on page 9 Fig. 7 on page 10

- **Pyelosinusual backflow**: it is the most common form. The contrast enters the renal sinus and tracks along infundibulae, renal pelvis and proximal ureter. Besides, it can also obscure the collecting system. This form of backflow is responsible for many of the urinomas seen frequently. Fig. 8 on page 11 Fig. 9 on page 12 Fig. 10 on page 13

- **Pyelolymphatic backflow**: It is a very rare condition. In this kind of reflux the contrast enters the peripelvic lymphatics due to the acute intrapelvic pressure increase.
  
  - Microlymphatic channels begin in the cortical interstitium near the glomeruli, are directed towards the medulla filling lymphatics in the periarcurate plexus and subsequently interlobular, interlobar and perihilar channels to finally fill in the para-aortic retroperitoneal lymph node chain.
  
  - On CT, we can see multiple tiny serpiginous tubular channels connected to each other. They begin intrarenally, direct towards the hilum of the kidney and extend caudally surrounding the ureter in the para-aortic lymph node chain in the retroperitoneum.
• Changes demonstrated by the CT were due to pyelolymphatic reflux caused by increased pressure in the collecting tubules filling the lymphatics with opaque urine after forniceal rupture. Fig. 11 on page 14 Fig. 12 on page 15 Fig. 13 on page 16 Fig. 14 on page 17

• **Pyelovenous**: it is rare. In this case the contrast enters interlobar and then arcuate renal veins. For depicting this finding on a CT the flow in the inferior vena cava or renal veins must be sufficiently slowed, which can occur in different situation: renal vein thrombosis, renal vein hypertension due to the "nutcracker phenomenon", or a reduced renal blood flow. On portal venous phase we will see the obstruction in the urinary tract, the secondary pyeloureteral dilatation and the obstruction in the renal vein. On excretory phase we will see the contrast is retained in the renal pelvis and after the rupture of the fornix the contrast will enter the intrarenal veins and extend into the renal vein. Fig. 15 on page 18 Fig. 16 on page 19

Images for this section:
Fig. 2: Pyelotubular backflow

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We can see the contrast backflow running into the terminal collecting duct (↑)(papillary ducts). It produces a wedge-shaped striated area or blush extending from a calyx (○).
Case n°1: 46 y.o. woman that presented with hematuria. On excretory phase CT we can see the collecting ducts being filled with pyelotubular backflow contrast from the calyx. It is considered a normal phenomenon.

Fig. 3: Pyelotubular backflow

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Case nº 2: 38 y.o. man with left flank pain. Excretory phase CT shows wedge-shaped striated areas extending from the calyx (it represents the contrast entering the the collecting ducts).

Fig. 4: Pyelotubular backflow

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Fig. 5: Pyelointerstitial backflow

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Case nº 3: 61 y.o. female that presented with abdominal pain that did not respond adequately to analgesic treatment. On excretory phase CT we can see a pyeloureteral dilatation. Due to the big amount of contrast reflux caliceal fornix breaks and contrast enters renal interstitium, which we can see on CT as a striated area extending from the calyx and reaching out to the edge of the renal cortex. Pay attention to the left kidney, which has already evacuated all the contrast.

Fig. 6: Pyelointerstitial backflow

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Fig. 7: Pyelointerstitial backflow

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**Fig. 8:** Pyelosinusal backflow

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Fig. 9: Pyelosinusal backflow

Case no 5: 49y.o. male with a colonic stent due to a neoplasm and desmoplastic reaction in the adjacent peritoneum that obstructs the ureter. Due to the obstruction there is a contrast reflux that breaks the fornix and leaks into the sinus and extends in the peri-infundibular, peripelvic and periureteral spaces.

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Case n°6: 61y.o. male that presented with right ureteral obstruction and subsequent contrast extravasation. Note the important periureteral contrast obscuring the obstructed ureter on the excretory phase CT.

**Fig. 10:** Pyelosinusal backflow

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Fig. 11: Pyelolymphatic backflow

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Fig. 12: Pyelolymphatic backflow

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Case nº7: On excretory phase CT we can see the same obstruction we have previously seen in the pyelography (green arrow) located in the proximal third of the ureter. Due to this obstruction, pyelolymphatic reflux occurs and we will be able to depict it on the excretory phase CT as multiple tiny, serpiginous tubular channels filled with contrast in the hilum of the kidney directed towards the para-aortic lymph node chain in the retroperitoneum (yellow arrows).

**Fig. 13:** Pyelolymphatic backflow

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Fig. 14: Pyelolymphatic backflow

Case n°8: A 72 y.o. male that presented at the emergency department with abdominal pain. On excretory phase CT mild dilatation of the pyelocaliceal system can be depicted due to the middle third ureteral obstruction (blue arrow). Besides, multiple tiny, serpiginous tubular channels filled with contrast are depicted leaving from the hilum of the kidney and directing towards the para-aortic lymph node chain in the retroperitoneum (yellow arrows). Note the pyelotubular reflux present in both kidneys (red circles).
Case n°9: 69 y. o. man with history of cigarette smoking presented with two-month history of gross hematuria. On ultrasound we can see a one centimeter nodular, solid image on the left wall of the bladder that did not move when changing patient’s position.

Fig. 15: Pyelovenous backflow

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**Case n°9:** 1: Portal venous phase CT scan shows dilated urinary tract (due to a bladder neoplasm) and left renal vein thrombosis (↑).
2 & 3: Contrast-enhanced multiplanar reformatted scans obtained during excretory phase show contrast material entering the left renal vein (↑).

**Fig. 16:** Pyelovenous backflow

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Conclusion

• Pyelorenal backflow occurs during the acute phase of urinary obstruction.
• This report presents cases demonstrated by CT urography.
• In the presence of pyelorenal backflow obstructive uropathy should be kept in mind, even in the absence of hydronephrosis.

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References