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Visual Case Discussion

Importance of axial kidney scans in ultrasound screening in prehospital assessment for renal colic

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1. Discussion

Renal screening sonography or renal point-of-care ultrasonography (POCUS) plays a crucial role in evaluating conditions such as renal colic in nephrolithiasis. When an obstructive cause such as a stone lodged in the urinary tract is not visualized sonographically during renal colic assessment, the presence of hydronephrosis and perirenal fluid becomes significant. These sonographic signs are often associated with more severe cases,[1] prompting the need for further investigation by urology and radiology specialists. Definitive diagnosis and management may require conventional sonography or the gold standard, computed tomography (CT). However, both imaging modalities and specialists are unavailable in peripheral prehospital settings, as are hematological and urine analyses.

Hydronephrosis consists of dilation of the kidney's pyelocaliceal system due to proximal or distal obstruction of the kidney's urine output tract. It is generally classified by the variation of magnitude of the dilation as small, moderate, or severe. Sonographically, hydronephrosis is seen as an increasingly dilated renal pelvis that is filled with urine and thus anechoic (black). As the obstruction increases, the area impacted by the volume of urine also increases, and dilation occurs back up the collecting system to the major calices, minor calices, and renal pyramids, eventually leading to thinning out of the renal cortex. At some point, the pressure of the hydronephrosis can cause rupture of the collecting system, leading to perirenal fluid. The most susceptible part of the collecting system for rupture is the renal fornix at the end of the minor calices.[2] Again, the urine appears as an echoic stripe surrounding the kidney.

2. Visual case discussion

A 41-year-old male patient presented to a basic emergency service (BES) complaining of low back pain radiating to the abdomen since that morning. He also mentioned a previous episode of severe renal colic 5 years prior on the same side (the right side), which required treatment at the same emergency department. Consequently, he was referred to a urology specialist in a reference hospital (RH).

Upon arrival at the BES, the patient was classified as code orange (Manchester triage), indicating an urgent level of severity. He reported a pain intensity rating of 8 on a scale of 0 to 10, he was apyretic, and he had a blood pressure of 148/73 mmHg with a heart rate of 88 beats per minute. Simple urine analysis using a Combur strip revealed traces of hematuria and triple crosses in protein with no nitrites detected.

During the examination by the emergency physician, renal tenderness was positive on the right side and negative on the left. The patient promptly received analgesic and antiemetic therapy. The physician requested a point-of-care ultrasound of the kidneys and bladder. Bladder scanning and observation of the transitional ureteropelvic junction proved inconclusive due to emptiness of the bladder as the patient had voided minutes earlier for urine collection.

A longitudinal view of the right and left kidneys was captured using a coronal technique, as shown in Video 1. For Video 2, the same technique

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was employed along with Doppler imaging to confirm or rule out suspicions of mild pyelocaliceal dilatation[3] raised by Video 1. Video 3 shows an axial scan of the right kidney conducted to evaluate the perirenal right space in a perpendicular plane to the longitudinal view. Similarly, a biplanar scan of the left kidney was performed on the contralateral side but showed no abnormalities.

Given the abnormality detected in the renal ultrasound and the persistent pain, the patient was referred to the RH for consultation with a urologist, where serum studies revealed leukocytes at 13.8 × 10^9/L (4.0 - 10.0); blood urea and nitrogen at 22 mg/dL (8.9 - 20.69 mg/dL), and creatinine (serum) at 1.6 mg/dL (0.7 - 1.3 mg/dL). The urology department requested a CT scan, which confirmed the POCUS findings in the BES. The transcribed report indicated mild right-sided ureterohydronephrosis determined by obstructive calculus measuring 2 mm at the ureterovesical junction on the same side.

There was no evidence of obstructive uropathy on the left side. There was mild perirenal fluid with no evidence of collections. In the prehospital setting, when facing very common situations like renal colic episodes, the real challenge is using clinical findings to discern which patients can be treated locally and which patients present signs of severity and should be referred to RH. In this context, POCUS can make a difference.

3. Questions and answers with a brief rationale true & false and/or multiple-choice questions

3.1. Question 1

Video 1 depicts a scan of the right and left kidneys in the longitudinal aspect. What conclusions can be drawn from observing the video?

Answer Options

a) Normal visualization of right and left kidneys and respective hepatorenal and splenorenal recess.
b) Technical acquisition is not correct as more liver should be observed on the right side.
c) An evident pattern of calcification is present in left renal parenchyma.
d) Pyelocaliceal dilation is suspected due to the discrete degree in the renal pelvis size in the right kidney.
e) High-grade collecting system dilatation is present in the right kidney, a sign of obvious obstruction.

Correct Answer* = *d

With the same technique employed to examine the hepatorenal recess, we systematically swept the probe up and down to capture a longitudinal view of the kidney, as shown in Video 1. Here, we identified a prominent anechoic area anechoic at the renal hilum in the right kidney. It measured 12 mm in the pyeloureteral transition and was suggestive of discrete pyelocaliceal dilation. Notably, this dilation was absent in the contralateral kidney, prompting suspicion of potential urinary drainage issues on the right side.

3.2. Question 2

Video 2 shows the right kidney in a longitudinal aspect like in Video 1 with the addition of color Doppler applied to the hilar area of the kidney. Are there any abnormalities or deviations from the expected pattern that you can identify?

Answer Options

a) There is a suspected exophytic cystic lesion on the inferior pole of the kidney.
b) There is no abnormal finding in this kidney or surrounding anatomical structures.
c) The hypoechoic area in pyeloureteral junction is a parapelvic cist mimicking a discrete grade of pyelocaliceal dilatation.
d) Poor technique was used by the operator; RI, PSV, and RAR should be ascertained to confirm the diagnosis.
e) The absence of a Doppler flow signal in the hilar renal anechoic area confirms discrete pyelocaliceal dilation.

Correct Answer* = *e

With the same technique utilized in Video 1, by positioning the right kidney at the center of the image, and activating the continuous flow Doppler technique, we can observe the absence of a Doppler flow signal within the anechoic area at the renal hilum. This confirms the presence of true pyelocaliceal dilation and helps distinguish it from potential dilation of vascular origin.

3.3. Question 3

Video 3 shows an axial sweep of the right kidney. Can you see any abnormal finding in the kidney or perineal space?

Answer Options

a) This video confirms the high-grade pyelocaliceal distension also seen in Video 1.
b) The perirenal space appears notably echogenic, traducing an obvious perirenal fat strand.
c) There is a thin semicircular anechoic line that may be related to perirenal fluid.
d) Axial sweep of the kidney is not of great help for POCUS renal screening.
e) The presence of perirenal fluid has no impact on managing patients in renal colic setting.

Correct Answer* = *c

Video 3 presents an axial scan of the right kidney employing a more anterior approach in probe positioning situated between the last ribs and the upper surface of the anterior superior iliac crest. The probe is systematically swept to scan the kidney, covering the upper pole, hilar zone, and lower pole repeatedly. Here, a thin semicircular anechoic represents perirenal fluid. In the presence of pyelocaliceal dilatation, perirenal fluid, and persistent pain, it is advisable to refer the patient for further investigation by medical specialists at a referral hospital.

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Sérgio Miravent: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Carla Gomes:** Visualization, Validation, Supervision, Resources, Investigation, Formal analysis. **Bruna Vaz:** Visualization, Validation, Software, Resources, Investigation.

Declaration of competing interest

The authors declare no conflict of interest.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.visj.2024.102020.

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