Imaging the Congenitally Absent Kidney: A Case Report

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Objective: This case report identifies the sources of an incorrect computer-assisted renogram analysis.
Methods: A 74-yr-old male patient with a history of transitional cell bladder carcinoma resulting in radical cystectomy and ileal conduit construction presented with deteriorating renal function. The patient was known to have congenital absence of the right kidney, but this kidney was presumably identified by diuretic renography. Furosemide renography with ^{99m}Tc-MAG$_3$ was performed to assess obstructive uropathy and overall renal function.
Results: Diuretic renography and region of interest (ROI) analysis appeared to demonstrate the presence of a right kidney. The images obtained from the study demonstrated a markedly dilated left renal pelvis that was misidentified as a right kidney because of size and shape similarities.
Conclusion: This case report demonstrates the importance of anatomic identification in the construction and analysis of renal scintigraphic images. It also demonstrates the importance of patient history to the overall evaluation of scintigraphic imaging.
Key Words: diuretic renography; image analysis; technetium-99m-MAG$_3$

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Acute and chronic genitourinary obstruction results from a variety of etiologies that include nephrolithiasis and tumor. Prompt evaluation of renal function is useful in the assessment of obstructive processes, and the information obtained from such assessment may be used to prevent irreversible kidney damage. Renal pelvic obstruction or dilatation cannot be completely assessed with conventional radiographic imaging techniques. Diuretic renography represents an important scintigraphic imaging modality for the assessment of urinary tract obstruction (*1,2,3*).

Furosemide (Lasix; 1.0 mg/kg to a maximum of 40 mg) is most often employed as the diuretic agent in these studies. The diuretic effect of furosemide is predicated on good overall renal function. Renal function, without furosemide and after furosemide administration, is generally assessed by ^{99m}Tc-MAG$_3$ imaging. Clearance of pelvicaliceal radiotracer activity after diuretic administration is followed with sequential images.

Computer analysis is used to identify electronic regions of interest (ROIs) that include the kidneys, aorta, urinary bladder and appropriate background structures. Summation of counts in the kidney ROIs from serial images is employed in preparing time-activity renogram curves that permit a comparison of the functional characteristics of each kidney. Here we report an example of incorrect computer-assisted renogram analysis due to misidentification of anatomical structures.

CASE REPORT

A 74-year old male patient was admitted to the hospital for evaluation of deteriorating renal function. His past medical history was significant for transitional cell bladder carcinoma that necessitated a radical cystectomy and ileal conduit construction. Dilatation of the left extrarenal pelvis had been previously observed. Additionally, the right kidney was congenitally absent. This patient was referred for diuretic renography to evaluate whether pelvic dilatation had progressed and to assess current renal function.

Diuretic renal urography was performed after the intravenous bolus injection of 5.3 mCi ^{99m}Tc-MAG$_3$. Images were acquired in the posterior projection with a low-energy, high-resolution, parallel-hole collimator. Two-second flow images were acquired during the first minute after the injection of ^{99m}Tc-MAG$_3$, and every 60 sec for 40 frames afterwards (Fig. 1). Furosemide (40 mg) was administered intravenously 20 min after MAG$_3$ injection, and images were acquired immediately after lasix administration. ROI analysis was performed with conventional renogram analysis software. Organ counts per pixel were employed in image analysis.

The initial images appeared to demonstrate the presence of a previously unknown right kidney (Fig. 2A). However, careful examination indicated that ROI analysis had been performed of the markedly dilated left renal pelvis instead of an anatomical right kidney. After repeat ROI determination and analysis of the left kidney, marked dilatation of the left renal pelvis and proximal ureter were noted (Fig. 2B). The

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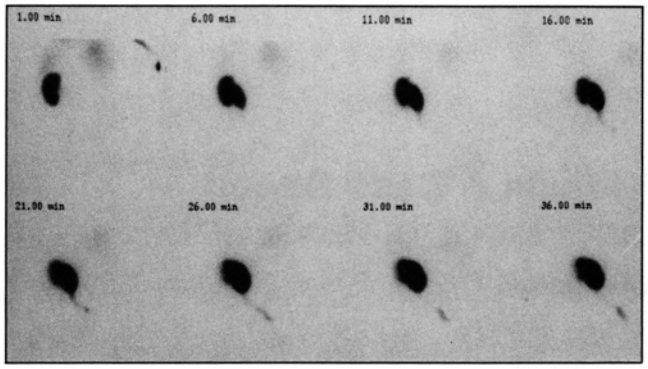

FIGURE 1. Posterior static images of furosemide renography demonstrating progressively increasing radiotracer activity in the left renal pelvis over time.

observed hydropelvis and hydroureter represented mechanical obstruction of urine flow that could have been the result of obstruction or narrowing of the proximal ureter.

Subsequent contrast-enhanced computed tomography of the pelvis demonstrated absence of the right kidney. The left kidney was enlarged, and this finding was consistent with unilateral agenesis of the right kidney. A large dilated left renal pelvis measuring 7 cm in greatest diameter was identified. The renal calyces were mildly dilated. The left hydroureter was seen extending to the region of the ileal conduit in the right lower quadrant.

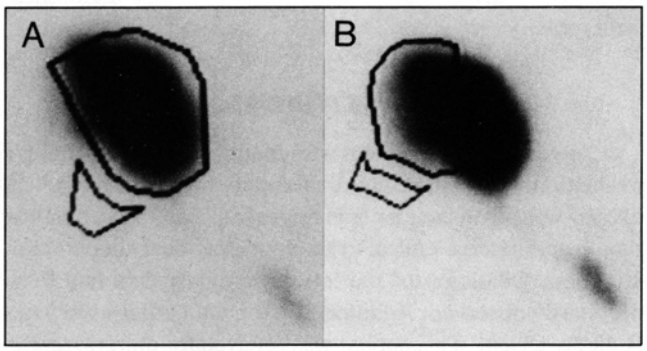

FIGURE 2. (2A) ROI drawn over markedly dilated renal pelvis. Smaller ROI is the background region. (2B) ROI appropriately drawn over the left kidney. Smaller ROI identifies the background region.

DISCUSSION

Technologists play an important role in properly identifying appropriate anatomical structures for accurate assessment of renal function. Renal scintigraphy and associated computer assisted renogram analysis are important procedures for the assessment of renal function and obstructive uropathy. Proper ROI location may be confused by a variety of technical and anatomic factors. Renal ROIs are semilunar in most cases because of the contour of the kidney. This shape permits ready identification of the kidney and renal pelvis. Improper filming or image processing may obscure renal parenchymal and pelvic structures, even in cases of normal anatomy.

Anatomical variants, however, may cause some confusion in image analysis. The kidney itself may be oddly shaped or rotated. Departures from the expected semilunar ROI contour should alert the technologist that pelvic or ureteral abnormalities or variants may also be present. In some cases, as in the one presented here, the renal pelvis itself may be so enlarged that it appears as an anatomic kidney. In the present case, additional confusion resulted because of the absence of the opposite kidney which made comparisons to contralateral anatomy impossible.

This case highlights the importance of clinical history and physical examination in the evaluation of scintigraphic images. Every nuclear medicine procedure should begin and end with an accurate assessment of clinical information.

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