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CASE REPORT

Renal scintigraphy in evaluation of ureteral leak in patients with compromised renal function: Report of three cases

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ABSTRACT

Ureteral injuries complicate 0.5-1% of pelvic surgeries in both genders. Diagnosis is usually delayed due to subtle presentation, causing accumulation of urea in the blood and acute renal injury. This prevents physicians from using contrast-based imaging modalities to locate the site of ureteral defect. We aim to reinforce the importance of renal scintigraphy in patients with ureter injury and coexisting renal functional compromise. Two cases of iatrogenic ureter injury and one case of a urinary leak following renal transplantation are presented. All three cases presented with increased creatinine level (due to delayed diagnosis) which made a CT scan, or intravenous pyelogram contraindicated. We used a Technetium-99m-L,L-ethylenedicysteine ([^{99m}Tc]Tc-EC) renal scan to locate the site of the ureteral defect without adversely affecting the renal function. In conclusion, [^{99m}Tc]Tc-EC is mainly excreted from nephron tubules and can be used in patients with decreased glomerular filtration rate with no additional harm to the kidney including in patients with delayed diagnosis of iatrogenic ureteral defect leading to acute kidney injury (AKI). While the CT scan or IVP was contraindicated, the [^{99m}Tc]Tc-EC renal scan located the ureteral defect without compromising kidney function, as [^{99m}Tc]Tc-EC is mainly excreted from nephron tubules and can be safely used in patients with AKI.

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INTRODUCTION

Ureter injuries mainly occur due to penetrating, blunt, or iatrogenic traumas, with an average mortality rate of 7% (range 0-25%) [1]. Although, iatrogenic ureteral injuries mostly happen in gynecologic operations, these injuries are reported to complicate 0.5-1% of pelvic surgeries in both genders [1]. Clinical problems arise because there are no classic signs or symptoms to diagnose these injuries on time [1]. No consensus exists on the imaging modality of choice to evaluate ureteral trauma, but nuclear medicine imaging is suggested as a potentially helpful modality in various medical scenarios [1, 2]. Herein, we reported three cases of iatrogenic ureteral injuries, which are complicated by acute renal failure. The anatomical site of the injury was confidently located by [^{99m}Tc]Tc-EC renal scan with no additional harm to the kidneys.

CASE PRESENTATION

Case 1

A 40-year-old man presented to a general surgeon with abdominal pain one week after undergoing transurethral lithotripsy (TUL). Physical examination was compatible with peritonitis. An unenhanced CT scan detected right perinephric fluid collection in retroperitoneal space. The patient undergoes laparotomy with the primary diagnosis of an abdominal abscess. During the procedure, the surgeon suspected that the urinary tract was the primary source of the abscess and referred the patient to the urologist after placing a suction drain. We visited the patient in our hospital and based on previous CT findings, we suspected ureter perforation. However, CT lacked an excretory phase, and we could not localize the ureteral defect. Due to elevated blood urea and creatinine, repeated contrast CT or intravenous pyelogram could cause aggravation of renal function; thus, we decided to perform a ureteral scan after a multidisciplinary consult. [^{99m}Tc]Tc-EC scan detected the site of perforation, which was repaired endoscopically (Figures 1 and 2). His follow up ultrasound exam after two months did not show any hydronephrosis.

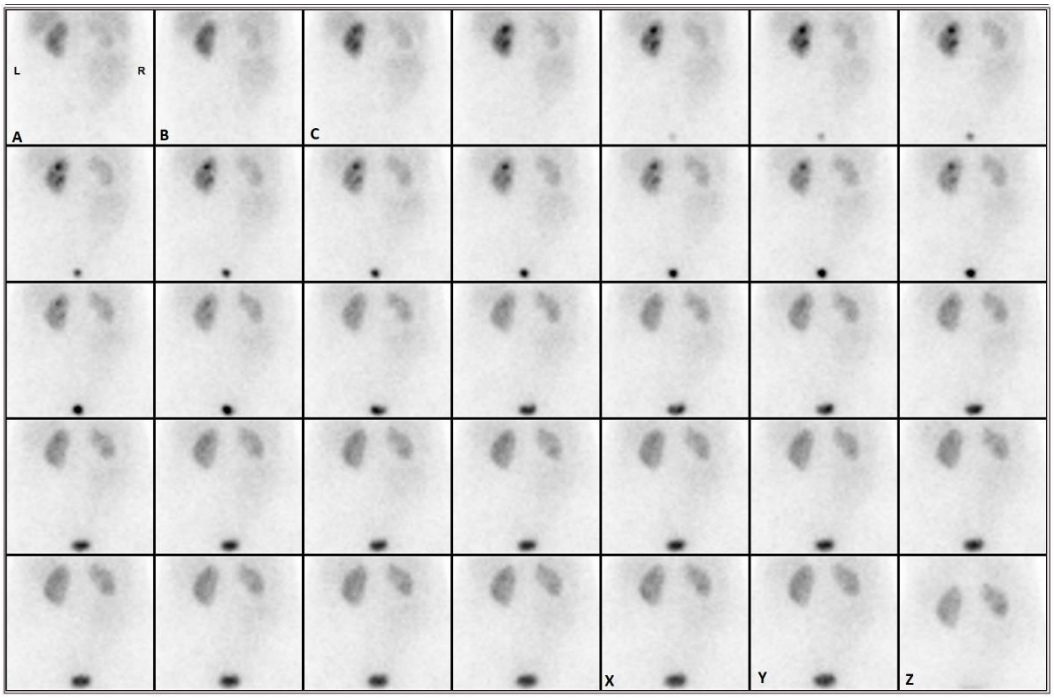

Figure 1. Dynamic images of [^{99m}Tc]Tc-EC renal scan from A to Z show decreased function of the right kidney and tracer accumulation beyond the lower pole (A)

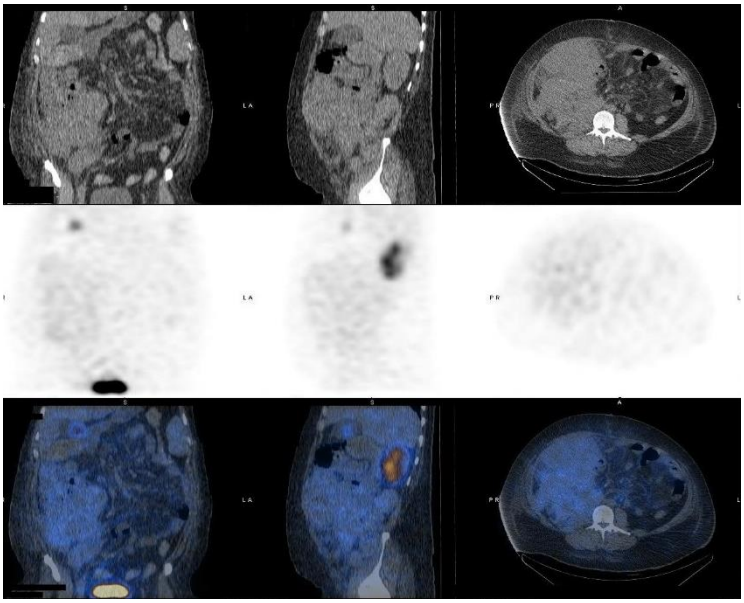

Figure 2. Upper, middle, and lower rows show CT, [^{99m}Tc]Tc-EC SPECT, and [^{99m}Tc]Tc-EC SPECT-CT images, respectively. They show urinary leak secondary to ureter injury and perinephric urinoma; from left to right on coronal, sagittal, and horizontal axes, respectively

Case 2

A 72-year-old woman with cervical carcinoma, who underwent a hysterectomy, became anuric following surgery. Based on ultrasound and CT scan findings, the patient was diagnosed with bilateral ureteral ligation. Since double-J stent placement attempt was unsuccessful, bilateral percutaneous nephrostomies were carried out to maintain urinary flow and to help to lower plasma creatinine level. The patient was on enoxaparin to prevent post-operational thrombosis however; her course was complicated by bleeding from the right kidney's PCN site. An unenhanced CT scan (due to elevated creatinine to 2.8 mg/dL) shows a misplaced PCN within a perinephric hematoma compatible with grade IV renal trauma. It was planned to manage the patient conservatively, but she developed a fever and aggravation of flank pain. Thus, with a suspected simultaneous ureter injury, the patient underwent Ureteral renal scan, which identified the exact injury site (Figures 3 and 4). The ureteral injury was managed by open surgery, and she remained symptom-free after a six-week follow-up.

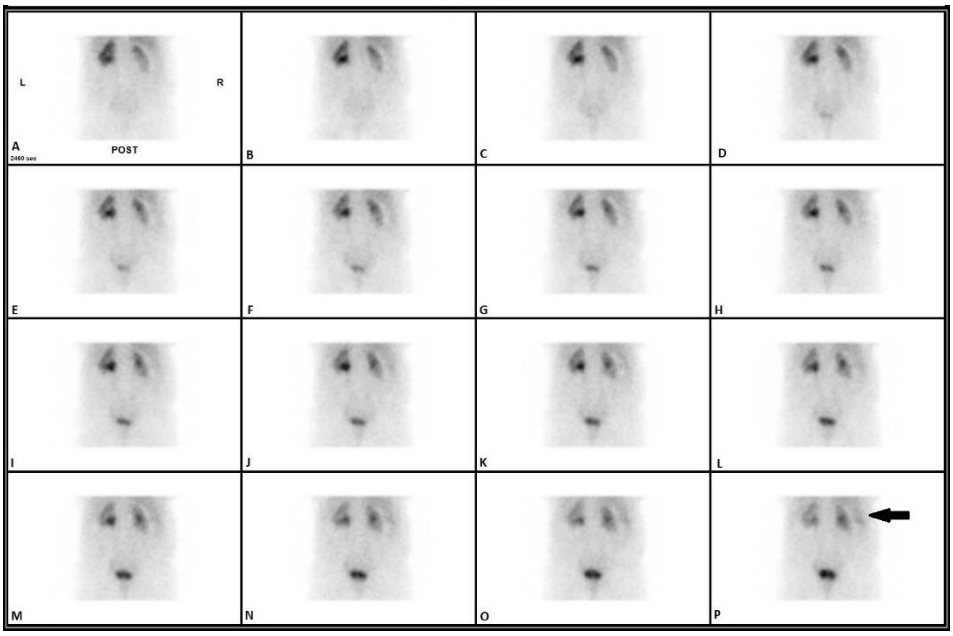

Figure 3. The [^{99m}Tc]Tc-EC renal scan from A to P shows the left functional kidney and hazy tracer accumulation lateral to the right kidney, suggesting extravasation (Black arrow)

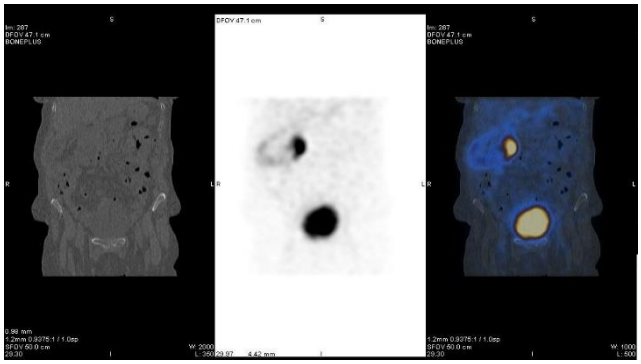

Figure 4. From left to right, the coronal plane shows [^{99m}Tc]Tc-EC accumulation around the right kidney on CT scan, SPECT, and SPECT-CT, respectively

Case 3

A 38-year-old man with chronic diabetic kidney disease who underwent renal transplantation (RT) developed progressive abdominal pain on the second day post-operational. Non-contrasted CT showed periureteral fluid collection. It was decided to perform a [^{99m}Tc]Tc-EC renal due to the coexisting renal functional loss. We performed renal scintigraphy thirty minutes after the IV injection of 65MBq [^{99m}Tc]Tc-EC. A functional kidney was visualized and the location of the urinary leak was detected. The leak was sealed endoscopically, and the patient maintained normal renal function during a two-month follow-up.

DISCUSSION

We reported three cases of ureteral injury/leak following medical intervention. There is no consensus on the gold-standard imaging modality for assessing ureter trauma [1]. The AUA recommends performing a contrast-enhanced abdominal/pelvic CT scan with an excretory phase after 10 minutes as the imaging modality of choice [1]. However, contrast CT can exacerbate renal injury in patients with compromised renal function. Intravenous pyelogram (IVP) is an alternative option in hemodynamically stable patients but possesses a low sensitivity in diagnosing ureteral injuries and is contraindicated in kidney failure [1]. Focused assessment of sonography in trauma (FAST) is widely used for traumatic patients but is unreliable for detecting ureter injury. Retrograde pyelography can detect ureteral injuries; however, it typically requires general anesthesia [1]. We proposed [^{99m}Tc]Tc-EC renal scan as a non-invasive and potentially helpful alternative modality without putting the patients at risk of general anesthesia or further renal functional compromise.

Bhattacharya et al. reported a case of hypertension and renal failure following lithotripsy. The patient's coexisting renal failure prevented performing an intravenous pyelogram. The rare diagnosis of ureteroileal communication was made via [^{99m}Tc]Tc-EC renal scan without aggravating renal function [3]. Another study demonstrated a man with rising creatinine following prostatectomy, where a Technetium-99m Mercaptoacetyl-Triglycine ([^{99m}Tc]Tc-MAG3) renal scan identified an intraperitoneal urinary leak [4].

Balasubramanian et al. presented a case of RT with decreased renal output and subsequent renal biopsy to rule out tubular necrosis. After a renal biopsy, the patient developed abdominal swelling. A CT scan detected two fluid collections with differential diagnoses of urinoma, lymphocele, and seroma. Subsequently SPECT/CT confirmed the diagnosis and location of urinomas [5]. [^{99m}Tc]Tc-EC renal scan is also valuable for the assessment of other post-RT complications. Senthil et al. showed that the delayed uptake of [^{99m}Tc]Tc-EC after RT (cold collection) could indicate lymphocele, abscess, or hematoma [6].

SPECT/CT imaging technique combines the functional information obtained from SPECT with the anatomical details provided by CT scans, but during the time of the study, we did not have SPECT/CT facility at our department.

Pharmaceuticals used in renal scintigraphy are roughly divided into three groups: 1) those eliminated via glomerular filtration, 2) those which are retained in the proximal tubules via proximal tubule receptor-mediated endocytosis, and 3) those eliminated via tubular secretion [7]. [^{99m}Tc]Tc-DTPA elimination occurs mainly through glomerular filtration and is used as an index of the glomerular filtration rate. DMSA is retained in proximal tubules and is primarily used to assess renal scars and pyelonephritis [7]. [^{99m}Tc]Tc-

MAG3, [^{99m}Tc]Tc-EC, and Ortho-iodohippurate (OIH) are examples of pharmaceuticals with tubular excretion. OIH is excreted mainly in proximal tubules, but it is widely substituted with [^{99m}Tc]Tc-MAG3 in the United States [7]. For patients with presumptive urinary obstruction and impaired kidney function, [^{99m}Tc]Tc-MAG3 is preferred over [^{99m}Tc]Tc-DTPA because the extraction fraction of [^{99m}Tc]Tc-MAG3 is twice as [^{99m}Tc]Tc-DTPA [7]. The [^{99m}Tc]Tc-EC is characteristically as same as [^{99m}Tc]Tc-MAG3 with predominant tubular secretion, negligible glomerular secretion, and extraction fraction of 70% [8]; additionally, it yields better renal delineation (due to scant liver absorption and lowers the kidney-to-background ratio) and faster clearance (with resultant lower radiation dose absorption [9, 10]. However, we may see gall bladder excretion in [^{99m}Tc]Tc-EC renal scan, which can be differentiated from the urinary leakage by the time of visualization of the intestine (i.e: before or after visualization of the gall bladder) and by late imaging after changing the patient position. As mentioned, pharmaceuticals with tubular secretion ([^{99m}Tc]Tc-MAG3 and [^{99m}Tc]Tc-EC) can reliably be used in patients with decreased glomerular filtration, provided that the extent of injury does not significantly affect the tubular function.

CONCLUSION

Ureteral traumas have no cardinal signs or symptoms, which can delay diagnosis. This delay can cause urea and creatinine elevation and prevent accurate injury site detection via contrast-mediated imaging. Renal [^{99m}Tc]Tc-EC scan is mainly secreted via tubules and can be used as an alternative modality for locating the urinary leak or injury without further harm to renal function.

REFERENCES

1. Phillips B, Holzmer S, Turco L, Mirzaie M, Mause E, Mause A, Person A, Leslie SW, Cornell DL, Wagner M, Bertellotti R, Asensio JA. Trauma to the bladder and ureter: a review of diagnosis, management, and prognosis. Eur J Trauma Emerg Surg. 2017 Dec;43(6):763-73.
2. Mohammadzadeh Kosari H, Masoudifard A, Zakavi SR, Asl Zare M, Soltani S, Akhavan Rezayat A, Aghaee A. Detecting aorto-ureteric fistula by 99mTc-Labeled Red Blood Cell SPECT. Iran J Nucl Med. 2020;28(2):38-41.
3. Bhattacharya A, Mittal BR, Singh B. Postlithotripsy ureteroileal communication identified on Tc-99m ethylene dicysteine renal scintigraphy. Clin Nucl Med. 2009 Jan;34(1):55-6.
4. Pogatchnik B, Monti S, Lewis DH, Heinrich DA, Mannelli L. Intraperitoneal urine leak after prostatectomy confirmed by 99mTc-MAG3 renogram. Clin Nucl Med. 2014 Aug;39(8):744-6.
5. Balasubramanian HC, Mittal BR, Bhattacharya A, Singh B, Minz M. Two urinomas after a renal allograft demonstrated by hybrid SPET-CT. Hell J Nucl Med. 2008 Sep-Dec;11(3):184.
6. Senthil R, Bhattacharya A, Sharma A, Balasubramanian Harisankar CN, Mittal BR. Delayed uptake of Tc-99m ethylene dicysteine in a post-transplant lymphocele demonstrated on dynamic renal scintigraphy and SPECT/CT. Clin Nucl Med. 2011 May;36(5):370-2.
7. Taylor AT. Radionuclides in nephrourology, part 1: Radiopharmaceuticals, quality control, and quantitative indices. J Nucl Med. 2014 Apr;55(4):608-15.
8. Dharmalingam A, Pawar SU, Parelkar SV, Shetye SS, Ghorpade MK, Tilve GH. Tc-99m Ethylenedicysteine and Tc-99m Dimercaptosuccinic Acid scintigraphy-comparison of the two for detection of scarring and differential cortical function. Indian J Nucl Med. 2017 Apr-Jun;32(2):93-7.
9. Buyukdereli G, Guney IB. Role of technetium-99m N,N-ethylenedicysteine renal scintigraphy in the evaluation of differential renal function and cortical defects. Clin Nucl Med. 2006 Mar;31(3):134-8.
10. Beiki D, Eftekhari M, Fallahi B, Gheisari F, Hozhabrosadati M, Fard-Esfahani A, Takavar A, Gholamrezanezhad A, Saghari M, Ansari Gilani K. Comparative scintigraphic study of renal function with Tc-99m-mercaptoacetyl-triglycine and 99mTc-ethylenedicysteine. DARU J Pharm Sci. 2008;16(1):41-46.