Bilateral Rising Renogram and Background Time-activity Curves Secondary to Subcutaneous Infiltration of radiotracer

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Abstract

We present the case of a 50-year-old man who underwent Tc-99m DTPA renal dynamic study. First pass images revealed poor visualization of the abdominal aorta and kidneys and the time-activity curves over both kidneys as well as over background region showed rising pattern. Twenty minute-to-peak count ratio was increased in both kidneys. Imaging of the site of radiotracer injection showed a zone of high radiotracer activity that suggested partial subcutaneous tracer infiltration. One day later the dynamic renography was repeated. Particular attention was paid to the intravenous bolus tracer injection. The patterns of renograms were normal with rapidly falling slopes beginning at 2.5-minute. Twenty minute-to-peak count was normal and background time-activity curve reached its peak at 3 minutes followed by a fast downward slope. This case demonstrates that background time-activity curve may be helpful in performing a quality assurance test in patients with suspected extravasations of radiotracer into the subcutaneous tissue at the time of bolus injection. It is important to note that partial dose infiltration should be considered if the renogram study shows obstructive pattern bilaterally. In such cases the background time-activity curve may serve as a control and help in distinguishing true obstructive renogram from the artifact caused by subcutaneous infiltration.

Key words: Renal Dynamic Study, Tc-99m DTPA, Urinary obstruction, subcutaneous infiltration.

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Introduction

Renal dynamic study provides functional and anatomic information. Common indications of a renal dynamic study are assessment of renal perfusion and function, renovascular hypertension, urinary tract obstruction, renal transplant evaluation and acute renal failure (1). Analysis of renogram curves is usually done by examining all the three phases of the time activity curve. Within 15 to 20 seconds following the injection of the radiopharmaceutical, there is rapidly rising slope (first phase), which at about 20 to 40 seconds reaches an inflection point. The second phase of the renogram is presented by a less rapid increase in activity, which reaches a peak normally at 3 to 5 minutes. By about 3 to 5 minutes, the renal activity begins to leave the kidney via the collecting system and reaches the bladder. Thereafter, the curve is represented by a rapidly falling slope. The renogram curve is affected by the state of hydration, radiotracer injection method, area of interest, and background chosen (2).

Case report

A 50-year-old man with a history of flank pain, nephrolithiasis and bilateral mild hydronephrosis was referred for diuretic renography to rule out urinary tract obstruction. After oral hydration with 10 ml/kg of water, 15 mCi of Tc-99m DTPA was injected intravenously in supine position and dynamic scintigraphy was performed in posterior projection using single head SPECT gamma camera (Model: DSX, Summit Medical Vision, France) equipped with a low energy, high resolution collimator. Frusemide (40 mg) was administered intravenously 15 minutes after the radiotracer injection. Regions of interest were drawn around the kidneys and background areas were defined using crescent shaped regions of interest inferior to the lower poles of the kidneys. The first phase of the study revealed poor visualization of the abdominal aorta as well as decreased perfusion of bilateral kidneys (Figure 1A). Subsequent serial functional images of the kidneys revealed gradual increase in the uptake of radiotracer by both kidneys. However, the background radioactivity

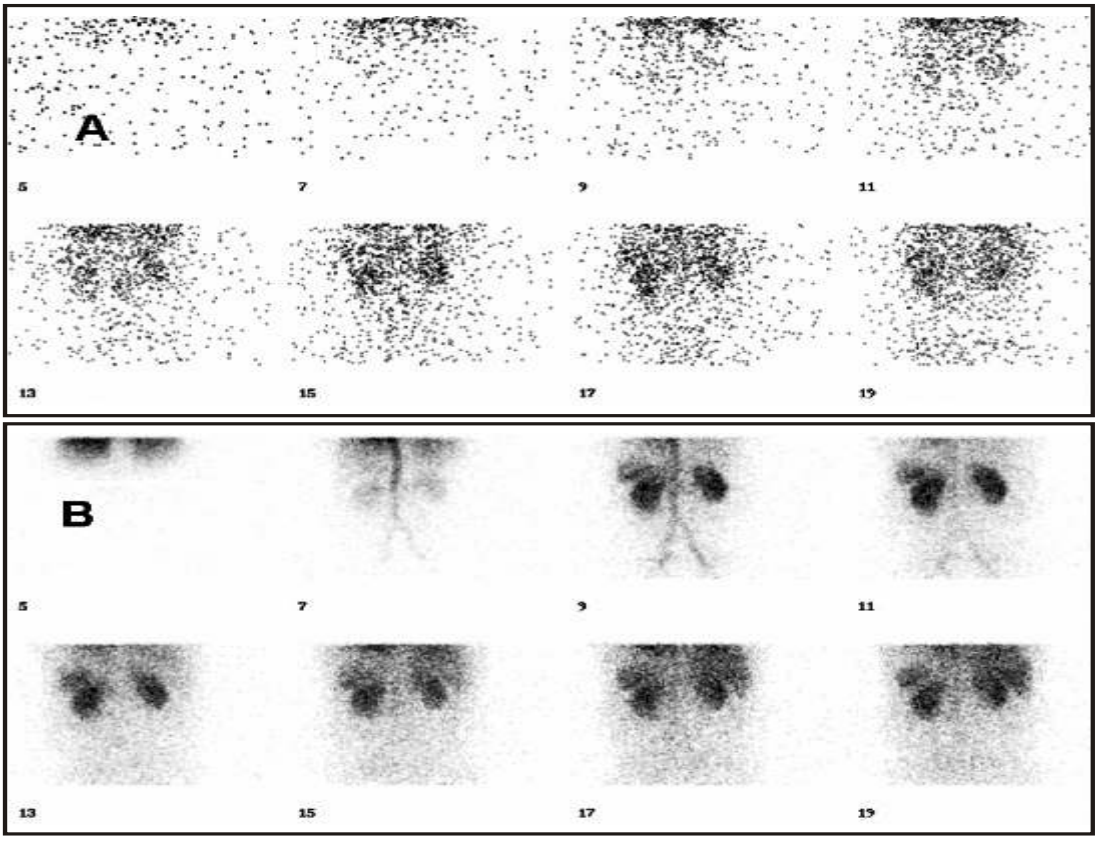

Figure 1. Flow phase images of renal dynamic study. A: Poor visualization of the abdominal aorta and kidneys secondary to partial subcutaneous tracer infiltration. B: Repeat scan with proper bolus intravenous injection shows normal visualization of the abdominal aorta and kidneys.

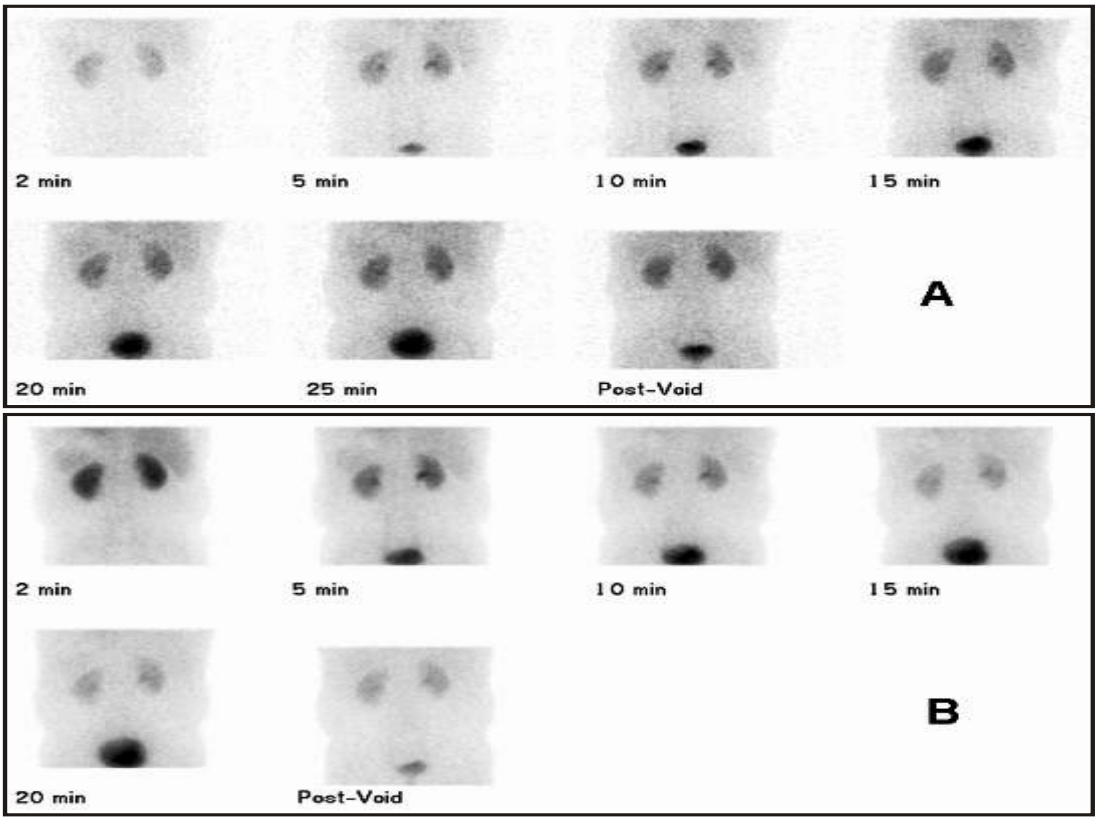

Figure 2. Renographic (Function) phase images of renal dynamic study. A: Gradually increasing in tracer activity throughout the abdomen (kidneys and background) secondary to subcutaneous tracer infiltration. B: Repeat scan with proper bolus injection shows gradually decreasing in activity throughout the abdomen and the kidneys.

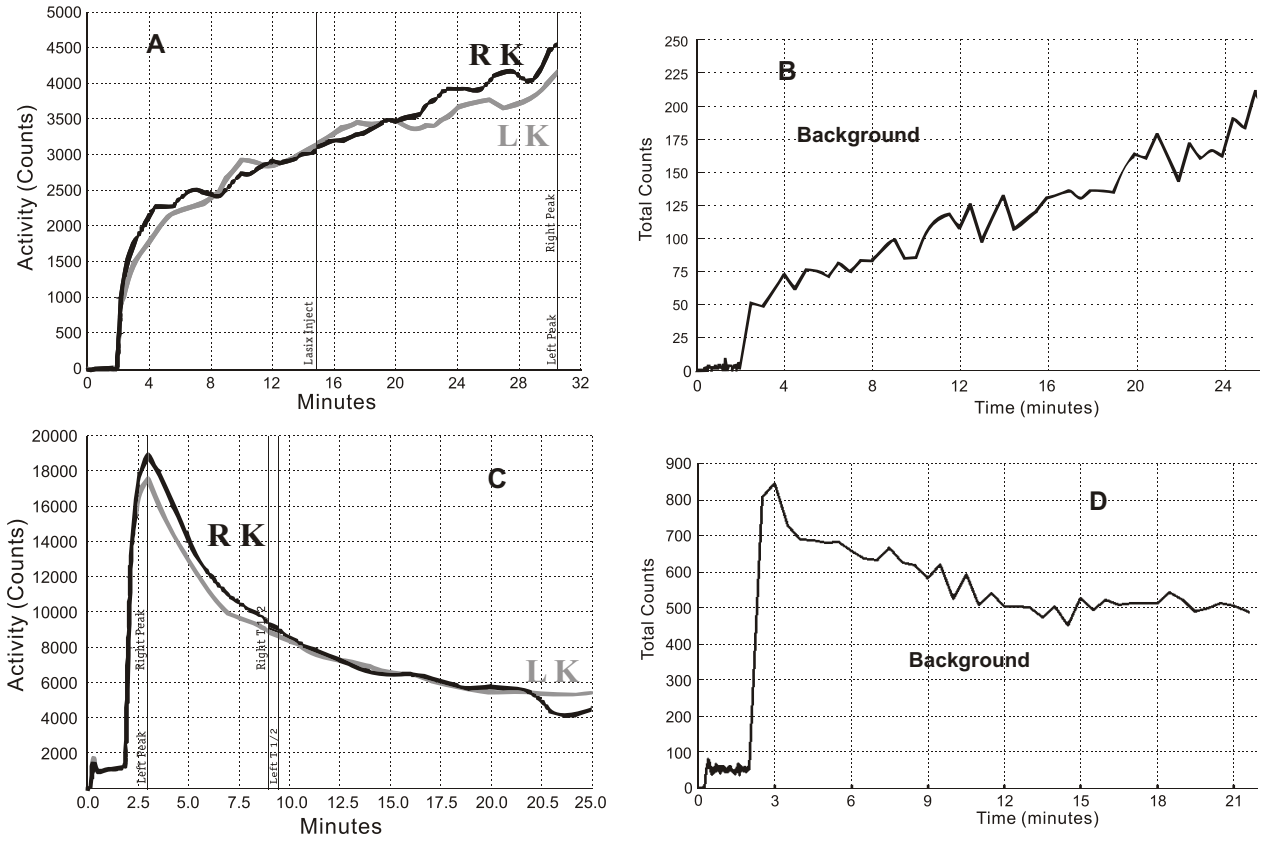

Figure 3: Renograms and background activity time-activity curves: A&B: Rising patterns secondary to subcutaneous tracer infiltration. C&D: Normal patterns in normal kidneys with proper tight bolus intravenous tracer injection (R K: Right Kidney, L K: Left Kidney).

throughout the abdomen surrounding the kidneys remained persistently high (Figure 2A). Examination of the time activity curves over bilateral kidneys and the background region revealed a rising pattern over the kidneys as well as over the background (Figure 3A, B). The ratios of 20-minute-to-peak count were 84% and 82% for left and right kidneys respectively. Although rising renogram is usually seen in patients with urinary tract obstruction, rising background curves are unusual. Further evaluation including imaging of the site of radiotracer injection showed a zone of high radiotracer accumulation that suggested partial subcutaneous extravasations.

The study was repeated one day later giving particular attention to the intravenous bolus injection of the radiotracer. The repeat study produced a perfectly normal renogram. Both kidneys revealed prompt and rapid perfusion during the first pass phase of the study (Figure 1B). Subsequent functional images revealed excellent uptake of the radiotracer by both kidneys, rapidly decreasing background activity throughout the abdomen (Figure 2B). The repeat study revealed normal renogram patterns in both the kidneys, with peaks at 2.5 minutes followed by rapidly falling slopes (Figure 3C). Quantitative analysis revealed the ratios of the 20-minute-to-peak counts as 30% and 29% for the left and right kidneys respectively. Concurrent background time-activity curves reached their peaks at around 3 minutes on both sides, followed by rapid downward slopes signifying prompt clearance of radiotracer from the background (Figure 3D).

Discussion

The rising curve in diuretic renography usually suggests obstructive process. Before accepting the conclusion of a definite obstructive response, the nuclear medicine physician must consider all possible reasons why it may be falsely positive: unrecognized dehydration, poor response to diuretic secondary to poor renal function, massive dilatation of upper urinary tract or full bladder (3). Cortical tracer retention and increased 20-min-to-peak activity may be seen on post-captopril study indicating renovascular hypertension or in patients with acute tubular necrosis (1-3).

A consensus on diuresis renography for investigation of the dilated upper urinary tract has already been published several years ago (4). The objectives of that consensus report were to standardize the technical aspects, performance and interpretation of diuresis renogram to provide accurate and reproducible results and enable comparison between the tests. In the present case, the initial study revealed significant background activity throughout the 30 minutes of the renography study, while the concurrent time-activity curves obtained over both the kidneys and background - all exhibited rising patterns

(Figures 2A & 3A,B). In case of optimal intravenous bolus injection and good renal function it is expected that the background activity reaches a peak rapidly and then fall with a rapid slope. In the absence of such results in the initial study we suspected extravasations of radiotracer, which was confirmed subsequently by scanning the site of injection. It is therefore suggested that the background time activity corves should be used for quality assurance in the analyses and interpretation of renography results. This would confirm the accuracy of intravenous injection and minimize the results of false positive studies vis a vis urinary obstruction. In this regard, it would be helpful to have an intravenous line in place before starting the renogram procedure.

References

1. Bazarjani S, Dekbeke D. Renal Scintigraphy. In: Habibian MR, Delbeke D, Martin W, Sandler MP. Nuclear Medicine Imaging, A Teaching File. Philadelphia, Lippincott Williams & Wilkins, 1999, pp 365-433
2. Barron BJ, Kim EE, Lamki LM. Renal nuclear medicine. In: Sandler MP, Coleman RE, Patton JA, Wackers FGTH, Gottschalk A (Eds), Diagnostic Nuclear Medicine (4th ed), Philadelphia, Lippincott Williams & Wilkins, 2003, 865-901.
3. Brown SCW. Nuclear medicine in the clinical diagnosis and treatment of obstructive uropathy. In: Murray IPC, Ell PJ, Van der Wall H, Strauss HW (Eds). Nuclear medicine in clinical diagnosis and treatment (2nd ed), Edinburgh, Churchill Livingstone, 1998, 291-314.
4. O'Reilly P, Aurell M, Britton K, Kletter K, Rosenthal L, Tito T. Consensus on diuresis renography for investigation of the dilated upper urinary tract. J Nucl Med 1996; 37: 1872-1876.