Annals of Nuclear Medicine Vol. 16, No. 1, 67–70, 2002

Usefulness of dynamic renal scintigraphy in a patient with renal arteriovenous fistula treated by transcatheter embolization

Tsuyoshi HASHIMOTO,* Kiyoshi KOIZUMI,** Kazuhiro SAITO,* Fumio KOTAKE,*
Naoki ITO*** and Kimihiko ABE***

*Department of Radiology, Kasumigaura Hospital, Tokyo Medical University
**Department of Radiology, Hachioji Medical Center, Tokyo Medical University
***Department of Radiology, Tokyo Medical University

Tc-99m-DTPA renal scintigraphy was performed before and after transcatheter coil embolization in a patient with renal arteriovenous fistula (AVF). Before embolization, scintigraphy showed a characteristic accumulation pattern compatible with the hemodynamics of an aneurysmal type of AVF in the vascular phase. After embolization, the effects of treatment, such as a change in the split renal function on the treated-side and the disappearance of the shunt flow through the fistula were evident. It was concluded that dynamic renal scintigraphy was very useful for patients with an aneurysmal type of renal AVF scheduled for transcatheter embolization.

Key words: Tc-99m-DTPA renal scintigraphy, renal arteriovenous fistula, transcatheter embolization

INTRODUCTION

BECAUSE of the less invasiveness, selective transcatheter coil embolization has been applied more frequently to patients with renal arteriovenous fistula (AVF) and aneurysm. To our knowledge, this is the first report on a case of an aneurysmal type of renal AVF treated by this method and examined by dynamic renal scintigraphy before and after treatment. The usefulness of dynamic renal scintigraphy in this case was noted.

CASE REPORT

A 49-year-old woman complained of acute abdominal pain and gross hematuria. Excretory urography showed a right ureteral calculus and a mass effect on the left renal pelvis. She was admitted to our hospital to receive extracorporeal shock wave lithotripsy (ESWL) treatment. She had a history of recurrent bilateral renal and ureteral calculi that had been treated by ESWL 4-1/2 years earlier. She also suffered from unstable hypertension that had been treated with antihypertensive drugs. A dynamic CT of the abdomen at admission revealed a 4 × 3 cm mass in the left renal pelvis and a dilated vein behind it, which were enhanced as much as the renal artery in the early phase. These findings were suggestive of a vascular anomaly such as renal AVF. The lesion was diagnosed as an aneurysmal type of AVF on the first renal arteriography (Fig. 1). Because she had hypertension (probably due to the existence of the AVF) combined with the risk that the lesion might rupture, active treatment was warranted. She suffered from bilateral renal insufficiency due to recurrent renal and ureteral calculi, which required preservation of the left renal function. Therefore, interventional radiology (IVR), selective transcatheter coil embolization of the left renal artery, was selected instead of the standard surgical approach. The patient had been about to undergo two courses of ESWL treatment in the right kidney before IVR. This IVR treatment we planned offered the potential for improved renal function by eliminating the shunt-flow through the fistula and thus

Received May 15, 2001, revision accepted October 10, 2001.
For reprint contact: Kazuhiro Saito, M.D., Department of Radiology, Kasumigaura Hospital, Tokyo Medical University, 3–20–1 Ami-machi Chuoh, Inashiki-gun, Ibaraki 300–0395, JAPAN.
E-mail: tsuyoshi@tokyo-med.ac.jp

increasing the blood flow through the renal parenchyma, but it also carried the risk of reducing renal function, since any coil deviation would aggravate the renal infarction. It was therefore necessary to assess left renal function separately to enable a more precise evaluation of the potential treatment effects of IVR. The need for this approach was considered especially important, since she received treatments for both kidneys during this hospitalization. Therefore, dynamic renal scintigraphy was planed before and after embolization in the following manner: Immediately after a bolus injection of 185 MBq Tc-99m-DTPA, vascular phase images at 2-second intervals were obtained for the first 60 seconds, followed by additional imaging at 1-minute intervals for the next 19 minutes. In those images, an early localized, increased accumulation of the radionuclide was noted in the area of the left renal hilus in the vascular phase (Fig. 2), which had rapidly disappeared in the subsequent sequential images (Figs. 3a–d). This finding was interpreted to be radionuclide accumulation in the AVF, and was totally compatible with the hemodynamics of an aneurysmal type of AVF. Bilateral renal glomerular filtration rates (GFRs) calculated by employing a modified Gates method[1,2] were 24.5 (left) and 11.6 (right) m*l*/min (Table 1). Results indicated that the right renal function was somewhat worse than the left, and reconfirmed the fact that to preserve the patient's renal function, the use of IVR would be preferable to a surgical approach. The procedure was followed by transcatheter embolization with 6 microcoils 3 days later, after which her blood pressure declined and the dosage of antihypertensive drugs was successfully reduced. A dynamic CT of the abdomen 4 days after embolization showed no inflow of the contrast medium into the AVF, indicating successful embolization of the lesion. Follow-up Tc-99m-DTPA renal scintigraphy was conducted 48 days after the embolization (Fig. 4). In those images, radionuclide accumulation in the mass on the left renal hilus was no longer seen, also indicating that the shunt flow through the fistula had disappeared. Dynamic CT of the abdomen conducted at the same time also showed no inflow of the contrast medium into the AVF, as well as a reduction in its size (1.5 × 2 cm in diameter). Bilateral GFRs were calculated to be 37.4 (left) and 18.2 (right) m*l*/min (Table 1), confirming bilateral improvement in renal function. The improvement in left renal function was concluded to result from the effects of IVR treatment, and that in the right due to ESWL treatments.

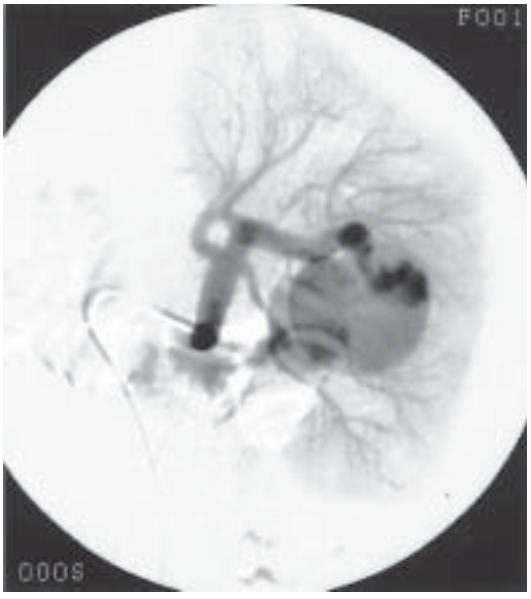

Fig. 1 Left renal arteriogram before embolization reveals an aneurysmal type of AVF. (Reprinted with permission from *The Official Journal of the Japanese Society of Angiography and Interventional Radiology*.[7])

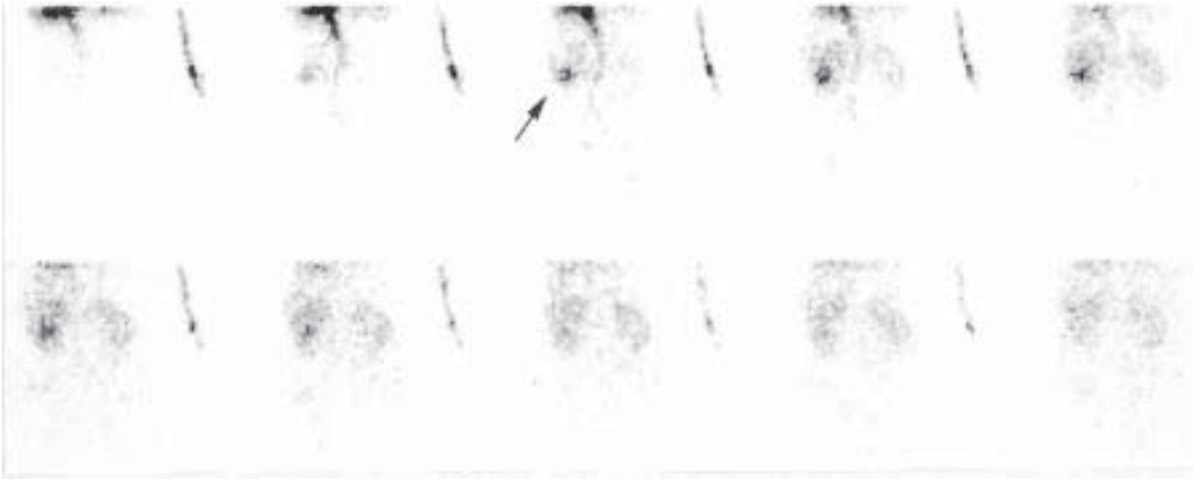

Fig. 2 Radionuclide flow study before embolization shows a localized increased accumulation of the isotope in the left renal hilus (*arrow*).

DISCUSSION

Renal AVF, a type of vascular anomaly, has been classified into cirsoid and aneurysmal types according to its angiographic appearance.[3] The former is considered to be a congenital form and has several varix-like communications between the arteries and veins. The latter, considered to be identical to the idiopathic or spontaneous type, has a limited number of relatively large cavernous channels for communication. Our case described here, which is relatively rare, belongs to this latter type. A frequent symptom of the cirsoid type of AVF is gross hematuria, whereas for the aneurysmal type it is hypertension due to massive venous return through the fistula and secondary renal ischemia distal to the fistula.[4] Although it is unusual for patients with asymptomatic AVF to require invasive treatments, symptomatic AVF does require certain procedures, e.g., total or partial nephrectomy, open ligation of the feeding artery of the AVF, and selective transcatheter embolization of the AVF such as applied in our case.[5] By employing a transcatheter coil embolization technique, the feeding arteries to the AVF can be selectively occluded, preserving the renal blood flow on the diseased side. The procedure is much less invasive than open surgery. The number of cases of renal AVF and aneurysms treated by this method has been increasing as the angiographic equipment and techniques have been refined. In our case, scintigrams obtained before embolization showed early localized accumulation of the radionuclide in the mass on the left renal hilus, which disappeared rapidly in the subsequent phase. This accumulation pattern was compatible with that of a case of AVF previously examined by employing dynamic renal scintigraphy and reported by Manoli et al.[6] We were also able to evaluate the therapeutic effects, such as changes in the split renal function and GRF, calculated by using a modified Gates method,[1,2] and the disappearance of the shunt flow through the fistula, as evidenced by renal scintigraphy that was conducted after embolization.

It was concluded that dynamic renal scintigraphy is

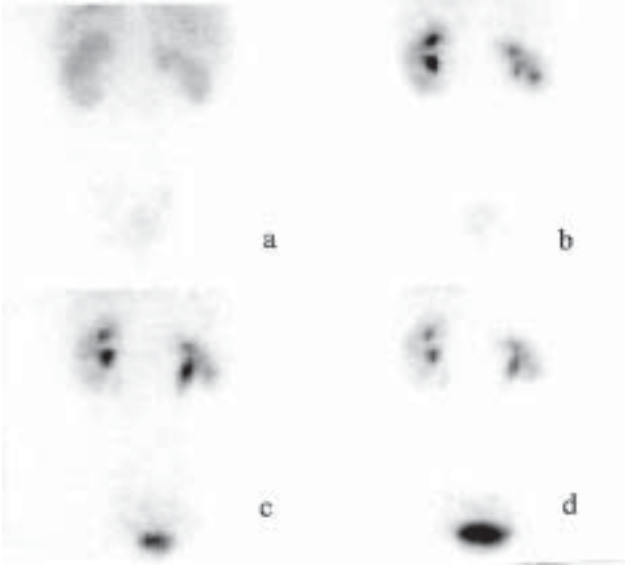

Fig. 3 a–d: Functional phase images 2, 6, 12 and 20 minutes after injection show rapid disappearance of the isotope accumulation in the lesion.

Table 1 Bilateral GFRs before and after embolization

	Before embolization	48 Days after embolization
Total GFR (ml/min)	40.1	55.6
Left GFR	28.5	37.4
Right GFR	11.6	18.2

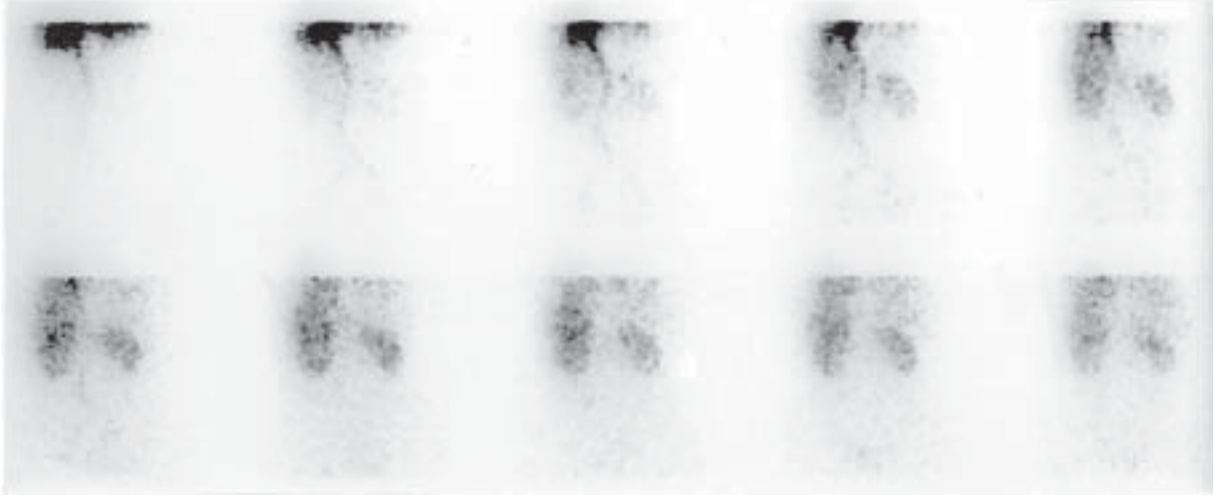

Fig. 4 Radionuclide flow study 48 days after embolization shows no radionuclide accumulation in the left renal hilus.

very useful for those patients with a renal aneurysmal type of AVF who are scheduled for transcatheter embolization.

REFERENCES

1. Gates GF. Glomerular Filtration Rate: Estimation from Fractional Renal Accumulation of ^{99m}Tc-DTPA. *AJR* 1982; 138: 565–570.
2. Itoh K, Arakawa M. Re-estimation of renal function with ^{99m}Tc-DTPA by the Gates' method. *KAKU IGAKU (Jpn J Nucl Med)* 1987; 24: 389–396.
3. Takaha M, Matsumoto A, Ochi K, Takeuchi M, Takemoto M, Sonoda T. Intrarenal arteriovenous malformation. *J Urol* 1980; 124: 315–318.
4. Takatera H, Nakamura M, Nakano E, Tokunaga K, Sakurai M, Takaha M, et al. Renal arteriovenous fistula associated with a huge renal vein dilatation. *J Urol* 1987; 137: 722–724.
5. Kearse WS Jr, Joseph AE, Sabanegh ES Jr. Transcatheter Embolization of Large Idiopathic Renal Arteriovenous Fistula. *J Urol* 1994; 151: 967–969.
6. Manoli RS, Soin JS. Congenital intrarenal arteriovenous fistula diagnosed by radionuclide study. *J Nucl Med* 1978; 19: 440–441.
7. Saito K, Ito N, Kotake F, Goto Y, Nagase Y, Nito H, et al. Two cases of aneurysmal type of renal arteriovenous fistula treated by transcatheter arterial embolization with absolute ethanol. *Jpn J Intervent Radiol* 2001; 16: 259–263.
8. Messing E, Kessler R, Kavaney PB. Renal arteriovenous fistulas. *Urology* 1976; 8: 101–107.
9. Kopchick JH, Bourne NK, Fine SW, Jacobsohn HA, Jacobs SC, Lawson RK. Congenital renal arteriovenous malformations. *Urology* 1981; 17: 13–17.