Atypical Renal Artery Stenosis in a Renal Transplant: Diagnosis by Radionuclide Techniques

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A case of a cadaveric kidney transplant recipient who developed progressively severe renal failure within 3 mo of transplantation secondary to renal artery stenosis is presented. The patient was primarily hypotensive and Doppler ultrasound showed normal flow. The problems in diagnosing this unusual case are reviewed. The findings on serial radionuclide studies eventually led to consideration of the correct diagnosis.

Key Words: kidney; radionuclide studies; renal arteries; stenosis; kidney transplant

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Nuclear medicine techniques are often used to assess problems associated with renal transplant recipients (*1*). We describe a case of a cadaveric transplant recipient who developed renal artery stenosis (RAS) at an unusual time (early after transplantation), primarily without hypertension, where proper diagnosis was delayed.

CASE REPORT

A 24-yr-old female with end-stage renal disease secondary to chronic glomerulonephritis received a cadaveric transplant. Our standard technique for renal transplant evaluation is given in Appendix 1. A ^{99m}Tc-DTPA renal scan 2 days post-transplantation showed intact perfusion with minimal excretion (Fig. 1). A ^{99m}Tc-sulfur colloid SPECT scan showed 2+ sulfur colloid uptake. The two studies, in combination, were interpreted as acute tubular necrosis (ATN) with superimposed early rejection.

Ultrasonography showed no evidence of obstruction. At 2-wk post-transplantation, repeat radionuclide studies showed decreased transplant perfusion with moderately decreased function and no sulfur colloid uptake which were interpreted prospectively as "no evidence of transplant rejection, consider cyclosporine toxicity." Clinicians checked the cyclosporine levels which were within the desired range and clearly not elevated. No other immediate action was taken.

Approximately 7 wk later (10 wk post-transplant), the patient presented with increasing renal failure (creatinine 3.1 mg/dl) and was re-evaluated. Repeat radionuclide studies, interpreted without the benefit of old scans, showed decreased renal flow and function, with no significant colloid uptake, and were interpreted as "no rejection." One week later, Doppler ultrasonography showed poor perfusion with transplant enlargement and no other abnormality. Another radionuclide study at this time showed decreased flow and function with no colloid uptake, interpreted with the report of previous studies, but not with the scans themselves. This study was again interpreted as "no rejection, consider cyclosporine toxicity." The patient at this time had a creatinine level of 6.0 mg/dl and we began dialysis.

Another radionuclide scan was performed 18 days later (3 mo post-transplantation with a creatinine level of 10.3 mg/dl), showing severe decrease in flow and function. This was interpreted with the results of old scans, but again without the old scans themselves, and showed prominent transplant dysfunction, but no rejection.

One week later (13 wk post-transplant), the clinicians brought all the old scans to the Nuclear Medicine Service for consultation on this case of "unexplained transplant failure." When reviewed in sequence (Fig. 1), the radionuclide studies showed intact perfusion immediately post-transplantation, with a progressive decline in flow and function over the next 3 mo. Cyclosporine toxicity had been excluded; there was no obstruction. By exclusion, the only remaining etiology was RAS. However, the patient was hypotensive and not hypertensive, and had had a negative captopril renogram at approximately 3 wk post-transplantation. Even more, the patient had a Doppler ultrasonography 4 days before this consultation which was completely normal (Fig. 2). In spite of these conflicting data, RAS remained the only conceivable consideration, therefore, renal arteriography was performed. This revealed a 95% stenosis of the proximal renal transplant artery (Fig. 3). Percutaneous transluminal angioplasty (PTCA) was performed a day later with successful reduction of the anatomic stenosis. The patient's serum creatinine level dropped from 10.3 to 3.0 mg/dl, without a need for further dialysis. Six weeks later, renal function began to decline and the patient became hypertensive. Repeat angiography revealed an intimal flap in the external iliac artery with a decrease in flow to the transplant. Surgical revascularization and repair were performed with improvement in function and blood pressure control. The patient's clinical condition has since been stable for 6 mo.

DISCUSSION

Radionuclide imaging of renal transplants is frequently performed to evaluate transplant dysfunction and to eval-

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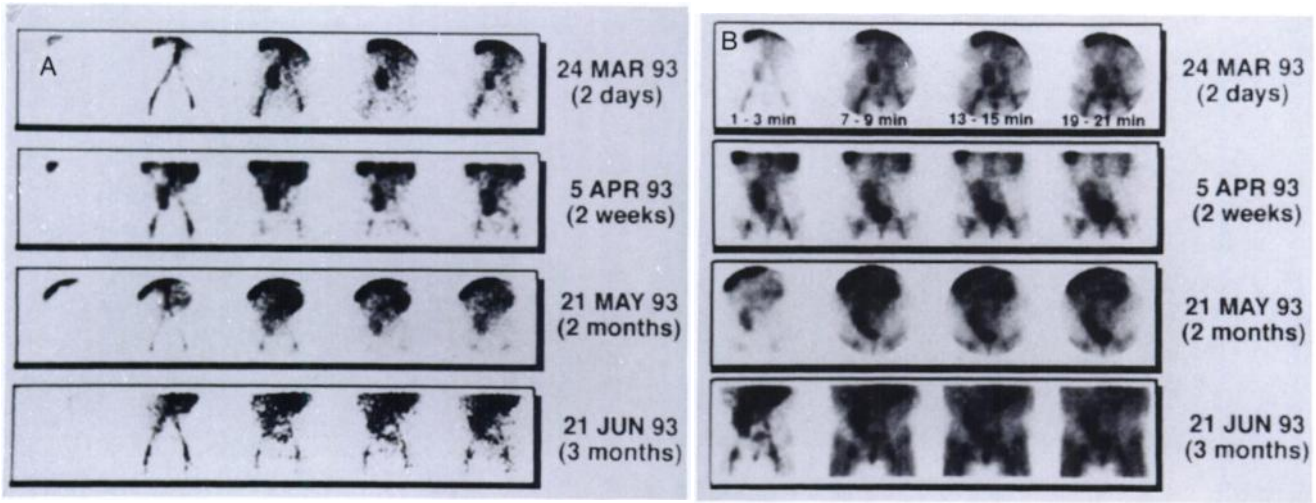

FIGURE 1. (A) Renal scans show initially intact perfusion and progressive decline in perfusion over time. Scans are summed images at 4 sec/frame. Arrival time is prompt on the first two studies and then delayed on the later scans. Overall perfusion of the transplant, as compared to the mesenteric blood flow, shows a progressive decline. (B) Renal scans show initially poor function secondary to ATN, improvement in function at 2 wk, and eventual decline in function over time.

uate for complications (*1*). Transplant complications include acute tubular necrosis (ATN), rejection, obstruction, cyclosporine toxicity, renal artery stenosis, renal vein thrombosis, cortical necrosis, urine leaks, and mass lesions such as hematomas, lymphoceles and urinomas. Since the introduction of cyclosporine for the prevention of transplant rejection, nuclear medicine techniques have been less frequently used to assess for rejection since rejection findings can be similar to those of cyclosporine toxicity. However, at our institution, we have found ^{99m}Tc-sulfur colloid useful in assessing rejection even in the face of cyclosporine use (*2*). We currently perform ^{99m}Tc-sulfur colloid SPECT, and this is our primary method for diagnosing rejection. Unless the transplant is totally nonperfused, we have found that the lack of sulfur colloid uptake has nearly a 100% negative predictive value for transplant rejection, regardless of the results of the DTPA scan.

RAS in a renal transplant typically presents at 6–12 mo after transplantation (*3,4*). The vast majority of patients with transplant RAS are hypertensive, though many transplant patients with normal renal arteries are also hypertensive. The DTPA scan may be entirely normal in the face of RAS. The scan may show a mild decrease in flow or in function on DTPA scans, but these findings are entirely nonspecific, and can be mimicked by rejection, cyclosporin toxicity or parenchymal disease from involvement of the transplant by native renal disease. The classic findings of RAS of decreased flow, delayed excretion and hyperconcentration are rarely seen. The same results hold for hippuran imaging as well.

Captopril renography has obviously been used successfully to detect RAS in native kidneys, but little work has been performed in the transplant population. It should be remembered that captopril renography detects physiologi-

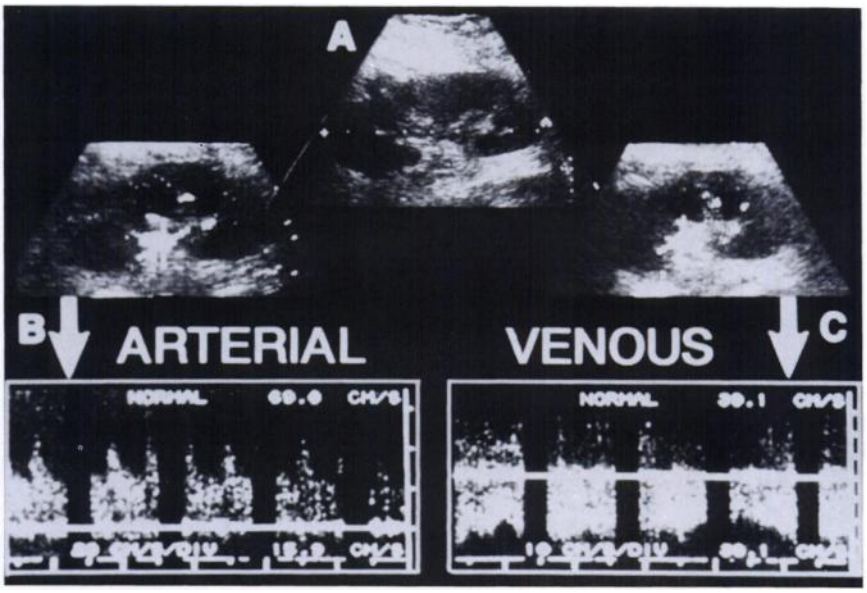

FIGURE 2. Doppler ultrasonography of transplant renal vessels shows entirely normal flow. (A) Transverse sonogram (B) Placement of Doppler probe and resulting arterial waveform. (C) Placement of Doppler probe and resultant venous waveform.

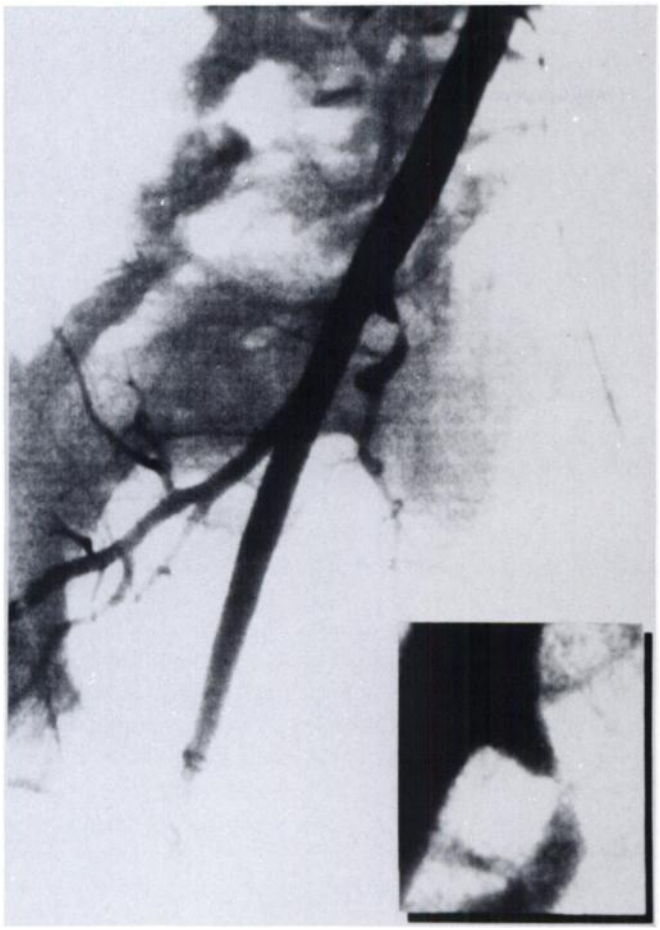

FIGURE 3. Renal transplant arteriogram shows 95% stenosis of the proximal renal transplant artery.

cally significant RAS causing renovascular hypertension, and many cases of RAS are not physiologically significant or causing hypertension. Early in the course of this patient's workup a captopril renal scan was normal. Our own experience with captopril renography in transplants (*5*) is that it detects most cases of physiologically significant RAS and predicts response to angioplasty. RAS does not equal physiologically significant renovascular hypertension.

In this patient, the diagnosis of RAS was delayed for several reasons. First, serial reports, but not the actual scans, were reviewed. The severity of the decline in flow and function were not obvious from the reports alone. The scans in Figure 1 clearly show this decline. Second, the time course and presentation were very unusual for RAS. Additionally, patients with RAS are generally hypertensive. Our patient was transiently hypertensive (2–4 wk after transplantation), though most of the time hypotensive. We have no explanation for this except that progressive renal failure existed. Third, Doppler flow studies were normal. Doppler ultrasonography has previously been used to assess renal blood flow in circumstances of renal artery stenosis with some success (*6*). However, this technique is both time-consuming and operator-dependent. In our patient, the only explanation for RAS not being detected by Doppler is simply failure of the method. When all the data were presented to the nuclear physicians, RAS was the only reasonable etiology remaining, in spite of ultrasonography, and we proceeded with angiography of the renal artery.

Nuclear medicine physicians are generally consultants and are not directly managing patient care. This case reemphasizes the need to utilize serial scans and points out the conflicts that occur between nuclear flow studies and Doppler ultrasonography. Total assessment of all available information is frequently required and usually leads to the proper diagnosis. Radionuclide methods for transplant evaluation remain a powerful tool in transplant management.

APPENDIX

Our standard technique for renal transplant evaluation involves the following procedures:

1. Following the injection of 2 mCi of ^{99m}Tc-sulfur colloid and a 30-min delay for localization, SPECT imaging of the pelvis is performed. A 20-min SPECT acquisition is performed using a triple-headed gamma camera, equipped with low-energy, high-resolution collimators (40 stops at 3° a stop, each stop imaged for 30 sec, each head traveling a total of 120°). Acquisition and reconstruction is in 64 × 64 × 64 matrix, with a pixel size of 6.56 mm. Reconstruction is performed using a Hanning filter with a cutoff of 0.7. Images are viewed in transverse and coronal axes. Planar reprojection images are also re-created in the anterior, posterior, and both lateral planes. Colloid uptake by the transplant is graded relative to uptake in the L5 vertebra, using the following scale: 0 = no uptake, 1+ < L5, 2+ = L5, 3+ > L5. Uptake of greater than or equal to 2+ is considered rejection. No uptake excludes rejection, and 1+ uptake is frequently secondary to mild rejection. We consider the results from the DTPA scan and clinical presentation in our management as 1+ uptake.
2. Using a dose of 15 mCi of ^{99m}Tc-DTPA, a flow study and renogram is performed using a single-headed large-field-of-view gamma camera, equipped with a low-energy, high-resolution collimator. Computer acquisition is performed using a 128 × 128 matrix (pixel size ≈ 2.8 mm). The flow study is acquired at 1 sec/frame for 1 min, and then a 27-min renogram is acquired at 1 min/frame.
3. A tracer dose of ^{131}I-hippuran (30 μCi) is injected immediately after the DTPA, and a blood sample at 44 min is used to calculate the effective renal plasma flow using the method of Tauxe and Dubovsky.

REFERENCES

1. Dubovsky EV, Russell CD. Radionuclide of renal transplants. *Semin Nucl Med* 1988;18:181–198.
2. Massengill SF, Pena DR, Drane WE, Fennell RS, Richard GA. Technetium-99m sulffur colloid accumulation as a predictor of acute renal transplant rejection. *Transplantation* 1992;54:969–973.
3. Raynaud A, Bedrossian J, Remy P, et al. Percutaneous transluminal angioplasty of renal arterial stenosis. *AJR* 1986;146:853–857.
4. Sniderman KW. Angioplasty of renal transplant artery stenosis. In: Kadir S, ed. *Current practice of interventional radiology*. Philadelphia: B.C. Decker, Inc.; 1991:617–625.
5. Shamlou KK, Drane WE, Hawkins IF, Fennell RS. Captopril renography and the hypertensive renal transplantation patient: a predictive test of therapeutic outcome. *Radiology* 1994;190:153–159.
6. Rifkin MD, Needleman L, Pasto ME, et al. Evaluation of renal transplant rejection by duplex Doppler examination. *AJR* 1987;148:759–762.