Renography within 1 Hour of Renal Transplantation: Technical Feasibility and Clinical Utility

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Key Words

Renal transplant · Renography · Nuclear medicine ·
Acute tubular necrosis

Abstract

Objective: Renographies obtained within 1 h of renal transplantation were studied prospectively to evaluate their technical feasibility and potential clinical impact on successful treatment of immediate posttransplantation complications such as arterial or venous thrombosis, which require prompt diagnosis and management. **Subjects and Methods:** During December 1996 to December 1998, 127 renal transplants were performed. Ninety-four patients had complete renographic studies within 1 h of surgery. It was not possible to perform renography on 26 patients who were not sent to the Department of Nuclear Medicine within 1 h of transplant and 7 other patients who could not undergo a complete renogram because of their postoperative condition. **Results:** There was no complication attributed to transporting patients to the Department of Nuclear Medicine for these studies so soon after surgery. Of the 94 renographies obtained immediately following transplant surgery 46 were abnormal. However, when compared with the usual policy of obtaining baseline renograms between 12 and 72 h after surgery, treatment was changed for only 2 patients.

Radionuclide renography within 1 h of transplant surgery was technically feasible. **Conclusion:** Based on the results of this study the clinical utility of obtaining renography within 1 h posttransplant was minimal and hence we recommended that it should not be performed routinely but could be used on an individual basis when imminent intervention is highly likely.

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Introduction

While radionuclide renography after renal transplantation has been advocated for many years, the examination is rarely performed shortly after the surgery. Many investigators have recommended obtaining a postoperative renogram – usually between 12 and 72 h following transplantation – as a baseline study [1–7]. This so-called baseline renography may identify acute tubular necrosis (ATN), most frequently seen in cadaveric allografts, and more importantly may be used for comparison with future renography performed to diagnose transplant rejection or other complications which may develop days, months, or years later. However, a study obtained between 12 and 72 h following transplantation could be thought of as late for the transplant surgeon wishing to identify vascular complications that

may lead to graft necrosis if left untreated for even a short time.

Either arterial or venous thrombosis may occur during or shortly after renal transplantation [8–10]. Although such vascular complications rarely happen, prompt surgical intervention often will preserve the renal transplant. Therefore, surgeons at our institution suggested immediate postoperative confirmation of renal transplant arterial perfusion and renal vein patency. While duplex and color Doppler mode ultrasound have been used to confirm vascular patency [8, 9, 11], surgeons at our institution prefer a radionuclide renogram which will both exclude vascular complications and also serve as a baseline study for comparison with future studies.

While many investigators have reported performing renography as early as 12 h following surgery, the clinical results of a performing of renography within 1 h of renal transplantation have not previously been described. Therefore, the aim of this study was to investigate the feasibility and potential clinical utility of such renography.

Subjects and Methods

During the period of December 1996 to December 1988, 127 postoperative renal transplant recipients (70 male and 57 female ranging in age from 13 to 69 years with a mean age of 41 years) underwent renography. Twenty-six patients were not brought to nuclear medicine within 1 h. Thus, of the 127 transplant recipients, only 101 arrived in the Department of Nuclear Medicine within 1 h of surgery. These included 72 living related donors and 29 cadaveric transplant recipients.

All the renal transplant recipients were brought directly from surgery to the department where ongoing postoperative analgesia and respiratory care were adequately maintained. In addition, transplant surgeons were available to treat any vascular complications if indicated by the renography. Thus, a commitment of resources and degree of support not typically required for renography was maintained, which included the presence of the surgeon, anesthesiologist, surgical nurse, nuclear medicine physician, and nuclear medicine technologist in the Department of Nuclear Medicine for these special renographies.

For all studies, between 185 and 370 MBq ^{99m}Tc MAG-3 were injected intravenously followed by a flow study (2 s per frame for 60 s) and sequential imaging (30 s per frame for additional 29 min). A large field-of-view gamma camera interfaced to a computer system allowed for digital image processing and quantitative analysis. Processing was performed by drawing a region of interest around the transplanted kidney, the ipsilateral internal iliac artery, and a background region. Time-activity curves for these regions were analyzed for the following parameters: perfusion index, time to maximum transplant uptake (T_{max}), time to half-maximum transplant uptake ($T_{1/2 \text{ max}}$), and functional uptake index. Both images and quantitative data were interpreted using previously described tech-

niques and standards [7, 12–19]. Interpretation included visual analysis of the flow study and sequential functional images as well as quantitative analysis of T_{max} , $T_{1/2 \text{ max}}$, perfusion index and functional uptake index (fig. 1).

Results

Of the 101 studies, 94 were of acceptable technical quality. For 7 patients, technical difficulties caused by the patient's postoperative condition [irritability and movement (5 patients) and blocked bladder catheter (2 patients)] made it impossible to complete the renographic examination. For these 7 patients, partial studies of generally limited diagnostic value were obtained. However, for all 7 of these patients the limited studies were adequate to exclude vascular complications requiring immediate surgical intervention. Thus, vascular complications were excluded for all the 101 patients. Accordingly, the protocol compliance rate during the immediate postoperative period was 101/127 (80%) transplant recipients. The technical success rate for obtaining a full renogram within 1 h of surgery was 93% (94/101 patients). However, the success rate for ruling out vascular complications (when requested to do so by the transplant surgeons) was 100% (101/101 patients). No patient suffered a postoperative complication while in the Department of Nuclear Medicine and there was no evidence that bringing these patients for renography immediately after surgery compromised the quality of postoperative care.

Of the 94 postoperative renographies 46 were abnormal. Forty-two showed ATN and only 4 had other findings: perigraft hematoma, infarct (eventually proven to be the result of renal vein thrombosis), mild rejection, and urine leak. Prompt surgical intervention for the patient with a perigraft hematoma led to evacuation of the hematoma and salvage of the allograft. Furthermore, prompt surgical intervention for the patient with renal vein thrombosis identified a badly infarcted allograft which could not be salvaged despite immediate surgery. Of the 42 renographies with findings typical of ATN, 23 occurred in patients receiving a cadaveric transplant and 19 in patients receiving an allograft from a living related donor.

Discussion

Although 46 postoperative renograms were abnormal, given the natural history of ATN, it could have been possible to detect 42 of these had the renogram been per-

Fig. 1. A radionuclide renography study of a patient with renal transplant. The study was performed immediately following surgery. The flow study (**a**) obtained for 2-second frames for 1 min shows normal perfusion to the transplanted kidney. **b** The regions of interest used to generate the perfusion curves shown. **c** The sequential functional images obtained following the flow study. These images were obtained every 30 s out to 30 min and displayed as 1-min frames. The image shows good uptake, build-up and excretion of the radiopharmaceutical by the transplanted kidney, which is also shown on the time-activity curve (**d**).

formed between 12 and 72 h after surgery as previously reported [2]. Thus, the yield of possibly significant abnormalities was among 4 of 94 cases: perigraft hematoma, renal vein thrombosis, mild rejection, and urine leak. Only the cases of renal vein thrombosis and perigraft he-

matoma led to prompt surgery. Only the patient with a perigraft hematoma had the allograft salvaged by immediate postoperative surgery. Treatment for the cases of mild rejection and urine leak was not surgical and probably would have been no different if the renogram had

been obtained between 12 and 72 h after surgery. Thus, in this series there was only 1 patient (the case of perigraft hematoma) for whom renography within 1 h of renal transplantation led to prompt surgical salvage of the renal allograft. However, within the first 24 h following transplantation, complications resulting in sudden loss of renal transplant function are rare. In fact, in this series of 127 renal transplant recipients, these were only two complications which posed an immediate threat to the transplanted kidney within the first few hours following surgery. For both cases, the renography led to surgical intervention resulting in the salvage of one of the allografts.

Nuclear medicine, transplant surgery, anesthesiology, and nursing service worked together to provide this round-the-clock imaging service. When an allograft from a living related donor was transplanted, the postoperative renography could be scheduled 1 day in advance. Cadaveric transplants at all hours of the night and day required renographies on an emergency basis. Typically, the surgeons would call nuclear medicine personnel before be-

ginning a cadaveric transplant, thus providing notice that a renogram would be required 3–4 h later. Fortunately, there were no instances in which lack of personnel, radio-pharmaceutical, or an operational gamma camera prevented us from performing a transplant renogram. Anesthesiology and nursing service accompanied all patients to the Nuclear Medicine Department. Transplant surgeons always accompanied the patients as well and were prepared to intervene as needed.

Conclusion

The results indicate that renography within 1 h of renal transplantation was technically feasible, safe for the patient, but had minimal clinical utility. Therefore we recommend that radionuclide renography within 1 h post-transplant should not be performed routinely but could be done on an individual basis when imminent intervention is highly likely.

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