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Techniques in Vascular and Interventional Radiology

Interventional Management of Vascular Renal Transplant Complications

Kanti Pallav Kolli, MD, and Jeanne M. LaBerge, MD

Renal transplantation is the therapy of choice in patients with end stage renal disease. Although transplant rejection remains the most common complication after renal transplantation, vascular anatomical complications occur in 1%-23% of renal transplant recipients. Interventional radiologists play an important role in the management of these complications. This review discusses the role of image-guided interventions within the context of multidisciplinary patient management. Particular emphasis is given to anatomical considerations unique to this patient population, techniques used for image-guided interventions, and outcomes of image-guided interventions.

KEYWORDS Renal transplantation, Complications, Transplant renal artery stenosis, Urinary leak, Ureteral obstruction

Introduction

Renal transplantation confers greater long-term survival than dialysis in patients with end stage renal disease.[1] Renal transplantation is, therefore, the preferred therapy in this patient population, with nearly 15,000 renal transplantations performed in the United States in 2015.[2] Although transplant rejection remains the most common complication after renal transplantation, vascular complications occur in 1%-23% of renal transplant recipients.[3-5] Interventional radiologists play an important role in the management of these complications.

Interventions in the vascular system of transplanted kidneys can be complex and require an understanding of current surgical techniques, image-guided interventional techniques, and multidisciplinary management strategies. We present here a concise review of image-guided interventions related to vascular complications occurring after renal transplantation. Particular emphasis is given to anatomical considerations, interventional management techniques within the context of a multidisciplinary approach, and outcomes of image-guided interventions.

Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA.

Address reprint requests to Kanti Pallav Kolli, MD, Department of Radiology and Biomedical Imaging, University of California San Francisco, 505 Parnassus Av, M-361, San Francisco, CA 94143. E-mail: kkolli@ucsf.edu

Anatomic Considerations

Knowledge of expected renal transplant anatomy and common variants is critical to safely performing image-guided interventions on patients with renal transplants. Operative reports should be consulted before intervention whenever possible. A brief description of typically encountered renal transplant anatomy follows.

Renal transplants are most commonly placed in a heterotopic extraperitoneal position in the right or left iliac fossa; the right iliac fossa is preferred because of the more superficial location of the iliac vessels for anastomosis. The renal transplant may be placed in an intraperitoneal location when there is preoperative uncertainty regarding the quality of bilateral iliac vessels for anastomosis as this position affords the transplant surgeon access to right and left iliac vessels and the abdominal aorta and inferior vena cava. Other circumstances in which an intraperitoneal location is used include situations in which the iliac fossae are of insufficient size to accommodate the transplant (eg, pediatric recipient of an adult organ) or have been used for prior transplantation.

The arterial anastomosis of a renal transplant is most commonly created as an end-to-side anastomosis between the renal transplant artery and the recipient external iliac artery, and less commonly as an end-to-end anastomosis between the renal transplant artery and the recipient internal iliac artery. When the renal transplant

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has been taken from a deceased donor, a small portion of the donor aorta is typically taken en bloc with the donor renal artery; this portion of the donor aorta is referred to as a Carrel patch. When multiple renal transplant arteries are present, the arteries may be separately anastomosed to the recipient external or internal iliac arteries or the renal transplant arteries may be joined to each other in side-to-side or end-to-side fashion with or without Carrel patches before anastomosis to the recipient artery. A blood-type matched allogeneic graft, autologous vein graft, or synthetic graft may be used if the renal transplant artery is of insufficient length. Several renal artery anastomotic configurations are shown in Figure 1.

The venous anastomosis is nearly universally created as a single end-to-side connection between the renal transplant vein and the recipient external iliac vein. In cases where the renal transplant initially drains through more than 1 renal vein, any vein $<50\%$ the diameter of the largest vein is ligated and the remaining vein or veins are used for anastomosis. Ligation of additional renal transplant veins does not result in venous congestion because intrarenal venous communications allow adequate venous drainage through the single patent vein used for anastomosis.[5]

Two special situations are intra-abdominal renal transplantation and pediatric en bloc renal transplantation. A transplanted kidney may be placed in an intra-abdominal location if the iliac fossa of a pediatric recipient is too small to accommodate the renal transplant. In this case the arterial and venous anastomoses are created in end-to-side fashions with the aorta and inferior vena cava, respectively. In the case of pediatric en bloc renal transplantation, the donor aorta and inferior vena cava are usually anastomosed to the external iliac artery (Fig. 2) and vein in end-to-side fashion and less commonly as short interposition grafts between transected sections of the external iliac artery and vein, respectively.

Figure 2 Pediatric en bloc renal transplant. The aorta of the pediatric donor is anastomosed to the external iliac artery. Note that in this case the superior lateral kidney has 2 renal arteries from the donor aorta. There is a single artery to the inferior medial kidney, which has a stenosis at its proximal segment. The renal artery stenosis in this en bloc transplant required use of microcatheters and sub-4 mm balloons delivered through a guiding sheath.

Transplant Renal Artery Stenosis

Incidence and Etiology

Transplant renal artery stenosis (TRAS) has been reported to occur in anywhere from 1%-23% of renal transplant recipients. The diagnosis of TRAS has been associated with

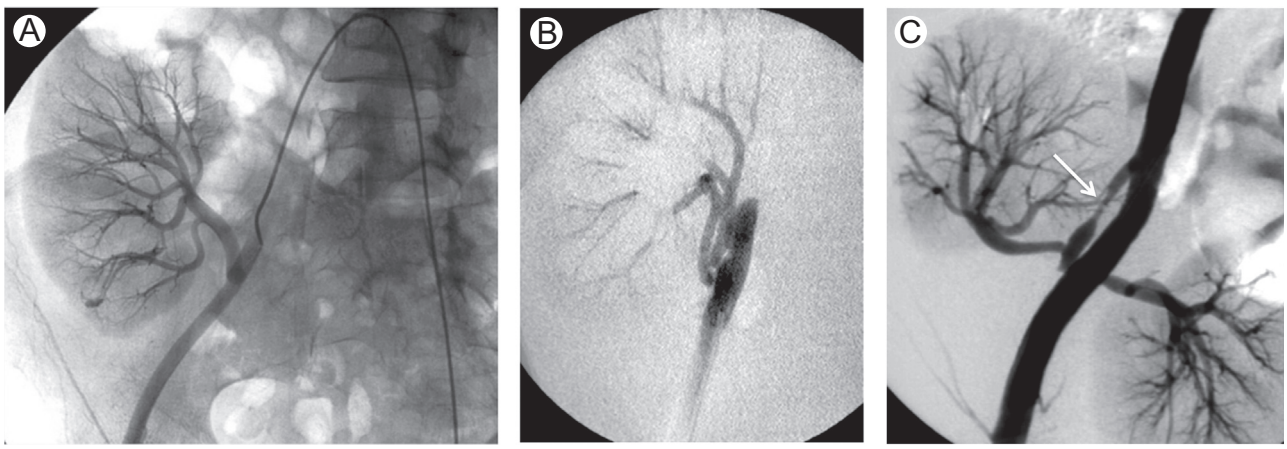

Figure 1 Renal artery anastomotic configurations. (A) Typical configuration of a renal transplant in the right renal fossa. The single donor renal artery is anastomosed to the recipient right external iliac artery. Note catheterization of the right iliac artery from a contralateral femoral artery approach. (B) Multiple renal arteries. The 2 renal arteries of the donor are anastomosed independently to the recipient external iliac artery. Note catheterization of the right external iliac artery from an ipsilateral femoral artery approach. (C) Pediatric en bloc renal transplant. The donor pediatric infrarenal aorta is anastomosed to the recipient external iliac artery. Note stenosis in the infrarenal aorta of the donor artery (arrow).