



Vascular Reconstruction in Kidney Transplantation

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Abstract

Kidney transplantation has become the preferred mode of treatment for patient with end stage renal disease (ESRD) after incorporating into clinical practice in the 1960s. With the rising increase in ESRD worldwide and higher life expectancy, the need for kidney transplants is rising and the gap between deceased donors and patients on the waiting list is becoming wider. Living donors are subjected to less than appreciated risk of morbidity and mortality and have to be considered carefully. It is of utmost importance to utilize the available donor organs efficiently in deceased and living donors. One of the limitations has been the complex vascular anatomy of the donor. Challenging vessels in the recipients are becoming more common with previous surgeries in the Iliac vessels and open/endovascular interventions for occlusive or aneurysmal disease. This review addresses the techniques of utilizing less than ideal donor and recipient anatomy to perform vascular reconstruction.

Keywords: Kidney transplantation; Multiple renal arteries; Arterial reconstruction; Venous reconstruction; Arteriosclerosis; Surgical technique; Anastomosis

Renal Transplantation

ESRD needs renal replacement therapy but the lowest mortality, better quality of life and better cost efficiency is provided with renal transplantation. This has become the standard of care for patient with good surgical risks with available organs. Since the first transplant in 1954 and with further refinements in laparoscopic and robotic methods, the surgical technique has remained unchanged but immune suppression and better methods of matching continues to evolve [1,2]. In an effort to better utilize donor organs from extremes of age, borderline function, coexisting infections (hepatitis and HIV) and challenging anatomy, new protocols are being implemented with increase in the number of organs utilized [3].

Deceased donors

Age is being expanded in donor selection with en-bloc double kidneys from children being used with good results in adults as well elderly donors with marginal function [4,5]. They pose particular challenges with size and vessel wall thickness disparities. Severe arteriosclerosis poses challenges in cannulation for cold perfusion and preparation for pump placement. Aortic cannulation is done with harvesting of kidneys en bloc with ureters up to bladder, after liver, pancreas and intestines are harvested. The length of the cava is negotiated with the liver team but usually the length of cava is sufficient for reconstruction of right renal vein. In the back bench, kidneys are separated carefully with aorta opened in the midline to look for renal artery ostia. If more than one is noted, they are taken with a carrel's patch. If multiple arteries are noted wide apart, each is taken with a patch with reconstruction performed later [6]. A Common ostium is constructed for pump placement to allow adequate pressure but a minor leak can be tolerated. Veins are left free for the pump. Correct identification of number of arteries and veins and injuries, if any, are important to note and relayed to implanting team. In pediatric donors, both kidneys are taken en bloc for implantation and Aorta, inferior vena cava and bladder are taken in-situ with no back bench preparation [7]. These are typically not placed on the pump. Gentle handling of tissues, especially intima of arteries is crucial to avoid thrombosis.

Living donors

Up to 50% of kidneys are donated by living donors in North America and this is on the rise [8]. While less cold ischemia time and better matching with better timing of surgery is an advantage, the risks involved to an otherwise healthy person are significant by subjecting to a surgery with a mortality and morbidity not to be taken lightly. Open donor nephrectomy is taken over by laparoscopic method with better recovery for the donor. Multiple arteries and veins can lead to

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technical difficulty, especially on right side [9]. In the absence of Carrel's patch and length to spare, living donor reconstruction is challenging. Left side offers a longer vein, which traditionally has been favored. However, right side vein can be used although this is a difficult laparoscopic procedure. Implantation is usually to the external iliac artery and vein but internal iliac artery or common iliac can be used as well [10-12]. Pediatric recipients are implanted to the aorta and inferior vena cava. End to side anastomosis with spatulation as an option is usually employed. Additional mobilization of the vein can be achieved with ligation of the internal iliac vein but ligation of the internal iliac artery for the same purpose is not recommended. Multiple arteries can be implanted to external or common iliac artery depending on the length and orientation achieved with other options being using internal iliac artery or inferior epigastric artery in end to end manner [15]. Implantation to main renal artery is another option with smaller branches and if the area of supply is less than 10% or too small in size, they may be ligated but this is at a small risk of infarction, infection and renal induced hypertension. Fashioning of Carrel's patches to create a common ostium has to consider the possible encroachment of lumen, dissection or exposure of sub-endothelial tissue or kinking or tension on suture line. Proper planning is needed before committing to re-fashioning at all stages.

Recipient operation

Standard implantation involves external iliac artery and vein in end to side orientation. In diseased vessels, length discrepancy and lack of space in retro-peritoneum allows the use of common iliac or internal iliac as well as Aorta and inferior vena cava in pediatric patients. In the advent of improved secondary patency with endovascular intervention this placement may be less important, especially with previous transplants or pancreas transplants occupying prime locations. Calcified arteries poses two distinct problems. Clamping related problems may be amenable to soft clamp use, Fogarty or Foley use for control or incorporating a conduit of donor vessel as inflow, which may then be used for anastomosis to the artery. Endarterectomy at time of surgery is not widely practiced since it adds ischemic time and in the absence of expertise and experience, might lead to complication with limb, pelvis and allograft ischemia as potential complications. Previously re-vascularized iliac vessels with open Aorto bifemoral bypass grafts can be safely used for inflow and even can be used in patient with poor arteries with TASC D aorto iliac disease at time of transplantation if previously unknown [16,17]. Aneurysmal disease, even when smaller than standard treatment criteria, may well be treated with either resection with primary anastomosis or graft placement may be incorporated prior to graft anastomoses. Preserving at least one internal iliac artery is of paramount importance to minimize risk of pelvic, spinal or colonic ischemia [13,14]. In the event of previous placement of stent, another inflow site needs to be determined and internal iliac use has to be considered carefully especially if the stent has essentially covered the ostium of ipsilateral internal iliac artery, as this will increase risk of pelvic ischemia. Pediatric kidneys (en bloc) are implanted with the donor aorta and cava end to side to iliac vessels the landing zone likely determined by the reach of bladder patch to the recipient bladder [18]. Special consideration is given to minimize risk of torsion or kinking as the donor vessels are thin and prone to kinking. These vessels grow with time and interrupted fine prolene sutures are used by some to accommodate this and avoid anastomotic stenosis in the future but with options of angioplasty, this may not be essential. However, similar to any other type of vascular anastomosis,

meticulous technique is of paramount importance in pediatric donors and recipients.

Special Situations

Living donors

Presence of renal artery stenosis, fibromuscular dysplasia or aneurysmal disease is not an absolute contra indication for donation. Back bench preparation will include careful endarterectomy of the diseased artery or interposition graft use – usually a saphenous vein is used but cadaveric or prosthetic grafts are options. Secondary patency can be maintained with endovascular interventions in the future. However, careful and meticulous technique cannot be overemphasized.

Deceased donors

Endarterectomy of a patch is a delicate process. Flow dynamics are important to minimize potential for dissection. A smooth tapering point is important and Kunlin type suture to secure the endothelium might be important.

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