Indications for Renal Autotransplant: An Overview

Bilal Azhar, Shaneel Patel, Priyanka Chadha, Nadey Hakim

Abstract

Advances in transplantation led to the first renal autotransplant in 1963 performed due to high ureteral injury sustained during aortic surgery. The procedure involves excision of the kidney and autologous re-implantation. Subsequently, multiple cases of renal autotransplantation have been reported in the literature for a range of indications. This review aims to assess the literature and experiences reported to assess the varying indications for renal autotransplant.

The evidence and literature generated from experiences in this procedure are largely limited to case reports and relatively small or moderately sized case series. The main indications reported for performing autotransplant broadly includes renovascular disease, ureteral pathology and neoplastic disease. The advent of laparoscopic techniques and their implications on renal autotransplant also are discussed. Varying degrees of success are reported with this procedure with controversial issues surrounding this procedure remain, particularly in the area of neoplastic surgery. Renal autotransplant may be a useful last resort in preventing kidney loss in highly selected circumstances and when conventional methods have failed.

Key words: Transplant, Kidney, Bench surgery, Ex vivo repair

Introduction

A decade after advances in allotransplant techniques, developed by Joseph Murray and colleagues, James Hardy completed the first renal autotransplant in 1963. The procedure was performed to repair a high ureteral injury sustained during aortic surgery, with reimplantation of the kidney into the ipsilateral iliac fossa of the same patient.

Together with developments in microvascular surgery and renal preservation techniques, this landmark procedure sparked the development of extracorporeal repair or bench-side surgery with autotransplant. Potential benefits of autotransplant included providing adequate surgical exposure, a bloodless surgical field, and hypothermic protection of the kidney against ischemia.

Experimental studies demonstrated that extracorporeal reconstruction of renal arteries could be performed in canines. The same authors reported that a patient received an autogenic saphenous vein autotransplant performed to treat renovascular hypertension secondary to renal artery stenosis. Reports of renal autotransplant grew in the world literature during the 1980s. The indications for autotransplant were extended. In addition to complex ureteral reconstruction for high ureteral injury or ureteral stenosis secondary to retroperitoneal fibrosis, renal autotransplant has been performed for renovascular disease such as renal artery aneurysms and renal artery stenosis. Belzer and coworkers performed autotransplant to treat bilateral renal artery stenosis with iliac, hypogastric, and splenic arterial grafts. Techniques also have been developed for treating neoplastic disease including renal cell carcinoma, ureteral cancer, complex nephrolithiasis, and severe loin pain hematuria syndrome.

Further technical developments have been described more recently with the advent of minimally
invasive approaches for living-donor nephrectomy in combination with extracorporeal repair and autotransplant. A nonsystematic review was performed to investigate the indications for renal autotransplant reported in the literature.

**Indications for renal autotransplant**

**Renovascular disease**

Renal autotransplant has been a method used to treat complex renovascular disease. The indications for surgery have included renal artery aneurysms, fibromuscular dysplasia, Takayasu disease, and atherosclerosis. Autotransplant has been used by various authors when percutaneous transluminal angioplasty or in vivo repair has not been possible.

Occlusive fibrodysplastic disease or atherosclerotic lesions within the renal artery usually are treated with percutaneous transluminal angioplasty (PTA). In certain situations, PTA may be ineffective or contraindicated, such as in aneurysmal lesions, lesions involving distal and intrahilar segmental renal artery branches, or inflammatory lesions such as those observed in Takayasu disease. Fibromuscular disease involving the trunk of the renal artery with segmental dissection may be unsuitable for PTA. A series of 63 patients in such situations has been reported by Brekke and coworkers. They reported satisfactory short- and long-term results when patients with fibromuscular dysplasia received renal autotransplants resulting in normalization or improvement of hypertension in 91% cases and maintenance of renal function in 95% patients. Only 10% patients would have been suitable for endovascular repair.

Flatmark and associates performed a study with a large surgical series of renal autotransplants. They reported a series of 305 renal autotransplants, of which 154 autotransplants were performed for renovascular disease. The renovascular pathology included fibromuscular disease with or without aneurysm in 56 cases and atherosclerotic disease in 98 cases. Approximately half of the patients with renovascular lesions presented with severe or malignant hypertension. Postoperative complications included 1 case of renal artery thrombosis and 1 case of renal vein thrombosis in autotransplants performed for fibromuscular disease. Complications in the atherosclerotic group consisted mainly of superficial wound infections and septicemia. A solitary kidney was autotransplanted in 22 patients. In the solitary kidneys autotransplanted, 2 of the 18 patients died postoperatively in the atherosclerotic group, 6 patients showed an improvement in renal function, and 10 patients had stable renal function. There was no loss of graft function. No postoperative deaths occurred in patients who had fibromuscular lesions. All patients had stable renal function, and no loss of graft function was encountered. In the 305 renal autotransplants, including all indications, postoperative mortality rate was 4%, and 3.6% kidneys were lost mostly because of vascular thrombosis.

More recent studies have demonstrated the safety and applicability of renal autotransplant in selected cases. Sevmis and coworkers have demonstrated improvements in creatinine concentration, creatinine clearance, and blood pressure in 5 patients with renovascular hypertension. Renal artery stenosis and poststenotic aneurysms were present in 3 patients, Takayasu arteritis in 1 patient, and an aneurysm arising from a segmental artery in 1 patient. Owing to the nature of the complex lesions and aneurysms arising from segmental arteries, autotransplant was selected as the treatment of choice. Full mobilization of iliac arteries allowed the authors to perform adequate anastomosis without the requirement of vascular grafts. The authors postulated that the avoidance of vascular grafts provided the benefit of avoiding complications such as graft thrombosis and recurrence of aneurysms. The mean duration of follow-up was 9.8 ± 5.7 years. During this period, the authors reported that no morbidity or mortality was encountered. Mean systolic blood pressure decreased from 168 ± 8.3 to 128 ± 8.9 mm Hg, and diastolic pressure decreased from 106 ± 8.3 to 82 ± 8.3 mm Hg after autotransplant.

Long-term outcomes of renal autotransplant for renovascular disease have been studied. Chiche and associates reported a series of 68 renal autotransplants performed for renovascular disease. Indications included fibromuscular dysplasia in 34 procedures, Takayasu disease in 26 procedures, and atherosclerosis in 8 procedures. The renal lesions were aneurysmal, occlusive, or both aneurysmal and occlusive. In addition to atherosclerotic pathology, aneurysmal disease was present in patients with fibromuscular dysplasia. Takayasu disease and atherosclerosis primarily involved occlusive disease. Actuarial survival rates were 96.2% at 5 years and 84.1% at 10 years in the fibromuscular disease group and 94.7% at both 5 and 10 years in the Takayasu
disease group. Secondary patency rates were 100% at 5 years and 92% at 10 years for the fibromuscular disease group and 91.3% at both 5 and 10 years for the Takayasu disease group. Hypertension normalized or improved in 96% patients with fibromuscular disease and 89% patients with Takayasu disease. However, in the atherosclerotic disease group, renal autotransplant produced actuarial survival rates of 54.7% at 5 years and 18.2% at 10 years. Secondary patency rates were 50.0% at 5 years and 33.3% at 10 years.

Experience has been gained in renal autotransplant in the pediatric population, indicated for renovascular hypertension. Corbetta and coworkers reported a series of 13 pediatric patients (mean age, 9.12 years at time of procedure) who had renovascular hypertension. Takayasu disease was present in 5 patients, renal artery fibrodysplasia in 3 patients, and neurofibromatosis type 1 in 1 patient. There were 3 patients who had failed percutaneous transluminal renal angioplasty with recurrence of obstructive lesions. Postoperatively, 61.5% patients achieved normalization of blood pressure without the need for medication and 38.5% patients achieved normalization of blood pressure with the adjuvant use of antihypertensive medical therapy. No postoperative deaths were reported. A hematoma in the right hilum of the kidney in 1 patient was the only postoperative complication encountered.

The role of PTA in the pediatric population is not as clear as in the adult population with respect to renovascular disease. Lesions with renal ostial occlusion, fibrotic tissue refractory to dilation, and tubular aortic narrowing with visceral arterial stenosis are examples of situations in the pediatric population (as in neurofibromatosis type 1 and middle aortic syndrome) where PTA may be ineffective. The unique characteristics of the population, such as long stenosed segments distal to the renal hilum, involvement of the aortic ostium, and the need for extracorporeal repair led to the decision of renal autotransplant being the treatment option of choice by the authors.

Ureteral disease

Ureteral injuries are rare but often can be complex and difficult to repair. They occur in conjunction with preserved renal parenchyma; therefore, repair and kidney salvage are desirable. Conventional techniques include ureteroureterostomy, psoas hitch procedure, Boari flap, transureteroureterostomy, or transureteropyelostomy reconstruction. These techniques cannot be used in severe ureteral loss or high ureteral injury. Bowel interposition can be an alternative technique but is associated with complications.

The first renal autotransplant in a human was performed because of a high ureteral injury, and resulted in successful repair and preservation of renal function. Subsequently, there have been multiple case series and case reports of autotransplant because of ureteral disease in the literature. Bodie and associates reported a case series of 26 patients receiving autotransplant for substantial ureteral loss. This study demonstrated excellent long-term results with renal function preserved in 93% patients during 14-year follow-up. Novick and coworkers, in a large series of 108 patients, performed renal autotransplants in 27 patients requiring replacement of all or a major portion of the ureter. Renal function was preserved successfully in 92% patients. Only 1 patient experienced chronic bacteriuria. Shekarriz and associates treated 2 patients who had ureteropelvic junction avulsion (1 patient) and proximal ureteral avulsion (1 patient). A pyeloureterostomy to the native distal ipsilateral ureter was performed in 1 patient and a direct ureterovesical anastomosis was performed in the other patient. Autotransplant restored renal function successfully in both patients, and no morbidity or mortality was encountered during follow-up.

Considering ureteric pathology, Eisenberg and coworkers reported a series of 15 patients receiving laparoscopic nephrectomy and autotransplant for complex ureteral strictures. In these patients, 12 patients had a history of nephrolithiasis, 2 patients had ureteropelvic junction obstruction and failed repair, and 1 patient had iatrogenic injury following a gynecologic procedure. Stricture length varied between 1 and 7 cm. No recurrence of stricture formation was discovered (median follow-up, 29 mo), and this demonstrated the durability of this reconstruction technique. Recurrent nephrolithiasis was observed only in 1 patient. There were 2 patients who had pseudoaneurysm formation (1 at 15 months and 1 at 3 years). This represented a 12% rate of vascular complications. Outcome studies of allograft have reported vascular complication rates between 1.4% and 6.6%, with pseudoaneurysms accounting for 0.14% to 0.2% vascular complications. Vascular complication rates in autotransplant
previously have been reported at 13% when autotransplants were performed for renovascular hypertension and ureteral injury. The higher rate of vascular complication has been postulated to occur because of an infection. All patients in the series by Eisenberg and coworkers received a nephrostomy tube or a ureteral stent, which are potential sources of infection and increased inflammatory state that has been linked to pseudoaneurysm formation.

Hau and associates reported that renal autotransplant is a safe and effective procedure and should be taken into consideration for ureteral disease when alternative strategies are not suitable. In addition to vascular pathology, they performed renal autotransplants because of high ureteral injuries. Indications included proximal ureter injury or avulsion secondary to ureteroscopic stone manipulation, ureter injury secondary to laparoscopic retroperitoneal lymphadenectomy in gynecologic cancer, or injury to the ureter after aortobifemoral bypass. Another patient had a ureter injury because of a retroperitoneal abscess secondary to a pancreatic transplant. Routine ureter reconstruction or bowel interposition were not possible in these cases; therefore, renal autotransplant was performed. There were complications in 2 of the 4 patients receiving autotransplant for ureteral disease, including wound infection, urinary tract infection, bleeding, pelvic abscess, and the formation of an urinoma. However, it was shown that creatinine and urea levels improved at 24-month follow-up compared with preoperative levels.

Neoplastic disease

There is controversy about surgical treatment of bilateral renal tumors or tumors in solitary kidneys. Radical nephrectomy may necessitate chronic dialysis and allotransplant with chronic immunosuppression in patients who have neoplastic disease. Attempts at renal preservation by in situ excision or extracorporeal repair and autotransplant are viable alternatives but there is concern about ensuring complete tumor excision. In their series of 305 renal autotransplants, Flatmark and associates performed 15 autotransplants due to renal tumors. All 15 patients had 1 functioning kidney before autotransplant. Frozen sections were performed intraoperatively to ensure that tumor-free margins were achieved. Postoperatively, 13 patients retained stable renal function and 2 patients demonstrated a decline in renal function. At long-term mean follow-up of 3.2 years, 11 patients were alive with a functioning graft, 3 patients had died with a functioning graft, and 1 living patient required a further retransplant. There were 2 postoperative complications encountered, including 1 superficial wound infection and 1 case of deep vein thrombosis. No data about tumor recurrence were reported in this series.

A prospective series of 36 patients evaluated renal autotransplant for complex renal cell carcinoma. Strict inclusion criteria had been developed by the authors from experiences in a retrospective analysis of a previous series of 21 cases of bench surgery and autotransplant. In the prospective series, all tumors were renal cell carcinomas that were organ-confined according to preoperative imaging. Pathologic assessment revealed staging ranging from pT1-pT3a, pN0, M0 (Union Internationale Contre le Cancer classification, 2002). In 2 patients, autotransplant was not performed due to a positive lymph node on frozen section analysis in 1 patient and the finding of a Bellini duct carcinoma in the other (due to the aggressive character of the tumors). Extracorporeal excision with autotransplant was chosen as the technique of choice because the tumors affecting either solitary kidneys, large central tumors or bilateral disease. There was 1 perioperative death at day 5 after surgery as a result of a myocardial infarction. There was 1 kidney that was lost because of a transplant failure, and 1 other patient required hemodialysis for 3 weeks until complete functional recovery. During short-term median follow-up of 2.8 years, 1 patient had distant metastases. Another patient had evidence of recurrent tumor in his kidney. This was treated by nephrectomy of the autotransplant. The author reported that with strict inclusion criteria, ex vivo tumor excision with autotransplant was a safe last-resort alternative to nephrectomy and the associated disadvantages of hemodialysis-associated morbidity and long waiting lists for donor transplants.

The long-term data of tumor recurrence in the setting of autotransplant are not clearly understood and remains controversial. Stormont and associates reported their experience of ex vivo renal cell carcinoma tumor excision and autotransplant during 10 years. They operated on 20 patients, and surgery was successful in 16 patients. The 4 unsuccessful procedures were due to renal vein thrombosis or extensive tumor involvement resulting in an
inadequate renal vein for anastomosis. At mean follow-up of 35 months, local recurrence of renal cell carcinoma was observed in 4 patients (25%), and only 6 of the 16 patients were free from recurrence of disease or dialysis. The authors recommended that computed tomography (CT) imaging of the auto-transplant site should be performed every 3 to 6 months after surgery for the early detection of tumor recurrence.

**Laparoscopic autotransplant**

Advancements in laparoscopic techniques have been applied to renal transplant. Authors have reported the use of laparoscopy in autotransplant by combining laparoscopic nephrectomy with ex vivo repair and autotransplant. Gill and coworkers reported a study with 5 patients who underwent retroperitoneal laparoscopic nephrectomy, including 4 patients who underwent autotransplant. The indications were a large proximal ureteral tumor, long distal ureteral stricture, and 2 cases of loin pain hematuria syndrome. In all cases, a 3-port retroperitoneal approach was used with a muscle splitting Gibson incision for renal extraction and autotransplant. No technical or surgical complications were reported. Total mean operative time was 5.8 hours, and average laparoscopic donor nephrectomy time was 3.1 hours.

Bluebond-Langner and associates reported their experience performing laparoscopy-assisted autotransplant. There were 4 patients who underwent renal autotransplant for the treatment of proximal ureteral avulsion (2 patients), ureteral malignancy, and ureteral stricture. A 4-port transperitoneal approach was used by the authors for nephrectomy, and autotransplant was performed into the right iliac fossa. All procedures were performed without intraoperative complications. Postoperative imaging indicated good perfusion to the transplanted kidneys. No postoperative rise in serum creatinine level was observed. There was 1 patient who developed loss of graft, owing to renal vein thrombosis; the patient later was discovered to have an undiagnosed thrombophilic disorder.

Meng and coworkers described a more expanded experience with the use of laparoscopic nephrectomy and autotransplant. In 7 patients with extensive ureteral injury, transperitoneal laparoscopic nephrectomy was performed with autotransplant. Mean operative time was 508 minutes, and mean warm ischemia time was 5 minutes. After ex vivo graft preparation, only 6 of 7 kidneys were suitable for autotransplant.

Eisenberg and associates performed a study observing the long-term outcomes of laparoscopic nephrectomy with autotransplant. Autotransplant was performed in 19 patients, and indications included complex ureteral disease in 15 patients and renal malignancy in 4 patients. There were 17 patients who had follow-up > 6 months; 4 of these patients had late complications requiring surgical intervention. Transplant nephrectomy was required in 2 patients because of nonfunction, complicated by a pseudoaneurysm in 1 patient and chronic loin pain in the other patient. There was 1 patient who had undergone percutaneous nephrolithotomy because of recurrent nephrolithiasis. A pseudoaneurysm developed in 1 patient and was treated successfully with endovascular techniques. In addition to these complications, 2 patients in the tumor group had recurrence of their disease, and this was treated medically in both cases.

**Conclusion**

The use of renal autotransplant has been reported in the literature for the treatment of renovascular disease, ureteral disease, and urologic tumors. Autotransplant may be a useful last resort in preventing kidney loss in highly selected circumstances and when conventional methods have failed. Controversy remains over the use of autotransplant in neoplastic disease. The use of laparoscopic techniques may decrease morbidity associated with autotransplant.

**References**