ORIGINAL REPOTRS

Renal Transplantation as a Platform for Teaching Residents Open Vascular Surgical Techniques: Effects on Early Graft Function

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BACKGROUND: Over the past decade, increases in vascular fellowships and the use of endovascular technology have decreased the general surgery residents' exposure to open vascular surgery. We sought to elucidate whether renal transplant is a safe way to teach general surgery residents the essential tenants of vascular surgery without adversely affecting early patient outcomes.

METHODS: All solitary, adult deceased donor kidney transplants performed at the University of Wisconsin from 2011 through 2016 were identified and divided into a resident-assist (RA) and fellow-assist cohorts (FA). DGF, defined by the requirement of dialysis within 1 week of transplant, was the primary outcome. Early graft survival and postoperative complications were considered the secondary endpoints.

RESULTS: Of the 774 total cases, there were 228 (29.5%) in the RA cohort and 546 (70.5%) in the FA cohort. The RA and FA cohorts had comparable characteristics, except for a nonclinically significant difference in mean donor creatinine (0.96 vs 0.88 mg/dL, $p = 0.03$). RA cases had a similar DGF rate compared to FA cases (25% vs 26%, $p = 0.93$). Additionally, there was no difference in 2-year graft survival (93.7% vs 95.5%, $p = 0.38$), nor the rates of graft thromboses (0.4% vs 0.7%, $p = 0.65$), incisional hernias (0.9% vs 1.8%, $p = 0.35$), and ureteral strictures (2.2% vs 1.6%, $p = 0.55$) between the 2 cohorts.

CONCLUSIONS: Resident involvement in renal transplantation has no effect on DGF and early allograft function. Though the procedural involvement of each resident in a case is variable, it seems to be a safe way to teach retroperitoneal vascular exposure and anastomotic techniques. (J Surg Ed ▮:▮▮▮-▮▮▮. © 2018 Published by Elsevier Inc. on behalf of the Association of Program Directors in Surgery)

KEY WORDS: Open vascular surgery, General surgery resident training, Kidney transplantation, Vascular surgery fellowships

COMPETENCIES: Patient Care, Practice-Based Learning and Improvement

BACKGROUND

In recent years, there has been a significant shift in the scope of general surgery resident training as nonoperative and minimally invasive techniques have become more prominent in the management of surgical patients.[1] Furthermore, the effects of work-hour restrictions and subspecialization have led to a considerable downtrend in major open procedures.[1-3] These factors, among others, have led to a considerable diminution of the surgery resident open operative experience.[1,4-6] Perhaps no skill is more threatened than the open vascular anastomosis. Recent advancements in endovascular procedures have led to a consequential decline in resident exposure to open vascular reconstructions, raising concern for their capacity to perform these procedures without advanced vascular training.[4,5] This is compounded by the prominence of vascular fellowships and the emergence of integrated vascular residency programs at major academic institutes.[3]

Renal transplantation is an open procedure that involves retroperitoneal vascular exposure and arterial and venous

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anastomoses. According to the Organ Procurement and Transplant Network there were 18,597 kidneys transplanted in 2015.[7] We sought to examine whether these transplants represent a safe training platform to acquire an open vascular skillset. To determine its safety, we used delayed graft function (DGF) as a marker, in that prolonged anastomotic times are associated with a higher risk of DGF.[8] Further, DGF has known implications on allograft survival and patient mortality.[9-11]

METHODS

The University of Wisconsin has a kidney transplant service consisting of either a first or second-year transplant surgery fellow and third-year surgery resident. Deceased donor kidney transplants are staffed by an attending surgeon and either the fellow or resident as a first assistant. We conducted a retrospective cohort study of all adult deceased donor kidney transplants performed at our center from 2011 through 2016. The transplant were sorted into resident-assist (RA) and fellow-assist (FA) cohorts. Cases where both the resident and fellow assisted were excluded.

Demographics between the 2 cohorts were compared based on known risk factors of DGF.[12] The primary endpoint of this study was DGF, defined as the requirement of hemodialysis within the first 7 days posttransplant. The secondary endpoints included 5-year graft survival and postoperative complications including graft thrombosis, incisional hernia, and ureteral stricture. Statistical analysis was performed using SAS statistical software (SAS Institute, Inc., Cary, NC). Recipient and donor characteristics were compared between the 2 cohorts using 2-tailed, 2-sampled *t*-tests for continuous variables and 2-sided Fisher exact test for categorical variables.

RESULTS

Over a 4 to 8 week transplant rotation, residents performed an average of 4.85 ±2.85 renal transplants. A total of 774 patients were included in the study with 228 (29.5%) in the RA cohort and 546 (70.5%) in the FA cohort. The 2 groups were well matched (Table 1) with regard to donor, recipient, and transplant variables. There was a statistically significant difference in mean donor creatinine, however, the difference between the means was only 0.08 mg/dL ($p = 0.03$). The DGF rate in the RA cohort was 25.4% while it was 26% in the FA cohort ($p = 0.93$). The 2-year graft survival was 93.7% following RA cases, compared to 95.5% in FA cases ($p = 0.38$). There were no statistically significant differences in the secondary outcomes examined (Table 2).

DISCUSSION

The landscape of general surgery resident training has changed tremendously in recent decades. Increasing levels of subspecialization, the proliferation of nonoperative management of traditionally surgical diseases and perhaps resident work hour restrictions have led to concerns about the competency of emerging general surgeons.[5] A recent U.S. study reported that 25% of graduating residents lack adequate confidence in open operative skills and 75% intend to pursue fellowship training.[3,13] Resident exposure to open vascular surgery has not been spared from this trend. Along with increased used of endovascular techniques and the presence of vascular surgical fellows and integrated vascular surgical residents, there has been a shift away from general surgical resident exposure to open vascular procedures.[1,4-6] Many general surgery residents learn to perform a vascular anastomosis on a simple bench or simulation model.[4,6] Although this is a start, it does not sufficiently prepare residents to safely perform an open arterial or venous anastomosis, a fact reflected by the 30% of graduating residents that lack subjective confidence in such skills.[6] Some of the goals of the vascular surgery rotation for a general surgery resident are to teach major vascular exposures, techniques of proximal and distal control, anastomosis formation and repair techniques. This basic skill set allows general surgeons to control intraoperative complications and manage traumatic vascular injuries. Unfortunately, these skills are among the most commonly listed deficits that general surgery residency graduates self-report.[6]

We analyzed whether renal transplantation is a good platform to teach the essential tenants of vascular exposure, proximal and distal control, and anastomosis creation by using DGF as a marker of patient safety. DGF is easily measured in the short postoperative period, and seems to be effected by intraoperative variables.[8,12] Further, DGF is a predictor of higher rates of rejection and poor graft survival.[10,11] Our study demonstrates that, in 2 well-matched cohorts, RA transplants have equal rates of DGF compared to FA transplants. Moreover, we have shown that resident involvement in renal transplant has no effect on 2-year graft survival, nor postoperative complications including graft thromboses, incisional hernias, and ureteral strictures. There were 5 graft thromboses that occurred during the study period. After review of the operative reports, 1 thrombosis in the FA cohort was clearly attributable to technical error after an artery was kinked. It was difficult to measure longer term outcomes as this was a recent cohort.

There is a significant need for procedures that provide vascular training for general surgery residents. However, this need must be considered in the context of patient safety and surgical outcomes. Transplant surgery is a highly scrutinized field, with observed:expected outcomes closely monitored by