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Elective Resection of Symptomatic Arteriovenous Fistulae and Grafts in Patients with Functioning Renal Allografts at A High Volume Transplant Hospital

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Objective: Patients with functioning renal allografts may need ligation of pre-existing hemodialysis conduits. Chronic immunosuppression for renal allografts may adversely affect wound healing and perioperative complications following these procedures. We sought to analyze outcomes following elective ligation and resection of symptomatic arteriovenous (AV) access in immunosuppressed patients with renal allografts no longer requiring dialysis at a high-volume renal transplant hospital.

Methods: We retrospectively reviewed procedure codes for hemodialysis access resection and revision from 2014–2020 at a single academic tertiary care hospital. Patients who underwent complete or subtotal dialysis access resection with a functioning renal allograft were included for analysis of preoperative, operative, and postoperative outcomes. We performed descriptive statistics, and student's t-test using Microsoft Excel.

Results: Thirty-four patients met inclusion criteria. The majority were male, 56%, and the most common causes of renal failure were hypertension and diabetes, respectively. Ligation and resection of proximal upper extremity access was performed in 68%. The mean operative time was 126 minutes with pain being the most common indication for intervention. Four patients required arterial reconstruction. Mean postoperative follow-up was 13 months. Arm pain and swelling resolved in 100% and 88% of patients following AV access resection, respectively. No impairment in mean postoperative glomerular filtration rates were noted. One patient required hemodialysis and died three months after fistula resection following complications from treatment of a newly diagnosed neuroendocrine tumor and subsequent fungemia,

Conclusion: Elective operative resection of symptomatic AV access may be performed safely in immunosuppressed patients with functioning renal transplants. The risk of allograft impairment and/or failure as a result of AV access resection in our series was low. Elective ligation and resection can be achieved with low mortality, excellent symptomatic relief, and few wound complications despite chronic immunosuppression.

INTRODUCTION

In 2019, 23,401 kidney transplants were performed in the United States.¹ Over 100,000 patients are currently on the waiting list nationally, many requiring hemodialysis through an arteriovenous fistula or graft for many years.¹ Because of prolonged patency from years of use prior to transplant, AV fistulae and grafts often become painful and aneurysmal. Many patients develop

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lifestyle limiting anxiety about trauma to AV access sites which may lead to bleeding. Ligation and removal of this AV access is sometimes indicated to improve the patient's quality of life.

Review of large secondary data sets has demonstrated the incidence of AV access ligation to be infrequent in the United States (4.6% of renal transplant recipients), and most commonly performed for steal syndrome.² As AV access ligation and resection appears to an uncommon procedure nationally, we reviewed our experience with AV access ligation and resection among patients with functioning renal allografts at a high-volume renal transplant hospital. The primary measure was to assess our clinical outcomes and explore for any variables that may be associated with adverse events.

METHODS

We reviewed the operative case logs at a single academic tertiary care hospital for all resection or revision of arteriovenous (AV) access completed between January 1, 2014 to June 30, 2020 by surgeons in the vascular division. Symptomatic patients with functioning renal allografts who underwent complete or subtotal AV access resection were included for analysis. Patient charts were abstracted for preoperative, operative, and postoperative variables. We performed descriptive statistics and student's t-test using Microsoft Excel.

Institutional Review Board Approval

This study was deemed exempt by the UCLA IRB (protocol number 20-000038). Patient informed consent was not required.

RESULTS

During the study period, 2,282 kidney transplants were performed at our hospital. Ninety nine operative procedures for revision or resection of hemodialysis access were performed during the study period, of which 34 patients met inclusion criteria. Inclusion criteria required that patients have lifestyle limiting symptoms associated with their patent AV fistula or graft and that a functioning renal transplant be present with no clinical evidence of rejection or failure. The transplant nephrology service determined that all patient's renal transplants were functioning optimally at the time of AV access resection based on serial creatinine and GFR measurements. The average age was 51 years, with a majority of male patients ($n=19$, 56%). Causes of renal failure were primarily secondary to hypertension ($n=8$, 24%), and diabetes ($n=8$, 24%). Seven patients (21%) had undergone two or more renal transplants prior to hemodialysis access ligation. The most common access location was in the proximal upper extremity, 68%. [Table I]

Pain in the upper extremity was the most common indication for dialysis access intervention,

Table I. Demographics of study cohort

Preoperative Demographics	<i>n</i> (%)
Age – years: average (S.D.)	51 (11)
Female	15 (44%)
Ethnicity	
Latino/Hispanic	18 (53%)
White	11 (32%)
Asian	3 (9%)
Black	2 (6%)
Cause of renal failure	
Hypertension	8 (24%)
Diabetes Mellitus	8 (24%)
Autoimmune/Sepsis	8 (24%)
Polycystic Kidney Disease	5 (15%)
Focal Segmental Glomerulosclerosis	5 (15%)
Renal Dysplasia	2 (6%)
Index renal transplant	27 (79%)
Deceased donor renal transplant	30 (88%)
Access resection from transplant - days; average (S.D.)	900 (1084)
Proximal upper extremity access	23 (68%)
Distal upper extremity access	11 (32%)
Preoperative GFR; average (S.D.)	62 (19)



Fig. 1. (A): 30 year old male presenting with painful cimino fistula aneurysm. (B): exposure of aneurysmal cimino fistula. (C): resection and vein patch angioplasty of painful cimino fistula aneurysm

Table II. Intraoperative data of study cohort

Operative Characteristics	n (%)
Estimated blood loss categories	
0-50 ml	20 (59%)
50-100 ml	7 (21%)
100-150 ml	1 (3%)
> 150 ml	6 (18%)
Arterial reconstruction	4 (12%)
Intraoperative drain	6 (18%)
Operative minutes; average (S.D.)	126 (74)
Operative indication	
Pain	31 (91%)
Painful Aneurysm	25 (74%)
Arm swelling	8 (24%)
High output cardiac failure	1 (3%)
Bleeding	1 (3%)
Ischemic steal	1 (3%)

91%, accompanied with painful aneurysmal degeneration in 74% ($n=25$). Anesthesia used were: General ($n=18$, 54%), Monitored Anesthesia Care (MAC) and Local ($n=15$, 44%) and MAC and supraclavicular block ($n=1$, 3%). The average operative time was 126 minutes, with four patients requiring direct arterial reconstruction. [Fig. 1A, B and C] Techniques for arterial reconstruction included: brachial artery patch ($n=2$) and primary suture repair of brachial ($n=1$) and radial ($n=1$) arteries. We elected to leave an operative drain in six patients and noted most had an average blood loss of less than 50 milliliters. [Table II]

The average follow-up after AV access ligation and resection was 13 months, and only one patient required hemodialysis due to renal allograft failure during the study period. This patient was diagnosed with a neuroendocrine tumor and died from septic shock secondary to fungemia three months following her elective fistula resection. No significant change in preoperative to postoperative average glomerular filtration rate was noted among patients. The vast majority had improved extremity symptoms of pain (100%) and swelling (77%). The most common postoperative complication was a

numbness at the incision site or in the fingers in five patients. All patients' numbness resolved during the follow up period. [Table III].

DISCUSSION

There are no clear consensus guidelines regarding management of AV access when a patient has a functioning renal allograft.³ The decision to electively remove a functioning AV fistula or graft following creation of a successful renal transplant may be a controversial one in some cases. The incidence of acute rejection following transplant within the first year is around 7.9%. Thus, removal of functioning AV access would require creation of an AV fistula or graft at another site if renal failure were to occur.⁴ Additionally, this patient population is generally considered "high-risk" due to the frequent presence of diabetes mellitus, hypertension and rheumatologic disorders (ie. Lupus, scleroderma, etc.). A recent meta-analysis by Palamuthusingam and colleagues demonstrated that kidney transplant recipients are at increased odds for postoperative mortality and acute kidney injury following elective surgery⁵

Table III. Postoperative findings of study cohort

Postoperative Findings	<i>n</i> (%)
Follow-up months: average (S.D.)	13 (10)
Functioning renal transplant at last follow up	33 (97%)
Preoperative GFR	62 ± 19
GFR at last follow-up; average (S.D.)	67 ± 16
Improved arm pain	31 (100%)
Improved arm swelling	7 (88%)
Transient extremity numbness	5 (15%)
Phlebitis	1 (3%)
Seroma	1 (3%)
Cellulitis	1 (3%)

Chronic immunosuppression is an integral component of renal transplantation and may also pose a challenge for the perioperative management of patients requiring surgical interventions. Patients on chronic immunosuppression may be at increased risk for postoperative soft tissue infections and wound complications. A recent study by Lee and colleagues studied outcomes in immunosuppressed patients undergoing elective hernia repair over an 11 year period.⁶ Although there was no difference in infectious complications between immunocompromised and immunocompetent patients, immunosuppression was a risk factor for hernia recurrence. Another study by McKechnie et al reviewed outcomes for 780,630 patients undergoing surgery for colonic diverticular disease.⁷ They demonstrated that morbidity was greater for immunosuppressed patients undergoing elective surgery compared with immunocompetent patients and mortality was greater for immunosuppressed patients for emergent surgery.

There is some evidence in the current literature that ligation of AV access may have beneficial cardiovascular effects.⁸ In a randomized prospective study, patients were assigned to ligation or no intervention of AV access. Those who underwent AV access ligation were observed to have improved left ventricular mass, and significant decreases in end diastolic/systolic volume without perioperative complications or loss of renal function. Though we do not routinely perform ligation of asymptomatic AV access, current literature suggests this to be an area worthy of investigation.

Our findings support those by Hicks², et al that the overall incidence of fistula ligation and resection amongst total patients undergoing kidney transplant was low at our institution. Only 1.5% of patients (34 in this study cohort/2,282 renal transplants during study period) underwent AV access ligation and resection. All patients in our

study cohort were cleared by the Transplant Nephrologists for AV fistula or graft ligation and resection secondary to lifestyle limiting symptoms. Asymptomatic patients were not offered access removal and are not included in this study. The most common indication observed was aneurysmal degeneration with associated extremity pain. Indications such as ischemic steal syndrome, and high output cardiac failure were infrequent. We observed a low rate of postoperative infections and wound complications despite 100% of patients taking chronic immunosuppression. We observed no complications related to postoperative drain use. No long-term neurologic or ischemia events occurred.

We advocate the elective ligation and resection of symptomatic and lifestyle limiting AV fistulae or grafts in patients with well-functioning renal allografts who are relatively good operative risk patients. For elective access removal, a minimum of 90 days from the time of renal transplant to elective resection is required. Patients with large aneurysmal fistulae are counseled that general anesthesia will most likely be required and that associated factors (ie. Intraoperative hypotension, hypovolemia, etc.) may contribute to renal failure. We discuss these issues in detail between the surgical and anesthesia teams during our preoperative surgical "Time-out". Using this protocol, postoperative renal failure directly associated with AV access ligation and resection did not occur in our study.

Our findings are limited by the retrospective nature of this study which exclude preoperative considerations made by providers in referring to our institution. We excluded patients with functioning renal allografts that did not have AV access ligation which may have permitted better description of the natural history of renal allograft function, and AV access patency. Additionally, because we have not included data for AV access ligated at outside

hospitals, it is possible that the rate of ligation in our cohort is higher. Our study also does not include complete data from the time of access creation, because many patients had them placed at outside institutions prior to being listed for transplant at UCLA. These represent additional limitations to our study.

CONCLUSION

Elective operative resection of symptomatic AV access may be performed safely in immunosuppressed patients with functioning renal transplants. The risk of allograft impairment and/or failure as a result of AV access resection in our series was very low. Elective ligation and resection can be achieved with low morbidity and mortality, excellent symptomatic relief and few wound complications despite chronic immunosuppression.

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