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Discharge to a Post-Acute Care Facility after Emergent Femoral Artery Repair is Not Protective Against Wound Complications

Joseph Anderson¹, Ryan King¹, Thomas Brothers^{1,2}, Jacob Robison¹, Ravi Veeraswamy¹, Mathew Wooster¹, Rupak Mukherjee³, Jean Marie Ruddy^{1,2}

¹Division of Vascular Surgery, Medical University of South Carolina, Charleston, SC.

²Surgery Section, Ralph H. Johnson Department of Medical Affairs Medical Center, Charleston, SC.

³Division of Cardiothoracic Surgery, Medical University of South Carolina, Charleston, SC.

Abstract

Background: Access site complication is the most common adverse event after endovascular intervention, and when emergent operative repair of the common femoral artery (CFA) is needed, patient morbidity can be significantly increased. The intent of this project was to identify predictors of wound events after emergent operative repair of the CFA due to an access site complication. It was hypothesized that patients discharged to a facility would benefit from an ongoing relationship with healthcare professionals as evidenced by more consistent follow-up and lower wound complication rates.

Methods: Patients who had a percutaneous CFA access complication and required emergent open CFA repair at an academic medical institution between 2015 and 2018 were included, and the charts were reviewed retrospectively. Primary outcomes included wound complication and outpatient compliance with vascular surgery clinic visit. Dichotomous groups were evaluated by the chi-squared test, and continuous variables were evaluated by Student's t-test. Univariate and multivariate regression analyses were completed to assess risk factors contributing to wound event or failure of clinic follow-up.

Results: Forty-four patients were identified with emergent CFA repair due to an access complication between July 2015 and June 2018. Among this population, 33% of patients had wound complications and 27% were discharged to a facility. Among those discharged to a facility, the rate of follow-up to the vascular surgeon's clinic was significantly lower than those discharged to home (40% vs. 85%, $P < 0.05$), and the incidence of wound complications appeared greater but did not reach statistical significance (50% vs. 27%, $P = 0.11$). Univariate analysis indicated that kidney disease, albumin < 3 g/dL, and current smoking were predictive of wound complication, whereas on multivariate analysis, only kidney disease remained predictive ($P < 0.05$, odds ratio = 22). The modified frailty index (mFI) was not predictive of wound complications or compliance

Correspondence to: Jean Marie Ruddy, MD, Division of Vascular Surgery, Medical University of South Carolina, 30 Courtenay Drive, MSC 295, Charleston, SC 29425, USA; ruddy@musc.edu.

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with follow-up. However, mFI did approach statistical significance when predicting discharge to a facility.

Conclusions: Despite the availability of medical personnel to arrange transportation and provide wound care in post-acute care facilities, patients who were discharged to a facility after CFA injury requiring emergent repair experienced lower compliance with clinic follow-up and may have suffered more wound complications. Strategies to improve compliance with patient follow-up and wound healing in patients sent to post-acute care facilities are warranted.

INTRODUCTION

The emergence of percutaneous treatment modalities, which can be accessed via the common femoral artery (CFA), has allowed specialists in vascular surgery, cardiology, neurosurgery, and interventional radiology to diagnose, manage, and treat an increasing variety of disease states. However the endovascular approach has numerous advantages, it is not without risk. Up to 11% of endovascular cases will have a complication, and this most commonly occurs at the access site.¹⁻⁴ Beyond local pain and suffering, access complications have been associated with increased 30-day mortality, potentially attributable to the consequences of emergency surgical intervention.^{3,5} Imposing a large groin wound on these often debilitated patients can compromise independence; therefore, they may require short- or long-term residence in rehabilitation or nursing care facilities.^{1,3,4,6} Unintended return to the operating room after percutaneous lower extremity revascularization has been shown to increase readmission rates.⁵ Similarly, loss of independence and discharge to a nonhome destination has also been shown to be strongly associated with hospital readmission.⁷

Wound events after emergent treatment of CFA access complications are similar to those observed after endarterectomy, such as lymphocele, infection, or skin necrosis, but the incidence has not been clearly described. Because the wound event may not occur until after the patient has left the hospital, the patient's environment and access to medical professionals have been expected to play a major role in initiation of proper wound care techniques. Having been managed inpatient by the team performing the index procedure (often not the vascular surgeon), it is unclear whether patients have adequate access to follow-up with the vascular surgeon for wound concerns. Previous studies evaluating patient compliance with postoperative clinic visits have often demonstrated low rates after elective vascular surgical procedures.⁸ Longitudinal surveillance and evaluation in the vascular surgery population has been associated with improved outcomes.⁹ In this specific population of patients who underwent emergent CFA repair after access complications, the rate of compliance with follow-up clinic visits has not been described and may significantly impact the incidence of wound complications.

As a corollary, the availability of medical personnel and transportation services at a post-acute care facility may also influence these postsurgical metrics. Therefore, this project aimed to identify patients with CFA access complications requiring open surgical repair and assess the incidence of wound events as well as compliance with follow-up. We have

hypothesized that discharge to a post-acute care facility will reduce wound events and improve patient attendance at post-operative clinic visits.

METHODS

After approval from the Institutional Review Board of the Medical University of South Carolina, a retrospective chart review was undertaken to identify patients older than 18 years who required emergent CFA repair because of access complication from any percutaneous procedure between 2015 and 2018. Patients were identified by current procedural terminology (CPT) codes for any femoral artery repair and International Classification of Diseases (ICD) codes consistent with CFA access complications. Methods of vessel repair and wound closure depended on patient characteristics and operative surgeon preference. Demographic and procedure data were collected, and the type of access complication (hematoma, pseudoaneurysm, or vessel occlusion) was identified. Kidney disease was defined as a hospital diagnosis of acute kidney injury (rise in creatinine 0.3 mg/dL or 50% increase in baseline creatinine) or pre-existent diagnosis of chronic or end-stage renal disease. The primary outcomes included wound event and compliance with outpatient follow-up clinic visit with vascular surgery specialist. A wound event was defined as wound breakdown or infection requiring intervention more than a wet-to-dry dressing. Modified frailty index (mFI) was calculated, and this 11-point scale includes diabetes mellitus, nonindependent status, chronic obstructive pulmonary disease, congestive heart failure, myocardial infarction within the previous 6 months, angina for less than 1 month, hypertension (HTN), history of rest pain or lower extremity revascularization, impaired sensorium, history of transient ischemic attack/cerebrovascular accident (CVA) without deficit, and history of CVA with deficit.¹⁰ The mFI has been demonstrated in several patient populations to be predictive of post-operative morbidity and mortality.^{10–12}

Statistical analyses included Student's *t*-test, chi-squared test, and univariate and multivariate regression analyses. All analyses were performed using Stata software (v15.0 College Station, TX), and a *P* value < 0.05 was the threshold for significance.

RESULTS

From 2015 to 2018, 44 patients who underwent urgent open repair of a percutaneous common femoral artery access complication were identified. Thirty-six patients were available for follow-up, and demographic data have been summarized in Table I. The patient mean age was 63 ± 16 years. Comorbid conditions included HTN (87%, *n* = 34), current smoker (39%, *n* = 17), hyperlipidemia (77%, *n* = 33), and obesity (30%, *n* = 13). The prevalence of diabetes was significantly higher in those discharged to a facility (*P* < 0.05), whereas kidney disease was significantly more common among patients discharged to home (*P* < 0.05).

Table II delineates periprocedural data. The sheath size was greater than 6 French in 57% of patients (*n* = 25) and more common among patients discharged to a facility (*P* < 0.05). Alternatively, a closure device was used in 55% of patients (*n* = 24) and more common in those discharged to home (*P* < 0.05). No relationship to wound complications was identified.

Overall 30-day mortality rate was 14% ($n = 6$) with 2 additional deaths occurring beyond 30 days in patients with prolonged hospital stays. There were no patient deaths directly attributable to the CFA repair. There was no statistically significant difference between operative times and discharge disposition or wound complications.

The procedural teams were interventional radiology (4%, $n = 2$), cardiothoracic surgery (7%, $n = 3$), cardiology (25%, $n = 11$), vascular surgery (23%, $n = 10$), and neurosurgery (41%, $n = 18$). All the patients from the vascular surgery and interventional radiology services attended their follow-up clinic visit. There was an 80% clinic follow-up among interventional cardiology patients. Both the interventional neurosurgery and cardiothoracic surgery had 50% patient compliance with vascular surgery follow-up.

As a tertiary care facility, a large volume of percutaneous procedures are completed yearly, but in this selected cohort of patients with access complications requiring urgent open surgical repair, there was a 33% ($n = 12$) rate of wound complications, and 28% ($n = 10$) were discharged to a post-acute care facility. Of the 10 patients discharged to a facility, 40% were seen in clinic follow-up and 50% experienced a wound complication. Conversely, of the 26 patients discharged home, 85% were seen in follow-up ($n = 22$) and only 26% sustained a wound complication ($n = 7$). The rate of follow-up to the vascular surgeon's clinic was significantly lower in the group discharged to a facility ($P < 0.05$); however, the wound complication rates only trended toward significance (Table III, $P = 0.11$). Discharge disposition was a statistically significant predictor of compliance with follow-up multivariate analysis ($P < 0.05$, Table IV). Univariate analysis indicated kidney disease, albumin < 3 g/dL, and current smoking were predictive of wound complication; however, on multivariate analysis, only kidney disease remained predictive ($P < 0.05$, Table V).

Considering the mFI, there was a trend for higher mFI score in those discharged to a facility ($P = 0.052$), but no other relationships were identified (Table VI). The mFI was included in the regression analysis and the average mFI score of the facility group (0.45 ± 0.18) was chosen as a threshold, but this dichotomous variable failed to be predictive of wound complication or compliance with follow-up (Tables IV and V).

DISCUSSION

Despite advancing technology focused on ultrasound-guided access and effective closure devices, CFA injury after percutaneous intervention continues to create significant periprocedure morbidity. Because the index procedure may have been focused on vascular, cardiac, neurologic, or other remote pathology, it has been challenging to study this diverse patient population. By limiting the investigation to those requiring open surgical repair, this project has identified lower compliance with follow-up and a higher rate of wound complications in patients discharged to a rehabilitation facility than those discharged home, thereby identifying an opportunity to use outpatient resources to improve patient outcomes.

Documented rates of surgical site infections after femoral artery exposure vary from 3% to 44% within the literature, and the incidence in this patient population (33%) is consistent with these prior reports.^{13–18} To focus on prevention, risk reduction models have been

created to identify patients with vascular disease with high likelihood for wound complication after elective intervention and subsequently implemented protocols to counteract those patient-specific factors such as optimizing nutrition, blood glucose control, and smoking cessation in the preoperative setting.^{15,16,19} Unfortunately, the urgent nature of the surgical procedures in this population does not allow for medical optimization. Alternatively, integrating negative pressure dressings into postoperative management of high-risk patients have significantly decreased the incidence of wound complications,^{13,14,20} and applying this post-operative technique to the acutely ill patients undergoing urgent CFA repair due to access complication may decrease incision-related morbidity.

Transitioning care from the inpatient hospital setting to either the outpatient or inpatient rehabilitation environment can be challenging, and coordination of care is highly complex. Data have demonstrated that compliance with clinic follow-up after vascular intervention is associated with improved outcomes,⁹ and this is even more important after a vascular access complication because that event predicts worse outcomes compared with matched counterparts.^{1,3,4,6} Moreover, patients who suffer complications after discharge typically re-present within 2 weeks,²¹ raising the question of appropriateness for discharge. Although studies have indicated decreased complications among those with short-term follow-up (7–10 days) clinic visits, these may be biased toward including patients with predisposition for complications.²¹ Although the electronic medical record was supposed to facilitate communication, quick and accurate transfer of patients and providing educational materials regarding wound care continue to be compromised. Rather than focusing on transporting the patient back to the clinic visit, other contemporary options include using telehealth capabilities to extend the surgery team's outpatient engagement with the patient and outside provider to monitor wound healing, initiate wound care interventions, and potentially decrease readmissions.

Technological advances and lower profile devices will continue to provide practitioners an opportunity to treat patients by endovascular means, thereby extending treatment opportunities to our aging, and potentially, frail population. Unfortunately, frail patients often have less reserve and struggle to recover from common periprocedure complications. It was interesting that our demo-graphics demonstrated different rates of diabetes and kidney disease in our groups separated according to discharge location; therefore, it was clear that additional assessment of the patient's functional status was needed. The impact of frailty on patients undergoing elective vascular surgery procedures has been investigated by using the mFI.^{10–12} Patients treated with both endovascular and open operations have been studied. The mFI was deemed a better discriminator than the American Society of Anesthesiologists (ASA) classification or Lee cardiac risk index for those who are undergoing open abdominal aortic aneurysm repair.¹¹ The mFI was also found to be the strongest predictor of death than age, functional status, and ASA classification in a review of 67,000 patients. In this same series, an mFI of 0.64 was associated with complication and mortality rates of 76.4% and 16.0%, respectively. Similarly, an mFI of 0.64 correlated with surgical site infection rate of 25%. Mortality rates increased to 24.3% at an mFI of 0.73.¹² Alternatively, there was greater than a 30% wound complication rate in the group studied herein of patients undergoing urgent CFA repair, and these events occurred at a lower average mFI of 0.42 ± 0.18 . This

exemplifies the challenge of using validated risk stratification tools across different study populations, particularly in those undergoing emergent interventions.

There are several limitations to this single-institution retrospective review of outcomes after urgent CFA repair due to percutaneous access complications. The retrospective nature of this review compromised the investigation into the severity of comorbidities and wound complications, therefore prospective evaluation of the incidence of wound infections may be needed to verify this potential association with discharge to a facility. Similarly, factors mitigating presentation to a follow-up visit are unable to be evaluated in this retrospective analysis and would also benefit from prospective analysis. Because this project chose to focus on patients with percutaneous access-related CFA injury requiring surgical repair, the sample size was small, and this certainly impacts the statistical power. Our analysis included Student's *t*-test, chi-squared test, and univariate and multivariate regression analyses. It is possible that propensity matching would have negated the differences between the groups discharged to a facility compared with those discharged home, but the overall number of patients in each group was not sufficient to enable this technique in this study. Based on the findings within this discrete population, a larger database inquiry using the Vascular Quality Initiative could provide valuable insight into how patient protocols may be constructed to decrease wound complications, improve communication with post-acute care discharge facilities compliance with follow-up, and optimize patient outcomes related to percutaneous access complications.

CONCLUSION

Considering patients who require urgent surgical repair of a CFA access injury, despite access to healthcare professionals and transportation services, discharge to a healthcare facility did not improve compliance with follow-up and was not protective against developing wound complications. As hospital systems mobilize resources to optimize postdischarge communication and minimize readmissions, further efforts to understand the needs and abilities of rehabilitation and skilled nursing facilities are necessary to truly optimize patient care.

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Table I.Demographic data (*n* = 44)

Demographic variable	Number	Facility (<i>n</i> = 10)	Home (<i>n</i> = 26)	<i>P</i> value
Age (average)	63 ± 16	63 ± 23	63 ± 14	0.968
Gender	34 Female 10 Male	10 Female 0 Male	21 Female 5 Male	0.444
Diabetes	50% (22)	90% (9)	42% (11)	0.006
Hypertension	84% (37)	90% (9)	77% (20)	0.321
Smoker	39% (17)	20% (2)	38% (10)	0.228
Hyperlipidemia	75% (33)	80% (8)	77% (20)	0.741
Kidney disease (AKI, CKD, ESRD)	45% (20)	30% (3)	42% (11)	0.033
Obese	30% (13)	40% (4)	35% (9)	0.919
BMI (average)	27 ± 6	28 ± 7	27 ± 7	0.662

ESRD, end-stage renal disease; AKI, acute kidney injury; CKD, chronic kidney disease; BMI, body mass index.

Table II.

Periprocedural data

Periprocedural data	Number	Facility (<i>n</i> = 10)	Home (<i>n</i> = 26)	<i>P</i> value
Existing anticoagulation	25% (11)	20% (2)	35% (9)	0.394
Hospital LOS (average)	10 ± 13 days	20 ± 19	5 ± 4	
ICU LOS (average)	5 ± 10 days	8 ± 9	1 ± 3	
Patients with sheath >6 French	57% (25)	100% (10)	50% (13)	0.005
Closure device	55% (44)	40% (4)	65% (14)	0.457
Type of Injury				
Pseudoaneurysm	32% (14)	30% (3)	38% (10)	0.636
Hematoma	23% (10)	20% (2)	23% (6)	0.842
Occlusion	45% (20)	50% (5)	38% (10)	0.529
Operating room time (minutes)	129 ± 56	141 ± 60	130 ± 40	0.576
30-day mortality	14% (6)			

Table III.

Chi-square primary outcomes

Primary outcome	Post-acute care facility (<i>n</i> = 10)	Home (<i>n</i> = 26)	<i>P</i> value
Follow-up	40% (4)	85% (22)	0.01
Wound complication (<i>n</i> = 12)	50% (5)	27% (7)	0.11

Table IV.

Multi-variate analysis of factors contributing to compliance with follow-up

Variable	<i>P</i> -value
Discharge disposition	0.02
Hgb (<8 g/dL)	0.08
Diabetes	0.12
Active smoker	0.18
mFI	0.52
Albumin (<3 g/dL)	0.57
BMI (>28 or <20)	0.94
Kidney disease (AKI, CKD, ESRD)	0.96

ESRD, end-stage renal disease; AKI, acute kidney injury; CKD, chronic kidney disease; mFI, modified frailty index; BMI, body mass index; Hgb, hemoglobin.

Table V.

Multivariate analysis of factors contributing to wound complication

Variable	<i>P</i> -value
Kidney disease (AKI, CKD, ESRD)	0.03
Active smoker	0.08
Albumin (<3 g/dL)	0.33
Hgb (<8 g/dL)	0.54
Diabetes	0.60
mFI	0.61
BMI (>28 or <20)	0.64
Discharge disposition	0.97

ESRD, end-stage renal disease; AKI, acute kidney injury; CKD, chronic kidney disease; mFI, modified frailty index; BMI, body mass index; Hgb, hemoglobin.

Table VI.

Modified frailty index

Home vs facility	0.052
Wound complication vs. no wound complication	0.244
Follow-up vs. no follow-up	0.628