



# Evaluation of the Safety of AV Fistula Creation Surgery in Ambulatory vs, Inpatient Hospital Setting

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## Introduction

The prevalence of End Stage Renal Disease (ESRD), defined as a reduction of kidney function to an estimated Glomerular Filtration Rate (eGFR) of less than 15 ml/min/1.73m<sup>2</sup>, is rising in the United States, with over 661,000 patients receiving treatment for ESRD in 2013 [1]. While renal transplantation is the preferred treatment for ESRD patients, providing an improved quality of life and a reduction in mortality compared to dialysis, it is not an appropriate option for all patients and is associated with potentially long waiting times [2]. While waiting for an available kidney, patients must often undergo maintenance dialysis, which requires a reliable and stable access to the bloodstream typically in an easily accessible non-dominant upper extremity. This vascular access is most commonly provided through the creation of a primary Arteriovenous Fistula (AVF), which offers higher rates of patency and fewer complications than other vascular access methods such as tunneled catheters and synthetic bridge grafts [3].

Given the multitude of disorders and comorbidities associated with declining renal function such as cardiovascular disease, hypertension, and diabetes mellitus, AVF creation surgery has traditionally been performed in an inpatient hospital setting, [4,5] and patients have generally not been considered good candidates for surgery in a free-standing outpatient facility [6]. Such surgeries were commonly performed under general anesthesia, even with the anesthesia related risks in patients with advanced chronic kidney disease. Increasingly, AVF creation surgery has been carried out in an outpatient setting at ambulatory surgical centers. Several studies have demonstrated that these surgeries can safely be performed in such ambulatory centers with low postoperative complication rates, despite patient comorbidities [7] particularly when paired with a regional anesthetic technique instead of general anesthesia. A recent retrospective analysis has demonstrated that both local anesthesia and brachial plexus blocks are effective modalities in

AVF surgery with markedly low rates of conversion to general anesthesia [8]. In addition to the benefits of improved analgesia and lower rates of complications seen with regional anesthesia [9,10], brachial plexus blocks may also promote successful outcomes through increased arterial and venous dilation [11,12], improved fistula patency [13], and potentially decreased postoperative length of stay. Prior studies have demonstrated that AVF surgery can be safely performed in an outpatient setting with a mean postoperative stay of only 112 minutes [14]

While earlier studies have evaluated the safety of vascular access surgery as an outpatient procedure, there has not been a direct safety comparison to similar surgeries performed in an inpatient setting. This study sought to directly compare the rate of complications and post-surgical mortality in AVF creation surgeries performed in outpatient surgical centers and inpatient hospitals.

## Methods

This was a multicenter retrospective study evaluating the safety and efficacy of AVF creation surgeries in an ambulatory setting compared to an inpatient hospital setting. The inclusion criterion was any patient who had undergone an AVF creation surgery in 2015 and 2016 at hospital centers included in the study. The exclusion criterion was any patient with missing medical records.

The Clinical Looking Glass (CLG) program was used to identify all AVF creation surgeries performed at the Hutchinson ambulatory surgical site at Montefiore Medical Center (MMC) and at the Moses or Weiler campuses of MMC, both inpatient hospital sites, in 2015 and 2016. The patients were separated into two groups: an outpatient surgery group, consisting of all patients whose surgeries were performed at the Hutchinson ambulatory center, and an inpatient surgery group, consisting of all patients whose surgeries were performed at the Moses or Weiler campuses.

The medical records of patients in both groups were queried for relevant demographic data, specifically age and sex, and for the following data points:

- Hospital admission within 24 hours post-surgery
- Hospital admission within 7 days post-surgery
- Emergency department visit within 24 hours post-surgery
- Emergency department visit within 7 days post-surgery
- Mortality at 30 days post-surgery

In the statistical analysis, continuous variables were analyzed using Student's t-test, and categorical variables were analyzed using chi-square analysis. All analyses considered a p value of 0.05 to be statistically significant.

Data with patient-identifying information were collected on a password-protected computer to protect patient confidentiality. The Institutional Review Board of the Montefiore Medical Center approved this study and waived the requirement for informed consent.

## Results

During 2015 and 2016, there were 179 outpatient AVF surgeries in the inpatient surgery group and 146 AVF surgeries in the outpatient surgery group. The groups were similar in most categories, including proportion of male and female patients, though the mean age was significantly higher in the inpatient surgery group than in the outpatient surgery group (61.8 vs 58.6 years, p=0.0239) (Table 1).

	Outpatient Surgeries	Inpatient Surgeries	P Value
Total Surgeries	146	179	-
Mean Age	58.6	61.8	0.0363*
Proportion Female	0.384	0.374	0.864
Proportion Male	0.616	0.626	

**Table 1:** Demographic characteristics of arteriovenous fistula surgery groups.

There were no deaths within 30 days in either group. There was no significant difference between groups in the rate of ED visits within 7 days or hospital visits (including admissions and ED visits) within 24 hours (Table 2). There was a significantly lower rate of inpatient admissions and total hospital visits within 7 days post-AVF creation for surgeries performed in the ambulatory center.

	Outpatient Surgeries (%)	Inpatient Surgeries (%)	P Value
All Inpatient Admissions: 7 Days	0.685	4.47	0.0386*
All Emergency Department Visits: 7 days	1.37	3.91	0.165
All Hospital Visits (ED Visit or Admission): 24 Hours	0.685	3.91	0.0619
All Hospital Visits (ED Visit or Admission): 7 Days	2.05	8.38	0.0131*

**Table 2:** Rates of hospital visits following arteriovenous fistula surgeries.

## Discussion

The safety of vascular access surgeries performed in outpatient settings has been demonstrated in previous studies [7,14] In spite of the numerous comorbidities commonly present in ESRD patients, these surgeries have been shown to result in low rates of postoperative complications. The results of this study align with those earlier findings, building upon them to provide a direct comparison of the safety of outpatient surgeries to those performed in more traditional inpatient settings through evaluation of post-operative hospital visits and mortality. The study found no greater rate, and in the case of hospital admissions and total hospital visits within 7 days, a significantly lower rate, of surgery-related hospital visits following AVF surgeries in ambulatory surgical centers. These results provide further support for performing these surgeries in outpatient settings. Previous data suggest that, in addition to being safe, vascular access surgeries performed in outpatient settings are also effective, particularly when paired with regional anesthesia techniques [15]. Because ESRD patients may have greater risk factors and comorbidities that may complicate the use of general anesthesia, an emphasis on regional anesthesia techniques at outpatient centers may be preferable [6,16] In addition to avoiding general anesthesia, regional anesthesia use improves pain control, results in lower rates of complications, [9,10] and promotes successful outcomes in vascular access surgeries through vasodilation, vasodilation and improved fistula patency [11-13]. Other benefits of outpatient surgeries to patients include increased convenience and comfort, providing an alternative to the potentially intimidating and confusing hospital setting and allowing patients to recover in their own homes.

As the prevalence of ESRD and the concurrent demand for vascular access surgeries in dialysis patients continues to rise in the United States, potential opportunities for cost reduction become

increasingly significant. These results build on those of previous studies to demonstrate that AVF surgeries can be performed in outpatient settings with no significant impact on efficacy or safety. Surgeries performed in outpatient settings such as ambulatory surgical centers have reduced healthcare costs in the US by more than \$38 billion annually, with more than \$5 billion directly decreasing costs to patients through reduced coinsurance and deductible payments [17]. Movement of more surgical procedures to ambulatory centers could result in a total reduction of costs of \$55 billion annually. The movement of certain procedures, such as vascular access surgeries, to ambulatory centers specialized in performing scheduled outpatient surgeries can lead to increased efficiency and a reduction in hospital burden, freeing up inpatient centers for more invasive or emergent procedures. The current study has some notable limitations. The population of patients whose AVF surgeries were performed at the ambulatory center were significantly younger than those whose surgeries were performed in an inpatient hospital setting (58.6 vs 61.8 years), though the average age difference was less than three years and likely did not play an independent role in the measured differences in post-operative hospital visits. Rates of patient comorbidities were not measured or compared between the two groups, so it is possible that the patients who had outpatient surgeries were, on average, healthier and had fewer comorbidities than those who had inpatient surgeries. Additionally, the study focused on AVF surgeries in a single hospital system within a two-year period, limiting the number of patients in the study. Future studies should seek to include more patients across a greater number of centers and should take into account patient comorbidities that could impact post-operative complication rates. By offering a direct safety comparison between surgeries in inpatient and outpatient settings, this study provides valuable, compelling new information and further demonstrates that AVF surgeries can be safely performed in ambulatory centers without sacrifice to patient outcomes. These findings, in combination with the potential for reduced overall costs and hospital burden and increased convenience and comfort to patients, provide robust support for the movement of AVF surgeries to an outpatient setting.

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