Original Article

Free Tissue Transfer during the COVID-19 Pandemic: A Proposed Evidence-Based Protocol for Early Discharge

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ABSTRACT

BACKGROUND
As free tissue transfer outcomes improve, institutions are examining early discharge protocols. "Early" is generally defined as between one and five days postoperatively, which correlates with the timing of most major complications and most opportunities for flap salvage. Given the trend towards early discharge, the need for healthcare cost reductions and shortage of ICU beds during a viral pandemic, we aimed to propose an evidence-based protocol to select patients for discharge within 72 h of free tissue transfer.

METHODS
A retrospective review of all patients who underwent free tissue transfer at Vanderbilt University Medical Center, Tennessee, USA since the onset of the COVID-19 (2020-2021) pandemic was performed. Patients were included for review if they were discharged within 72 h of surgery. Literature relating to expedited discharge after free tissue transfer was also reviewed.

RESULTS
Six patients met inclusion criteria for retrospective review. None suffered intraoperative or postoperative inpatient complications and all were discharged within 72 h postoperatively. There were no flap failures within 30 d of reconstruction.

CONCLUSION
This study reviews a patient cohort undergoing free tissue transfer during the COVID-19 pandemic. These cases were reviewed for factors that may have contributed to their postoperative success after discharge within 72 hours. These data points were combined with published evidence on risks for failure after free flap reconstruction to design a protocol to select patients for early discharge. The benefits of early discharge include reducing healthcare costs, risks of inpatient hospitalization, and ICU utilization, which is of paramount importance in the midst of a global pandemic..

KEYWORDS
Early, discharge, Free flap, Free tissue, Microvascular, Reconstruction

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INTRODUCTION

Severe wounds compromised by critical structure exposure often require reconstruction by free tissue transfer. As microvascular reconstruction has become more commonplace and institutional experiences increase, outcomes have subsequently improved[1-5]. Free tissue transfer is now an established tool used to maximize outcomes after reconstruction of post-traumatic, post-infectious and post-extirpative defects[6-8]. A relative disadvantage of microvascular free tissue transfer is the length of surgery and degree of post-operative care. Average length of stay (LOS) for such patients ranges from 1 to 4 wk depending on the nature of the defect, patient comorbid status, flap selection and postoperative course[9-15]. LOS is highly variable in this patient population and is related to the need for close postoperative observation, physical rehabilitation, consolidation of wound care and the ability to arrange ancillary services needed to safely discharge[12]. Nevertheless, an extended LOS translates into a significant increase in hospital cost[15-17].

As free tissue transfer gains popularity and surgeons become more comfortable, outcomes continue to improve, with free flap failure rates quoted as low as 1%-2% in some series[14,18-23]. This has given rise to trends towards early discharge for patients with few medical comorbidities and are otherwise deemed "low-risk" by their surgeons[7,14,15]. Aside from decreasing healthcare costs, truncating postoperative LOS decreases patient-centric risks associated with prolonged hospitalization[14]. Discharge in as few as 1-3 d postoperatively has been shown to be safe in appropriately selected patients for free tissue reconstruction[14].

The year 2020 has brought with it many challenges, none as great as COVID-19. The viral pandemic has strained hospital systems across the globe and resulted in substantial intensive care unit (ICU) bed shortages in the United States[24]. This has resulted in a difficult situation for patients requiring microvascular reconstruction in the time of the pandemic. Given the need for ICU beds and decreased hospital systems utilization, expedited discharge protocols are needed now more than ever. We aimed to examine a single-institution's experience during the COVID-19 pandemic alongside published literature to propose a protocol for discharge within 72 h of free tissue transfer.

METHODS

After Institutional Review Board approval (IRB 210044), a retrospective chart review was conducted at Vanderbilt University Medical Center, Tennessee, USA. Patients who underwent free tissue transfer from 2020-2021, during the time of the COVID-19 pandemic, were identified. Those patients discharged within 72 h postoperatively were selected for analysis. Data from the preoperative, intraoperative, and postoperative periods were analyzed. Descriptive statistics were utilized with means and ranges plus or minus standard deviations when appropriate.

Criteria consistent among patients was identified again compared to existing literature that has shown to be predictive of complications and prolonged LOS after free tissue transfer. A protocol was then proposed to identify patients who are appropriate for discharge within 72 h after free tissue transfer.

RESULTS

Six patients met inclusion criteria for the retrospective review. There were four males and two females, with an average age of 44.7 years. All patients (6/6) were admitted electively for their procedure and no patient had a history of chronic steroid usage, radiation to the wound bed or a preoperative diagnosis of a bleeding diathesis. All patients were ASA class 3 or lower (Table 1). Five patients underwent free fascia-

Table 1. Preoperative Patient Information

Gender	66.7% Male (4/6)	33.3% Female (2/6)	
Age	44.7 ± 12.8 Years (Range 32 – 63 Years)		
Past Medical History	50% HTN (3/6)	16.7% CAD (1/6)	83.3% Current Smoker (5/6)
Indication for Reconstruction	50% Exposed Bone (3/6)	33.3% Exposed Tendon (2/6)	33.3% Non-healing Surgical Wound (2/6)
Wound Mechanism	50% Post-traumatic (3/6)	33.3% Post-extirpative (2/6)	16.7% Post-infectious (1/6)
Chronic Steroid Usage (>6 months)	100% No (6/6)		
Preoperative Radiation to Wound Bed	100% No (6/6)		
Preoperative Dx of Bleeding Disorder	100% No (6/6)		
	Female	*Male*	
Preoperative Hemoglobin	0% ≥ 12.0 g/dL (0/6) 33.3% < 12.0 g/dL (2/6)	33.3% ≥ 13.0 g/dL (2/6) 16.7% < 13.0 g/dL (1/6)	16.7% N/A (1/6)
Preoperative Albumin Level	50% ≥ 3.5 g/dL (3/6)	50% N/A (3/6)	
ASA Class	I - 0% (0/6)	II - 50% (3/6)	III - 50% (3/6) ≥ IV – 0% (0/6)

HTN – hypertension; CAD – coronary artery disease; Dx – diagnosis; N/A – not available; ASA – American Society of Anesthesiologists only flap reconstruction and one patient underwent free fasciocutaneous flap reconstruction. All flaps were based on perforators from the descending branch of the lateral femoral circumflex artery. There were no intraoperative complications and no patients required intraoperative transfusions. In every case, surgery time was less than 360 min and intraoperative crystalloid transfusion was 2,900 cc or less (Table 2).

All patients were admitted postoperatively and underwent serial clinical and Doppler examinations. There were no inpatient postoperative complications and length of stay was 48 h in five patients and 72 h in one patient. One patient suffered a postoperative wound infection and one suffered partial flap necrosis. Each of these patients developed their complications after the first follow up visit. There were no flap failures within 30 d postoperatively. One patient developed a delayed postoperative surgical site infection that required hardware extraction and flap excision at 5 months postoperatively. Length of follow up averaged 5.5 months (Table 3).

DISCUSSION

Although free flap failure rates continue to decline, postoperative complications are not infrequent[1,6,7,9,25-30]. Complication rates from 15%-30% in certain cohorts are reported[1]. However, most data corroborates that the majority of complications occur within 48-72 h postoperatively[31-33]. This correlates with the fact that the best opportunity for flap salvage is within the same timeframe[12,31,34-39]. Postoperative monitoring protocols vary greatly between institution; however, most surgeons monitor their patients between five to seven days prior to discharge[32,33]. This highlights the discrepancy between the timing of complications and the length of postoperative monitoring, as the effectiveness of flap monitoring beyond 72 h has been questioned[39]. This discordance has led to the exploration of early discharge after free tissue transfer. While several institutions have subscribed to the belief that some patients are over-monitored, there has not yet been a defined protocol to identify patients who may

Table 2. Intraoperative Patient Information

Flap Type	83.3% Free-fascia only (5/6)	16.7% Free fasciocutaneous (1/6)		
Donor Site	100% Thigh* (6/6)			
Recipient Site	83.3% Foot/Ankle (5/6)	16.7% Scalp (1/6)		
Number of Venous Anastomoses	50% Single (3/6)	50% Double (3/6)		
Venous Coupler Size	16.7% 1.5mm (1/6)	50% 2.0mm (3/6)	16.7% 2.5mm (1/6)	16.7% 3.0mm (1/6)
Arterial Anastomosis	100% Interrupted (6/6)	100% 9-0 Nylon (6/6)		
Intraoperative Complications	100% No (6/6)			
Intraoperative Transfusion	100% No (6/6)			
Estimated Intraoperative Blood Loss	119.2 ± 57.5 cc (Range 50 – 200cc)			
Operative Time	294.5 ± 44.9 minutes (Range 250-360 minutes)			
Intraoperative Crystalloid	2000 ± 640 cc (Range 1250-2900 cc)			

*All flaps were based off the descending branch of the lateral femoral circumflex artery.

Table 3. Postoperative Patient Information

Postoperative Destination	83.3% SICU (5/6)	16.7% Ward (1/6)	
Inpatient Complications	100% No (6/6)		
Length of Stay	83.3% 48 hrs (5/6)	16.7% 72 hrs (1/6)	
Outpatient Complications	83.3% None (4/6)	16.7% Wound Infection (1/6)	16.7% Partial Necrosis (1/6)
Flap Failure	100% None*(6/6)		
Length of Follow Up	5.5 ± 4.3 months (Range 1 – 10 months)		

*One patient developed a deep space wound infection several months postoperatively that ultimately required hardware removal and flap excision. SICU – surgical intensive care unit.

Table 4. Checklist for Discharge within 72 hours of Reconstructive Surgery by Free Tissue Transfer

Preoperative Criteria	
A1c	< 6.5%
Preoperative Radiation to Site of Reconstruction	No
Preoperative Chronic (> 6 months) Steroid Usage	No
Preoperative Diagnosis of Bleeding Diathesis	No
ASA	≤ III
Preoperative Albumin Level	≥ 3.5 g/dL
Preoperative Hemoglobin Level	≥ 12.0 g/dL (women) or ≥ 13.0 g/dL (men)
Intraoperative Criteria	
Intraoperative PRBC Transfusion	None
Intraoperative Crystalloid Infusion	< 7,000 cc
Total Operative Time	< 540 minutes
Flap Selection	Fasciocutaneous or fascia-only perforator

ASA – American Society of Anesthesiologists; PRBC – packed red blood cell.

be candidates for early discharge. Although the NSQIP calculator has been used to predict LOS, it has not been consistent in the free tissue transfer population[7].

Multiple studies have examined potential risk factors for suboptimal outcomes after free tissue transfer. Identified preoperative risk factors for postoperative complications and/or prolonged LOS include a preoperative diagnosis of a bleeding disorder, preoperative albumin level of less than 3.5g/dL, increasing ASA class and a preoperative diagnosis of anemia[1,40]. Notably a preoperative diagnosis of diabetes mellitus has also been associated with complications. While a preoperative diagnosis should not excluded patients from the benefit of free tissue reconstruction, these patients may not be appropriate for expedited discharge[1,41-43]. In the head and neck literature, pre-operative radiation therapy was also associated with prolonged LOS[15]. While a prerogative diagnosis of coronary artery disease (CAD) is a significant predictor or morbidity in many surgeries, there is a lack of consensus on its risk in free flap reconstruction[14]. Additional risk factors include the preoperative use of steroids, which have not only been associated with wound complications, but also free flap failure and thrombosis[1,44]. Interestingly, age itself does not increase the risk of complications after free tissue transfer[45,46].

Intraoperative risk factors include volume resuscitation greater than seven liters[7] and increasing operative time[1,7,47]. Several studies have shown increased complications and LOS with operative times exceeding 510-700 min[1,7,47]. Regardless of the exact duration, increasing operative time has been correlated with poorer outcomes in free flap surgery[1,47-49]. In order to mitigate risks associated with prolonged operative time, institutions have adopted a two-team approach with one team working on recipient bed preparation while the other works on flap elevation[7,14,50-53]. This is the approach used at our institution.

After retrospectively reviewing our institutional experience with early discharge after free flap reconstruction during the COVID-19 pandemic, we identified factors that were consistent amongst these patients that also correlated with published literature. Using these preoperative and intraoperative values we proposed a protocol to select patients who may be candidates for discharge within 72 h of free tissue transfer (Table 4). The protocol consists of two sections, the preoperative section identifies patients who are non-diabetic, have no history of radiation to the wound bed, do not use steroids chronically, do not have a preoperative bleeding disorder, are ASA 3 or less, do not have a preoperative diagnosis of anemia or hypoalbuminemia. The intraoperative section identifies patients who do not require intraoperative PRBC transfusion, receive less than seven liters of crystalloid infusion, have a total operative time of less than 540 min and undergo reconstruction by either fasciocutaneous or fascia-only flaps. These criterion were based on the aforementioned study results[1,7,14,15,40-53], and flap selection criteria was included to minimize donor site morbidity associated with muscle-based flaps.

This study has several limitations, most notably the cohort size. In addition, patients were retrospectively analyzed in order to isolate variables that are consistent with acceptable outcomes after early discharge. The protocol is a proposal and requires prospective validation alongside a properly controlled group. However, this algorithm serves as a starting point on which to build an evidence based system to select patients who may succeed with early discharge protocols.

CONCLUSION

This study examined a series of patients undergoing free tissue based reconstruction during the COVID-19 pandemic. These cases were reviewed for factors that may have contributed to their postoperative success after discharge within 72 hours. These data points were combined with published evidence on risks for failure after free flap reconstruction to design a protocol to select patients for early discharge after free flap reconstruction. The benefits of early discharge include reduced associated healthcare costs and risks of inpatient hospitalization, as well as reducing ICU utilization which is of paramount importance in the midst of a global pandemic.

CONFLICTS OF INTEREST

The authors have no financial disclosures or conflicts of interest.

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