

# Postoperative Care in an Intermediate-Level Medical Unit after Head and Neck Microvascular Free Flap Reconstruction

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**Objective:** The need for intensive care unit (ICU) admission and mechanical ventilation after head and neck microvascular free flap reconstructive surgery remains controversial. Our institution has maintained a longstanding practice of immediately taking patients off mechanical ventilation with subsequent transfer to intermediate, non-ICU level of care with specialized otolaryngologic nursing. Our objective was to describe postoperative outcomes for a large cohort of patients undergoing this protocol and to examine the need for routine ICU transfer.

**Materials and Methods:** We performed a retrospective review of 512 consecutive free flaps treated with a standard protocol of immediate postoperative transfer to an intermediate-level care unit with specialized otolaryngology nursing. Outcome measures included ICU transfer, ventilator requirement, flap failure, postoperative complications, and length of stay. Predictors of ICU transfer were identified by multivariable logistic regression.

**Results:** The vast majority of patients did not require intensive care. Only a small fraction ( $n = 18$  patients, 3.5%) subsequently transferred to the ICU, most commonly for respiratory distress, cardiac events, and infection. The most common complications were delirium/agitation ( $n = 55$ ; 10.7%) and pneumonia ( $n = 51$ ; 10.0%). Sixty-five cases (12.7%) returned to the OR, most commonly for hematoma/bleeding ( $n = 41$ ; 8.0%) and anastomosis revision ( $n = 20$ ; 3.9%). Heavy alcohol consumption and greater number of medical comorbidities were significant predictors of subsequent ICU transfer.

**Conclusions:** Among head and neck free flap patients, routine cessation of mechanical ventilation and transfer to intermediate-level care with specialized ENT nursing was found to be safe with infrequent subsequent ICU transfer and low complication rates. Routine transfer to intermediate-level care in this population may prevent unnecessary ICU utilization and facilitate the delivery of high-value, disease-centered care.

**Level Of Evidence:** 3b

**Key Words:** Free flap reconstruction, head and neck cancer, ICU, intensive care unit, intermediate care unit.

## INTRODUCTION

Microvascular free flap surgery is widely used for reconstruction in head and neck surgery. There is variability in care pathways including postoperative intensive care unit (ICU) transfer and mechanical ventilation. According to survey data, 88.9% of microvascular free flaps performed by otolaryngologists in the United States rely on immediate ICU transfer.<sup>1</sup> Recent patient cohort studies, however, have presented positive outcomes with regards to safety and cost effectiveness after establishing new protocols where patients are transferred to specialized floor units or intermediate step-down units after reconstruction.<sup>2-6</sup> Whereas these other studies have

presented outcomes for newly instituted protocols, this has been a longstanding practice at our institution; we routinely take patients off mechanical ventilation following head and neck microvascular free flap reconstruction with subsequent transfer to an intermediate, non-ICU level of care with specialized otolaryngologic nursing.

Herein, we evaluate the need for routine ICU transfer and mechanical ventilation after head and neck microvascular free flap reconstruction in over 500 patients encompassing a diversity of flap types and sites, with a comprehensive assessment of postoperative outcomes including flap complications, and identification of factors associated with increased likelihood of ICU transfer.

## MATERIALS AND METHODS

A total of 515 consecutive free flap reconstructions were performed for 492 patients treated from April 2009 through November 2013. Of these, three had planned direct postoperative admissions to the ICU because they were already admitted to the ICU or had joint neurosurgical procedures and were admitted to the neurointensive care unit by neurosurgery. These three patients were excluded and the remaining 512 consecutive free flap reconstructions performed for 488 patients were retrospectively reviewed. All patients were taken off mechanical ventilation immediately after surgery and transferred to an intermediate-care unit where the standard postoperative protocol consists of 48 hours of monitoring by a dedicated, specialty-trained nurse (2:1 ratio) who performs

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Editor's Note: This Manuscript was accepted for publication 22 September 2018.

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DOI: 10.1002/liv.221

hourly flap checks. In-house resident physicians monitor the flap every two hours via external Doppler. Patients are then transferred to regular floor care after 48 hours. Thereafter, patients with aerodigestive tract reconstruction are started on tube feeds on postoperative day 2; patients with tracheostomy are downsized and capped as tolerated on postoperative day 5; arm and leg casts are taken down on postoperative day 7; and patients with tracheostomy tube are decannulated as early as postoperative day 7 (per surgeon discretion).

The primary study outcome was ICU transfer, with a secondary outcome of postoperative complications, including surgical complications (hematoma, anastomosis revision, flap failure, hematoma, and fistula) and medical complications (delirium, pneumonia, and cardiovascular events). Flap failure was defined as complete flap loss or removal of the flap in a reoperation.

Predictors of ICU transfer were identified by multivariable logistic regression. Factors assessed included patient demographics (age, sex, race, comorbidities, alcohol use, and tobacco use); disease-related variables (primary site, cancer stage, and history of radiation, chemotherapy, or prior surgery); and surgery-related variables including tracheostomy. Heavy alcohol consumption was defined as  $\geq 7$  drinks/week in females or  $\geq 14$  drinks/week in males, as defined by the Department of Health and Human Services.<sup>7</sup> Statistical significance was determined with two-sided t-tests at the  $P < .05$  level. Data analysis was performed using SPSS version 22.0 (IBM, Armonk, NY). This study was approved by the Massachusetts Eye and Ear Human Studies Committee (IRB #16-133H).

## RESULTS

### *Demographics and Case Characteristics*

The majority of patients were Caucasian and male, and the mean age was 63.5 years (standard deviation [SD] = 12.2 years) (Table I). Most patients had stage IV cancer ( $n = 202$ ; 39.5%), and the most common subsite was the oral cavity ( $n = 261$ ; 51.0%). The majority of cases ( $n = 306$ ; 59.8%) had new or preexisting tracheostomies, and 92 patients (18%) underwent total laryngectomy. The radial forearm was the most common free flap ( $n = 389$ ; 76%).

### *Patient Disposition and ICU Transfer*

All patients were taken off mechanical ventilation prior to transfer to an intermediate care unit. Eighteen patients (3.5%) required subsequent ICU transfer. The median number of days to ICU transfer was 5.5 days. The most frequent indication for ICU transfer was respiratory distress ( $n = 6$ ), followed by cardiovascular events ( $n = 4$ ), infection ( $n = 4$ ), hemodynamic instability ( $n = 2$ ), hematemesi s ( $n = 1$ ), and seizure ( $n = 1$ ).

Among patients requiring escalation of care, the majority occurred after the first 24 hours. Two transfers (11.1%) occurred during the first 24 hours postoperatively, one for respiratory distress and the other for cardiac arrest and delirium tremens. Ten patients (55.6%) were transferred postoperative days 2 through 7 for respiratory distress ( $n = 4$ ), cardiac events (myocardial infarction  $n = 1$ ; pulmonary embolism  $n = 2$ ), hemodynamic instability ( $n = 1$ ), seizure ( $n = 1$ ), and hematemesi s ( $n = 1$ ). Six patients (33.3%)

TABLE I.  
Demographic Characteristics

Characteristic	Frequency (Proportion)
Sex	
Female	170 (33.2%)
Male	342 (66.8%)
Age	
18–54	107 (20.9%)
55–74	306 (59.8%)
$\geq 75$	99 (19.3%)
Race	
Caucasian	447 (87.3%)
African American	15 (2.9%)
Other	50 (9.8%)
Last tobacco use	
$\geq 6$ months	400 (78.1%)
$< 6$ months	112 (21.9%)
Alcohol consumption	
Light/None	437 (85.4%)
Heavy	75 (14.6%)
Comorbidities	
$< 3$	413 (80.7%)
$\geq 4$	99 (19.3%)
Primary site	
Oral cavity	261 (51.0%)
Oropharynx	65 (12.7%)
Hypopharynx/larynx	88 (17.2%)
Nasal cavity/sinus	29 (5.7%)
Cutaneous/face/ear	53 (10.4%)
Other	16 (3.1%)
Cancer stage	
Benign	66 (12.9%)
1	50 (9.8%)
2	90 (17.6%)
3	63 (12.3%)
4	202 (39.5%)
Unknown	41 (8%)
Previous radiation	221 (43.2%)
Previous surgery	194 (37.9%)
Previous chemotherapy	136 (26.6%)
Tracheostomy	
New	297 (58%)
Preexisting	9 (1.8%)
Laryngectomy	92 (18%)
Flap type	
Radial	389 (76%)
Fibula	59 (11.5%)
Anterolateral thigh	55 (10.7%)
Scapula	6 (1.2%)
Latissimus dorsi	3 (0.6%)

were transferred after the first postoperative week for sepsis ( $n = 4$ ), myocardial infarction ( $n = 1$ ), and respiratory distress ( $n = 1$ ).

## ICU Course

Among patients who were transferred to the ICU, seven (1.4%) required ventilator support, and four (0.78%) required vasopressor support. Only two patients had reoperations after being transferred to the ICU. The average length of stay in the ICU was 4.5 days.

## Flap Outcomes and Postoperative Complications

The overall flap failure rate was 19 of 512 (3.7%). The most common complications were delirium/agitation (n = 55; 10.7%) and pneumonia (n = 51; 10%) (Table II). Sixty-five patients (12.7%) returned to the OR, most commonly for hematoma/bleeding (n = 41; 8%) and then for anastomosis revision (n = 20; 3.9%).

## Length of Stay

Median length of stay for all patients was 9 days. The mean length of stay was 11.7 days (interquartile range 8–13 days). Specifically, ICU transfer was associated with longer mean length of stay (22.9 days for ICU transfer versus 11.3 days for non-ICU transfer,  $P = .002$ ).

## Multivariable Regression

In multivariate analysis, heavy alcohol consumption (OR 14.1; 95% confidence interval [CI] 3.67–53.9;  $P < .001$ ) and  $\geq 4$  comorbidities (OR 4.33; CI 1.43–13.1;  $P = .01$ ) were significant predictors of ICU transfer (Table III). Recent tobacco use, age, stage, previous radiation/chemotherapy/surgery, and tracheostomy were not found to be independent predictors.

## DISCUSSION

This study demonstrates that among head and neck patients undergoing microvascular free flap reconstruction, routine transfer to intermediate-level care with specialized otolaryngology nursing is safe and rarely

TABLE II.  
Complication Rates

Complication	Frequency (Proportion)
<b>Surgical</b>	
<i>Return to OR required:</i>	
Hematoma/control of bleeding	41 (8%)
Anastomosis revision	20 (3.9%)
Flap failure	19 (3.7%)
<i>Managed at bedside:</i>	
Hematoma/seroma drainage	34 (6.6%)
Fistula packing	33 (6.4%)
<b>Medical</b>	
Delirium/agitation	55 (10.7%)
Pneumonia	51 (10%)
Cardiovascular events (MI, PE, CVA, DVT)	11 (2.1%)

CVA = cerebrovascular accident; DVT = deep vein thrombosis; MI = myocardial infarction; PE = pulmonary embolism.

TABLE III.

Logistic Regression Predicting Need for ICU Transfer (n = 512)

Variable	Odds Ratio	95% CI	P-value
<b>Sex</b>			
Female	Reference		
Male	0.63	0.18–2.16	.46
Age (per 1 additional year)	1.04	0.99–1.1	.13
<b>Last tobacco use</b>			
$\geq 6$ months/non-smoker	Reference		
<6 months	1.21	0.32–4.57	.78
<b>Alcohol consumption</b>			
Light/None	Reference		
Heavy	14.1	3.67–53.9	<.01*
<b>Comorbidities</b>			
<3	Reference		
$\geq 4$	4.33	1.43–13.1	.01*
<b>Primary site</b>			
Oral cavity	Reference		
Oropharynx	1.03	0.15–7.11	.97
Hypopharynx/larynx	0.48	0.07–3.09	.44
Nasal cavity/sinus	0.84	0.06–11.7	.90
Cutaneous/face/ear	0.18	0.01–3.21	.24
Other	0.00	--	.99
<b>Cancer stage</b>			
Benign	Reference		
1	0.95	0.04–22.4	.97
2	6.72	0.62–72.5	.12
3	0.61	0.03–13	.75
4	1.21	0.1–14.3	.88
Unknown	0.96	0.04–23.1	.98
Previous radiation	0.42	0.06–2.84	.37
Previous surgery	1.00	0.27–3.72	.99
Previous chemotherapy	1.54	0.2–12	.68
Tracheostomy	0.35	0.05–2.53	.3

Race was removed due to lack of significance; heavy alcohol consumption was defined as  $\geq 7$  drinks/week in females or  $\geq 14$  drinks/week in males; \* Indicates significance at the  $P < .05$  level

requires subsequent ICU transfer. Patients necessitating subsequent ICU transfer required escalation of care primarily for medical, rather than surgical, concerns. Complication rates were comparable to those reported in the literature, both among prior cohorts cared for in intensive care<sup>2–4,6,8,9</sup> and non-intensive care settings.<sup>3,6,8–11</sup> Multivariable regression analysis identified the presence of multiple medical comorbidities and heavy alcohol consumption as factors associated with greater odds of ICU transfer, consistent with a prior study demonstrating increased complications after head and neck free flap reconstruction among patients with alcohol withdrawal syndrome.<sup>10</sup>

This study represents the largest review to date of head and neck free flap reconstruction patients managed postoperatively in an intermediate care unit, corroborating results of smaller cohort studies. Favorable outcomes for non-ICU protocols have been reported for 68 patients

by McVeigh et al.,<sup>12</sup> and for 44 patients by Godden et al.<sup>13</sup> Arshad et al. compared 125 free flap reconstruction patients admitted postoperatively to a specialized head and neck non-intensive care unit to 119 patients admitted postoperatively to the ICU.<sup>3</sup> They did not find a difference in outcomes and length of stay was longer in patients transferred to the ICU. Additionally, the average cost per patient was \$3238 higher in patients transferred to the ICU. Panwar et al. performed a retrospective review of 72 patients in a non-ICU protocol compared to 175 patients in an ICU protocol and similarly found that avoiding the ICU was associated with shorter hospital stays and substantially less hospital charges.<sup>6</sup> These studies provide further valuable information regarding the length of stay and cost by virtue of having a comparative arm of patients transferred to the ICU.

In contrast, this study evaluates a large number of patients encompassing a diversity of flap types (radial, fibula, ALT, scapula, and latissimus) and head and neck sites (oral cavity, oropharynx, hypopharynx, nasal cavity, and cutaneous). These patients were treated over 5 years in an institution where this has been a longstanding practice, in comparison to other studies that present outcomes for newly instituted protocols, showing that this practice is also sustainable. Therefore, this study offers external validation of the safety and efficacy of non-ICU care for head and neck free flap reconstructions.

Limitations of this study include the retrospective nature, which precluded the analysis of all variables of interest. Specifically, we were unable to describe the cost of care for these patients. Another limitation is the lack of a control cohort of patients transferred to the ICU because this non-ICU protocol has been the practice at our institution for over a decade. We were unable to assess possible associations between a delay in ICU transfer with patient outcomes due to inherent selection bias in our patient cohort. Patients transferred to the ICU are biased towards sicker patients, likely explaining a higher rate of medical and surgical complications in this subpopulation. We were also unable to ascertain if there were negative outcomes associated with delayed versus immediate transfer to the ICU since no patients in our cohort were transferred directly to the ICU.

Despite these limitations, given the positive outcomes, we continue this practice of admitting all microvascular free flaps to an intermediate care unit at our institution today. The transition to this protocol was critically dependent on nursing education and training. While this is easiest with nurses who already have familiarity with otolaryngology patients, it can also be applied in other practice settings where stepdown nurses take care of patients from multiple specialties. Dedicated in-services specifically related to tracheostomy care, laryngectomy care, and flap monitoring initially familiarize nursing with otolaryngology, and inevitably we found nursing comfort level to improve as they took care of more

free flap patients. An additional consideration is involving ancillary services who routinely care for free flap patients, such as respiratory therapy and speech and swallow therapy. Our experience has been that postoperative care in this setting offers the surgeon and patient multiple advantages including working with nurses who have specialized training and expertise in head and neck free flap reconstructions; improving the efficiency of care and optimizing resource utilization; decreasing the length of stay; and potentially lowering the cost of care.

## CONCLUSION

Our results demonstrate that head and neck microvascular free flap reconstruction patients do not routinely require postoperative mechanical ventilation and can be safely cared for in an intermediate-level care unit setting without incurring increased morbidity. Indeed, the cost effectiveness and avoidance of ICU-related morbidity, as well as the complications that require transfer, bear further examination. Limiting ICU utilization in this population may facilitate delivery of high-value and lower cost disease-specific care.

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