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Research Article

Trends in Surgical Volume and Postoperative Outcomes of Head and Neck Free Flap Reconstruction Using the Finance-Electronic Medical Record Digital Dashboard

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Abstract

Introduction

The impact of COVID-19 on surgical volume and outcomes among patients undergoing head and neck microvascular free flap reconstruction is not well-defined. This study aimed to explore trends in outcomes using a hybrid finance/electronic medical record (EMR) dashboard.

Methods

The finance/EMR dashboard was designed by linking financial billing data to CPT codes in an automated, real-time fashion within a tertiary-level academic institution. Surgical outcomes of patients undergoing free flap reconstruction from January 1, 2019 to December 31, 2022, primarily for head and neck cancer diagnoses, were extracted to assess trends before, during, and after the COVID-19 pandemic. Surgical outcomes included length of stay, return to Emergency Department (ED), readmissions, reoperations, postoperative hemorrhage, and mortality.

Results

Head and neck microvascular free flap surgical volume was 238 in 2019, 226 in 2020, 240 in 2021, and 280 in 2022. Surgical volumes reached a nadir in 2020 Q1 coinciding with the beginning of the COVID-19 pandemic, and returned to historic baseline levels in by Q2. Rates of return to ED (23%), readmission (23%), postoperative hemorrhage (18%), reoperation within 24 hours (3%), reoperation within 30 days (13%), and mortality (5%) were all relative or absolute peaks during the first quarter of 2020, coinciding with the beginning of the COVID-19 pandemic.

Conclusion

The finance/EMR dashboard provided real-time summaries of surgical volume and postoperative outcomes for head and neck free flap procedures. Our findings demonstrate the utility and applicability of the finance/EMR in surgical practice to enhance patient safety, research, and quality improvement efforts.

Conclusion: Temporary smell disturbance scores may be seen in patients undergoing bariatric surgery.

Keywords: bariatric surgery; smell test; olfactory function

Introduction

Since electronic medical records (EMR) were first introduced in the 1990s, they have attained widespread adoption amongst hospital systems in the United States. [1] In recent years, there have been a growing number of studies reporting on utility of different EMR dashboards, including for personalized osteoporotic fracture risk, centralized Emergency Department (ED) vital signs, iron deficiency testing in pediatric inflammatory bowel disease, central line-associated bloodstream infection checklist, and others. [2-8] While most of these dashboards are integrated into the EMR interface to assist with clinical decision-making, digital dashboards may also be utilized to summarize clinical data with custom stratification capabilities, such as filtering ED metrics by patient demographics.[9] We have recently

reported on a hybrid finance/EMR dashboard in the pediatric otolaryngology setting which combined financial records and EMR data to support custom analyses. [10]

To date, to our knowledge, there have been no other published reports of a digital dashboard linking financial billing records with EMR data. In this study, we aimed to demonstrate the applicability of the hybrid finance/EMR dashboard to analyze surgical volumes and outcomes of head and neck microvascular free flap reconstruction. Microvascular free flap procedures are the mainstay treatment to reconstruct the extensive defects of head and neck cancer ablation. The impact of cancellation of elective procedures due to COVID-19 on surgical delivery of this patient population has not been explored.

By assessing trends over a four-year time period between 2019 and 2022, we aimed to capture trends before, during, and after the COVID-19 pandemic for complex microvascular procedures. We hypothesized that the finance/EMR dashboard would allow us to determine if adverse outcomes including return to ED, readmissions, reoperations, and mortality increased during the initial phase of the COVID-19 pandemic. Based on our findings, we discuss implementation of the finance/EMR dashboard in other healthcare systems to monitor patient safety and quality improvement initiatives, enhance research efforts, and identify areas of improvement for healthcare teams across surgical specialties.

Materials and Methods

Patient selection

This cross-sectional quality-improvement study was performed according to SQUIRE 2.0 (Standards for QUality Improvement Reporting Excellence) guidelines. [11] Patients aged 18 years or older who underwent a free flap procedure at a tertiary-level, academic institution were included. Current Procedural Terminology (CPT) codes were obtained from billing data charged between January 1, 2019 and December 31, 2022. CPT and ICD-10 codes were manually sorted into meaningful procedure groups. The procedure group for free flaps included: CPT 15756, free muscle or myocutaneous flap with microvascular anastomosis; CPT 15757, free skin flap with microvascular anastomosis; CPT 15758, free fascial flap with microvascular anastomosis; CPT 20969, free osteocutaneous flap with microvascular anastomosis; ICD-10 0KR007Z, Replacement of Head Muscle with Autologous Tissue Substitute, Open Approach; ICD-10 0KR207Z, Replacement of Right Neck Muscle with Autologous Tissue Substitute, Open Approach; ICD-10 0KR307Z, Graft of muscle or fascia. This study obtained Institutional Review Board approval (#21-151).

Hybrid finance/EMR dashboard design

The hybrid finance/EMR dashboard continually links financial billing records to information stored in the EMR in an automated, real-time fashion, as previously described.[10] Encounter data including office visits, admission and discharge dates, and provider information were obtained from finance records and mapped to associated procedure groups. Telephone visits and operating room (OR) logs with a charge related to a CPT or ICD-10 code were extracted from the EMR and mapped to associated procedure groups. Postoperative hemorrhages were tabulated from either diagnoses of hemorrhage in the EMR or surgery logs identifying hemorrhage as reason for reoperation. The schema of the finance/EMR dashboard design is depicted in **Figure 1.**

The dataset was inputted into a user-friendly Tableau dashboard supporting custom dynamic filtering to support real-time analysis **(Figure 2**). Surgery dates were selected as January 1 to December 31 for each year. Age group was set to "adult", hospital site was set to the main hospital branch to exclude ancillary hospitals, procedure group was set to "free flap", and type of encounter was filtered to "inpatient." Institute was set to "Head and Neck Institute" to limit the output to head and neck procedures billed to otolaryngologists. Insurance type (Medicaid, Medicare, private, or other), surgeon, and discharge status were not filtered.

Outcomes of interest

Surgical outcomes extracted from the dashboard included 30-day complication rates for telephone callbacks, return to ED, readmissions, postoperative hemorrhages, return to OR, and mortality. Hospital length of stay was described as mean and standard deviation (SD). Categorical variables were described as frequency rates and percentages. Free flap volume, length of stay, and surgical outcomes were each tabulated by fiscal quarter and by year. Surgical volumes in 2020 were compared to historic surgical volumes in 2019 to evaluate impact of the COVID-19 pandemic.

Results

In total, 238 microvascular head and neck free flap procedures were performed in 2019, 226 procedures in 2020, 240 procedures in 2021, and 280 procedures in 2022. Trends in surgical volumes by fiscal quarter are depicted in **Figure 3A**, demonstrating a nadir in surgical volume in the first quarter of 2020 coinciding with the start of the COVID-19 pandemic. Free flap surgical volumes returned to baseline in the second quarter of 2020. Compared to historic monthly volumes, free flap volumes declined sharply in May of 2020 (**Figure 4**). Length of stay for free flaps reached a nadir of 6.5 days in the first quarter of 2021, and reached a peak of 10.4 days in the third quarter of 2021 (**Figure 3B).**

Surgical outcomes for each year are summarized in **Table 1**. Return to the ED was highest in 2020, with 38 (16.8%) patients returning to the ED Compared to 12.9-15.5% for the other years. Rate of 30-day readmissions from 12.2-16.4% for the years included. Postoperative hemorrhage was highest in 2020, occurring in 21 (9.3%) patients following free flap procedures. 24-hour and 30-day reoperation rates were highest in 2020, occurring in 3 (1.3%) and 14 (6.2%) patients, respectively. Rates of 30-day mortality ranged from 0.4-2.5% for the years included. Telephone callbacks were most frequent in 2020 during the early part of the COVID-19 pandemic, with 176 (77.9%) of postoperative patients initiating a telephone call to the office.

Surgical Outcomes	2019 (n=238)	2020 (n=226)	2021 (n=240)	2022 (n=280)
Average length of stay, in days	8.5 ± 6.3	9.9 ± 7.5	8.32 ± 6.1	9.2 ± 7.2
Telephone Callbacks	158 (66.4%)	176 (77.9%)	152 (63.3%)	188 (67.1%)
Returns to Emergency Department	37 (15.5%)	38 (16.8%)	34 (14.2%)	36 (12.9%)
Readmissions within 30 days	35 (14.7%)	29 (12.2%)	32 (13.4%)	39 (16.4%)
Postoperative hemorrhage within 30 days	14 (5.9%)	21 (9.3%)	11 (4.6%)	10 (3.6%)
Return to OR within 24 hours	0 (0%)	3 (1.3%)	3 (1.3%)	2 (0.7%)
Return to OR within 30 days	6 (2.5%)	14 (6.2%)	10 (4.2%)	13 (4.6%)
Mortality within 30 days	1 (0.4%)	4 (1.8%)	6 (2.5%)	2 (0.7%)

Abbreviations: ED, Emergency Department. OR, Operating Room

Table 1: Surgical outcomes for free flap procedures by year.

Trends in surgical outcomes by fiscal quarter are depicted in **Figure 5**. Rates of return to ED (23%), readmission (23%), postoperative hemorrhage (18%), reoperation within 24 hours (3%), reoperation within 30 days (13%), and mortality (5%) were all relative or absolute peaks during the first quarter of 2020, coinciding with the beginning of the COVID-19 pandemic, and returned to historic baseline levels thereafter.

Discussion

This study demonstrated the utility of the hybrid finance/EMR digital dashboard by assessing trends in postoperative outcomes following head and neck microvascular free flap surgery before, during, and following the COVID-19 pandemic. Although free flap surgical volume decreased in the first quarter of 2020, rates of adverse surgical outcomes including readmissions, return to ED, reoperations, postoperative hemorrhage, and mortality were increased during this quarter relative to historic levels. Adverse outcomes and surgical volume returned to baseline levels following Q1 of 2020.

Timely and regular assessments of surgical outcomes are needed to ensure patient safety and healthcare quality. At present, detection of adverse events occurs manually via chart review of the electronic medical record, often a time-consuming and laborious process requiring dedicated, trained personnel. Likewise, voluntary reporting and clinical observation of outcomes are subjective and limited.[12] The inability to systematically tabulate outcomes in a timely manner resents a barrier to understanding changes and identifying areas of improvement for healthcare delivery. Outcomes following changes in procedural techniques, providers, and surgical, anesthesia, or nursing protocols remain relatively unknown besides subjective, anecdotal insight until long-term data are manually reviewed. The novel finance/EMR dashboard described herein utilizes systems already in place, as most healthcare institutions in the United States have adopted EMRs. Without disruptions to clinical workflow or data storage, the dashboard streamlines data extraction by mapping financial billing records and stored information in the EMR into one conjoined dataset. Data is continually updated in real-time, and outputs can be filtered for custom analyses based on questions of interest.

The dashboard proved particularly useful during a time of unprecedented environmental changes such as the COVID-19 pandemic, with procedural bans often announced on short notice. Beginning in the first quarter of 2020, the Ohio Department of Health issued several bans on non-essential surgeries in an effort to conserve personal protective equipment for anticipated rises in COVID-19 cases and limit nosocomial spread of the coronavirus. [13] Non-essential surgeries were defined as those that could be safely delayed. Specifically, surgeries treating conditions that were a threat to life, would result in imminent permanent organ or limb dysfunction, would progress in cancer staging, or lead to rapid worsening to severe symptoms were constituted as essential. The first procedural ban lasted 37 days, and two subsequent procedural bans lasting 11 and 28 days were implemented in November and December of 2020, respectively, following regional surges in COVID-19 caseloads. [14] At our institution, a decline in surgical volume was observed in the first quarter of 2020 in response to abrupt cancellations of elective procedures. However, volume remained high, as microvascular free flap surgeries are often the mainstay reconstructive option for the surgical treatment of head and neck cancer and likely met criteria for categorization as essential surgeries. Non-surgical options or watchful waiting may compromise oncologic control. [15]

There may have been greater selection for more severe, urgent cases requiring surgical intervention in the first quarter of 2020. This may explain why several postoperative outcomes were worsened during this time coinciding with the beginning of the COVID-19 pandemic. Postoperative hemorrhage, reoperations, and mortality reached a mild peak in 2020 Q1. Upon further investigation, mortality during this time were attributable to the acute complications of surgery: cardiac arrest, pneumonia-induced septic shock, decline in respiratory status, and worsening kidney injury. The increased incidence of adverse postoperative outcomes despite no changes in surgeons or technique may reflect more medically complex patients. While age was similar between years, other patient-level variables such as cancer staging and socioeconomic status were not studied. Patient reluctance for in-person evaluations of symptoms has been reported to lead to delayed cancer diagnoses during the COVID-19 pandemic for breast, colorectal, and esophageal cancers.[16] Presentation of head and neck cancer at higher stages is more difficult to surgically manage, requiring more complex reconstruction, and may have contributed to the prolonged hospitalization, higher rate of postoperative complications, and increased mortality during Q1 of 2020. [17,18]

There was a slight trend towards prolonged length of stay from an average of 8.8 days in Q1 of 2020, to 9.0-9.2 in Q2-Q4. A possible explanation may be diversion of healthcare resources towards the COVID-19 response. Our institution experienced dramatic increases in hospitalization rates corresponding to COVID-19 case numbers, which demanded re-allocation of limited healthcare resources and personnel. The study by White *et al* demonstrated that longer operative time and ventilator dependence were predictors of longer hospitalization.[19] In addition to greater cancer disease burden at presentation necessitating longer recovery time, these factors may have also influenced longer hospitalization in our Q1 2020 patient cohort.

Telephone callbacks were highest in 2020 compared to the other study years, with 77.9% of patients initiating a call after free flap surgery. The callback rate is likely higher after free flap surgeries compared to other less complex procedures, likely due to the intensive postoperative course of an extensive, invasive surgery with higher morbidity and baseline deficits. Additionally, inadequate pain relief may require dose escalation. The increased rate of callbacks in 2020 suggests a reluctance for in-person visits for evaluation. Callbacks can help determine whether an in-person visit is necessary. Analyzing the content of patient inquiries may identify areas of misunderstanding or concern common after free flap procedures to improve patient education prior to discharge. Close telephone follow-up from a member of the surgical team may help prevent unplanned ED visits.[20,21]

Limitations

In this cross-sectional study, the year 2020 served as a proxy for examining effects of the COVID-19 pandemic; however, other environmental changes including personnel and protocol changes in this timeframe may have contributed to the outcomes observed. Information stored in EMR was used as a primary data source for input into the dashboard; however, data in EMR may be inaccurate, outdated, or conflicting. [22] Furthermore, the outcomes analyzed were limited to those captured by the dashboard. Specific complications of free flap surgeries such as flap failure or compromise, wound complications, or tumor-related factors were not captured. Future areas of development include specialty-specific and procedure-specific outcomes, opioid use, intensive care unit admission, costs analysis, and patient-reported quality-of-life metrics such as speech and swallowing outcomes. [23]

Conclusion

Free flap surgical volume declined at the beginning of the COVID-19 pandemic, despite rises in COVID-19 case numbers and abrupt bans on elective procedures. The development of the hybrid finance/EMR digital dashboard at our institution permitted identification of trends in surgical volume and postoperative thirty-day outcomes for free flap surgeries. The finance/EMR dashboard described herein may be applied at any healthcare institution that supports EMR, and presents useful opportunities for enhancing research efforts, monitoring surgical quality, and improving patient safety.

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