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FACTORS CONTRIBUTING TO THE RISK OF SURGICAL SITE INFECTION AND SEPSIS FOLLOWING RECONSTRUCTIVE FLAP SURGERY

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ABSTRACT

Introduction: *Reconstructive flap surgery, vital for addressing defects in diverse body regions, is employed in post-cancer and traumatic wound reconstruction, yielding favorable outcomes. While minor complications are well-documented, systemic complications, particularly sepsis, remain underexplored. This systematic review fills the gap by investigating sepsis incidence and associated risk factors in reconstructive flap surgery, aiming to enhance understanding, prevent complications, and improve patient care.*

Method*: The researchers in this study followed the 2020 Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines to ensure that their work met the required standards. This was done to ensure the precision and reliability of the conclusions derived from the research.*

Result*: Our search produced 14 results. After looking at the titles and summaries, we found several papers that fit our criteria. At first, we excluded few articles because they were written in review and case report style. But after reading the full papers carefully, we included five papers in our final analysis. These papers included retrospective review study and retrospective studies.*

Conclusion: *Postoperative sepsis and surgical site infections (SSIs) are significant challenges in reconstructive flap surgery, with a 2.1% sepsis incidence and identified risk factors including comorbidities, BMI, and ASA Score. Sepsis elevates 30-day mortality risk almost fivefold, emphasizing the need for preventive measures. Our study underscores the impact equivalence of SSIs and Major Postoperative Infections (MPIs) and recommends a 72-hour antibiotic prophylaxis duration in head and neck free flap surgery. Notably, preoperative recipient site infection in lower extremity tissue transfer influences graft outcomes, and longer operating time consistently predicts SSIs, necessitating strategic planning and comprehensive comorbidity management. Prospective studies are crucial for refining predictors and optimizing patient care in reconstructive flap surgery.*

Keywords: *Reconstructive flap surgery**,** sepsis, surgical site infection*

INTRODUCTION

Reconstructive flap surgery has emerged as a crucial approach for addressing defects in various body regions, proving effective not only in post-cancer reconstruction but also in managing traumatic wounds of the upper and lower extremities, yielding favorable functional and aesthetic outcomes.[1,2] When patients require flap reconstruction due to traumatic injuries, primary stabilization takes precedence. Additionally, in the context of oncological cases undergoing flap reconstruction, the timing of the procedure is influenced by adjuvant treatments, resulting in delayed surgeries spanning from hours to weeks or even months. While minor complications like fat necrosis and local wound infection are frequently reported after reconstruction, major complications such as complete or partial flap loss and arterial or venous thrombosis, though rare, are documented.[3]

The incidence of flap loss varies (0.5% to 2.2%) based on the flap's anatomical region, prompting extensive research and resources devoted to local tissue complications and flap viability. However, there is a notable dearth of information in the existing literature regarding systemic complications following reconstructive flap surgery, particularly concerning sepsis. Sepsis, defined as a life-threatening organ dysfunction resulting from a dysregulated host response to infection, carries significant mortality and morbidity risks after various surgical procedures.[4,5] The surviving sepsis campaign (ssc) reported that between 2005 and 2010, 18,766 patients in the us were admitted to the icu with sepsis or septic shock following surgical interventions. Surgical patients contribute to one-third of all sepsis cases and continue to pose a challenging cause of death in the united states.[6]

Despite the clinical recognition of the potential risk of sepsis, especially in procedures like flap surgery of the head and neck, the literature often overlooks this serious complication. This study aims to address this gap by investigating the incidence of sepsis following reconstructive flap surgery and identifying associated risk factors. Understanding these risk factors is essential for preventing this life-threatening complication and improving patient outcomes, not only by ensuring flap viability but also by mitigating the adverse effects of sepsis on microcirculation and gas exchange in the human body.[7] Consequently, the overarching purpose of this systematic review is to contribute to the comprehensive knowledge of complications associated with reconstructive flap surgery, with a specific focus on sepsis and surgical site infection, thereby enhancing patient care and surgical decision-making.

METHODS

Protocol

This study adhered to the guidelines outlined in the 2020 Preferred Reporting Items for Systematic Review to ensure alignment with necessary standards, thereby guaranteeing the accuracy of conclusions derived from the investigation.

Criteria for Eligibility

For this systematic review, the authors systematically compared and evaluated written articles pertaining to risk factors of complications associated with reconstructive flap surgery, with a specific focus on sepsis and surgical site infection. Throughout the document, the primary objective was consistently to emphasize the significance of identified risk factors. Data extraction involved consideration of authorship, publication year, study design, sample size, results, and discussion. Primary outcomes focused on variables assessed to establish the main results for pediatric patients experiencing septic shock.

Participating researchers had to meet specific conditions: the paper should be in English and should specifically address the determination of risk factors associated with stunting in toddlers. Published articles meeting the following conditions were included: those published since 2019 within the timeframe relevant to this systematic review. Excluded were studies falling into categories such as editorials, submissions lacking a DOI, already published review articles, and entries essentially mirroring already-published journal papers.

Search Strategy

Researchers independently conducted a search for relevant articles in multiple databases (PubMed and SAGE Pub) on February 2024, using specific keywords related to risk factors of complications associated with reconstructive flap surgery, with a specific focus on sepsis and surgical site infection. The search strategy included MeSH terms, All Fields, and logical operators. Manual searches were also conducted to identify articles meeting the specified criteria, ("risk factors"[MeSH Terms] OR ("risk"[All Fields] AND "factors"[All Fields]) OR "risk factors"[All Fields] OR ("risk"[All Fields] AND "factor"[All Fields]) OR "risk factor"[All Fields]) AND ("sepsis"[MeSH Terms] OR "sepsis"[All Fields]) AND ("surgical flaps"[MeSH Terms] OR ("surgical"[All Fields] AND "flaps"[All Fields]) OR "surgical flaps"[All Fields] OR ("reconstructive"[All Fields] AND "flap"[All Fields]) OR "reconstructive flap"[All Fields]) AND ("surgery"[MeSH Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "general surgery"[MeSH Terms] OR ("general"[All Fields] AND "surgery"[All Fields]) OR "general surgery"[All Fields] OR "surgery s"[All Fields] OR "surgerys"[All Fields] OR "surgeries"[All Fields]).

Inclusion and exclusion criteria

The studies included had specific criteria: (1) they needed to be original research related to risk factors of complications associated with reconstructive flap surgery, with a specific focus on sepsis and surgical site infection; (2) they could be Randomized Controlled Trials (RCTs) or observational studies (cohort or case-control studies); (3) relevant data had to be accessible. On the other hand, certain studies were excluded if they: (1) were ongoing or lacked available data; (2) were duplicates, in which case the most recent article was selected; (3) were not in English.

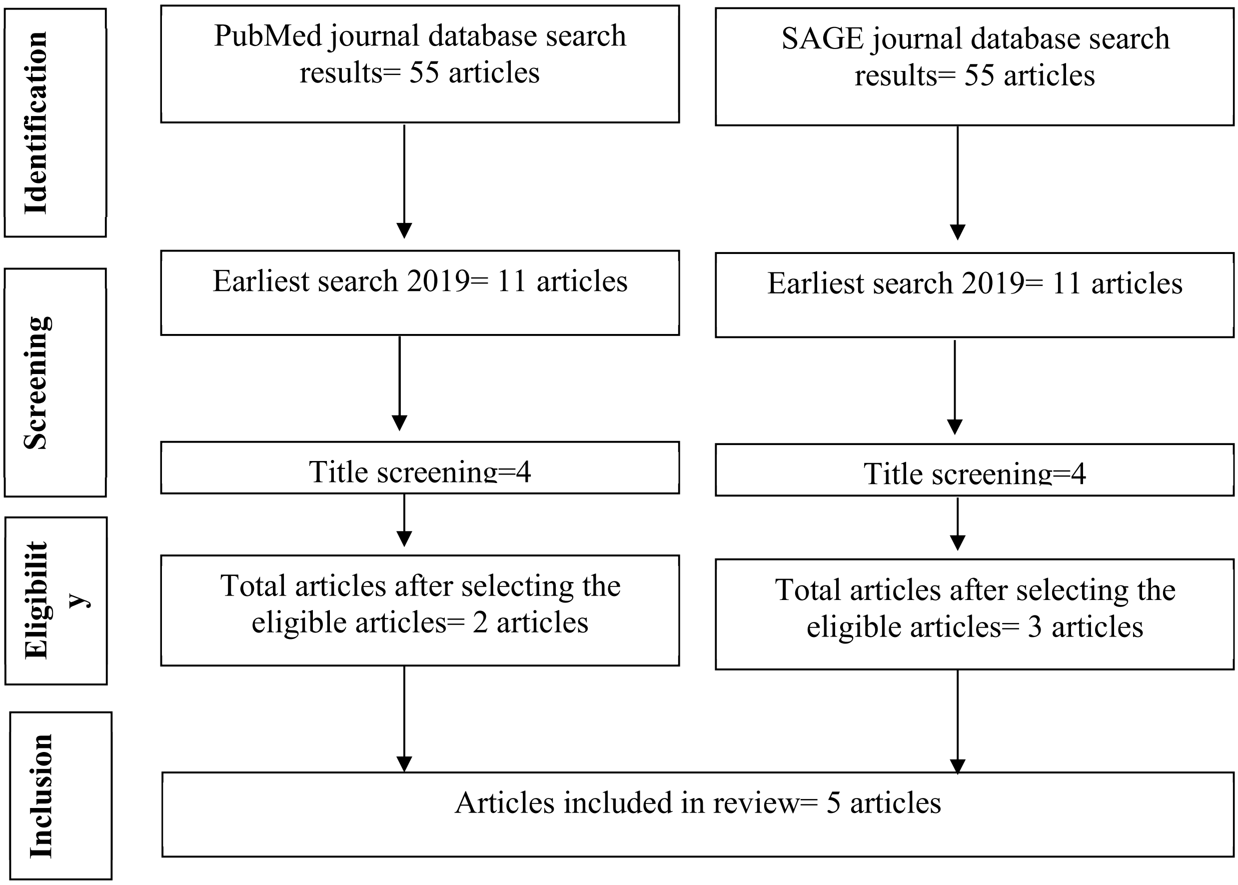

Figure 1. Article search flowchart

Data Retrieval

After reviewing abstracts and titles, the authors assessed each study's fulfillment of inclusion criteria. They then selected relevant studies to be incorporated as references in their article. The systematic review exclusively considered papers meeting all specified inclusion criteria. Findings from studies failing to meet the criteria were disregarded. The analysis of research findings involved examining various facets of information, including names, authors, publication dates, geographical locations, study methodologies, and parameters, aligning with the study's objectives.

Author	Origin	Method	Sample Size	Result
Sparenberg et al., 2019.[8]	US	Retrospective study.	24,257 patients who underwent flap reconstruction were included in this study.	Statistical analyses were performed to ascertain risk factors associated with the development of sepsis. 24,257 patients who underwent flap reconstruction were included in this study. Of these, 511 developed sepsis postoperatively (2.1%). Multivariate analysis showed that male gender ($p<.001$), African-American race ($p<.001$), hypertension requiring medication ($p<.001$), smoking ($p<.001$), a higher Charlson comorbidity Index score ($p<.001$), evidence of preoperative wound infection ($p<.001$), chronic steroid use ($p<.001$), and prolonged operative time ($p<.001$) all significantly were associated with the development of sepsis. Sepsis resulted in a higher chance of 30-day mortality ($p<.001$) and increased the risk of developing septic shock (OR: 2.578, CI: 1.241–5.354) This study shows that postoperative sepsis is a serious complication of reconstructive flap surgery.

Gugliotta et al., 2023.[9]	Italy	Retrospective review.	100 consecutive patients who underwent microvascular reconstruction surgery between 2016 and 2021 at a single institution.	In this study, 24 patients developed infectious complications. Higher American Society of Anesthesiologists (ASA) score was statistically associated with higher risk of infectious complications (p = 0.01), need for postoperative transfusions (p = 0.01), and higher T and N stage (p = 0.03 and p = 0.02, respectively) in patients with cancer. We also found a correlation between the increase in surgery duration, hospitalization, and intensive care unit (ICU) stay with higher risk of infection (p = 0.03, p = 0.01, and p = 0.001, respectively). Nine patients reported partial or total flap necrosis and in this group of patients, a higher incidence of infectious complication was recorded (p = 0.001).
Gearing et al., 2021.[10]	Australian	A retrospective cohort study	325 patients receiving free-flap reconstruction for head and neck cancer defects at a tertiary hospital in Melbourne, Australia between 2013 and 2019.	Risk factors for SSI included female gender, T-classification, hardware insertion, clindamycin prophylaxis, and operative duration. There was a trend towards increased SSI with shorter ≤24-hour prophylaxis (OR = 0.43).A total of 218 LE free flap reconstructions were performed during the study period. 152 (69.7%) of patients were male. Rate of secondary amputation following attempted limb salvage was 4.6%. LE reconstructions utilized either fasciocutaneous (79.4%) or muscular flaps (20.6%). The type of free flap used for reconstruction had no effect on reconstructive outcomes or flap viability. Preoperative bacterial wound cultures were obtained in 102 (46.8%) patients; 80 cultures (78.4%) were positive for bacterial growth. Of these, 33 (41.2%) grew Grampositive bacteria, 14 (17.5%) grew Gram-negative bacteria, and 33 (41.2%) grew multiple organisms. Positive preoperative wound culture was independently associated with flap failure at 120 days (p ¼ 0.04) when compared to wounds with no infection. Among patients with positive cultures, polymicrobial infection was significantly associated with higher rates of amputation (p ¼ 0.04) compared to single Gram-positive or Gram-negative infectious agents.
Barrette et al., 2021.[11]	USA	A retrospective review	A total of 218 LE free flap reconstructions were performed during the study period.	Risk factors for SSI included female gender, T-classification, hardware insertion, clindamycin prophylaxis, and operative duration. There was a trend towards increased SSI with shorter ≤24-hour prophylaxis (OR = 0.43).
Hassan et al., 2023.[12]	US	Retrospective analysis of prospectively collected clinical data within the NSQIP database from years 2005 to 2020.	A total of 218 LE free flap reconstructions were performed during the study period. 152 (69.7%) of patients were male.	37,177 patients underwent RFS, of whom 7.5% (n = 2,776) developed SSI. A significantly greater proportion of patients who underwent LE (n = 318, 10.7%) and trunk (n = 1,091, 10.4%) reconstruction developed SSI compared to those who underwent breast (n = 1,201, 6.3%), UE (n = 32, 4.4%), and H&N (n = 100, 4.2%) reconstruction (p < .001). Longer operating times were significant predictors of SSI following RFS across all sites. The strongest predictors of SSI were presence of open wound following trunk and H&N reconstruction [adjusted odds ratio (aOR) 95% confidence interval (CI) 1.82 (1.57–2.11) and 1.75 (1.57–1.95)], disseminated cancer following LE reconstruction [aOR (CI) 3.58 (2.324–5.53)], and history of cardiovascular accident or stroke following breast reconstruction [aOR (CI) 16.97 (2.72–105.82)].

RESULT

Our search produced 14 results. After looking at the titles and summaries, we found several papers that fit our criteria. At first, we excluded few articles because they were written in review and case report style. But after reading the full papers carefully, we included five papers in our final analysis. These papers included retrospective review study and retrospective studies.

Upon initial screening of the NSQIP dataset, a total of 59,567 patients underwent reconstructive flap procedures, either as primary or concurrent interventions. Among this cohort, 1845 patients (3.1%) developed postoperative sepsis. After excluding concurrent procedures, 24,257 patients underwent reconstructive flap surgery as the primary procedure, with 2.1% (n=511) developing sepsis postoperatively. The majority of patients were female (67.3%), and the mean age was 55.1 ± 13.9.[8]

While sepsis showed no association with increasing age, various preoperative comorbidities were associated with the development of sepsis. These included diabetes, hypertension requiring medication, chronic steroid use, bleeding disorders, smoking, preoperative wound/infection, and recently diagnosed pneumonia. Higher Charlson Comorbidity Index (CCI) scores, ventilatory support before surgery, and an ASA classification score of 3 or higher were also significantly associated with postoperative sepsis.[8]

Postoperative complications, such as bleeding, wound infection, blood transfusion, urinary tract infections, wound dehiscence, deep vein thrombosis, and pulmonary embolism, were more likely in the sepsis group. Increased operating time and longer length of stay further contributed to a higher incidence of postoperative sepsis. Thirty-day mortality was significantly higher in the sepsis group compared to the non-sepsis group. [8]

Multivariable logistic regression analysis, controlling for age, gender, race, BMI, and CCI score, revealed that male gender and African-American race had a higher chance of developing postoperative sepsis. BMI served as a predictor for sepsis, with each 5-point increase raising the odds of postoperative sepsis. Comorbidities such as hypertension requiring medication, diabetes, smoking, chronic steroid use, and preoperative wound/infection also contributed to sepsis development. Ventilatory support and bleeding disorders, while significant in univariate analysis, did not remain significant in the multivariable logistic regression model. An ASA classification score of 3 or higher resulted in a 2.5-fold increased chance of sepsis. The presence of sepsis alone increased the chance of 30-day mortality, septic shock, and subsequent 30-day mortality significantly. [8]

The authors conducted a retrospective review of patients who underwent surgical reconstruction for head and neck defects, a total of 298 reconstructive surgeries in the head and neck regions were identified, of which 110 involved microvascular reconstruction. Ten patients were excluded, leaving 100 participants (52 male, 48 female) with a mean age of 62.3 years (range, 20–85 years; median, 63 years). The majority underwent surgery for malignant tumor resection (75%), with no significant difference in infectious complications compared to those with benign pathology or requiring secondary reconstruction (25%) ($p = 0.1$).[9]

Infectious complications occurred in 24% of cases, with local infections in 9 cases, systemic complications in 10 cases, and both local and systemic infections in 5 patients. Risk factors such as smoking, alcohol consumption, debilitating comorbidities, previous radiotherapy, and chemotherapy were not associated with a higher risk of infection. However, a higher ASA score was significantly linked to a higher risk of infection ($p = 0.01$). Surgical factors such as procedural classification, flap donor sites, use of titanium reconstruction plate, tracheostomy, and neck dissection did not show a statistical association with infective complications.[9]

The average duration of surgery was 8.7 hours, and longer operative times increased the risk of infection ($p = 0.03$). Intraoperative blood transfusion did not influence the incidence of infections ($p = 0.2$). Postoperative steroid therapy and its duration, antibiotic prophylaxis, and different blood transfusion scenarios did not significantly affect infection rates ($p > 0.05$). Patients with advanced tumors (T3–4 or N ≥ 2a) were at a higher risk of infection ($p = 0.03$ or $p = 0.02$, respectively). Postoperative complications, including partial or total flap necrosis, were more frequent in patients with infectious complications ($p = 0.001$). [9]

The mean length of stay in the ICU was 3.2 days, associated with a higher incidence of infectious complications ($p < 0.05$). The overall hospitalization time also showed a significant association with increased infectious complications ($p < 0.05$). [9]

This retrospective cohort study received approval from the RMH Human Research Ethics Committee (HREC) under project number QA2019019. The study focused on cases recorded in the RMH Plastic and Reconstructive Surgery Register, covering planned operations from January 1st, 2013, to February 19th, 2019. Out of 10,042 cases screened, 404 cases met the criteria for review, with 325 cases included. The majority of these cases were indicated for resection of malignant tumors (94.5%), primarily squamous cell carcinomas (84.6%).[10]

The patient cohort comprised 196 men (60.3%) and 129 women (39.7%), with an average age of 60.4 years. The majority had T2 or greater classification (81.7%), and 43.2% had T4 tumors. Most patients fell into ASA class II-III (88.5%). Smoking prevalence was 19.6%, former smokers were 31.1%, and 12.3% had diabetes. The mean BMI was 27.1, and the mean pre-operative albumin level was 37.9. Operative procedures involved tracheostomy in 92.6% of cases, removed after a mean of 11.8 days. Patients were kept nil-by-mouth for a mean of 13.6 days, with a drain tube at the recipient site for a mean of 12.7 days. The mean operation duration was 624 minutes, and neck dissection was performed in 283 cases. All cases included microvascular free flap reconstruction, with various flap types and bony flaps in 29.8% of cases. [10]

Cephazolin-based prophylaxis was predominantly used, with various combinations. The mean duration of antibiotic prophylaxis was 7.6 days, with 83.2% receiving >24-hour prophylaxis. Topical antibiotic ointment and oral nystatin were prescribed in certain cases. Twenty percent of patients developed a recipient SSI, with Streptococcus spp. and Staphylococcus spp. being the most common isolates. Patients with SSI were more likely to require a return to theatre and experience complete free flap failure. Univariate and multivariate analyses identified risk factors for SSI, including bony flap use, prophylaxis type, and days with a recipient drain tube. Patient comorbidities and resection site were not significant risk factors. Shorter antibiotic prophylaxis duration (≤24 hours) was associated with a higher risk of SSI. [10]

Analysis revealed that shorter prophylaxis duration was a significant risk factor for infection. Sensitivity analysis with different cut-offs and exclusion of certain tumor types supported these findings. Short prophylaxis was associated with higher rates of recipient SSI, returns to theatre for infection, sepsis, and a trend towards increased mortality. [10]

Retrospective cohort analysis was performed utilizing continuous data from a single academic center in the United States ranging from 2010 to 2021. All patients who underwent free tissue-based LE reconstruction in this period were identified from the electronic medical record (EMR) using a free-text search engine (PennSeek) of operative notes using Boolean search terms "lower extremity", "reconstruction", and "free flap".[11]

A ttotal of 218 lower extremity (LE) soft tissue reconstructions were conducted during the study period, utilizing either muscle or fasciocutaneous flaps. The LE wounds in this patient group were categorized as surgical site wounds (13%), traumatic wounds (42%), oncologic wounds (10%), or were otherwise classified (35%). Robust follow-up data at 60-, 120-, and 180-day intervals was available for 218 (100%), 216 (99%), and 216 (99%) patients, respectively. [11]

Within this cohort, the amputation rate following attempted limb salvage using microvascular free flaps was 4.6%. Over 90% of free flaps demonstrated viability at the 60-, 120-, and 180-day intervals. In instances of flap failure, patients underwent interventions such as negative pressure wound therapy, repeat free flap procedures, or amputation, guided by the expert clinical judgment of senior authors. Both free flap types exhibited comparable viability at the 60-, 120-, and 180-day intervals. [11]

Out of 102 (46.8%) preoperative wound cultures, 80 (78.4%) demonstrated growth of Gram-positive, Gram-negative, or multiple organisms. Twenty-two (22%) cultures were negative for bacterial growth. Free flap reconstructions were categorized based on confirmed positive preoperative wound culture versus no confirmed wound infection. The analysis included rates of wound dehiscence, necrosis, flap failure, sepsis, and amputation, as well as reconstruction viability at 60-, 120-, and 180-day intervals. A confirmed positive preoperative wound culture was associated with higher rates of free flap failure at the 120-day interval ($p = 0.04$, Fisher's exact test). However, no associations were found between positive preoperative culture and other outcomes, such as dehiscence, partial necrosis, full necrosis, sepsis, amputation, or viability at 60 and 180 days. [11]

Upon further analysis, it was determined that preoperative wound cultures with growth of multiple organisms were associated with higher rates of free flap failure at the 120-day time point compared to patients without confirmed preoperative wound infection ($p = 0.02$, Fischer's exact test). Multi-drug resistant (MDR) bacterial growth on culture was not independently associated with adverse outcomes compared to wounds with no documented preoperative infection. [11]

In a subset analysis of patients with confirmed positive preoperative wound cultures, MDR bacterial infection did not show associations with higher levels of flap failure or amputation. Gram-positive and Gram-negative status, as well as aerobe status, were not linked to differences in reconstructive outcomes, including dehiscence, necrosis, sepsis, or amputation. Polymicrobial infection of a wound was significantly associated with higher rates of amputation after flap failure ($p = 0.04$, Pearson's chi-square) compared to single Gram-positive and Gram-negative infections. However, rates of flap viability at 60, 120, or 180 days did not differ significantly between polymicrobial and single-organism infections. Subset analysis comparing patients with confirmed positive and confirmed negative cultures failed to show statistically significant differences in rates of dehiscence, necrosis, sepsis, amputation, or flap viability at the 60-, 120-, and 180-day intervals (all p-values > 0.05). [11]

Study and investigation by Hassan et al constitutes a retrospective analysis of prospectively collected clinical data of patient cohort comprises a total of 37,177 individuals who underwent Reconstructive Flap Surgery (RFS). The mean age ± standard deviation (SD) of the patients was 54.76 ± 13.49 years, with a median (IQR) BMI of 28.8 (24.9–33.1) kg/m2. The median (IQR) total operating time was 272 (148–439) minutes, and the median (IQR) length of total hospital stay was 3 (2–5) days. Figure 1 visually represents the distribution of patients who underwent RFS according to the sites of reconstruction. The majority of patients in our cohort underwent breast reconstruction (n = 18,947, 51.0%), followed by trunk (n = 10,447, 28.1%), Head and Neck (H&N) (n = 4,086, 11.0%), Lower Extremity (LE) (n = 2,963, 8.0%), and Upper Extremity (UE) (n = 3,697, 9.92.0%) reconstruction.[12]

Within our cohort, a total of n = 2,776 (7.5%) patients developed Surgical Site Infections (SSI) following RFS, with the majority occurring in breast reconstruction (n = 1,201, 43.3%). Figure 1 (light blue bars) depicts the proportion of patients who developed SSI within 30 days following RFS, stratified by the site of reconstruction. The rate of SSI following LE (n = 318, 10.7%) and trunk (n = 1,091, 10.4%) reconstruction was significantly higher than that following breast (n = 1,201, 6.3%), UE (n = 32, 4.4%), and H&N (n = 134, 3.3%) reconstruction ($p < .001$). [12]

Variables with a $p < .2$ upon comparison were utilized in multivariate logistic regression models to identify significant predictors of SSI following RFS at each site. After adjustment with multivariate logistic regression, longer operating time emerged as a consistent predictor of SSI across all sites. The presence of an open wound was a significant predictor across most reconstruction sites, except for extremities. [12]

For breast reconstruction, the strongest predictor of SSI was a history of cerebrovascular accident/stroke [adjusted odds ratio (aOR) 95% confidence interval (CI) 16.97 (2.72–105.82)], followed by preoperative dyspnea at rest [aOR (CI) 5.13 (1.42–18.52)]. Alcohol use [aOR (CI) 1.27 (1.11–1.45)] and diabetes mellitus on insulin [aOR (CI) 2.0 (1.42–2.82)] were unique risk factors. Other risk factors included BMI, smoking, hypertension, loss of more than 10% of body weight within 6 months prior to surgery, and prior operation within 30 days. The presence of an open wound was the strongest predictor of SSI following trunk reconstruction [aOR (CI) 1.82 (1.57–2.11)], followed by preoperative Systemic Inflammatory Response Syndrome (SIRS) [aOR (CI) 1.59 (1.18–2.14)]. Requiring ventilator-assisted respirations within 48 h prior to surgery emerged as a unique protective factor for SSI following trunk reconstruction [aOR (CI) 0.31 (0.12–0.79)]. Other risk factors included BMI, smoking, loss of more than 10% of body weight within 6 months prior to surgery, and preoperative dyspnea with moderate exertion. [12]

Similarly, the presence of an open wound was the strongest predictor of SSI following H&N reconstruction [aOR (CI) 1.75 (1.57–1.95)], followed by loss of more than 10% of body weight within 6 months prior to surgery [aOR (CI) 1.67 (1.27–2.19)] and disseminated cancer [aOR (CI) 1.56 (1.27–1.93)]. Preoperative white blood cell (WBC) count was a unique risk factor for SSI following H&N reconstruction [aOR (CI) 1.04 (1.02–1.05)]. Other risk factors included preoperative SIRS, American Society of Anesthesiologists (ASA) class III and ASA class IV. For extremity reconstruction, the strongest predictor of SSI was disseminated cancer [aOR (CI) 3.58 (2.324–5.543)] following LE reconstruction, and preoperative dyspnea at rest [aOR (CI) 4.2 (1.47–12)] following UE reconstruction. [12]

DISCUSSION

In the medical field, there is a growing emphasis on complication rates and quality outcome measures. The ACS–NSQIP facilitates the examination of perioperative factors as predictors for poor outcomes through a national, multi-institutional dataset. Reducing complications is crucial for enhancing the quality of care, and our study focuses on the often-overlooked occurrence of sepsis in reconstructive flap surgery. Our findings indicate a relatively high overall sepsis rate in reconstructive flap surgery (2.1%), comparable to other well-described adverse events such as deep venous thrombosis (1.3%) and partial flap loss (2.2%). Significantly, patients developing sepsis had an increased risk of mortality within 30 days post-surgery. Robust preoperative screening, especially considering modifiable risk factors like smoking and BMI, is crucial in plastic surgery. The study highlights that a higher BMI is strongly associated with postoperative sepsis. While higher BMI is generally considered a negative influence on surgical outcomes, the relationship with sepsis outcomes is complex and warrants further exploration.[8]

Smoking status was identified as a risk factor for sepsis, increasing the risk by almost 60% compared to nonsmokers. Male gender and African-American race were also associated with a higher chance of sepsis. Age, surprisingly, did not correlate with increased sepsis incidence. Comorbidities such as chronic steroid use, the need for dialysis, hypertension requiring medication, higher CCI scores, and ASA classification > 3 contributed to an increased risk of postoperative sepsis. Evidence of a preoperative wound or infection was strongly associated with sepsis development. Despite the study's limitations, including reliance on the NSQIP dataset and the absence of detailed analysis of concurrent procedures, it sheds light on the high incidence of sepsis in flap reconstruction. Prospective studies are warranted to explore the clinical severity of sepsis in flap reconstruction comprehensively. [8]

Postoperative infections present significant morbidity challenges in major head and neck free-flap reconstruction. Existing studies suggest a wide-ranging surgical site infection (SSI) rate of 9.8–50% in microvascular head and neck reconstruction, with recognized risk factors including higher T classification, lymph node dissemination, bony flap insertion, prolonged operative duration, tracheostomy days, and recipient site drain tube days. According to CDC guidelines, patient factors like age, nutritional status, and diabetes are associated with an elevated risk of infectious complications. [9]

While only a few studies comprehensively report the incidence of major postoperative infections (MPI) in head and neck free-flap cases, our study focused on 100 patients undergoing such surgeries. Our findings revealed MPIs in 15% of patients and SSIs in 14%. Pneumonia, a prominent MPI, occurred in 9%, aligning with reported literature incidences (4.5–18.8%). Bloodstream infection (BSI) incidence was 6%, surpassing rates in other studies (0.7–4.3%), and no cases of septic shock were recorded. Urinary tract infection (UTI) incidence was 1%, lower than in other studies. [9]

The SSI incidence of 14% in our study falls within the reported range for clean-contaminated head and neck surgery (3–41%) and microvascular reconstruction (9.8–50%). Notably, few studies report SSI incidence without antibiotic prophylaxis (range, 78–87%). Univariate analysis in our study linked a high ASA score, T and N stages, and longer surgery duration to a higher incidence of infections. However, no significant associations were found with sex, age, BMI, comorbidities, smoking, alcohol consumption, or steroid use. [9]

The study did not find differences in antibiotic prophylaxis schemes affecting infection rates. Literature supports the role of penicillins and cephalosporins in prophylaxis, with no added advantage to prolonged courses (> 48/72 h). Steroid use did not impact infection rates. Complex surgeries with significant blood loss and transfusions may elevate complications, emphasizing the importance of adequate preoperative blood management. Overall, optimizing surgical conditions is crucial in mitigating postoperative complications. [9]

A retrospective study identified diabetes mellitus, younger age, hypertension, and preoperative radiotherapy as statistically significant demographic risk factors for surgical site infections (SSIs). However, these factors did not show significance in our study, possibly due to the study's majority of patients being of similar age (60.4 ± 14.6), non-diabetic (87.7%), and not exposed to preoperative radiotherapy (91.7%), suggesting potential underpowering for these variables. Female gender emerged as a significant factor in our study, associated with smoking, warranting further investigation.[10]

Karakida et al. highlighted T classification as a significant disease-related SSI risk factor in head and neck surgery, reflecting resection size, surgical invasiveness, and dead-space occurrence after reconstruction. T classification 2-4 was a significant risk factor in the study, even after excluding T1 tumors in a secondary analysis. Operative duration, often indicative of procedural complexity, was a risk factor for SSI in our study ($p = 0.004$). Bony flaps and hardware use correlated with operative duration, acting as infection nidus and were significant SSI risk factors ($p < 0.001$). Prophylaxis with cephazolin-metronidazole, per Australian guidelines, appeared effective, and alternative regimens should be compared. Clindamycin-based prophylaxis was inferior for patients with penicillin allergy. Topical antimicrobials did not prove beneficial for SSI prophylaxis, aligning with recent CDC systematic review findings.[10]

Regarding prophylaxis duration, while Australian guidelines suggest 24-hour prophylaxis, our study suggests this may be inadequate for head and neck free-flap surgery. No significant difference in SSI rates was observed with a 72-hour cut-off, suggesting a potential recommendation for extended prophylaxis. The literature remains inconclusive on the optimal duration, with varying recommendations up to 48 hours or even 5 days.[10]

Microvascular free flaps for lower extremity wound reconstruction represent a critical option for limb salvage before considering amputation. The success of grafts relies on optimal preoperative patient management and wound preparation to minimize the risk of reintervention, flap complications, or failure. Wounds in need of distant free tissue transfers for reconstruction often disrupt local vascular supply, leading to increased thrombosis risk in the microvasculature due to endothelial injury, resulting in a hypoxic environment prone to infections. While demographic factors and comorbidities like diabetes mellitus have been explored concerning postoperative morbidity and graft failure, conclusive risk factors remain variable. The study hypothesized that confirmed positive preoperative infections, in conjunction with the size and complexity of wounds requiring distant free tissue transfers, would significantly elevate the risk of adverse postoperative outcomes.[11]

Previous investigations identified operative time, preoperative donor site infection, and positive wound cultures as potential risk factors. However, definitive risk factors remain elusive. This series of 218 free flaps found that preoperative recipient site culture positivity correlated with a higher risk of flap failure at the 120-day mark compared to wounds with negative cultures or low concern for infection. Adverse outcomes were generally low, with secondary amputation required in 4.6% of total patients, and other flap failures treated with repeat free flap procedures or negative pressure wound therapy. Traumatic injuries, primarily in male patients, constituted a significant portion of wounds treated with microvascular free flap reconstruction. [11]

While multidrug-resistant (MDR) infections weren't independently associated with increased adverse outcomes, polymicrobial infections were significantly linked to amputation following attempted limb salvage compared to wounds without preoperative infection. Subset analysis of patients with positive and negative preoperative wound cultures showed no statistically significant differences in surgical outcomes. The study suggests that preoperative wound culturing may be necessary for patients undergoing lower extremity soft tissue reconstruction with high clinical suspicion of infection, aiming to minimize adverse outcomes and the need for additional interventions. [11]

Postoperative Surgical Site Infections (SSI) present a severe complication in reconstructive flap surgery (RFS), with potential morbidity and mortality implications. Our study, utilizing the NSQIP multi-institutional database, is the first and largest to compare SSI incidence and predictors across different RFS sites. We aimed to offer insights guiding patient selection, counseling, and surgical planning for reduced SSI risk postoperatively. In this cohort, the overall 30-day SSI incidence rate was 7.5%, aligning with literature ranges. However, due to varied techniques, reconstruction sites, surgeon expertise, patient demographics, and follow-up duration, comparing complication rates among studies remains challenging.[12]

For breast RFS, 6.3% developed SSI, with higher BMI, smoking, hypertension, and diabetes significantly increasing SSI odds. Unique risk factors included longer operating time, open wounds, and a history of CVA/stroke. Trunk reconstruction's SSI incidence was lower than reported literature ranges (20%–28.6%). Obesity, smoking, open wounds, longer operating times, preoperative systemic inflammatory response syndrome (SIRS), significant weight loss, and preoperative dyspnea were predictors. Head and Neck (H&N) RFS displayed a 4.2% SSI rate, differing from existing literature. Longer operating times, open wounds, significant weight loss, disseminated cancer, high preoperative WBC count, preoperative SIRS, and higher ASA classes were identified risk factors. [12]

Extremity reconstruction SSI incidence was lower than reported literature (27.5%). Unique predictors included disseminated cancer for lower extremity (LE) and preoperative dyspnea for upper extremity (UE). Regardless of site, longer operating times were consistently associated with increased SSI odds, potentially reflecting surgeon experience. While the retrospective nature and limitations of the NSQIP database exist, our study provides valuable insights into SSI risk factors following RFS across different reconstruction sites. Further research is warranted for a comprehensive understanding. [12]

CONCLUSION

Postoperative complications, including sepsis and surgical site infections (SSI), pose significant challenges in reconstructive flap surgery. Our findings reveal a 2.1% incidence of postoperative sepsis, with identified risk factors encompassing higher Charlson Comorbidity Index, greater BMI, diabetes, hypertension, chronic steroid use, smoking, and an ASA Score of 3 or greater. Importantly, sepsis elevates the risk of 30-day mortality almost fivefold, necessitating heightened awareness and preventive measures. Additionally, our study emphasizes the equivalence of impacts between SSIs and Major Postoperative Infections (MPIs) on patient and surgical outcomes, urging meticulous pre- and postoperative management. Antibiotic prophylaxis duration in head and neck free flap surgery may find a prudent compromise at 72 hours, as suggested by our research. Further, we highlight the novel significance of preoperative recipient site infection in lower extremity tissue transfer, influencing graft outcomes and guiding infection management. Finally, longer operating time emerges as a consistent predictor of SSI, urging strategic surgical planning and robust comorbidity management to mitigate risks. Prospective studies are crucial for refining our understanding of predictors and optimizing patient care in reconstructive flap surgery.

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