RM118 **Management and Characterization of Skin Penetration Sites and Infectious Complications in Osseointegrated Implants for Major Extremity Amputees**

Walter Reed National Military Medical Center, Bethesda
Presenter: **Jason M. Souza, MD**
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Background

Osseointegrated implants have demonstrated promising functional results, improvements in pain, and increased prosthetic use for patients with limb loss who are unable to tolerate a traditional socket-based prosthesis. However, as with any transdermal implant system, there is an increased risk of infectious complications. Superficial soft tissue infection near the skin-implant interface is the most frequently encountered complication and can be a challenging diagnosis, especially for providers unfamiliar with osseointegration. We sought to report our early experience and management of the skin-implant interface in patients who underwent osseointegration at our institution.

Methods

We are conducting two prospective studies in patients with transhumeral and transfemoral amputations under an FDA Early Feasibility Study and Humanitarian Device Exemptions, respectively using the Osseointegrated Prosthesis for the Rehabilitation of Amputees (OPRA) implant system. Routine clinical assessment of the skin penetration site (SPS) is conducted two weeks following the second stage surgery and again at 3, 6, 12 and 24 months. Characterization of the SPS is completed by either of two senior surgeons (JAF, BKP), both of whom have performed all osseointegration procedures at our institution. The SPS is characterized by the presence or absence of erythema, frequency and quality of secretion, and superficial or deep infection.

Results

Six transhumeral amputation patients have received a total of six implants without any infectious complications. One patient had serous discharge that resolved without additional treatment.

19 transfemoral amputation patients have received a total of 28 implants (9 bilateral). Erythema at the SPS during follow-up visits at two weeks, 3, 6, and 12 months post stage-2 are as follows: 3/17, 1/16, 0/14, and 1/4. Secretions at the SPS during the same follow-up visits are as follows: 4/17, 0/16, 3/14, 0/4. There was one deep infection not involving the bone or implant and five superficial soft tissue infections occurring at a median 47 days following stage-2 surgery (range: 26-84 days). All infections have been successfully treated with antibiotic therapy, and all implants have been retained.

Conclusion

Osseointegration features an intramedullary implant in communication with the external environment through a skin-implant interface, which has given surgeons hesitation in performing this procedure due to concern for implant related infection. Close monitoring and characterization of the SPS in this population is critical to identifying indications for intervention and for promoting antibiotic stewardship. In summary, our experience with the OPRA implant system has demonstrated relatively few complications at the skin-implant interface and acceptable rates of soft tissue infection.

RM119 **National Distribution of Pedicled and Free TRAM Flaps**

Rush University Medical Center, Chicago
Presenter: **Aaron Lee Wiegmann, MD**
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Background

The investigators evaluated the geographic distribution of transverse rectus abdominis myocutaneous (TRAM) flaps for soft tissue reconstruction in the United States. These tertiary procedures often require comprehensive peri-operative care that a patient living in a rural area may not have access to.

Methods

All Medicare insurance claims from 2008 through 2014 were analyzed. Only patients with coded TRAM reconstruction were included. Free and pedicled TRAM flaps were distinguished. Hospital location as per state, county, and zip code were analyzed and used to generate density maps of the United States (Tableau®, Seattle, WA, USA) for the study sample. Descriptive statistics were also calculated.

Results

1,707 patients (98.3% female) underwent pedicled TRAM reconstruction, the majority were aged 65-69 and occurred in the southern United States. California and New York had the most pedicled TRAM procedures—163 and 134 respectively. 1,549 patients (97.9% female) underwent free TRAM reconstruction, the majority were aged 65-69 (but 40% occurred in patients less than 64 years) and occurred in the southern United States. Pennsylvania and California had the most free TRAM procedures—161 and 146 respectively. The geographic distribution of the TRAM procedures is heavily centered around major metropolitan areas or those areas with large academic medical centers as seen in figures two and four. The Medicare database was unable to quantify those geographic locations where less than 15 TRAM procedures took place.

Conclusion

The TRAM reconstruction patient population is largely elderly, female (likely secondary to oncologic breast reconstruction), and having their surgeries performed in geographic locations near major metropolitan areas or large academic hospitals. This observation is related to the complexity of these reconstructive operations, but highlights the vast areas of the United States where these procedures are not taking place. Rural patients likely are disproportionally not offered TRAM reconstruction.

RM120 **Improving Patient Outcomes in Autologous Microvascular Breast Reconstruction after Masectomy**

Grace Keane, St. Louis
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Background: Autologous microvascular breast reconstruction following mastectomy has gained popularity due to its associated improvements patient satisfaction, cosmetic results, and long-term outcomes in comparison to implant reconstruction. However, disadvantages to this procedure remain, including donor site morbidity, considerable post-operative pain, and longer time to recovery. Post-operative pain has traditionally been managed with IV opioid analgesics, which constitute a major public health issue due to their high rate of abuse. The goal of our study was to determine if we could optimize patient recovery and minimize post-operative opioid use through the institution of a new, comprehensive recovery protocol, termed "Enhanced Recovery After Surgery" (ERAS).

Methods: This was a single-surgeon, retrospective cohort study of two groups of patients that underwent autologous microvascular reconstruction with muscle-sparing transverse rectus abdominis myocutaneous (ms-TRAM), deep inferior epigastric perforator (DIEP), or superficial inferior epigastric artery (SIEA) flaps between May 2014 and February 2018. Patients who underwent surgery before the ERAS protocol institution in August 2015 received traditional care (pre-ERAS). Patients in the ERAS cohort were administered acetaminophen, NSAIDs, gabapentin, a paravertebral block, and primarily oral opioids postoperatively. The primary post-operative recovery measures for both groups were length of hospital stay, time to ambulation, opioid usage, and patient-reported pain measures.

Results: We enrolled 39 patients in the pre-ERAS and 44 patients in the ERAS cohorts. The two groups were consistent in regards to surgical operation, including tissue donor site, operative side, and abdominal closure. Mean length of stay (3.20 vs. 4.62, $p<0.001$) and time to ambulation (1.86 vs 2.88, $p<0.001$) were significantly decreased for patients in the ERAS cohort. Additionally, the patients of the ERAS cohort were administered fewer opioids (291mg vs. 707mg, $p<0.001$) and required a shorter period of IV opioid usage (16.0h vs 78.2h, $p<0.001$) in comparison to the pre-ERAS cohort. There was no significant difference in patient-reported pain scores or complication rate between the two groups.

Conclusion s: The implementation of a comprehensive, patient-centered recovery protocol following autologous microvascular breast reconstruction resulted in significant improvements in recovery timeline with no changes in short-term complication rate. Even more exciting was its effects on post-operative pain management, which demonstrated significant reductions in post-operative opioid usage with no effect on patient-reported pain scores. We believe these results

demonstrate a benefit to restructuring surgical patient management to decrease unnecessary opioid usage and improve post-operative outcomes.

RM121 **A Nationwide Analysis of Early and Late Readmissions Following Free Tissue Transfer for Breast Reconstruction**

University of Utah School of Medicine, Salt Lake City
Presenter: **David Magno-Padron, MD**
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Background: Traditionally, surgical quality outcomes are assessed using a 30-day postoperative window. For breast cancer patients undergoing free tissue transfer for breast reconstruction, we sought to describe the distribution of and specific risk factors for early and late readmissions within a 0-90-day postoperative period.

Methods: The Nationwide Readmissions Database was used for years 2013 and 2014 to conduct this retrospective cohort study. Breast cancer patients undergoing free tissue transfer for breast reconstruction between January and September of either year were identified using ICD-9 diagnosis and procedure codes. 90-day readmissions related to infection or wound complications were identified for these patients. Descriptive statistics and univariable and multivariable logistic regression models were used to identify associations between patient clinical and demographic characteristics and 0-90-day readmission rates as well as readmissions that occurred early (0-30 days) and late (31-90 days) after the index surgical procedure.

Results: In the weighted sample, we identified approximately 9,023 free flap breast reconstructions and a surgical wound-related readmission rate of 4.7% (n=426): 63.8% of the readmissions occurred within the first 0-30 days after surgery while 36.2% occurred during the 31-90 days after surgery. The mean days to readmission was 27 and 75% of all readmissions occurred within the first 38 days after surgery. The mean cost of a readmission was $44,356. Reconstruction performed in an urban hospital was associated with decreased readmissions during the 0-90-day period (OR 0.59, p=0.010). Variables independently associated with readmissions during the 0-90-day postoperative period included: history of COPD (OR 2.03, p=0.005), obesity (OR 2.33, p=<0.001), history of radiotherapy (OR 2.11, p=0.002), history of smoking (OR 3.23, p=0.002), and increasing length of stay at the index admission (OR 1.09, p=0.016). The variables independently associated with the early readmission period were the same as those identified for the 0-90-day postoperative period. The variables independently associated with late readmissions were different: history of depression (OR 3.71, p<0.001) and history of smoking (OR 4.20, p=0.001).

Conclusion: The conventional 30-day hospital readmission rate classically used as a quality metric is overlooking a significant portion of admissions after free flap based breast reconstruction. Different variables were found to be associated with readmission in the early versus late cohorts. Interventions targeting these specific variables could decrease readmissions and their associated costs.

RM122 **Perfusion Management in 777 Autologous Breast Reconstruction Patients at an Academic Cancer Center**

Memorial Sloan Kettering Cancer Center , New York
Presenter: **Thais Polanco, MD**
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Background

Perioperative fluid management in autologous breast reconstruction (ABR) procedures can be challenging, with no standardized or clear guidelines for intraoperative fluid administration and vasopressor usage in this patient population. This study aims to understand the effects of implementing an enhanced recovery surgery (ERAS) pathway on intraoperative fluid administration and vasopressor usage and its impact on perioperative complications and outcomes in ABR patients.

Methods

A retrospective cohort review was performed for patients undergoing immediate or delayed ABR during January 2010 to April 2017 at a tertiary care center. In April 2015, this center implemented an ERAS protocol using goal-directed fluid therapy (GDFT) for intraoperative fluid management. With GDFT, patients were administered intraoperative fluids, vasoactive agents, and inotropes according to cardiac output and other hemodynamic indices. Primary outcomes of interest included: amount and rate of fluid delivery, urine output (UOP), vasopressor administration, perioperative complications, and length of stay (LOS). Patients prior to April 2015 were considered pre-ERAS cohort.

Results

Overall, 777 patients underwent ABR (ERAS: n=312, pre-ERAS: n=465). ERAS patients received significantly less total fluid volume (3.75L vs 5L) ($p<0.001$) at an overall, lower rate compared to pre-ERAs patients. UOP, estimated blood loss, and total fluid balance were all significantly lower in the ERAS compared to pre-ERAS cohort ($p<0.001$). ERAS patients were significantly more likely to receive vasopressor agents compared to pre-ERAS cohort (ERAS: 47%, pre-ERAS: 35%; $p<0.001$). Major and minor complications did not significantly differ between cohorts ($p=0.47$), including rates of intraoperative or postoperative thrombotic events. No significant difference was noted in readmission rates between cohorts. Lastly, LOS was significantly lower in the ERAS cohort (4 days) compared to pre-ERAS patients (5 days; $p<0.001$).

Conclusion

GDFT as part of an ERAS protocol and prudent use of vasopressors were found to be safe and did not increase postoperative complications or morbidity in ABR patients. Patients received less fluid, with higher rates of vasopressor administration under the protocol.

RM123 **Decreasing Opioid Consumption in Autologous Free-Flap Breast Reconstruction Patients with Enhanced Recovery Pathway Protocols – an Examination of Sustainability and Patient Reported Outcomes**

Memorial Sloan Kettering Cancer Center , New York
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Background

Given the opioid crisis in the United States, increased focus has been placed on multimodality perioperative pain regimen and enhanced recovery pathways (ERPs). Enhanced recovery pathways (ERPs) aim to achieve early, postoperative recovery and improve surgical and quality of life outcomes. However, there is limited data regarding ERPÕs efficacy in decreasing opioid consumption for autologous, free-flap breast reconstruction patients. This study aims to determine the efficacy of ERPs on patient outcomes, primarily focusing on opioid consumption and physical well-being among autologous, free-flap breast reconstruction patients.

Methods

A multidisciplinary ERP was developed for patients undergoing autologous free-flap breast reconstruction in April 2015 at this tertiary care center. ERP patients underwent breast reconstruction after April 2015 and were compared with a non-ERP cohort (reconstructions before from 2007 to 2015). Core elements of this ERP included a multimodal pain regimen of intravenous ketorolac, aspirin, and transversus abdominis plane blocks with liposomal bupivacaine. The primary outcome was total postoperative opioid consumption (intravenous morphine equivalents [IV-ME]). An analysis of factors influencing high versus low opioid consumption was conducted. Secondary outcomes included overall complications and short-term patient-reported outcomes using the BREAST-Q.

Results

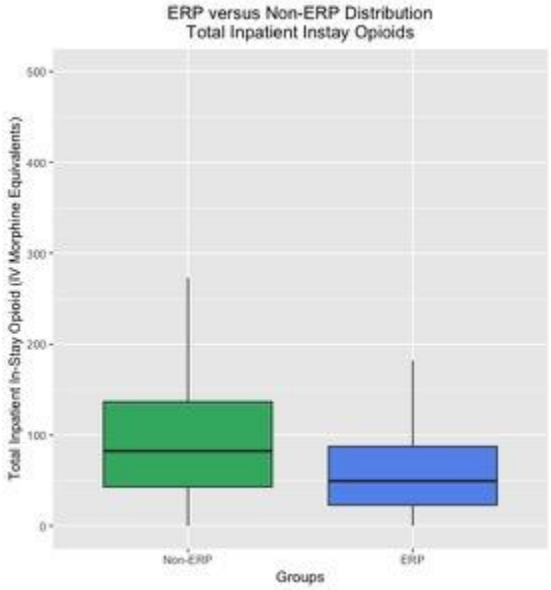
Among 602 included patients, 230 were in the ERP and 372 in the non-ERP cohort. There was a significant decrease in average total intraoperative (ERP: 29.71 IV-ME; non-ERP: 41.00 IV-ME; $p<0.001$) and postoperative inpatient morphine (ERP: 69.10 IV-ME; non-ERP: 116.00 IV-ME; $p<0.001$) for ERP patients versus non-ERP patients. ERP patients were more likely to receive

ketorolac intra-operatively ($p<0.001$) and postoperatively ($p=0.001$) compared to non-ERP patients. Complications did not differ between the two groups ($p= 0.232$). Examining patient reported outcomes; there were no significant differences in BREAST-Q Physical Well-being of the Chest or Physical Well-being of the Abdomen scores at three-months postop.

Conclusion

ERPs are an effective strategy to systematically reduce opioid consumption in ABR patients, both intraoperatively and postoperatively without impacting perioperative complications. Such protocols may not directly alter patient reported physical wellbeing, which warrants further examination.

Figure 1



Non-ERP median (IQR): 84.00 (43.33-139.25); ERP median (IQR): 49.75 (23.38-89.12)

RM124 **A Novel Free Flap Monitoring System: Initial Experience with an Automated 3D Portable Point-of-Care Ultrasound (EchoSureTM)**

Louisiana State University Health Sciences Center, New orleans
Presenter: **Radbeh Torabi, MD**
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Background

Free flap monitoring includes clinical exam and pulse Doppler checks. Majority of these are performed by nursing staff who can perform reliable exams, however subtle changes from baseline can be missed, particularly when multiple hand-offs occur throughout a patient's stay. Presented here is our institution's initial experience using a novel system that provides objective information on free flap vascular flow.

Methods

The monitoring system is comprised of a bioresorbable echogenic marker (EchoMark, Sonavex Inc., Baltimore, MD, USA) and an automated 3D portable point-of-care ultrasound with an 8 MHz transducer (EchoSure, Sonavex Inc., Baltimore, MD, USA).

Prior to final inset of free flaps on 11 patients, the marker was implanted beneath the pedicle of the flap. After closure, EchoSure was used to establish baseline venous and arterial flow through the pedicle. The evaluation was repeated during the postoperative period. Simultaneous clinical and pulse Doppler evaluation of the flaps, as per our standard protocols, were used to influence clinical decision making.

Results

Flap arterial and venous flow was assessed reliably for 15 free flaps performed on 11 patients. Patients underwent bilateral breast (n=4), lower extremity (n=3), upper extremity (n=2) and scalp reconstruction (n=2). Relative flow was displayed as a percentage of flow compared to baseline. This data was displayed in a simplified interface demonstrating relative flow, colored doppler, and arterial and venous wave forms (figure 1)

Conclusion

EchoSure's deep learning and image processing algorithms enable non-sonographers to rapidly collect both visual and quantitative anastomotic flow data through venous and arterial anastomoses. Our initial experience demonstrates the device's potential to provide objective flap monitoring in various forms of reconstruction.

Figure 1. Sonavex interface displaying relative volumetric flow rate, color flow doppler, and arterial and venous wave form.