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ARTICLE

Trends and characteristics of neurotization during breast reconstruction: perioperative outcomes using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP)

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ABSTRACT

This study aimed to investigate the impact of performing neurotization during breast reconstruction on total operating time and post-operative morbidity. The 2015 through 2019 American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) databases were utilized to identify patients who underwent breast reconstruction with and without neurotization. Baseline demographics, comorbidities, operative characteristics and outcomes were examined for each group. Thirty-day complication and readmission rates were compared using univariable and multivariable logistic regressions. Of 73,507 patients identified who underwent breast reconstruction, 240 had reconstruction with neurotization. Autologous reconstruction was more prevalent for patients with neurotization (90.8% vs. 18.5%, $p<.001$). Average operating time was longer when neurotization was performed during both autologous (527.1 ± 152.4 vs. 414.8 ± 186.3, $p<.001$) and alloplastic-only reconstruction (310.9 ± 115.9 vs. 173.0 ± 94.3, $p<.001$). The likelihood total operating time exceeded 521 min (two standard deviations above average) increased when neurotization was performed (OR 2.464, CI 1.864–3.255, $p<.001$). Thirty-day complications occurred in 13.8% of patients with neurotization and 6.8% without ($p<.001$). Similarly, 30-day readmission rates were higher for patients with neurotization (7.5% vs. 4.2%, $p<.001$). However, when adjusted for comorbidities and operative characteristics, neurotization did not significantly impact 30-day complication rates (OR 0.802, CI 0.548–1.174, $p=.256$) or 30-day readmission rates (OR 1.352, CI 0.822–2.223, $p=.077$). Although neurotization during breast reconstruction increases operating time, comorbidities and procedural characteristics play a greater role in post-operative outcomes than neurotization alone.

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Breast reconstruction; neurotization; national data; trends; outcomes

Abbreviations: ACA: affordable care act; ACS: NSQIP: American College of Surgeons National Quality Improvement Program; ASA class: American Society of Anesthesiology physical status classification system; BMI: body mass index; CHF: chronic heart failure; COPD: chronic obstructive pulmonary disease; CPT: current procedural terminology; CVA: cerebrovascular accident; DM: diabetes mellitus; DVT: deep venous thrombosis; ERAS: enhanced recovery after surgery; HRRP: hospital readmission reduction program; OR: odds ratio; P: probability value; PMBR: post-mastectomy breast reconstruction; SD: standard deviation; SIRS: systemic inflammatory response syndrome; SSI: surgical site infection; TE: tissue expander; TRAM: transverse rectus abdominus muscle; UTI: urinary tract infection; %: percent.

Introduction

Post-mastectomy breast reconstruction (PMBR) is well established as an integral component of comprehensive breast cancer care [1]. Studies have documented that PMBR significantly improves patient satisfaction and quality of life [2,3]. Over the years, plastic and reconstructive surgeons have refined the structural and aesthetic appearance of reconstructed breasts; however, the paradigm has recently shifted to focus on restoring breast function, including sensation [4].

Studies have shown that breast sensation after PMBR can return spontaneously [5], but often returns sporadically and unpredictably [5,6]. Breast neurotization involves surgical connection of nerves during PMBR in order to expedite and enhance sensory recovery of reconstructed breasts [4]. Re-innervation can be accomplished by direct nerve coaptation, with donor nerve allografts, or with synthetic or biologic nerve conduits. Several studies have concluded that neurotization improves both speed of sensory recovery and final sensation after PMBR [5–8]. However, few studies report data on the safety of performing neurotization during PMBR.

It is generally accepted that the benefits of PMBR outweigh the risks [1,4]; however, PMBR is associated with known complications [9–11]. Although most of the surgery remains unchanged, adding neurotization to PMBR increases total operating time [12–14], which increases risk of post-operative complications [15,16]. Our study aims to utilize national data to analyze the impact of breast neurotization on operating time and post-operative complications. These results may further elucidate the safety

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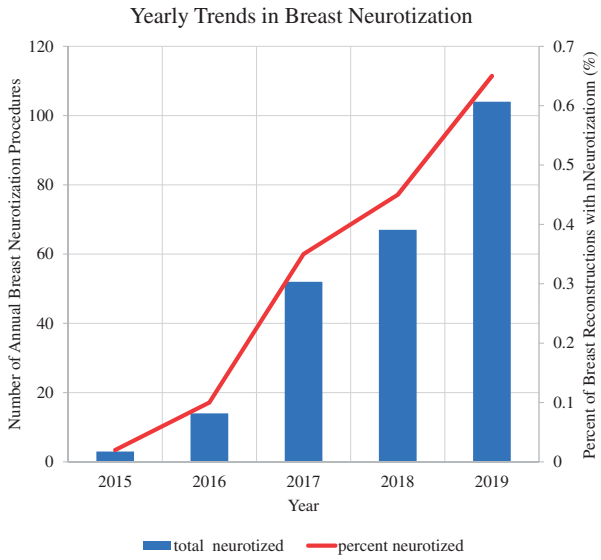

Figure 1. Trends in breast neurotization over time.

profile of neurotization during PMBR to help guide decision-making regarding neurotization, and determine focused areas of improvement to optimize patient safety.

Materials and methods

The 2015 through 2019 American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) databases were queried utilizing current procedural terminology (CPT) codes to identify all patients who underwent breast reconstruction. Patients with concurrent neurotization were further identified with CPT codes (Supplementary material, Table A1). Baseline patient demographics and pre-operative characteristics examined included age, body mass index (BMI), race and medical comorbidities. Procedural characteristics examined included immediate vs. delayed breast reconstruction, unilateral vs. bilateral reconstruction, breast reconstruction type and neurotization type. Given significant differences in reconstruction type for patients with and without neurotization, a separate sub-analysis was performed for patients who had any autologous reconstruction with and without implant or tissue expander (TE).

The primary outcomes of interest were differences in total operating time and 30-day morbidity for patients who underwent breast reconstruction with and without neurotization. Total operating time was assessed as a continuous linear variable and categorical variable, with categories defined by number of standard deviations above average. Thirty-day morbidity was defined as having one or more of the NSQIP reported 30-day complications. Secondary outcomes included length of stay, unplanned reoperation and 30-day readmission. Prolonged hospital stay was defined as greater than five days, based on definitions established by prior studies [16,17].

Patient characteristics and outcomes were summarized using mean with standard deviation and frequency with percentage. Mean differences between continuous variables and proportions were assessed using the two-sided independent *t*-test and Pearson's chi-square statistic, respectively. Statistical significance was determined by $p<.05$. Univariate regression analyses were performed using baseline demographics, comorbidities and procedure characteristics as independent variables to assess associated odds of primary and secondary outcomes. Variables with significant association on univariate analysis were included in multivariate regression models to determine adjusted associations between independent variables and outcomes of interest. All analyses were performed using IBM SPSS version 27 (IBM Corp, Armonk, NY).

Results

Of 73,507 patients identified who underwent breast reconstruction, 240 patients (0.3%) had neurotization procedures. The rate of neurotization increased yearly from 0.02% in 2015 to 0.65% in 2019 (Figure 1). Baseline demographics and comorbidities of patients are reported in Table 1. Patients who underwent neurotization were younger (50.0 vs. 51.5, $p=.024$) and had higher BMIs (29.2 vs. 28.1, $p<.001$) on average. Patients in both groups had few comorbidities; the most common were hypertension, smoking and diabetes.

The subgroup of patients with autologous reconstruction included 13,561 patients, 218 of whom underwent reconstruction with neurotization. Baseline demographics for this subgroup are shown in Table 1. Patients with neurotization were significantly younger (50.6 vs. 51.9, p .042) and had lower prevalence of hypertension (19.7% vs. 26.2%, p .031). Both groups had higher average BMIs than the full patient cohort (neurotized: 29.7, non-neurotized 29.7, $p=.874$). Rates of other comorbidities were low and similar between groups.

Patients with concurrent neurotization were significantly more likely to have inpatient surgery (93.3% vs. 41.5%, $p<.001$). Over half of all patients had immediate reconstruction following mastectomy (neurotized: 54.2%, non-neurotized: 59.5%) and almost one-third had bilateral reconstruction (neurotized: 30.0%, non-neurotized: 31.5%). The most common breast reconstruction type for patients with neurotization was reconstruction with free flap (83.3%), followed by reconstruction with TE (5.8%) and implant (2.5%) (Supplementary Table A2, Figure 2(A)). Nerve repair with conduit and allograft were the most common neurotization techniques (Figure 3). The most common non-neurotized breast reconstruction types were TE-based reconstruction (43.8%), and implant-based reconstruction (29.2%) (Figure 2(B)).

Average operating time (minutes) was longer when neurotization was performed during both autologous (527.1 ± 152.4 vs. 414.8 ± 186.3, $p<.001$) and alloplastic-only reconstruction (310.9 ± 115.9 vs. 173.0 ± 94.3, $p<.001$). The likelihood total operating time exceeded 521 min (two standard deviations above average) increased when neurotization was performed (OR 2.464, $p<.001$) (Table 2). However, autologous reconstruction (OR 89.124, $p<.001$) and bilateral reconstruction (OR 2.585, $p<.001$) had greater odds of increasing operating time (Supplementary Table A3). Hospital stays (days) were also longer for patients undergoing neurotized autologous (4.2 ± 3.3 vs. 3.6 ± 2.5, $p=.009$) and alloplastic-only reconstruction (1.5 ± 0.91 vs. 0.96 ± 1.83, $p=.011$). However, after adjusting for covariates shown in Table A4, neurotization decreased the odds of prolonged hospital stay (OR 0.581, $p=.045$). Variables associated with greatest odds of prolonged hospital stay were comorbid sepsis (OR 31.876, $p<.001$) and operating time over 521 min (OR 6.402, $p<.001$) (Supplementary Table A4).

Thirty-day complications were observed in 13.8% of patients with neurotization and 6.8% without ($p<.001$). Patients who underwent neurotization experienced a higher incidence of bleeding requiring blood transfusion (5.8% vs. 1.6%, $p<.001$), superficial SSI (4.6% vs. 1.9%, $p<.001$) and *Clostridium difficile* infection

Table 1. Baseline demographics and comorbidities of patients with breast reconstruction, for all patients and patients with autologous reconstruction.

	All patients			Autologous reconstruction		
	(%) non-neurotized	(%) neurotized	*p*	(%) non-neurotized	(%) neurotized	*p*
Total patients (*n*)	73,267	240		13,561	218	
Age, years	51.5 (SD 11.3)	50.0 (SD 10.0)	.024*	51.9 (SD 10.1)	50.6 (SD 9.6)	.042*
BMI	28.1 (SD 6.2)	29.2 (SD 6.6)	.002*	29.7 (SD 5.8)	29.2 (SD 5.2)	.874
Race						
American Indian	0.3	0		0.3	0	
Asian	3.9	3.3		3.9	3.2	
Black	9.8	15.4		14.0	17.0	
Native Hawaiian	0.05	0		0.2	0	
White	70.9	75.8		62.7	74.8	
Unknown	14.9	5.4		18.8	5.1	
Hispanic ethnicity	7.6	11.3	<.001*	8.1	9.6	.400
Comorbidities						
Hypertension	24.3	19.6	.090	26.2	19.7	.031*
Diabetes (non-insulin)	4.9	4.6	.861	5.9	5.1	.811
Diabetes (insulin)	1.7	1.3	.861	1.7	1.4	.811
Smoking within 1 year	8.8	5.8	<.001*	7.7	6.4	.494
Dyspnea, at rest	0.08	0	.517	0.1	0	.650
Dyspnea, with exertion	1.7	0.8	.517	1.6	0.9	.650
Disseminated cancer	1.4	1.3	.873	0.7	0	.217
COPD	0.8	0	.165	0.01	0	.858
Ascites	0.01	0	.909	0.1	0.5	.077
Chronic heart failure	0.1	0.4	.083	5.9	5.1	.811
On dialysis	0.05	0	.721	0.04	0	.777
Open wound/infection	0.5	0	.253	1.9	0.5	.128
Steroid use	1.9	1.3	.463	1.2	0	.101
Weight loss >10%	0.3	0.4	.609	1.6	0.9	.432
Bleeding disorders	0.7	0.4	.600	0.2	0.5	.484
Pre-op RBC transfusion	0.03	0	.788	0.6	0.5	.755
ASA classification			<.001*			.060
ASA class I	6.7	0.4		3.3	0.5	
ASA class II	67.0	57.5		62.8	58.7	
ASA class III	26.0	41.7		33.5	40.4	
ASA class IV	0.1	0.4		0.4	0.5	
Surgical characteristics						
Inpatient procedure	41.5	93.3	<.001*	91.56	99.1	<.001*
Elective surgery	99.2	100	.564	98.92	100	.303
Immediate reconstruction	59.5	54.2	.096	47.2	50.0	.414
Bilateral reconstruction	31.5	30.0	.639	28.5	32.1	.246
Reconstruction type			<.001*			
Autologous-only	15.3	85.8		82.7	94.5	
Alloplastic-only	75.4	8.3		–	–	
Autologous + alloplastic	3.2	5.0		17.3	5.5	
Other	6.1	0.8		–	–	

*Significance at $p<.05$.

(1.25% vs. 0.08%, $p<.001$) (Table 3, Figure 4). Among patients with autologous reconstruction, 13.8% with neurotization and 14.9% without experienced one or more complication ($p=.999$). There were no significant differences in individual complication rates between the two groups, except *Clostridium difficile* infection (neurotized: 0.9%, non-neurotized: 0.1%, $p<.001$) (Table 3). After adjusting for comorbidities and operative characteristics, neurotization did not significantly impact 30-day morbidity (OR 0.802, $p=.256$) (Table 2). However, comorbid sepsis (OR 5.345, $p=.008$) and blood transfusion (OR 3.003, $p=.033$) were mostly associated with increased odds of 30-day morbidity (Supplementary Table A5).

Thirty-day readmission rates were higher for patients with neurotization in both the full cohort (7.5% vs. 4.2%, $p<.001$), and in the autologous sub-group (6.9% vs. 5.9%, $p=.016$). However, after adjusting for comorbidities and operative characteristics, neurotization was not significantly associated with increasing odds of 30-day readmission (OR 1.352, $p=.235$), (Supplementary Table A6). Unplanned reoperation rates were not significantly different for patients with neurotization; therefore, multivariate regression was not performed.

Discussion

Neurotization is a relatively new innovation in breast reconstruction [4], that warrants further exploration prior to expanding its application to patients. The ACS-NSQIP is a nationally validated registry [18] created to measure quality and safety outcomes which allows for evaluation of trends and outcomes after surgery. To the best of our knowledge, this is the first national database study examining outcomes after breast reconstruction with neurotization.

In this cohort of patients, neurotization was more commonly performed during autologous reconstruction. Autologous reconstruction affords further dissection of donor nerves, minimizing tension introduced during connection to recipient nerves [13]. The first published study reporting breast neurotization described TRAM flap re-innervation by connecting the rectus intercostal nerve end-to-end to the lateral mammary ramus of the fourth intercostal nerve [19]. Autologous reconstruction with end-to-end or end-to-side direct nerve coaptation were the main methods described in literature until the first study utilizing a synthetic nerve conduit was published in 2013 [13]. More recent studies

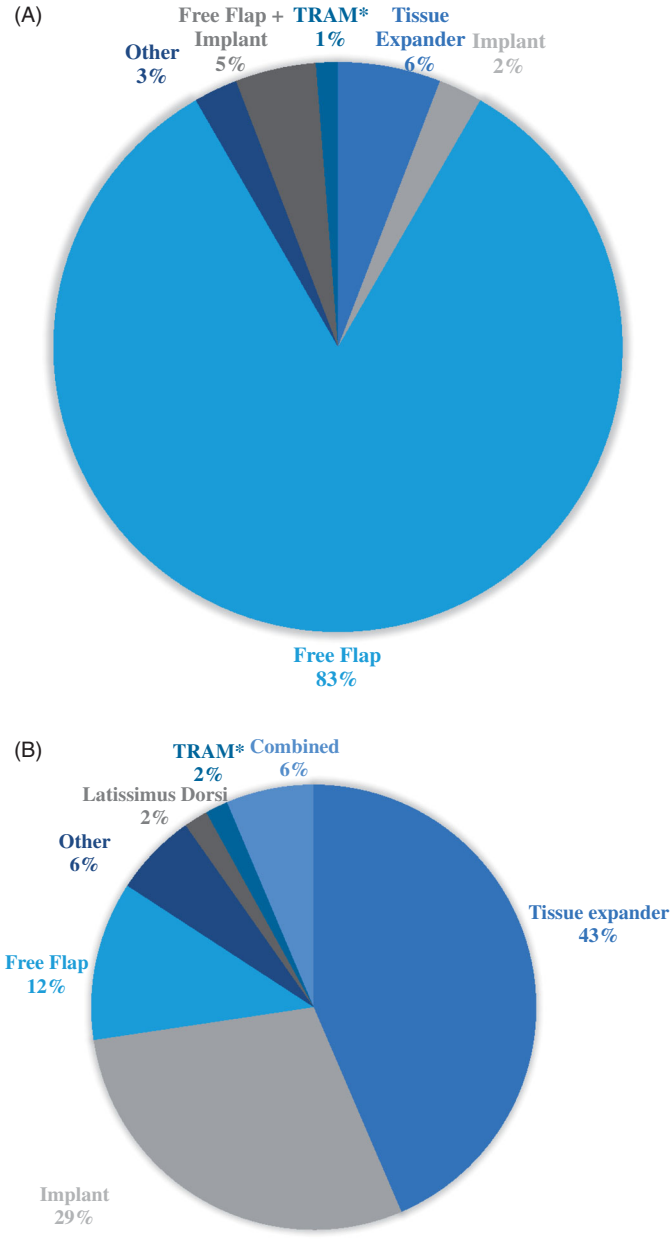

Figure 2. (A) Breakdown of breast reconstruction types for patients with neurotization. (B) Breakdown of breast reconstruction types for patients without neurotization. *TRAM: transverse rectus abdominis muscle includes single pedicle with and without supercharge and double pedicle TRAM flaps.

have reported neurotization for implant-based reconstruction with use of a nerve allograft [8,14]. In our cohort of patients, neurotization was more frequently performed using synthetic nerve conduits and allografts than by direct coaptation. Almost all patients with neurotization during implant or TE placement had re-innervation with synthetic nerve conduit or vein allograft. This patient cohort with breast neurotization captured by the ACS-NSQIP database appears to reflect that plastic and reconstructive surgeons are implementing novel breast re-innervation techniques and technologies.

Significant differences in reconstruction types exist among patients with and without neurotization. Patients with autologous reconstruction had higher rates of 30-day complications and readmissions, which is consistent with reports from prior studies [20,21]. Consequently, the sub-group analysis illustrated that the higher complication rates seen in patients with neurotization can

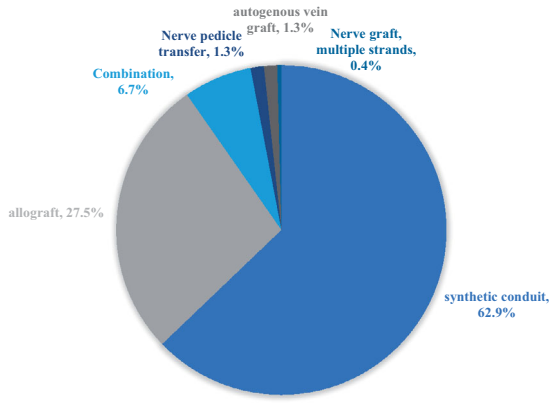

Figure 3. Breakdown of neurotization techniques used for re-innervation during breast reconstruction.

partially be attributed to differences in breast reconstruction type. Notably, patients who underwent neurotization were significantly younger and had a lower prevalence of hypertension. Prior studies have shown that hypertension is a significant risk factor for post-operative complications [10,20], specifically in autologous reconstruction [20], suggesting selection of lower risk patients for neurotization. The few key differences in comorbidities and reconstruction type between the two cohorts influenced the outcomes observed in each group, underscoring the importance of accounting for these differences when examining impact of neurotization on postoperative outcomes.

After adjusting for operative characteristics including immediate reconstruction following mastectomy, bilateral reconstruction and autologous reconstruction, neurotization was associated with increased odds of prolonged total operating time. However, other factors including autologous reconstruction, inpatient surgery and bilateral reconstruction were associated with greater odds of prolonged operating time. Primary studies reporting operating time dedicated to neurotization estimate that nerve coaptation adds between 8 and 38 min per nerve [12,13], whereas in this cohort, average operating time increased by more than 100 min during neurotized autologous and alloplastic reconstruction. However, without detailed operative notes, we were unable to assess time dedicated specifically to neurotization. Nevertheless, total operating time remains an important consideration for patient safety. Longer operating time increases the risk of complications such as post-operative infections [15]. Our analysis revealed that longer operating time increased the risk of 30-day morbidity and 30-day readmission. Thus, the association between neurotization and operating time remains an important consideration, as longer operating time can have implications on post-operative patient outcomes.

Another important consequence of longer operating time is prolonged post-operative hospital stay. Studies utilizing ACS-NSQIP data concluded that operating time longer than 500 min increased total hospital length of stay [16,17], which is consistent with findings in this study. Prolonged hospital stays have been associated with hospital acquired infections and increased costs to hospitals and patients [15,22]. Enhanced recovery after surgery (ERAS) protocols have been implemented nationwide in an effort to decrease length of hospital stay, and have been successful in many cases [22]. However, not all factors influencing extended hospital stays can be addressed with ERAS. Offodile et al. found that longer operative time, BMI and ASA class were significantly associated with extended hospital stay (five or more days) after breast reconstruction with free flap [17]. Reassuringly, Bonde et al.

Table 2. Association of neurotization with outcomes of interest.

Dependent outcomes	Unadjusted model OR (95% CI)	*p* Value	Adjusted model OR (95% CI)	*p* Value
Operating time >521 min	13.697 (10.595–17.706)	<.001	2.464 (1.865–3.255)[a]	<.001
Prolonged hospital stay	3.068 (1.843–5.107)	<.001	0.581 (0.341–0.998)[b]	.045
30-Day morbidity	2.188 (1.514–3.163)	<.001	0.802 (0.548–1.174)[c]	.256
30-Day readmission	2.063 (1.265–3.363)	.004	1.352 (0.822–2.223)[d]	.235

DM: diabetes mellitus; COPD: chronic obstructive pulmonary disease; CHF: chronic heart failure; ASA: American society of anesthesiologists.

[a]Covariates: autologous reconstruction, immediate reconstruction, bilateral reconstruction, race, BMI, dyspnea, DM, smoking and disseminated cancer.

[b]Covariates: autologous reconstruction, immediate reconstruction, bilateral reconstruction, inpatient surgery, operating time, race, ethnicity, BMI, age, DM, dyspnea, COPD, hypertension, dialysis, disseminated cancer, open wound, bleeding disorder, blood transfusion, pre-operative sepsis and ASA class.

[c]Covariates: autologous reconstruction, immediate reconstruction, bilateral reconstruction, length of stay, operating time, race, BMI, DM, smoking, COPD, CHF, hypertension, disseminated cancer, open wound, steroid use, recent weight loss, bleeding disorder, blood transfusion, comorbid sepsis, ASA class, race, dyspnea and dialysis.

[d]Covariates: autologous reconstruction, immediate reconstruction, bilateral reconstruction, length of stay, operating time, race, BMI, DM, smoking, COPD, hypertension, disseminated cancer, open wound, bleeding disorder, comorbid sepsis, ASA class, dyspnea and steroid use.

Table 3. Outcomes for patients after any breast reconstruction with and without neurotization and after autologous reconstruction with and without neurotization.

	All patients			Autologous reconstruction		
Outcome	(%) non-neurotized	(%) neurotized	*p*	(%) non-neurotized	(%) neurotized	*p*
Superficial incisional SSI	1.9	4.6	.002*	3.8	4.6	.558
Deep incisional SSI	0.7	1.7	.074	1.2	1.4	.774
Organ space SSI	1.3	0.4	.220	1.1	0.5	.382
Wound disruption	0.9	0.4	.429	1.8	0.5	.413
Pneumonia	0.1	0.4	.169	0.3	0.5	.780
Unplanned intubation	0.04	0	.750	0.1	0	.580
Pulmonary embolism	0.2	0	.469	0.5	0	.288
Ventilator >48 h	0.03	0	.803	0.1	0	.688
Renal insufficiency	0.03	0	.788	0.1	0	.623
Acute renal failure	0.01	0	.864	0.02	0	.826
UTI	0.3	0	.420	0.5	0	.306
CVA/stroke	0.02	0	.843	0.01	0	.858
Cardiac arrest	0.02	0	.830	0.04	0	.756
Myocardial infarction	0.04	0	.754	0.1	0	.674
Bleeding transfusions	1.6	5.8	<.001*	6.8	6.4	.817
DVT/thrombophlebitis	0.3	0.8	.096	0.8	0.9	.780
Sepsis	0.4	0.8	.320	0.8	0.5	.618
Septic shock	0.03	0	.793	0.1	0	.674
C. difficile infection	0.1	1.3	<.001*	0.1	0.9	<.001*
Any complication	6.8	13.8	<.001*	14.9	13.8	.999
Return to OR	6.4	9.2	.081	10.3	9.2	.589
Any readmission	4.2	7.5	<.001*	5.9	6.9	.016*

SSI: surgical site infection; UTI: urinary tract infection; CVA: cerebrovascular accident; DVT: deep venous thrombosis.
*Significance at $p<.05$.

instituted measures, similar to ERAS, including early mobilization, earlier drain and catheter removal, non-opioid analgesia and planned early discharge, which decreased length of stay after breast reconstruction, regardless of operating time [23]. The downstream effect of increased operating time on prolonged length of hospital stay is important to consider when assessing the risks and benefits of performing neurotization.

Complication rates after breast reconstruction remain an area for continued improvement. Studies have reported complication rates as high as 50% [9,10,24]. In this cohort of patients, we observed a much lower percentage of patients with one or more complications. Although patients with neurotization experienced higher complication rates, neurotization alone did not increase odds of morbidity. In fact, immediate post-mastectomy reconstruction, autologous reconstruction, bilateral reconstruction and operating time above average were procedural characteristics which were more consequential in increasing the odds of 30-day morbidity. Several studies have echoed these findings, reporting higher rates of complications after autologous reconstruction [21,24] and immediate post-mastectomy reconstruction [9,21]. In addition to operative characteristics, several comorbidities have been reported to be associated with increased morbidity, including hypertension, smoking [10], BMI [9,10,21] and history of radiation [10,21]. Although the NSQIP database is limited by the distinct comorbidities and complications recorded, and by the 30-day timeframe, the data captured in this study reflect findings from institutional studies. Reconstruction after mastectomy should not be avoided in patients with pre-existing comorbidities; however, patients' unique risk factors should be considered when selecting optimal reconstruction modalities for them, including re-innervation.

Since the implementation of the Affordable Care Act (ACA) Hospital Readmission Reduction Program (HRRP), 30-day readmissions are another important metric, not only for patient safety, but also for reducing financial penalties to hospitals [25]. Although patients with neurotization had higher readmission rates, our analysis showed that neurotization was not an independent risk factor for 30-day readmissions. Rather, patient comorbidities and procedural characteristics, including timing of

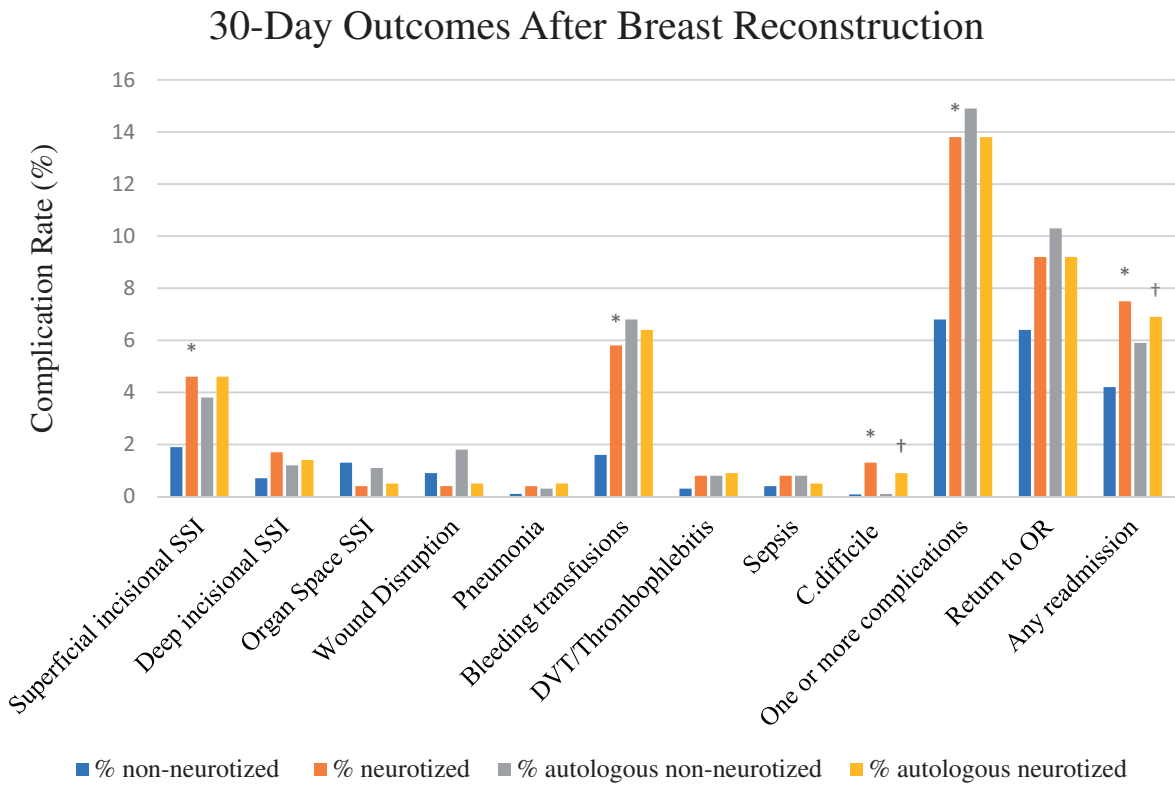

Figure 4. Thirty-day complication rates after breast reconstruction for all patients and patients with autologous reconstruction, with and without neurotization.

reconstruction following mastectomy and total operative time, influence 30-day readmissions. Risk factors for readmission consistently reported across studies include smoking, obesity, hypertension and prolonged operating time [20,21]. Utilizing knowledge of which patient factors are predictive of readmission and other adverse outcomes may help to better risk stratify patients when determining if the benefit of neurotization exceeds the risk and costs associated the additional operating time.

Although this study provides an overview of national trends and outcomes in patients with breast neurotization, it should be interpreted within the context of its limitations. This study utilized a national database, which is limited in scope by pre-defined data collection points. First, we were not able to evaluate the sensory outcomes or effects of neurotization on patients who underwent the procedure. Certain preoperative and postoperative outcomes relevant to breast reconstruction were not possible to assess, including history of radiation, seroma, hematoma, capsular contracture and graft failure. This database does not specify surgical center; therefore, it was not feasible to control for center volume, surgeon experience or technique, which may impact outcomes. Only complications within 30-days of the operation were evaluated, which may provide an incomplete picture of patient outcomes. Findings from this study may be used as a guide to better risk stratify patients before considering breast re-innervation, but the final decision regarding breast reconstruction should remain between the surgeon and patient.

Conclusions

These data suggest neurotization is associated with significantly increased operating time, but is not independently associated with 30-day complications or readmissions. Nevertheless, longer operating time has potential downstream effects of increasing risk of 30-day complications, readmissions and re-operations. Patient comorbidities and other operative characteristics were found to be more influential for patient outcomes than neurotization, and should be considered when counseling patients on their reconstructive options. More robust data on postoperative outcomes, cost–benefit analysis and patient-reported sensory outcomes are needed to determine whether neurotization should be considered standard care during breast reconstruction.

Disclosure statement

No conflicts of interest are associated with this publication.

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