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Ambulatory latissimus dorsi flap breast reconstruction: A prospective cohort study of an enhanced recovery after surgery (ERAS) protocol

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Abstract *Purpose:* Enhanced recovery after surgery (ERAS) protocols improve quality of recovery and decrease length of stay for patients undergoing both alloplastic and autologous breast reconstruction. Their use in latissimus dorsi (LD) flap reconstruction has not been well established. The purpose of this study was to compare postoperative outcomes, length of stay, and total costs in a prospectively enrolled group of patients who underwent LD flap breast reconstruction using an ERAS protocol to those of a retrospective cohort of patients who were treated with a traditional recovery after surgery (TRAS) protocol.
Methods: In a prospective cohort study conducted from 2016 to 2019, an ERAS protocol was implemented for patients undergoing LD flap breast reconstruction. The primary outcome was 24-h discharge, and secondary outcomes were readmission rate, complications, and quality of recovery. Outcomes of patients who underwent LD flap reconstruction with the ERAS protocol were compared with those of a retrospective cohort of patients who underwent LD flap reconstruction with TRAS protocols.
Results: Twenty patients enrolled in the ERAS group were compared with 58 patients in the TRAS group. Postoperatively, 100% of ERAS patients were discharged within 24 h (60% on the same day) as compared to 21% (9% on the same day) in the TRAS group ($p<0.0001$). Minor and major complication rates were similar (30% ERAS vs. 33% TRAS and 20% ERAS vs. 10% TRAS, respectively, $p > 0.05$). There was significant reduction in length of stay and total cost

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between the two groups (6.4 h vs. 58.5 h ($p = 0.003$) and $5,666.80 vs. $8890.25 ($p = 0.0003$), respectively).
Conclusions: Breast reconstruction with the LD flap can be performed safely and effectively in the ambulatory setting. The implementation of an ERAS protocol was successful in discharging all patients home within 24 h, and the expedited discharge was associated with an acceptable complication rate, reduced length of stay, and excellent quality of recovery. Conversion from TRAS to ERAS protocols was associated with $3,223.45 cost savings per patient.

Introduction

Enhanced recovery after surgery (ERAS) protocols are evidence-based perioperative programs successfully adopted in multiple surgical disciplines to improve postoperative morbidity, patient satisfaction, and length of stay in hospital. This multimodal approach typically involves varying degrees of preadmission counseling, goal-directed fluid resuscitation, multimodal analgesia, and expedited hospital discharge.[1] Recently, these protocols have been implemented safely and effectively in the context of both alloplastic[2,3] and autologous[4] breast reconstruction. Existing studies on ERAS pathways in breast reconstruction, however, predominantly focus on free flaps owing to their extended hospital stay and the disproportionate resources involved.[5]

Latissimus dorsi (LD) flap breast reconstruction combines autologous tissue transposition with expander or implant placement. To date, the role of ERAS protocols for LD flap breast reconstruction is not well established and is particularly useful considering the unique pain profile and the fact that inpatient flap monitoring is not necessary. Despite the transition to ambulatory surgery at some centers,[6,7] the vast majority of patients undergoing LD flap breast reconstruction will be admitted to hospital with lengths of stay ranging from 1 to 12 days.[8-10]

The objective of this study was to prospectively enroll patients who underwent LD flap breast reconstruction using an ERAS protocol and compare postoperative outcomes, length of stay, and hospital-perspective costs with those of previous patients who underwent LD flap reconstruction using the traditional recovery after surgery (TRAS) protocol.

Methods

Research ethics board approval (#20160216-01H) was obtained in June 2016 for a prospective cohort of women who underwent LD flap breast reconstruction enrolled in the ERAS group. Data were collected for a retrospective cohort of women undergoing the same surgery but who received treatment by the TRAS protocol. A summary of preoperative, intraoperative, and postoperative elements of the ERAS protocol is outlined in Appendix 1.

A preoperative consult determined the patient eligibility for an expedited discharge pathway. All French- and English-speaking patients undergoing a pedicled LD flap were included irrespective of chronic pain history, BMI, and smoking status. French translation of the study protocol and consent forms was made available. Patients were excluded from the study only if they had serious medical comorbidities that would prevent safe ambulatory discharge. For the patients recruited to the study, the preoperative visit was used to educate them on the study and their perioperative course. They were reassured that if there were any reservations regarding discharge, a bed would be made available for hospital admission. Patients were kept fasting from solid foods at midnight the day before surgery and were allowed clear fluids up to three hours before their surgery. Preoperatively, all patients were offered an ultrasound-guided nerve block by an anesthesiologist, either in the form of a PECSI/serratus block (interfascial plane block between pectoralis major and pectoralis minor (Pecs I) plus that between LD and serratus anterior (Serratus/SAP) or in the form of a thoracic paravertebral block (injections of 0.5% ropivacaine with epinephrine at T1 through T5 spinal levels). For patients who refused preoperative nerve blocks, intraoperative intercostal nerve blocks were administered by the surgeon. All patients received a total of 30 ml of 0.5% (5 mg/ml) ropivacaine with epinephrine 1:400,000 (2.5 mcg/ml) for their blocks. Two plastic surgeons performed reconstructions with the same technique, and all reconstructions involved prosthesis insertion.

Following surgery, the patient was immediately started on a regimen of celecoxib 200 mg orally q12 h for 3 days, gabapentin 300 mg orally q8h for 3 days, and acetaminophen 1000 mg orally q6h for 3 days. The recovery room nurses provided a dose of hydromorphone 1 mg orally for breakthrough pain while in hospital. The patient was also given a regimen of twenty 1 mg tablets of hydromorphone and instructed only to take it for breakthrough pain at home while taking the standard nonopioid pain regimen.

When the patient met PACU nursing discharge criteria, they were stepped down to the day surgery unit (DSU); if not, they were admitted to the ward. DSU discharge criteria involved well-controlled pain as well as ability to understand instructions, tolerate oral intake, and ambulate independently. If there was difficulty in arranging disposition or if the patient needed extra time to recover, they were allowed to rest in DSU and be auto-discharged in the morning (Figure 1).

Predetermined outcome definitions were established to compare postoperative outcomes between the ERAS and TRAS groups. These included minor and major complication rates, 72 h readmission rates, 30-day ER visit rates, length of stay in hospital, and hospital-perspective costs (Appendix 2).

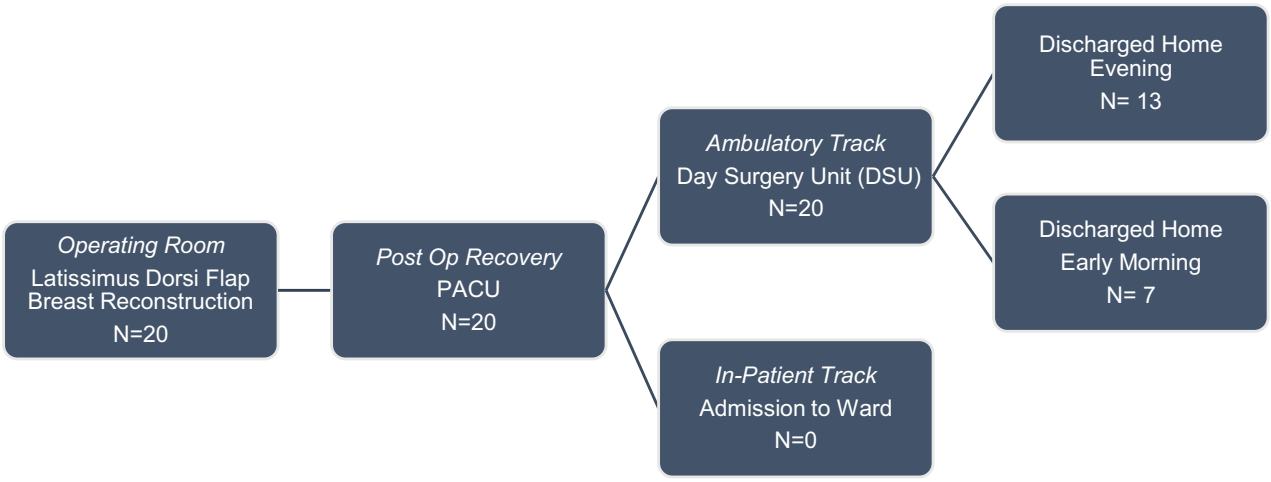

Figure 1 ERAS group.

Discharged patients were sent home with a Quality of Recovery (QoR-40) Questionnaire[11] to be filled out on postoperative day 1. The QoR-40 is a well-validated[12,13] and widely adopted[14] measure of quality of recovery that incorporates a five-point Likert scale score for patient support, comfort, emotions, physical independence, and pain. QoR-40 scores range from 40 (extremely poor quality of recovery) to 200 (excellent quality of recovery). The authors considered QoR-40 scores above 170 as "excellent recovery," from 120 to 170 as "average recovery," and below 120 as "poor/unacceptable recovery."

To perform a cost analysis, all direct and indirect hospital-perspective costs billed per patient in both ERAS and TRAS groups were collected using a case costing approach. All costs were presented in 2019 Canadian dollars (CAD).

Statistical analyses were performed using SAS® Version 9.3 software.[15] Descriptive statistics were calculated using Fisher exact and chi-square tests for categorical variables and t tests for continuous variables. Demographic and clinical characteristics were compared using ANOVA. The primary outcome of interest was length of stay in hospital, specifically with regard to the percentage of ambulatory discharges (defined as discharge within 24 h) and same-day discharges (defined as discharge before midnight the same day of surgery). Secondary outcomes included hospital-perspective costs, postoperative outcomes, and quality of recovery as measured by the QoR-40 questionnaire.

Results

Patient demographics

Seventy-eight patients were included in the study; 20 patients were prospectively enrolled into the ERAS group and 58 patients enrolled as retrospective controls in the TRAS group (Table 1). Patients in the ERAS and TRAS groups were adequately matched for age, BMI, comorbidities, smoking status, and radiation ($p > 0.05$). The ERAS group had significantly higher preoperative ASA scores (ASA3 65% vs. 5%, ASA1 0% vs. 62%, $p < 0.0001$) and the TRAS group had higher preoperative chemotherapy rates (78% vs. 50%, $p = 0.02$).

Length of stay and hospital-perspective cost analysis

There was a significant reduction in median length of stay between the ERAS and TRAS groups (Table 2). The median length of stay in the ERAS group was 6.4 h (0.3 days) versus 58.5 h (2.4 days) in the TRAS group ($p < 0.0001$). All 20 (100%) patients in the ERAS group were discharged successfully in the ambulatory setting, and of them, 12 (60%) went home the same day of surgery. This was a significantly greater proportion of patients than that in the TRAS group, who were discharged home within 24 h only 21% of the time, 9% of which were on the same day of surgery ($p < 0.0001$). The 72 h readmission rate was 0% in both groups, and the 30-day ER visit rate was 25% in the ERAS group versus 16% in the TRAS group ($p = 0.33$).

Not surprisingly, a calculation of all direct and indirect hospital-perspective costs incurred for each patient in the ERAS and TRAS groups followed similar trends, with a statistically significant reduction in median total cost seen in the ERAS group ($5666.80 vs. $8890.25, $p = 0.0003$). In other words, using an ERAS protocol instead of TRAS was associated with $3223.45 cost savings per patient.

Outcome comparison

There was no statistically significant difference in all postoperative outcomes between the ERAS and TRAS groups (Table 2). The minor and major complication rates were 30% and 20% in the ERAS group and 33% and 10% in the TRAS group ($p = 0.82$ and $p = 0.27$), respectively. The most common minor complication rate was seroma in both groups (20% ERAS vs. 19% TRAS), and the most common major complication rate was infection (10% ERAS vs. 7% TRAS). Of the 6 patients with minor complications in the ERAS group, 4 were minor seromas drained percutaneously, 2 were cellulitis managed with oral antibiotics alone, and 1 had asymp-

Table 1 Patient demographics.

Patient characteristics	ERAS $N=20$	TRAS $N=58$	p value
Age, mean (SD)	52 (11.5)	52 (10.2)	0.8812
BMI, mean (SD)	27 (4)	27 (6)	0.7303
ASA (1-6)			
1	0 (0%)	36 (62%)	***<0.0001***
2	7 (35%)	17 (29%)	
3	13 (65%)	3 (5%)	
4	0 (0%)	2 (3%)	
Laterality of reconstruction			
Unilateral	19 (95%)	57 (98%)	0.4496
Bilateral	1 (5%)	1 (2%)	
Timing of reconstruction			
Delayed	19(95%)	58 (100%)	0.2564
Immediate	1(5%)	0 (0%)	
Smoker (*N*/%)	4 (20%)	3 (5%)	0.0672
Preoperative radiation (*N*/%)	17 (85%)	51 (88%)	0.7106
Preoperative chemotherapy (*N*/%)	10 (50%)	45 (78%)	***0.0196***
History of anxiety or depression (*N*/%)	6 (30%)	16 (28%)	0.8361
Number of comorbidities (*N*/%)			
0	4 (20%)	19 (33%)	0.6330
1	8 (40%)	20 (35%)	
2	4 (20%)	13 (22%)	
3	3 (15%)	4 (7%)	
4	1 (5%)	2 (3%)	
Obesity	6 (30%)	13 (22%)	0.5510
Asthma (*N*/%)	0 (0%)	12 (21%)	0.0301
Hypertension (*N*/%)	4 (20%)	6 (10%)	0.2689
Cardiac history (*N*/%)	1 (5%)	3 (5%)	1.0000
COPD (*N*/%)	0 (0%)	1 (2%)	1.0000
CKD (*N*/%)	1 (5%)	0 (0%)	0.2564
DVT/PE (*N*/%)	2 (10%)	0 (0%)	0.0633
Sleep apnea	1 (5%)	2 (4%)	1.0000
Anemia	1 (5%)	5 (9%)	1.0000
Coagulopathy	2 (10%)	0 (0%)	0.0633
Diabetes	0 (0%)	7 (12%)	0.1810
Rheumatoid arthritis	2 (10%)	1 (2%)	0.1598

tomatic fat necrosis. Of the 4 patients with major complications, 1 patient slipped on the ice and fell on her back, leading to a large dehiscence requiring operative closure, 1 patient had a small area of mastectomy flap necrosis that required surgical revision in the OR, and the remaining 2 patients had periprosthetic infections necessitating surgical explantation.

Quality of recovery questionnaires (QoR-40) were available only for the prospective cohort; therefore, a comparison was not possible. Despite this, the average QoR score was 180 (range 143–197), which represented excellent quality of recovery.

Discussion

In the context of Canada's public health care system, there are increasing regulatory pressures to maximize clinical outcomes and patient satisfaction while minimizing healthcare expenditures. As such, ERAS protocols have emerged in multiple surgical domains as an innovative way to enhance the perioperative experience while safely decreasing length of stay and hospital expenditures.

The objective of the present study was to evaluate the feasibility of shifting LD flap breast reconstruction to a peripheral ambulatory surgical center with no inpatient admission capabilities. To date, Davidge et al. have documented the most compelling evidence for ambulatory autologous breast reconstruction in 2013 publishing a retrospective[6] review of 91 TRAM flaps, 40% of which were successfully discharged within 24 h and, in 2015, publishing a prospective[7] review of 27 TRAM flaps and 13 LD flaps, 60% of which were successfully discharged within 24 h. It is unclear, however, how many of the patients discharged home within 24 h were truly same-day discharges versus discharges the morning after surgery.

LD flap breast reconstruction provides a unique pain profile, as harvest from the back and tunneling through the axilla add a significant pain burden over and beyond that of pectoralis major and mastectomy flap elevation.

Table 2 Postoperative outcomes.

Patient characteristics	ERAS $N=20$	TRAS $N=58$	*p* value
Ambulatory discharge (<24 h) (*N*/%)	20 (100%)	12 (21%)	**<0.0001**
Same-day discharge (*N*/%)	12 (60%)	5 (9%)	**<0.0001**
Length of stay in hospital (LOS) (h)	6.4	58.5	**<0.0001**
Median (IQR)	(4.4, 15.6)	(26.3, 85.2)	
Total cost (CAD) median (IQR)	$5666.80 (5379.35, 6381.83)	$8890.25 (5968.62, 11,934.45)	**0.0003**
Quality of recovery (QoR-40) score mean (SD) ($N/A=1$)	180 (14.8)	NA	NA
Readmission rate within 72 h (*N*/%)	0 (0%)	0 (0%)	NA
30-day ER visit rate (*N*/%)	5 (25%)	9 (16%)	0.3340
Minor complication rate (overall) (*N*/%)	6 (30%)	19 (33%)	0.8197
Seroma (*N*/%)	4 (20%)	11 (19%)	1.000
Infection (*N*/%)	2 (10%)	7 (12%)	1.000
Dehiscence (*N*/%)	0 (0%)	4 (7%)	0.567
Fat necrosis (*N*/%)	1 (5%)	3 (5%)	1.000
Major complication rate (overall) (*N*/%)	4 (20%)	6 (10%)	0.2689
Dehiscence (*N*/%)	2 (10%)	0 (0%)	0.0633
Infection (*N*/%)	2 (10%)	4 (7%)	0.6432
Complete flap necrosis (*N*/%)	0 (0%)	0 (0%)	NA
Partial flap necrosis (*N*/%)	0 (0%)	0 (0%)	NA

Furthermore, the addition of a partially inflated tissue expander stretches the overlying soft tissues, further exacerbating the pain.

We hypothesized that incorporating a regional nerve block would be an essential adjunct to facilitate expedited discharge with our ERAS protocol. It has become standard of practice at our center to offer our patients a preoperative mixed PECSI/SAP block, which we believe offers the optimal anesthesia for pedicled LD flap harvest and inset. These blocks provide analgesia to the lateral and medial pectoral nerves, intercostal nerves, long thoracic nerve, thoracodorsal nerve, and intercostobrachial nerve, all of which are implicated in pain following breast reconstruction with the LD muscle. Alternatively, a paravertebral block can be used, which has been shown to be associated with reduced pain, narcotic consumption, and length of stay for patients undergoing alloplastic breast reconstruction.[16]

All 20 patients enrolled in the ERAS protocol were successfully discharged within 24 h, which contrasts significantly with previously documented hospital stays following LD flap reconstruction, studies of which report 1,[17] 6,[18] to as much as 12[10] days in hospital. Despite the successful 24-hour discharge rate, only 60% were comfortable enough to go home the same day of their surgery, while 40% were autodischarged first in the next morning. It is unclear whether this was due to the case starting late in the day, variability in nursing practices within the day care surgery unit, or simply due to patient preference. Nevertheless, it demonstrates that while this surgery can be performed safely and effectively in an ambulatory setting, there must be either overnight stay capabilities or the option for transport to a tertiary care center for overnight stay. Moving forward at our institution, the results of this study reflect that these surgeries can be safely off-loaded to our ambulatory center, which has no inpatient capabilities, and should a patient require overnight stay, they are transported to a nearby hospital's surgical day care unit.

The present study is limited by its small sample size, its primary focus on delayed rather than immediate breast reconstruction, and the single QoR-40 questionnaire, which is completed the day after surgery, preventing comparison of QoR-40 scores with time. Follow-up studies will be required to ensure ERAS protocols continue to facilitate safe and effective ambulatory LD flap surgery.

Conclusion

Breast reconstruction with the LD flap can be performed safely and effectively in the ambulatory setting. The implementation of an ERAS protocol was successful in sending all patients home within 24 h, and the expedited discharge was associated with an acceptable complication rate, reduced hospital length of stay, and excellent quality of recovery. Conversion from TRAS to ERAS protocols was associated with $3223.45 cost savings per patient.

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Declaration of Competing Interest

None of the listed authors have conflicts of interest or any disclosures.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.bjps.2019.06.039.

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