OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE

Breast

Understanding the Impacts of Surgical Drains on Postoperative Pain and Quality of Life

Goutam K. Gadiraju, BS*
Matthew R. Prospero, BS*
Finn Tobias, BA†
Andrew J. Malek, BS‡
Erik Reiche, MD†
Justin M. Broyles, MD, MPH†

Background: Surgical drains are commonly used in breast surgery and breast reconstruction for seroma prevention. Although many surgeons are aware that surgical drains can cause considerable discomfort to patients, less is understood about the specific impacts of drains on postoperative pain and quality of life (QOL).

Methods: A cross-sectional survey was conducted among patients at our institution who had previously undergone mastectomy or breast reconstruction procedures to better understand patients' experiences with surgical drains. Patients were asked to report their attitudes toward a series of QOL statements and rate postoperative pain using numeric pain scales. Pair-wise analysis was used to identify predictors of responses.

Results: A total of 203 complete responses were recorded. Increased pain scale ratings for pain at the body wall, incision site, and drain entry site were significantly associated with drain duration at 2–3 weeks or longer ($P < 0.05$). Notably, 84.7% of patients reported that drains increased the difficulty of completing daily tasks. Most patients (66.0%) reported negative impacts on mood, and 37.0% reported apprehension toward undergoing future procedures that may require drains. Most patients (65.0%) also expressed that they would prefer to receive care from institutions that utilize improved alternatives to standard drains.

Conclusions: Surgical drains cause substantial discomfort to most patients and exert several negative impacts on QOL. In addition to limiting drain use wherever possible, innovations in technique and the development of alternatives to existing drains may offer patients a less painful, improved postoperative recovery experience.
(Plast Reconstr Surg Glob Open 2025; 13:e6474; doi: 10.1097/GOX.0000000000006474; Published online 27 January 2025.)

INTRODUCTION

Closed suction drain devices such as the Jackson-Pratt and Blake drains are used across a variety of surgical procedures to promote wound healing and prevent seroma formation.[1] By applying negative pressure to a potential space created during surgery, surgical drains simultaneously prevent fluid collection and encourage tissue apposition. A substantial body of evidence supports the efficacy of surgical drains in reducing the risks of postoperative seroma formation, particularly when drains remain in place until minimal fluid egresses from the wound site.[1,2]

Despite their efficacy in preventing seromas, the use of surgical drains is not without controversy, as prolonged drain usage has been associated with increased rates of infection.[3,4] Furthermore, some studies have suggested that drain use may pose barriers to discharge following autologous breast reconstruction.[5] Considering the impacts of drains is particularly important to the practice of plastic and reconstructive surgery, where procedures such as breast reconstruction, abdominoplasty, and face lifts routinely require the placement of one or more drains.

More recently, the utilization of patient-reported outcomes to collect information from patients regarding health, quality of life (QOL), and functional abilities has been critical to improving patient care[6] and supporting shared decision-making between patients and physicians,

*From the *Harvard Medical School, Boston, MA; †Division of Plastic and Reconstructive Surgery, Department of Surgery, Brigham and Women's Hospital, Boston, MA; and ‡Louisiana State University Health Sciences Center, School of Medicine, New Orleans, LA.*

Received for publication August 12, 2024; accepted November 25, 2024.

DOI: 10.1097/GOX.0000000000006474

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

particularly in challenging contexts such as postmastectomy breast reconstruction.[7,8] Though it is commonly understood that drains cause considerable pain and discomfort to patients, formal evaluations of the immediate impacts of surgical drains on QOL have yet to be conducted. In this study, we aimed to assess patients' experiences of postoperative pain and recovery following mastectomy or breast reconstruction, 2 categories of surgical procedures that routinely require the placement of 1 or multiple drains.

Takeaways

Question: How do surgical drains and drain site pain impact quality of life following mastectomy and breast reconstruction?

Findings: Patients considered surgical drains to be a significant, largely negative aspect of postoperative recovery. The majority of patients (84.7%) reported that drains negatively affected their abilities to complete routine, daily tasks, and most (65.0%) would prefer to receive care from physicians and facilities that utilize alternative solutions.

Meaning: Though drains are a mainstay for seroma prevention, their use is associated with several negative impacts on quality of life in the immediate postoperative setting.

METHODS

Survey Design

An anonymous survey was developed by the study authors (G.K.G., M.R.P., E.R., and J.M.B.) to assess utilization data and complications related to surgical drains among respondents. Participants were asked to respond about the following data: number of drains placed, duration of drain placement, incidence of drain-associated complications, pain management strategies, postoperative drain-related pain, and attitudes regarding the impact of drains on QOL and future surgery. Drain-associated complications consisted of skin irritation, clotting/clogging, avulsion/damage, infection, or unanticipated healthcare visits (eg, to the clinic, to the emergency department) due to severe pain or an unforeseen complication. No further circumstantial information was solicited from respondents regarding a particular complication event, if reported. Pain management strategies included the use of over-the-counter analgesics, prescription pain medications (eg, opioids), topical agents, or cold/heat packs. Questions eliciting data on respondents' pain and agreement with QOL statements utilized a 10-point numerical pain scale and a 5-point Likert scale, respectively. Respondents reported pain at 3 anatomic locations (ie, body wall, incision site, and drain entry site) and attitudes toward 6 QOL statements (ie, impacts to daily activity, overall recovery, mood, sleep, apprehension towards future surgery, and affinity toward drain alternatives). A respondent text view of the survey is provided in Supplemental Digital Content 1. (**See appendix, Supplemental Digital Content 1**, which displays a respondent text view of the survey used in this study, **http://links.lww.com/PRSGO/D808**.)

The study was approved by the Mass General Brigham (MGB) institutional review board. The survey was designed and distributed in REDCap (Research Electronic Data Capture, Vanderbilt University),[9] and data collection was managed using an MGB-affiliated REDCap server. To maximize patient privacy and encourage higher response rates, we did not ask respondents to provide details on demographic data such as age, sex, race and ethnicity, or socioeconomic status. The study team did not extract any data from patient medical records. Procedure counts and descriptive data on the study population were retrieved from the MGB Research Patient Data Registry (RPDR); in accordance with RPDR standards for patient privacy, select variables are reported within ±3 of the true value. Notably, efforts to ensure anonymity precluded a nonresponder analysis.

Survey Administration

The survey was administered from December 2023 to January 2024 to adults aged 18 or older who underwent mastectomy, tissue expander removal without implant exchange, or autologous breast reconstruction at our institution between January 2022 and August 2023. Procedures were identified by searching for select Current Procedural Terminology codes listed in Supplemental Digital Content 2. (**See table, Supplemental Digital Content 2**, which displays a table reporting queried Current Procedural Terminology codes and the corresponding number of patients who underwent specified procedures at our institution from January 2022 to August 2023, **http://links.lww.com/PRSGO/D809**.)

A 10-person pretest phase was initially conducted to confirm that participants would be able to access and successfully complete the survey. Responses from the pretest phase and incomplete responses were excluded. Only complete responses were included for statistical analysis.

Statistical Analysis

Continuous variables were summarized using mean and SD. Ordinal variables were summarized using a median with an interquartile range. A nonparametric Friedman test was used to compare pain scores across anatomic sites. A nonparametric Kruskal–Wallis test was used to identify associations between drain use characteristics and pain scale or Likert scale responses, where usage characteristics were modeled as independent variables and responses were treated as dependent variables. A P value less than 0.05 was considered for statistical significance. All analyses were performed using R software version 4.1.0.

RESULTS

Study Population and Drain Use Characteristics

RPDR was used to identify 1300 eligible participants. The mean age of this pool was 53.1 years (SD = 13.8, range: 20–89), and the majority were White (83.4%). Approximately 5.4% were Black or African American, 4.3% were Asian, and

Table 1. Demographics and Characteristics of Eligible Study Participants (n = 1300)

Eligible Participant Characteristics		
Age (mean, SD)	53.1	13.8
	n (±3)	Approximate %
Race		
White	1084	83.4
Black or African American	70	5.4
Asian	56	4.3
Native American or Alaska Native	<3	—
Two or more	12	0.9
Other	57	4.4
Unknown/missing	12	0.9
Ethnicity		
Non-Hispanic	1235	95.0
Hispanic	23	1.8
Unknown/missing	42	3.2
Prior procedures		
Mastectomy	1156	88.9
Tissue expander removal without implant insertion	28	2.2
Breast reconstruction with latissimus dorsi flap	30	2.3
Breast reconstruction with free flap (including DIEP/SIEA)	241	18.5
Breast reconstruction with TRAM flap	7	0.5

DIEP, deep inferior epigastric perforator; SIEA, superficial inferior epigastric artery; TRAM, transverse rectus abdominis myocutaneous.

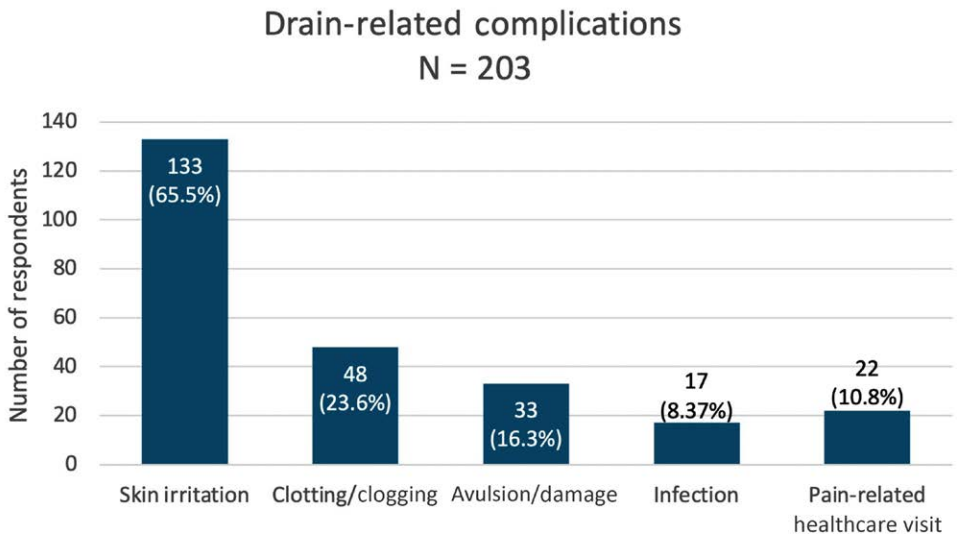

Fig. 1. Patient-reported drain-related complications, N = 203. Complications listed on the *x* axis, and the number of respondents reporting a given complication provided on the *y* axis. Respondents were able to choose multiple options.

1.8% identified as Hispanic. Most patients (88.9%) underwent mastectomy, and 18.5% of patients underwent free flap breast reconstruction. Characteristics of the eligible study population are summarized in Table 1. A total of 376 surveys (28.9%) were initiated. There were 203 complete, unique survey responses (15.6%). Of those who completed the survey, 203 (100%) reported at least 1 surgical drain for a prior procedure, with a median of 3 drains (IQR = 2). Most patients (n = 132, 65.0%) required drains for 2–3 weeks.

Drain Complications

Most participants (65.5%) reported having experienced skin irritation, including pain or discomfort, at the drain insertion site. The second most common concern related to drain use was clotting and clogging of drain tube contents, which 23.6% of participants reported. Regarding other complications, 16.3% of patients reported drain avulsion/damage, 8.37% reported infection, and 10.8% reported an unanticipated visit to clinic or the emergency department due to pain or an unforeseen complication. Subgroup analyses for complications of avulsion versus damage and drain-related versus drain-unrelated unanticipated visits to the clinic versus emergency department were unable to be performed per the methods. A summary of complication data is provided in Figure 1.

Table 2. Pain Scale Data at 3 Body Sites Across Postoperative Time Intervals

	Drain Site		Incision Site		Body/Chest Wall		*P**
Postoperative Time Interval	Mean	SD	Mean	SD	Mean	SD	
1–3 d	3.94	3.13	4.43	2.71	4.09	3.13	0.013
1 wk	3.56	2.56	3.59	2.61	3.37	2.82	0.052
2–3 wk	2.86	2.47	2.50	2.20	2.57	2.48	0.763
1 mo	1.64	2.30	1.63	1.96	1.70	2.16	0.061

*A nonparametric Friedman test was used to compare pain scores at a given time interval across anatomic sites.

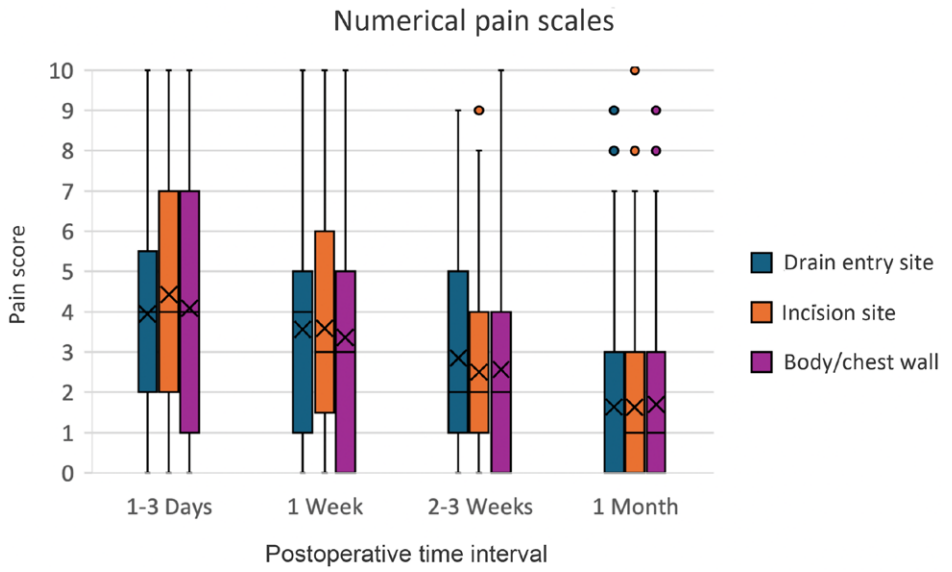

Fig. 2. Numerical pain scale data across anatomic sites. "X" represents the mean pain score, and "—" represents the median pain score. Interquartile ranges were calculated including the medians. Outliers fell outside of the upper or lower quartiles.

Pain Scales and Pain Management Strategies

At 1–3 days postoperation, pain scale ratings were significantly higher ($P = 0.013$) at the incision site (mean = 4.43) when compared with the body/chest wall (mean = 4.09) and the drain site. After 1 week, pain scale ratings at the incision site (mean = 3.59) and drain site (mean = 3.56) were higher than the body/chest wall (mean = 3.37), with differences trending toward significance ($P = 0.052$). No difference was observed in pain scores at 2–3 weeks among the 3 anatomical sites. Pain at the body/chest wall (mean = 1.70) was worse than pain at the incision (mean = 1.63) and drain insertion (mean = 1.64) sites at 1 month postoperation, with differences trending toward significance ($P = 0.061$). Pain scale data are summarized in Table 2 and may be visualized in Figure 2.

Increased duration of drain placement was significantly associated with higher pain scale ratings at the body wall, incision site, and drain entry site at 2–3 weeks and 1 month ($P < 0.05$). Statistically significant associations were also observed between higher numbers of drains used and incision site pain at 1 week ($P = 0.01$), incision site pain at 2–3 weeks ($P = 0.04$), and body/chest wall pain at 1 month ($P = 0.02$). Statistically significant relationships between drain use characteristics and pain scale data or patient attitudes are summarized in Table 3. The results of all Kruskal–Wallis tests, including results that were not statistically significant, are provided in Supplemental Digital Content 3. (**See table, Supplemental Digital Content 3**, which displays a table reporting all Kruskal–Wallis statistical test results, including results that were not statistically significant, **http://links.lww.com/PRSGO/D810**.)

Most patients reported using over-the-counter medications to manage pain (89.7%), and 46.8% of patients required prescription medications (eg, opioids). Heat and cold packs were used by 20.7% of patients, and topical medications were used by 18.7%. Data on pain management strategies are presented in Figure 3.

Patient Attitudes and QOL Statements

Most patients (84.7%) expressed that surgical drains made it more difficult to complete routine, daily tasks, and 90.2% agreed that the surgical drain was a significant aspect of the postoperative recovery process. Furthermore, 66.0% experienced negative impacts on mood. Surgical drains negatively affected the quality of sleep for 76.8% of patients, and 37.0% reported apprehension toward undergoing future procedures that may require drains. Most patients (65.0%) also expressed that they would prefer to receive care from institutions that utilize improved alternatives to standard drains. Apprehension towards

Table 3. Significant Associations Between Drain Use Characteristics and Pain Scale Response or Attitudes Toward QOL Statements

Drain Use Characteristic	Pain Scale Response	*H*-statistic	*P**
Drain number			
	Incision site pain 1 wk	14.8	0.01
	Incision site pain 2–3 wk	11.7	0.04
	Body/chest wall pain 1 mo	6.24	0.02
Drain duration			
	Drain site pain 1 wk	10.36	0.034
	Drain site pain 2–3 wk	20.8	<0.001
	Drain site pain 1 mo	43.16	<0.001
	Incision site pain 2–3 wk	11.25	0.02
	Incision site pain 1 mo	16.65	0.002
	Body/chest wall pain 2–3 wk	13.54	0.009
	Body/chest wall pain 1 mo	15.77	0.003
	QOL statements		
Drain number			
	Apprehension towards future surgery	12.09	0.016
Drain duration			
	Increased difficulty with daily tasks	8.62	0.03
	Negative impact on mood	11.93	0.007

*A nonparametric Kruskal–Wallis test was used to assess the relationship between increasing numbers of drains or duration of drain use and increasing pain scores or attitudes of "strongly agree" or "agree" toward QOL statements. Drain use characteristics were treated as independent variables, and pain scores or QOL data were treated as dependent variables.

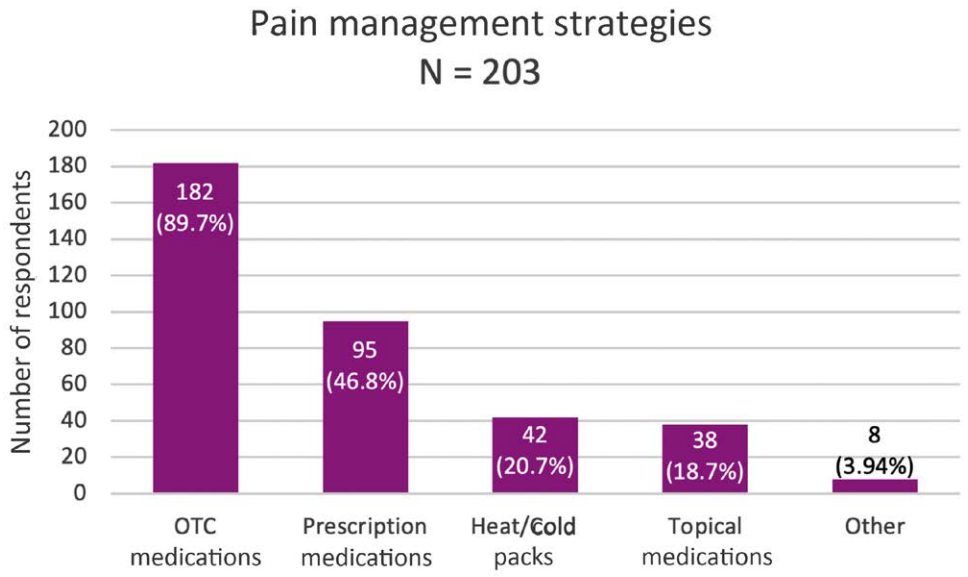

Fig. 3. Pain management strategies, N = 203. Respondents were able to choose multiple options. OTC, over the counter.

future surgery was significantly related to the number of drains ($P < 0.05$), whereas attitudes on ability to complete daily tasks and negative mood were significantly related to drain duration ($P < 0.05$, $P < 0.01$). Data on patient attitudes may be visualized in Figure 4.

DISCUSSION

As rates of breast cancer continue to rise in the United States,[10] increasing numbers of patients undergo breast surgery each year, with breast reconstruction becoming increasingly common.[11,12] In seeking to optimize those patients' care, it is essential to consider patient-reported outcomes and QOL, particularly in the field of plastic and reconstructive surgery, where assessing patient satisfaction is instrumental to evaluating and improving quality.[13] Postoperative surgical drain use is particularly common among this population, where reports of drain use following mastectomy and breast reconstruction among surgeons are as high as 85%.[14] To better understand the impacts of drains on patients' postoperative recovery experiences, we conducted a cross-sectional survey study of 203 patients previously treated at our institution.

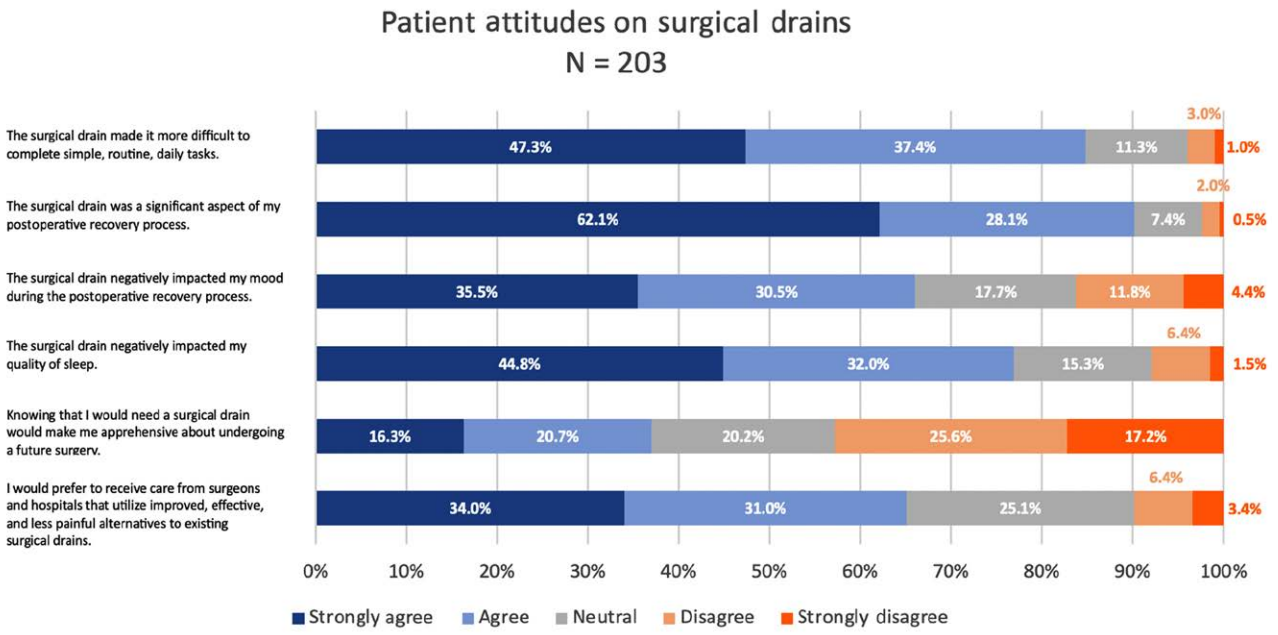

Fig. 4. Attitudes toward QOL and viewpoint statements. The percentage of respondents who strongly agreed, agreed, felt neutral, disagreed, or strongly disagreed is provided alongside corresponding survey questions.

Overall, our results substantiate the general understanding that drains are poorly tolerated, with the majority of study participants reporting that drains were a significant, largely negative aspect of recovery. Notably, most patients (84.7%) further reported that drains made it more difficult to complete simple, daily tasks. These responses were significantly associated with increased durations of drain use; evaluation of this relationship is particularly important when seeking to optimize functional outcomes following breast reconstruction. Studies have demonstrated that mastectomy and both implant-based and autologous breast reconstruction procedures are accompanied by subjective reports and objective findings of postoperative disability.[15] Notably, in a study involving patients recruited from the Mastectomy Reconstruction Outcomes Consortium Study, Weichman et al[16] demonstrated that patients who underwent breast reconstruction did not fully recover in fields of physical well-being and fatigue at 3 months postoperation, regardless of reconstructive modality. Current evidence supports early mobilization and at-home rehabilitation to expedite recovery.[15,17] However, when used following deep inferior epigastric perforator (DIEP) flap-based breast reconstruction, abdominal site surgical drains have been reported to limit mobility, further requiring daily care at home.[5] In conjunction with those reports, our results suggest that the negative impacts of drains cannot be overlooked as possible contributors to delayed rehabilitation and reduced functional status in the immediate postoperative setting.

Drains may have further contributed to subjective reports of postoperative disability by causing drain site irritation and disturbances to the quality of sleep, which were reported by 65.5% and 76.8% of respondents, respectively. A longitudinal prospective study conducted by Azizoddin et al[18] sought to investigate relationships among demographic, surgical, and psychological factors and postoperative sleep disturbance following mastectomy. Interestingly, patients who underwent mastectomy and breast reconstruction with tissue expanders were more likely to experience sleep disturbances in comparison to patients who underwent mastectomy alone. Regarding pain management, the study team identified that disturbed sleep was strongly associated with continued opioid use at 2 weeks following surgery. Notably, anxiety, depression, and decreased quality of sleep have also been associated with increased reports of postoperative pain among patients who have undergone treatment for breast cancer.[19,20] Given that 67.0% of patients in our study also reported that drains negatively impacted their mood, it is possible that drains affect postoperative pain and opioid use beyond simply causing irritation at the surgical site. Further study on the potential impacts of drains on opioid use is warranted, as nearly half of our respondents required prescription medications for addressing drain-related pain. Our results further showed that negative impacts on mood are significantly associated with increased durations of surgical drain use, considering this relationship may be helpful in counseling patients and anticipating challenges in postoperative pain management.

In addition to studying attitudes to QOL statements, we also sought to obtain data on postoperative pain in relation to drain use characteristics. Procedures across nearly every surgical subspecialty regularly implement surgical drains to reduce fluid accumulation and prevent seroma and hematoma formation. Though specific criteria for drain removal may vary between surgeons and procedures, drain output is of principal importance. For example, common removal criteria require that output is less

than 20–30 mL over a 24-hour period for 1–2 consecutive days.[21] In keeping with previous findings,[22] we observed that most patients required surgical drains for a period of 2–3 weeks. Notably, drain site pain at this time interval was comparable in intensity to pain at the incision site and body wall. We further observed that increased durations of drain use were significantly associated with higher pain scores at not only the drain site, but also the incision site and body wall. Similarly, increased numbers of drains were associated with higher pain scores at incision and body wall sites. Increased pain across anatomical sites may be explained by prolonged irritation to the wound bed, particularly as drain output volumes decrease. Mechanical forces, such as tension caused by pulling or piston-like movements of the drain, may further drive pain with prolonged use. By far, the most commonly reported concern or complication regarding drain use was drain site irritation; although premature discontinuation of drains may increase the risk of seroma formation, our findings support prompt removal of drains wherever possible. Our data further support the use of fewer drains, particularly given that evidence exists to suggest that single drains may prevent seromas at similar rates to multiple drains with fewer overall complications.[23]

Though drains are beneficial in preventing various adverse events, they have also been associated with higher rates of surgical site infections (SSIs),[3] as they introduce a path for bacterial infiltration and subsequent infection at the surgical site. Previously, SSIs have also been associated with greater postoperative pain, particularly at the incision site.[24] Among the patients included in our study, 8.37% reported postoperative infections. Breast surgery commonly carries a risk of SSI of approximately 5% following mastectomy, with an incidence of up to 10% following mastectomy and immediate reconstruction.[25] The increased frequency of lymphatic disruption following lymph node biopsy involved with these procedures leads to greater amounts of fluid production postoperatively, which has previously been attributed to an increased risk of infection; however, recent data demonstrate that drain use practices may contribute to increased risk.[26] A 2016 study showed that in immediate implant-based reconstruction, infection risk among patients who received surgical drains increased with increased durations of drain use, independent of the total amount of fluid drained by the time of removal.[4] A recent survey study conducted by Tian et al[22] further identified that the risk of infection associated with drains may cause substantial concern among patients. Beyond direct risks to patients' health, SSIs have been estimated to drive upward of $10 billion in healthcare costs annually. Furthermore, on average, SSIs increase lengths of hospitalization by 7–11 days, with nearly 80% of patients with SSIs requiring readmissions.[27] The resulting economic strain on hospitals is substantial, as Medicare and Medicaid do not reimburse hospitals for costs associated with hospital-acquired illness, including SSIs.[28] Unanticipated visits to the clinic or emergency department due to excessive pain or an unforeseen complication, which 10.8% of our study population reported experiencing, further contribute to the strain experienced by hospital systems. Costs associated with unforeseen and nonglobal healthcare encounters like those to the emergency department may further subject patients to financial toxicity in the form of out-of-pocket expenditures, a growing concern relevant to the management of breast cancer and breast reconstruction.[29,30]

In considering the negative impacts of drains, it is necessary to encourage efforts that either obviate their need or iterate on previous designs to improve postoperative care. A systematic review performed by Janis et al[1] identified several strategies for seroma prevention apart from utilizing closed-suction drains, including the use of sharp or ultrasonic dissection and the use of quilting or progressive tension sutures for closure. The latter strategy has successfully proven to allow the omission of abdominal site drains in DIEP flap procedures.[5,31] Recently, in an adaptive cohort study, Evgeniou et al[31] further demonstrated that patients who underwent DIEP procedures without receiving abdominal or breast drains had significantly shorter hospital stays with no increase in complications. Though fields across medicine and surgery are driven by innovation, the mainstays of postoperative seroma prevention continue to be the Jackson-Pratt and Blake drains, invented in 1971 and 1983, respectively.[21] The vast majority of patients in our study expressed preferences toward receiving care from surgeons and institutions that utilize improved alternatives to existing surgical drains, with some patients further expressing that drains generated apprehension towards undergoing future surgery; for those reasons, innovating toward less morbid, better-tolerated solutions to seroma prevention is crucial.

This study is not without limitations. Principally, the retrospective nature of our survey may have affected our ability to accurately capture data on pain. Pain scales are widely applied tools in research, but without validation and clinical context, their use is limited. Responses to QOL statements worked to generate a more comprehensive understanding of patients' attitudes toward drains and supplemented numerical pain scores. As in any survey study, the accuracy of the information we collected is subject to participants' ability to recall details of their treatment courses. Collection of additional information regarding specific complication types such as the circumstances surrounding avulsion/damage and the principal reason for, and clinical setting of, unanticipated visits would have provided greater context with which to interpret the results of this study. Similarly, our survey is subject to self-selection bias, as the patients who were most affected by surgical drains may have been more likely to participate in this study. However, compared with other administration methods that require a public pool of respondents to self-report their surgical history, our data were collected from patients with a confirmed history of mastectomy or breast reconstruction who were treated at our institution. Patients who underwent implant-based reconstruction were not included in this study, which may restrict the generalizability of these results. Finally, we were limited to using pair-wise analysis in identifying associations between drain use characteristics and pain scores or QOL statements. Collecting more details on procedural

data and patient demographics may have further provided context for identifying drivers of increased complications or worsened postoperative pain and QOL.

CONCLUSIONS

To our knowledge, this study captures experiential characteristics of postoperative recovery in relation to surgical drain use among the largest verified sample of patients who have previously undergone mastectomy or breast reconstruction. Our findings demonstrate that surgical drains cause substantial discomfort and negatively impact QOL immediately following surgery. Future study of drain utilization across other procedures is likely to provide broader insight into the impacts of drains and serve to inform drain practices among surgeons.

Justin M. Broyles, MD, MPH
Division of Plastic Surgery
Brigham and Women's Hospital
75 Francis Street
Boston, MA 02120
E-mail: jbroyles@bwh.harvard.edu

DISCLOSURES

Dr. Broyles serves on the scientific advisory board for Healshape LLC, receives consulting support from the Agency for Healthcare Research and Quality, and serves on the Medical Device Advisory Board for the Food and Drug Administration. The other authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Janis JE, Khansa L, Khansa I. Strategies for postoperative seroma prevention: a systematic review. *Plast Reconstr Surg.* 2016;138:240–252.
2. Jiang T, Li J, Ren J. Continuous negative pressure drain is associated with better outcome: a randomized prospective trial in plastic surgery patients. *Aesthetic Plast Surg.* 2019;43:91–97.
3. Mujagic E, Zeindler J, Coslovsky M, et al. The association of surgical drains with surgical site infections—a prospective observational study. *Am J Surg.* 2019;217:17–23.
4. Chen CF, Lin SF, Hung CF, et al. Risk of infection is associated more with drain duration than daily drainage volume in prosthesis-based breast reconstruction: a cohort study. *Medicine (Baltimore)* 2016;95:e5605.
5. Nagarkar P, Lakhiani C, Cheng A, et al. No-drain DIEP flap donor-site closure using barbed progressive tension sutures. *Plast Reconstr Surg Glob Open* 2016;4:e672.
6. Tevis SE, James TA, Kuerer HM, et al. Patient-reported outcomes for breast cancer. *Ann Surg Oncol.* 2018;25:2839–2845.
7. Myckatyn TM, Parikh RP, Lee C, et al. Challenges and solutions for the implementation of shared decision-making in breast reconstruction. *Plast Reconstr Surg Glob Open* 2020;8:e2645.
8. Santosa KB, Qi J, Kim HM, et al. Long-term patient-reported outcomes in postmastectomy breast reconstruction. *JAMA Surg.* 2018;153:891–899.
9. Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009;42:377–381.
10. American Cancer Society. Key statistics for breast cancer. 2024. Available at https://www.cancer.org/cancer/types/breast-cancer/about/how-common-is-breast-cancer.html. Accessed July 26, 2024.
11. 2023 ASPS procedural statistics release. 2024. Available at https://www.plasticsurgery.org/documents/news/statistics/2023/plastic-surgery-statistics-report-2023.pdf. Accessed July 26, 2024.
12. Plastic surgery statistics report. 2020. Available at https://www.plasticsurgery.org/documents/News/Statistics/2020/plastic-surgery-statistics-full-report-2020.pdf. Accessed July 26, 2024.
13. Yang AZ, Hyland CJ, Tsai TC, et al. Health care value in plastic surgery practice. *Plast Reconstr Surg.* 2024;153:1175–1183.
14. Fairhurst K, Roberts K, Fairbrother P, et al; Diamond Study Collaborative. Current use of drains and management of seroma following mastectomy and axillary surgery: results of a United Kingdom national practice survey. *Breast Cancer Res Treat.* 2024;203:187–196.
15. Nelson JA, Lee IT, Disa JJ. The functional impact of breast reconstruction: an overview and update. *Plast Reconstr Surg Glob Open* 2018;6:e1640.
16. Weichman KE, Hamill JB, Kim HM, et al. Understanding the recovery phase of breast reconstructions: patient-reported outcomes correlated to the type and timing of reconstruction. *J Plast Reconstr Aesthet Surg.* 2015;68:1370–1378.
17. Kim KH, Yeo SM, Cheong IY, et al. Early rehabilitation after total mastectomy and immediate reconstruction with tissue expander insertion in breast cancer patients: a retrospective case-control study. *J Breast Cancer* 2019;22:472–483.
18. Azizoddin DR, Soens MA, Beck MR, et al. Perioperative sleep disturbance following mastectomy: a longitudinal investigation of the relationship to pain, opioid use, treatment, and psychosocial symptoms. *Clin J Pain* 2023;39:76–84.
19. Belfer I, Schreiber KL, Shaffer JR, et al. Persistent postmastectomy pain in breast cancer survivors: analysis of clinical, demographic, and psychosocial factors. *J Pain* 2013;14:1185–1195.
20. Schreiber KL, Zinboonyahgoon N, Xu X, et al. Preoperative psychosocial and psychophysical phenotypes as predictors of acute pain outcomes after breast surgery. *J Pain* 2019;20:540–556.
21. Meyerson JM. A brief history of two common surgical drains. *Ann Plast Surg.* 2016;77:4–5.
22. Tian WM, Rames JD, Schroeder BE, et al. Perceptions of surgical drains among breast reconstruction patients and health care staff: a qualitative survey study [published online ahead of print 2024]. *J Reconstr Microsurg.*
23. Khan S, Khan M, Wasim A. Single vs. double drain in modified radical mastectomy: a randomized controlled trial. *Turk J Surg.* 2023;39:145–152.
24. Strobel RM, Leonhardt M, Förster F, et al. The impact of surgical site infection—a cost analysis. *Langenbecks Arch Surg.* 2022;407:819–828.
25. Olsen MA, Nickel KB, Fox IK, et al. Incidence of surgical site infection following mastectomy with and without immediate reconstruction using private insurer claims data. *Infect Control Hosp Epidemiol.* 2015;36:907–914.
26. Unalp HR, Onal MA. Analysis of risk factors affecting the development of seromas following breast cancer surgeries: seromas following breast cancer surgeries. *Breast J.* 2007;13:588–592.
27. Seidelman JL, Mantyh CR, Anderson DJ. Surgical site infection prevention: a review. *JAMA.* 2023;329:244–252.
28. Stone PW. Changes in Medicare reimbursement for hospital-acquired conditions including infections. *Am J Infect Control* 2009;37:A17–A18.
29. Berlin NL, Abrahamse P, Momoh AO, et al. Perceived financial decline related to breast reconstruction following mastectomy in a diverse population-based cohort. *Cancer* 2022;128:1284–1293.
30. Ganesh Kumar N, Berlin NL, Hawley ST, et al. Financial toxicity in breast reconstruction: a national survey of women who have undergone breast reconstruction after mastectomy. *Ann Surg Oncol.* 2022;29:535–544.
31. Evgeniou E, Liew J, Lee G, et al. Are surgical drains needed in DIEP flap surgery? The drain-free DIEP flap concept. *Plast Reconstr Surg.* 2023;152:708–714.