

Tumescent Technique Does Not Increase the Risk of Complication Following Mastectomy with Immediate Reconstruction

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ABSTRACT

Background. Despite the growing interest in the advantages of tumescent mastectomy technique, there remain concerns that tumescent solution may increase postoperative complication rates. This study evaluates patient outcomes following tumescent mastectomy in the setting of immediate prosthetic reconstruction.

Methods. Retrospective review of 1,491 breasts (1,030 patients) treated by 4 oncologic and 2 reconstructive surgeons between 2004 and 2012 at a single institution. The primary outcomes of interest included seroma, hematoma, infection, and mastectomy flap necrosis, as well as conversion to autologous reconstruction. Multiple logistic regression was used to determine the adjusted influence of tumescence on outcomes.

Results. The tumescent cohort ($n = 890$ breasts) was younger and experienced lower rates of preoperative radiation than the nontumescent cohort ($n = 601$ breasts). Mean follow-up was 21.2 months. While tumescent procedures were on average 20 min faster, postoperative complication rates did not significantly differ between cohorts. Regression analysis controlling for potential confounders, including differences in surgeon technique, failed to identify tumescent mastectomy as an independent risk factor for complication [odds ratio (OR) = 1.2, 95 % confidence interval (CI) = 0.8–1.8, $p = 0.385$]. Individually, neither seroma, hematoma, infection, nor flap necrosis was affected significantly by the use of tumescence (OR = 1.66, 95 % CI = 0.73–3.78, $p = 0.229$; OR = 1.11, 95 % CI = 0.42–2.95, $p = 0.837$; OR = 0.84,

95 % CI = 0.4–1.75, $p = 0.689$; OR = 1.19, 95 % CI = 0.7–2.03, $p = 0.67$, respectively).

Discussion. This longitudinal study is well equipped to assess the influence of tumescent mastectomy technique in the hands of experienced and high-volume oncologic surgeons on postoperative outcomes. Our analysis suggests that in the setting of an immediate prosthetic reconstruction, tumescent mastectomy does not independently affect postoperative complication rates.

Within the past decade, the use of immediate, implant-based breast reconstruction has continued to gain popularity among mastectomy patients.¹ Understanding the influence of several well-established pre- and intraoperative risk factors has allowed for evidence-based decision making to improve patient outcomes and minimize adverse events within this burgeoning patient population.^{2–4} Recently, the tumescent mastectomy technique has gained popularity within the surgical community; however, its impact on postoperative outcomes are only just beginning to be elucidated.

First described by Worland⁵, the tumescent technique for mastectomy provides a bloodless, hydrodissection tissue plane that facilitates sharp dissection and avoids potential complications associated with electrocautery.^{6–8} The vasoconstriction induced by epinephrine also reduces intraoperative bleeding and contributes to an overall decrease in operative time.^{8–10} Furthermore, tumescence has been shown to provide analgesic benefits, reducing perioperative pain.^{6,8,11–13} Despite these apparent benefits, several recently published studies have demonstrated that the tumescent technique in combination with immediate reconstruction may increase the risk for certain complications.^{14–17} Others, however, report a more positive experience and suggest a role for confounding factors, including surgeon experience and technique, in those negative findings.¹⁸

Despite this conflicting evidence within the literature, interest in tumescent mastectomy technique continues to grow. Further investigations of postoperative outcomes are warranted to more objectively guide surgeons in determining how to utilize this emerging technique. In this single-institution study of nearly 1,500 breasts, we sought to characterize the influence of postoperative complication rates in patients undergoing mastectomy with immediate expander–implant-based reconstruction.

METHODS

This study was performed under the approval of the Northwestern University Institutional Review Board. A retrospective review of medical records was performed for 1,030 consecutive patients (1,491 breasts) treated by four mastectomy surgeons and two reconstructive surgeons. All patients underwent mastectomy with immediate tissue expander–implant-based reconstructions at a single institution between 2004 and 2012. For each patient, inpatient and outpatient records were thoroughly reviewed, and relevant demographic information, clinical characteristics, operative factors, follow-up, and postoperative outcomes were recorded.

Tumescent solution consisted of lactated Ringer's mixed with a local anesthetic: i.e., 1 % lidocaine, and dilute (1:1,000) epinephrine. Tumescent mastectomies were performed as described by Staradub and Morrow.⁸ Nontumescent mastectomies were performed primarily by using electrocautery or harmonic scalpel dissection. Patients with a recorded history of smoking within 1 month of the operation were deemed smokers. Other patient demographics and clinical characteristics included age, body mass index, hypertension, premastectomy radiation, and postmastectomy radiation. Operative factors included acellular dermal matrix use, intraoperative tissue expander fill, tumescent versus nontumescent mastectomy technique, and operative time.

The primary outcomes of interest were postoperative complications and conversion to autologous breast reconstruction. Postoperative complications included: seroma, hematoma, infection requiring at minimum intravenous antibiotics, and mastectomy flap necrosis requiring surgical excision with or without closure at the bedside or in the operating room. An overall complication was defined as the occurrence of any one or more postoperative complication. Conversion to autologous reconstruction included only nonelective cases.

Statistical analysis was performed on the study population using Pearson's Chi squared for categorical variables and Student's *t* tests for quantitative variables. Multiple logistic regression models were used to control for potentially confounding variables and to identify the impact of the tumescent

mastectomy technique as an independent risk factor for postoperative outcomes. All analyses were performed with SPSS version 21.0 (IBM Corp., Chicago, IL, USA).

RESULTS

A total of 1,491 breasts (1,030 patients) underwent mastectomy with immediate tissue expander–implant-based reconstruction, of which 890 (59.7 %) were performed using tumescent mastectomy technique. The mean follow-up for all patients was 21.2 months. The nontumescent cohort tended to be older than the tumescent cohort (49.3 vs. 47.7 years; $p = 0.004$) and experienced higher rates of both pre- and postmastectomy radiation (8.2 vs. 2.9 %; $p < 0.001$, and 25.3 vs. 20.0 %; $p = 0.016$, respectively). There were no significant differences in body mass index, hypertension, and smoking (Table 1). Tumescent and nontumescent procedures also were similar in terms of acellular dermal matrix use and intraoperative tissue expander fill percentages (Table 1). The tumescent cohort on average experienced shorter operative times (195 vs. 216 min; $p = 0.007$).

The overall complication rate for all breasts was 16.2 % (253/1,566), with no significant difference in the complications rate between tumescent and nontumescent breasts ($p = 0.082$). There was no significant difference in the rate of any individual complication between the two cohorts (Table 2). Flap necrosis was the most common postoperative

TABLE 1 Clinical and operative characteristics in breasts with and without tumescent mastectomy technique

Characteristic	Tumescent (<i>n</i> = 890 breasts)	Nontumescent (<i>n</i> = 601 breasts)	<i>p</i> value
Age (years) ^a	47.7 ± 10.5	49.3 ± 11.1	0.004
BMI (kg/m ²)	25.6 ± 5.8	25.8 ± 5.3	0.555
Hypertension	142 15.96 %	100 16.64 %	0.725
Active smoker	79 8.88 %	55 9.15 %	0.855
Premastectomy radiation ^a	26 2.92 %	49 8.15 %	<0.001
Postmastectomy radiation ^a	178 20 %	152 25.29 %	0.016
Acellular dermis	397 44.61 %	242 40.27 %	0.097
Intraoperative TE fill (%) ^b	54.6 ± 28.5	53.3 ± 27.6	0.379
0–33.33 %	196 22.02 %	141 23.46 %	0.368
33.34–66.66 %	301 33.82 %	195 32.45 %	0.585
66.67–100 %	352 39.55 %	224 37.27 %	0.808
Operative time (min) ^a	195.4 ± 71.3	215.6 ± 91.1	0.007

BMI body mass index, *TE* tissue expander

Data presented as percentage of breasts

Continuous variables reported as mean ± SD

^a *p* values <0.05

^b 82 breasts without data on intraoperative TE fill

complication (9.8 % tumescent vs. 7 % nontumescent; $p = 0.06$), followed by infection requiring IV antibiotics (4.8 vs. 4.7 %; $p = 0.878$). Seroma (3.3 vs. 3.2 %; $p = 0.911$) and hematoma (2.5 vs. 1.7 %; $p = 0.291$) formation were rare in both cohorts; 8.2 % of patients within the tumescent cohort and 9.2 % of patients in the nontumescent underwent a nonelective conversion to autologous reconstruction ($p = 0.579$).

Multiple logistic regression analysis, adjusting for age, hypertension, obesity, smoking, pre- and postmastectomy radiation, acellular dermal matrix use, tissue expander intraoperative fill, mastectomy surgeon, and reconstructive surgeon, was used to obtain risk adjusted odds ratios for the influence of tumescence on the incidence of each postoperative outcome. The use of tumescent mastectomy technique did not independently increase the likelihood of any postoperative outcome (Table 3).

DISCUSSION

As interest in the tumescent mastectomy technique continues to grow within the surgical community, it has

TABLE 2 Complications in breasts with and without tumescent mastectomy technique

Characteristic	Tumescent		Nontumescent		<i>p</i> value
	<i>n</i> = 890 breasts)		<i>n</i> = 601 breasts)		
Overall complication	156	17.53 %	85	14.14 %	0.082
Hematoma	22	2.47 %	10	1.66 %	0.291
Infection	43	4.83 %	28	4.66 %	0.878
Seroma	29	3.26 %	19	3.16 %	0.911
Flap necrosis	87	9.78 %	42	6.99 %	0.060
Converted to autologous	73	8.2 %	55	9.15 %	0.579

Data reported as percentage of breasts

TABLE 3 Multiple logistic regression, odds ratio of tumescent mastectomy technique

Complication	OR	95 % CI		<i>p</i> value	HL	C-statistic
		Lower	Upper			
Overall complication	1.197	0.797	1.798	0.385	0.313	0.654
Flap necrosis	1.188	0.696	2.027	0.528	0.754	0.670
Seroma	1.658	0.727	3.78	0.229	0.179	0.753
Hematoma	1.108	0.416	2.952	0.837	0.336	0.708
Infection	0.836	0.4	1.749	0.635	0.243	0.689
Converted to autologous	0.989	0.517	1.891	0.973	0.101	0.794

assumed an important position in the mastectomy surgeon's armamentarium. Between 2004 and 2012, tumescence was used in nearly 60 % of mastectomies with immediate prosthetic reconstruction included in this study; this number increases to 89.5 % of mastectomies performed within the final 2 years. Nevertheless, the influence of tumescence on postoperative outcomes remains controversial. Complications often can lead to additional surgeries, less favorable aesthetic outcomes, and in some cases may even delay the initiation of adjuvant therapy. Further analysis of tumescence as a risk factor for complications is warranted to more objectively guide surgeons in their decision making and to improve patient outcomes. Our study of 1,491 mastectomies is the largest to date and aims to clarify the impact of tumescence on complications following a mastectomy with immediate expander-implant reconstruction.

In a retrospective review of 100 tumescent and 280 nontumescent mastectomies with immediate reconstruction Chun et al.¹⁶ found a significantly increased risk of flap necrosis when tumescent technique was used [odds ratio (OR) = 3.93; 95 % confidence interval (CI) = 1.91–8.04]. Their analysis, however, was limited by a small sample size and large amount of surgical variation with 22 oncologic surgeons, and their findings were not consistent with others' experiences.¹⁸ A larger cohort study, including 457 tumescent mastectomies from our institution, included an expanded analysis of complications, including flap necrosis, as well as infection, hematoma, and seroma.¹⁷ This analysis similarly found that tumescence increased rates of major flap necrosis but did not affect any other complication. Again, however, these results were limited by substantial variations in surgeon experience and technique. The study included 15 mastectomy surgeons and 6 reconstructive surgeons, each with a relatively low surgical volume. Because of the small sample size within the emerging tumescent cohort, we were at that time unable to limit the analysis to dedicated, high-volume surgeons experienced in tumescent technique. In this longitudinal study, we were finally able to control adequately for any learning curve and the transiently increased complication rates associated with it, upon switching to tumescent technique.

With nearly 1,500 mastectomies with reconstruction, including 890 using tumescent solution, performed by only 4 mastectomy and 2 reconstructive surgeons, this study includes the largest cohort to date with the least inter-surgeon variation. The last surgeon to adopt tumescence did so a full 2 years before the end of our data collection period and achieved a high volume with nearly 200 tumescent procedures. Our analysis reveals that tumescent mastectomy technique is not a risk factor for developing complications following a mastectomy with immediate prosthetic reconstruction. Although we noted a trend

towards a greater rate of flap necrosis requiring surgical excision in the tumescent cohort, the difference was not significant for any complications. Multiple logistic regression models corroborated these results, failing to identify tumescence as an independent risk factor for complication after adjusting for potential perioperative confounders and inherent differences between surgeons.

Multiple factors, including excessive skin tension, seroma or hematoma formation, infection, and devascularization of the skin flaps, have been implicated in the development of flap necrosis.¹⁹ Earlier studies hypothesized that the vasoconstrictive effect of epinephrine contributes to ischemic compromise of flap viability; however, this effect of epinephrine is considered to be transient and fairly short-lived. Furthermore, many reconstructive surgeons routinely trim the tenuous edges of the native skin flap most susceptible to compromise in order to minimize the risk of complication. Any potential contribution of tumescent solution towards the postmastectomy, hypovascular milieu did not manifest itself clinically in this series. It is important to note, however, that our definition of flap necrosis included only those that required surgical excision and is not intended to capture minor flap necrosis requiring conservative management.

Although tumescence did not independently increase the risk for flap necrosis in our series, it is possible that its effect may work synergistically with other risk factors to increase the incidence of flap necrosis within certain patient populations.¹² A young patient without comorbidities may complete a tumescent mastectomy and immediate reconstruction without any difficulty, whereas in patients with an elevated risk, tumescent technique may tip the scales of flap viability in favor of necrosis. A notable difference in our cohort compared with previous studies is the low rate of preoperative radiation in the tumescent cohort (2.92 vs. 7–9 % in other studies). A synergistic interaction between the two may explain the previously noted increase in the risk for flap necrosis. More clearly understanding the specific interactions of tumescence with other potential risk factors, including radiation, acellular dermal matrix use, and intraoperative fill, will further clarify its impact on flap viability.

Tumescent solution was similarly not found to affect the postoperative rates of any other complications. Although a previous study reported increased rates of hematoma after tumescent mastectomies with and without immediate reconstruction, our findings corroborate the hypothesis that in the setting of an immediate reconstruction, the extended operative time allows for a thorough evaluation of hemostasis as the effect of the tumescent epinephrine subsides.^{15–17} To our knowledge, no published study to date, including our own, has found an increased risk of infection or seroma formation with tumescence. The

tumescent cohort did, however, demonstrate decreased operative times, by an average of 20 min. Decreased intraoperative bleeding also has been reported as a potential advantage of tumescence; however, data for blood loss was difficult to obtain on chart review and we were unable to account for that in our study.

These findings suggest that in the hands of an experienced surgeon tumescent mastectomy technique did not pose a significant deleterious effect on patient outcomes. Although the benefits of decreasing operative time and, potentially, intraoperative bleeding may tempt mastectomy surgeons to switch to tumescence, these benefits must be weighed against the risks of adopting a less familiar technique. Surgeons may experience a transient spike in postoperative complications as they overcome the associated learning curve. This may have contributed to the previously noted increase in the risk of flap necrosis, as their relatively low volume of tumescent mastectomies may not have allowed for complication rates to renormalize.^{16,17} This study benefits from a longitudinal review of nearly 900 tumescent mastectomies performed by only a handful of high-volume surgeons dedicated to oncologic breast surgery; it is well-equipped to effectively mediate any transient spike in complications and to determine the impact of tumescence in the hands of an experienced surgeon on complications. A high-powered, single-surgeon experience of a switch to tumescence would better clarify the influence of this potential learning curve on patient outcomes.

Although the aforementioned advantages of this study allowed for clinically and statistically relevant results, it is not without its limitations, mainly stemming from the retrospective nature of the review. We were not able to take into account the contribution of flap thickness, which is often a function of the individual oncologic surgeon, flap length, or any other objective measure of the breast on the rates of flap necrosis. A well-powered, prospective, randomized, controlled trial would mitigate effectively the inherent biases of our study and definitively quantify the influence of a tumescent mastectomy with immediate implant-based reconstruction on postoperative outcomes.

As the advantages of tumescent mastectomy continue to attract attention within the surgical community, understanding its effect on patient outcomes can guide a surgeon's decision to begin using tumescence. The potential for synergy between tumescence and other risk factors, as well as a potential learning curve, warrant further analyses to clarify their effect on patient outcomes. However, when performed by an experienced surgeon, tumescent mastectomy technique does not seem to independently affect the risk of postoperative complications following mastectomy with immediate expander-implant reconstruction.

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