Evaluation of Prepectoral Breast Tissue Expander Reconstruction Intraoperative Fill: Air or Saline

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Introduction: Staged implant-based breast reconstruction with immediate tissue expanders is the most common method of breast reconstruction after mastectomy. Tissue expanders traditionally are filled with saline for expansion. Some surgeons have advocated initial intraoperative fill of the tissue expander with air to avoid excess pressure on ischemic mastectomy skin flaps. The purpose of the study was to compare intraoperative air versus saline tissue fills.

Methods: All patients who underwent prepectoral tissue expander reconstruction after mastectomy from 2017-2019 were reviewed. The primary predictive variable was whether saline or air used for initial tissue expansion. Outcome variables included mastectomy skin necrosis, nipple necrosis, infection, number of expansions, hematoma, and explant.

Results: A total of 53 patients(88 tissue expanders) were included in the study: 28 patients(44 tissue expanders) who underwent initial intraoperative fill with air and 25 patients(44 tissue expanders) who underwent an initial saline fill were assessed. There were no significant differences in complication rates between initial TE fill with saline versus air including nipple necrosis, wound dehiscence, cellulitis, abscess, or TE removal($p=1.0$). The number of postoperative tissue expander fills in the initial air fill group was 3.2 compared to 2.7 in the initial saline fill($p=0.27$).

Conclusions: Prepectoral tissue expander initial fill with air has similar postoperative outcomes compared to initial saline fill. We found no benefit to initially filling prepectoral tissue expanders with air intraoperatively. Given the additional effort of exchanging air for saline during the first postoperative fill, there was no clinical advantage of filling prepectoral tissue expanders with air.

Tissue expander (TE) reconstruction after mastectomy is frequently performed as a first stage of implant reconstruction or delayed-immediate microsurgical breast reconstruction[1-2].Traditionally, TEs have been filled with saline intraoperatively then serially during clinic visits. Placing the TE in the prepectoral plane rather than submuscularly has become more popular over the past 5 years[3-10]. Anecdotally, some surgeons have advocated performing the initial intraoperative TE fill with air and subsequently exchanging the air for saline during clinic visits[11-13]. The rationale is to achieve the desired initial volume with less weight/potential pressure on the skin flaps compared to saline fill. Filling the prepectoral TE with air initially may decrease venous congestion on the partially ischemic skin flaps immediately following mastectomy[14]. Air in the TE is exchanged for saline at a postoperative clinic visit when the skin flap perfusion has improved to track a more precise fill volume. The air for saline exchange requires additional time and effort during the clinic visit. No comparative data has been reported to help guide the clinical decision of what medium to choose for initial TE fill in prepectoral expansion. The purpose of this study was to evaluate the perioperative outcomes for initially filling the TE with air or saline in immediate prepectoral breast reconstruction.

Following approval from our Institutional Review Board, a retrospective review was performed on patients who underwent immediate prepectoral breast TE reconstruction following mastectomy. Patients were divided into two groups: Group I (intraoperative air fill) and Group II (intraoperative saline fill). Group I patients had air exchanged for saline during the 2-week postoperative visit. Both groups underwent further subsequent expansion with saline filling. The patients in both groups were consecutive patients by the senior author (A.H.H) who switched from air to saline fill to simplify the initial clinic fill.

Statistical analyses were performed within SPSS Statistics version 19 (IBM Corporation, Chicago, IL). Two-tailed values of $P < 0.05$ were considered significant. Continuous variables were compared with t-tests. Categorical data was evaluated with Fisher's exact test. Means are presented with standard deviation.

The study included 53 women (88 tissue expanders) who underwent immediate prepectoral TE reconstruction on the day of the mastectomy. Group I had 28 patients (44 tissue expanders) and Group two had 25 patients (44 tissue expanders). The two groups had no significant differences in demographic data, cancer type, form of mastectomy, and treatment (**Table 1**). We performed a Kolmogorov-Smirnov Test of normality for our data for expander fill volumes and mastectomy weights, and our data was found to be normally distributed.

Mean initial intraoperative volume fill in Group I was 238 cc air and Group II was 219 cc saline (p=0.65), which were 54% and 48.1% of the final fill volumes respectively (p=0.42). The number of postoperative tissue expander fills in Group I was 3.2 compared to 2.7 in Group II (p=0.27). No differences in postoperative complication rates were significant between the groups. There were no hematomas in Group I or Group II. No differences were observed in Group I or Group II for nipple necrosis (p=0.5), mastectomy skin necrosis (p=0.5), cellulitis requiring oral antibiotics (p=0.68), cellulitis requiring IV antibiotics (p=1.0), abscess (p=0.5), or TE removal (p=0.23) (**Table 2**). All patients were placed on prophylactic antibiotics postoperatively. All the episodes of cellulitis occurred after the exchange of air for saline. In Group I, 50 % (n=1/2) of patients who were treated with intravenous antibiotics required device removal compared to 100% (n=2/2) in Group II.

Prosthetic reconstruction utilizing a two-stage saline tissue expander-to-implant procedure is the most common technique for breast reconstruction following mastectomy in the United States [15-17]. The initial use of a TE provides additional time for patients to select between implant reconstruction and microsurgical reconstruction[2]. In the present study, no differences were identified in complication rates between initially filling the TE with air or saline during the first-stage operation.

There are theoretical advantages to filling tissue expanders initially with air. Filling with air obviates the need for a saline fill set up in the operating room. Theoretically, air is less dense than water which could potentially translate to less weight and potential pressure on mastectomy flaps with air compared to saline. These advantages were not reflected in our current data but are theoretical advantages that may be more apparent in a larger study. A disadvantage of initial air fill is the need to exchange air for saline on a postoperative visit. Our study revealed similar number of expansions in both the air fill and saline fill groups. However, removing air from a tissue expander prior to filling prior to filling with saline is more time consuming than only filling with saline.

A post hoc power analysis was conducted to estimate the power to detect the observed differences in postoperative complication rates between the treatment groups. With sample sizes of 44 in each group and a 4.5% difference in rate of mastectomy skin flap necrosis (4.5% in the air fill group and 0% in the saline fill group), our study was underpowered. In order to achieve a power of 80% to detect a 5% difference in our sample size, a study would require 868 patients.

The study was underpowered with the number of patients included and serves as preliminary evidence. There is a potential for a type II error.

We found prepectoral tissue expander initial fill with air has similar postoperative outcomes compared to initial saline fill. This study was limited by retrospective methodology with a small number of patients. Considering the additional effort of exchanging air for saline during the first postoperative fill, there was no clinical advantage in this study of filling prepectoral tissue expanders with air.

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		AIR FILL (GROUP I)	SALINE FILL (GROUP II)	P-VALUE
	N	44	44	-
	AGE (YEARS)	48.6 (SD 10.8)	46.6 (SD 10.3)	0.54
	BMI (CM2/KG)	29.2 (SD 5.8)	28.5 (SD 6.8)	0.71
	DIABETES STATUS	17.9% (5)	12% (3)	0.55
	SMOKING STATUS	3.6% (1)	0% (0)	0.34
Type of Breast Cancer	INVASIVE BC	71.4% (20)	80.0% (20)	0.47
	DCIS	28.6% (8)	20.0% (10)	0.47
	LCIS	3.6% (1)	0% (0)	0.34
Mastectomy Type	SKIN-SPARING	42.9% (12)	52.0% (13)	0.51
	NIPPLE-SPARING	57.1% (16)	48.0% (12)	0.51
	PROPHYLACTIC	10.7% (3)	0% (0)	0.09
	MASTECTOMY WEIGHT (G)	669.4g (SD 381.0)	589.0g (SD 352.0)	0.44
Breast Cancer Treatment	NEOADJUVANT CHEMOTHERAPY	28.6% (8)	16.0% (4)	0.28
	ADJUVANT CHEMOTHERAPY	28.6% (8)	36.0% (9)	0.56
	ADJUVANT RADIATION	28.6% (8)	16.0% (4)	0.28
	PREVIOUS RADIATION	2.3% (1)	6.8% (3)	0.31
	HORMONAL THERAPY	57.1% (16)	60.0% (15)	0.83

Table 1. Patient demographic and treatment data of patients undergoing prepectoral tissue

	AIR FILL (Group I)	SALINE FILL (Group II)	P-VALUE
INITIAL FILL VOLUME (IFV)	238 cc (SD 166)	219 cc (SD 146)	0.65
# OF EXPANSIONS	3.2	2.7	0.27
FINAL FILL VOLUME (FFV)	428 cc (SD 159)	400 cc SD (178)	0.55
PERCENT INITIAL FILL VOLUME OF FINAL FILL VOLUME (IFV/FFV x 100)	54.0% (SD 22%)	48.1% (SD 30.2%)	0.42
HEMATOMA	0% (0)	0% (0)	1.0
NIPPLE NECROSIS	4.5% (2)	0% (0)	0.50
MASTECTOMY SKIN NECROSIS	4.5% (2)	0% (0)	0.50
CELLULITIS (PO ABX)	4.5% (2)	9.1% (4)	0.68
CELLULITIS (IV ABX)	4.5% (2)	4.5% (2)	1.0
ABSCESS	0% (0)	4.5% (2)	0.50
RUPTURE	4.5% (2)	0% (0)	0.50
WOUND DEHISCENCE (MINOR)	4.5% (2)	6.8% (3)	0.65
EXPLANTATION	4.5% (2)	11.4% (5)	0.23
ANY COMPLICATION	15.9% (7)	15.9% (7)	1.0

Table 2. Initial fill volume, number of expansions, and postoperative complication rates for Group I and Group II.