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IDEAS AND INNOVATIONS

Breast

A Novel Technique of Preserving Internal Mammary Artery Perforators in Nipple Sparing Breast Reconstruction

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Summary: As nipple-sparing mastectomy with implant-based reconstruction has increased, attention must be paid to the viability of the nipple-areolar complex. This article describes the use of preoperative Doppler ultrasound to identify the internal mammary artery perforators. Preserving the internal mammary artery improves vascular supply to the nipple-areolar complex. *(Plast Reconstr Surg Glob Open 2014;2:e198; doi: 10.1097/GOX.0000000000000131; Published online 11 August 2014.)*

Nipple-sparing mastectomy (NSM) with implant-based reconstruction (IBR) has gained in popularity.[1,2] Greater than 15% of nipple-areolar complex (NAC) loss is attributed to vascular compromise.[3] Moreover, in patients who subsequently undergo IBR, NAC necrosis can lead to chronic open wounds, infection, implant exposure, and need for explantation.[4–8]

Blood supply of the breast stems from a deep and a superficial arterial system. The superficial system is composed of perforators from both lateral thoracic and internal mammary arteries.[9] According to Palmer and Taylor,[10] the internal mammary artery (IMA) contributes significant blood supply to the NAC. IMA perforators are superficial and can be identified using a handheld Doppler probe.[9]

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Previous investigations have used Doppler ultrasound to identify major perforators to the NAC to increase nipple viability in reduction mammoplasty for gigantomastia.[11] However, the application of Doppler ultrasound has not been applied to NSM with IBR.

In this study, we introduce a novel, easy, and inexpensive technique for improving NAC viability in NSM with IBR. Specifically, we employ preoperative Doppler ultrasound to identify IMA perforators to augment NAC perfusion.

PATIENTS AND METHODS

Patient Selection

With institutional review board approval, we retrospectively studied outcomes of a prospectively enrolled database of consecutive patients who received NSM with IBR in 2010–2012. Group A did not receive Doppler ultrasound and group B did. One oncologic surgeon (A.S.) and 1 plastic surgeon (M.T.) performed all procedures at Weill Cornell Medical Center. NSM was not offered if tumor size was greater than 2.5 cm or if tumor-to-nipple distance was less than 4 cm.[12] NSM was not offered

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to patients with grade III ptosis or cup size greater than C. Outcomes were reviewed. Nipple ischemia ranged from epidermolysis to full-thickness necrosis; we applied the same grading system from our earlier works.[13,14]

Ultrasound Analysis

Patients were marked in a supine position with a handheld 8-MHz linear probe Doppler ultrasound (Siemens, Erlangen, Germany) by the oncologic surgeon. The probe was placed on the breast just lateral to the sternum and directed cranially to caudally, from the clavicle to the inferior costal margin. IMA perforators were identified on the skin surface (Fig. 1).

Surgical Technique

NSM was performed using a subdermal technique, as described in earlier works.[13,14] IMA perforators corresponding to the Doppler mapping were identified and spared (Fig. 2). IBR was then performed, in 1-stage or 2-stage procedures, depending on patient and surgeon preference, as described in earlier works.[13,14]

This article was composed with the highest ethical standards and that the Institutional Review Board of Weill Medical College (New York, N.Y.) approved all study procedures in accordance with state and federal guidelines.

RESULTS

On hundred ninety-four NSM with IBR (117 patients) were reviewed in this series: 97 breasts (56 patients) did not receive Doppler ultrasound (group A) and 97 breasts (61 patients) did (group B). No patients were excluded from the database because of demographic factors, risk factors, oncologic burden, or postoperative results. When the ultrasound Doppler was used, all patients had identifiable IMA perforators, and the corresponding vasculature was visualized in flap dissection. There were no adverse events related to ultrasound. This clinical application added approximately 4 minutes to the surgical procedure. The results are summarized in Table 1.

This series demonstrated the use of Doppler ultrasound to define the vascular anatomy of mastectomy skin flaps; this study was not powered to correlate NAC ischemia with prespecified demographic criteria, comorbid conditions, or operative details. As such, no statistically significant relationship could be found between NAC ischemia and these endpoints. For example, for a 2-tailed Fisher's exact test with n=97 in each group, and full-thickness NAC ischemia

Fig 1. Doppler technique.

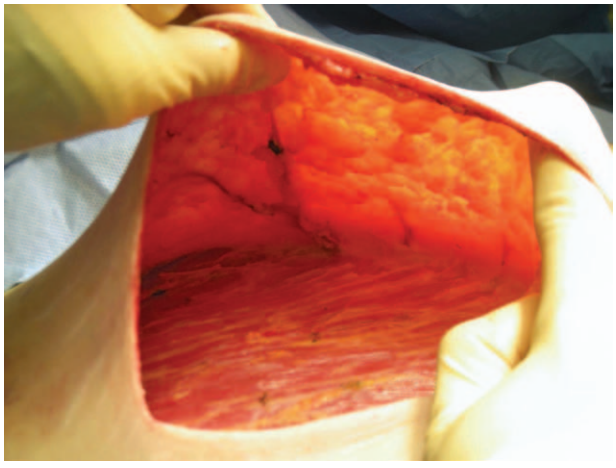

Fig 2. Intraoperative preservation of IMA perforators.

of 7.2% for group A and 10.3% for group B, and type I error of 0.05, the statistical power is low, 7.5%.

DISCUSSION

NAC ischemia after NSM occurs in 2.5%–60% of patients; rates vary significantly between institutions with respect to patient selection criteria, operative technique, and other factors.[4–8] Previous investigators have reported surgical techniques to reduce the rate of NAC ischemia in NSM. In his series of NSM, Stolier et al[15] discusses the importance of the incision to preserve sufficient inflow to the NAC. The most commonly employed incisions in NSM are inframammary, radial, and lateral.[16–18] Colwell et al[19] suggest that an inferior radial incision optimizes IMA exposure and nipple blood supply. In our experience, inframammary incisions provide superior cosmetic results and maintain adequate perfusion of the NAC.

Strategies for NSM preservation have been reported. Mastectomy flap thickness and sharp dissection with minimal use of electrocautery have been

Table 1. Summary of Patient Demographics, Surgical Indications, Operative Technique, and Postoperative Complications

	Group A		Group B		
	Range/n	**Average/Rate (%)**	**Range/n**	**Average/Rate (%)**	***P***
Demographics					
Age	26–74	45	25–76	48.9	0.0047
Body mass index	16.1–25.8	20.8	17.5–29.4	21.9	0.0084
Follow-up duration (approximate days)	13–1897	764	7–735	371	<0.0001
Diabetes	5	5.15	0	0.00	0.0235
Smoking (current)	2	2.06	0	0.00	0.1552
Breast base width (cm)	11–16	13.26	11–19	14.07	0.0005
Sternal notch-to-nipple (cm)	16–26	20.90	17–29.5	22.19	0.0008
Prior lumpectomy	53	54.64	55	56.70	0.7726
	n	**Rate (%)**	**n**	**Rate (%)**	
Surgical indications/technique					
Single stage	20	20.62	11	11.34	0.0778
2 stage	77	79.38	86	88.66	0.0778
Chemotherapy	50	51.55	13	13.40	<0.0001
Radiation (before NSM)	10	10.31	10	10.31	1.0000
Radiation (after NSM)	11	11.34	7	7.22	0.3222
Cancer type					
Invasive ductal	30	30.93	35	36.08	0.4469
Invasive lobular	9	9.28	6	6.19	0.4200
Invasive ductal/lobular	0	0.00	1	1.03	0.3161
DCIS	20	20.62	13	13.40	0.1810
LCIS	0	0.00	1	1.03	0.3161
Combination DCIS/LCIS	0	0.00	2	2.06	0.1552
Prophylactic	38	39.18	39	40.21	0.8860
Cancer stage					
NA (proph)	38	39.18	37	38.14	0.8854
0	15	15.46	17	17.53	0.6988
I	22	22.68	24	24.74	0.7357
II	14	14.43	16	16.49	0.6913
III	8	8.25	1	1.03	0.0169
IV	0	0.00	0	0.00	NA
Unknown	0	0.00	2	2.06	NA
	n	**Rate (%)**	**n**	**Rate (%)**	
Complication					
Partial-thickness NAC necrosis	23		15		0.1478
Full-thickness NAC necrosis	7		10		0.4462
Mastectomy flap necrosis	7		11		0.3222
Hematoma	6		5		0.7563
Seroma	2		8		0.0514
Dehiscence	1		2		0.5607
Fat necrosis	1		0		0.3161
Infection or cellulitis	0		3		0.0809

DCIS, ductal carcinoma in situ; LCIS, lobular carcinoma in situ; NA, Not Applicable; proph, prophylactic.

described.[20] For high-risk nipple necrosis, surgeons have surgically delayed the NAC to maximize the viability of the nipple for a future NSM.[1,21] Furthermore, preoperative patient selection of women with small, nonptotic breasts with limited comorbidities improves surgical aesthetic outcome for NSM.[4–8] Also, adjunctive postoperative measures such as topical nitroglycerin paste have been useful.[22]

More advanced technologies that aid in the objective diagnosis of ischemia are currently in development, such as the SPY Elite System (LifeCell, Bridgewater and Branchburg, N.J.). For example, a study by Komorowska-Timek and Gurtner[23] showed a significant decrease in ischemic complications from 15.1% to 4% ($P < 0.01$) after laser-assisted indocyanine green perfusion mapping was performed. Given the limited reports of SPY and the cost ($1000.00 with each screening and the fixed cost of the imaging device), we opted not to use this technique in our study.

Although Doppler ultrasound has been used to identify the vascular supply to the NAC in breast surgery,[11] our investigation uniquely reports its use with NSM and IBR; however, there are several limitations of this article. This investigation is a small case series designed to highlight a novel technique; this article is not powered to draw correlative conclusions about comorbid conditions or operative details, which may be expected to play a role in NAC ischemia.

CONCLUSIONS

Preoperative Doppler ultrasound of IMA perforators in NSM with IBR is a clinically useful adjunct to visualize perfusion of mastectomy skin flap to maximize nipple viability. In addition, this technique is easy, inexpensive, and rationally based.

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