Managing Necrosis of the Nipple Areolar Complex Following Reduction Mammaplasty and Mastopexy

Neal Handel, MD*, Sara Yegiyants, MD

KEYWORDS
- NAC necrosis • Reduction mammaplasty • Reduction mastopexy • Prevention • Management
- Reconstruction of ischemic necrosis of NAC

KEY POINTS
- Necrosis of the nipple areolar complex (NAC) is an infrequent but devastating complication of reduction mammaplasty and mastopexy. However, with strategic management and properly timed reconstruction, it is possible in most cases to restore a natural-appearing NAC.
- To prevent necrosis of the NAC, it is most important to maintain a pedicle of adequate thickness, be cognizant of the length to width ratio of the pedicle, prevent kinking the blood supply when inseting the flap, and avoid an excessively tight skin closure, no matter what type of technique is performed. Especially in the case of secondary reduction mammaplasty or mastopexy in the previously augmented patient, great care must be taken because the breast anatomy and physiology has changed because of the previous procedures.
- In the immediate postoperative period, the ischemic NAC can be transferred as a full-thickness graft. When it is elected to convert to a graft, all the circulatory changes have to be stabilized to confirm that the ischemia is irreversible and the recipient site is healthy enough to accept a graft.
- The guiding principle in surgical management of ischemic complications of the NAC is to avoid aggressive treatment until the tissue necrosis obviously demarcates. When the missing part is small, the nipple can be reconstructed by composite grafting from the contralateral nipple. When a major part of the nipple is lost, reconstruction using a local flap can yield a favorable result.
- The areola can be reconstructed using a full skin graft from the contralateral areola, the labia minora, or the upper inner thigh. Intradermal tattooing can be used to obtain a desirable color match.

INTRODUCTION

Necrosis of the nipple areolar complex (NAC) is an infrequent but dreaded complication of reduction mammaplasty and mastopexy. When there is significant loss of nipple and/or areolar tissue, it not only results in major cosmetic deformity but also may be a source of great angst for the surgeon and patients alike.

The manifestations of nipple areolar ischemia run the gamut from spontaneous, completely reversible nipple congestion (Fig. 1) to total loss...
of the nipple (Fig. 2) with extensive necrosis of subadjacent breast tissue (Fig. 3). The appropriate response to nipple ischemia depends on the degree of circulatory compromise. The guiding principle is to avoid aggressive surgical therapy as long as possible to give the injured tissues the best possible chance to recover spontaneously.

Circulatory compromise of the NAC may be due to arterial insufficiency but is more commonly caused by venous congestion. Clinical signs of venous congestion include excessively brisk capillary refill, dark rapid bleeding on pinprick, and cyanosis and edema of the nipple. Venous congestion can occur for a variety of reasons: inadequate preservation of venous drainage, long pedicles, kinking or compression of the pedicle, excessively tight skin closure, or a hematoma.

The risk of nipple areolar ischemia is increased with large-volume tissue removal, transposition of the NAC a great distance (more than 15 cm), and in cases whereby secondary mastopexy is performed in previously augmented patients. Systemic factors, such as obesity, diabetes, and cigarette smoking, may also increase the risk of ischemia.

The objectives of this article are to explain the mechanisms of injury that result in ischemia of the NAC, to offer recommendations about the management of this complication, and to illustrate reconstructive techniques that can be used to correct deformities arising from necrosis of the NAC. With these goals in mind, the remainder of this article is divided into 3 sections: (1) prevention of ischemia of the NAC, (2) management of the ischemic nipple, and (3) reconstruction after ischemic necrosis of the nipple and areola.

PREVENTING ISCHEMIA OF THE NIPPLE AREOLAR COMPLEX

Clearly, preventing ischemic complications is greatly preferable to treating a necrotic nipple and areola. When performing reduction mammoplasty or mastopexy, care must be taken to select the operation that will likely produce the best outcome with the least risk of complications.

Understanding of breast vascular anatomy is crucial in preserving the arterial inflow and the essential venous drainage network of the nipple areola complex. Cadaveric dissection studies have shown that the most reliable blood supply to the nipple areola complex is from the internal thoracic–anterior intercostal system, supplying the NAC from the medio-inferior aspect. An
additional collateral system composed of lateral thoracic and other minor contributors supplies the NAC from the superolateral aspect. Venograms of the breast have shown an extensive network of veins draining the NAC with the most reliable patterns located in the superomedial/medial and inferior pedicles.

A wide variety of techniques have been described for transferring the nipple in breast reduction and mastopexy. The most commonly performed procedure combines the Wise-pattern skin incision with an inferior pedicle for nipple transposition. This operation has gained popularity because of the reliability of the blood supply to the nipple, the relatively short learning curve, and the applicability of this method to reductions of all sizes. The main drawback to this approach is that aesthetic results are not always optimal. There may be a boxy contour to the breasts; it can be difficult to achieve desired breast projection; there is a tendency to pseudoptosis over time; and there is invariably a long scar in the inframammary fold. For these reasons, a variety of alternate pedicles and different skin patterns have evolved. In addition to the traditional inferior pedicle, the superior, superomedial, and central pedicle have all been successfully used in breast reduction and mastopexy. The reported rates of nipple necrosis vary with the use of different pedicles ranging from 0.8% to 2.3% (0.8% with inferior pedicle, 2.1% total nipple necrosis with the use of superodermal pedicle, and 2.3% with superolateral pedicle). However, there are no randomized controlled trials comparing NAC necrosis rates for the different techniques.

In recent years, short scar techniques, including the vertical pattern and short-scar periareolar-inferior pedicle reduction (SPAIR) technique, have been introduced. Because there are so many possible combinations and permutations of skin pattern and vascular pedicle, it is difficult to objectively compare one technique with another. In a recent matched cohort study, the investigators compared superomedial pedicle vertical scar breast reduction with inferior pedicle Wise-pattern reduction and found there was no significant difference in complications between these two techniques. It is likely that adherence to the basic principles of plastic surgery is more critical than the particular surgical technique selected. Regardless of which approach is chosen, the surgeon must be careful to maintain a pedicle of adequate thickness, be cognizant of the length to width ratio of the pedicle, prevent kinking the blood supply when setting the flap, and avoid excessively tight skin closure.

One group of patients especially at risk for ischemic complications of the NAC is previously augmented women with ptosis who present for mastopexy. These patients are at increased risk of circulatory compromise because of the inevitable changes in breast anatomy and physiology caused by implants. In many augmented patients, the soft-tissue envelope surrounding the implant becomes attenuated. Tebbetts observed: “The consequences of excessively large breast implants include ptosis, tissue stretching, tissue thinning, inadequate soft-tissue cover, [and] subcutaneous tissue atrophy.” These very same changes occur not just with “excessively large” implants as described by Tebbetts but with all breast implants to some degree over time. Most of the thinning and atrophy caused by implants occurs in the inferior pole of the breast. It is important to take this into account when selecting which pedicle to use in patients undergoing secondary mastopexy. A conventional Wise-pattern skin excision coupled with an inferior pedicle may be prone to ischemia because of thinning of the tissues of the inferior pole. In such cases, it may be prudent to preserve a superior pedicle as well (as in a traditional McKissock reduction mammoplasty) to ensure adequate arterial perfusion and sufficient venous drainage. Vertical mastopexy techniques are applicable in previously augmented patients; however, vertical techniques that depend on an inferior pedicle, such as the SPAIR mammoplasty may be relatively contraindicated. Procedures that incorporate a superior pedicle (Lejour, Lassus, Hall-Findlay) are probably safer in terms of preserving circulation to the nipple and areola.

When selecting the specific mastopexy operation for correction ptosis in augmented patients, there is a wide spectrum of procedures from which to choose. These procedures include crescent nipple lift, periareolar mastopexy, vertical lift, and finally the conventional Wise-pattern mastopexy. In general, the least aggressive mastopexy that will achieve the desired result is preferred. In secondary mastopexy patients, it is also critical to consider the effect of prior skin incisions on the blood supply of the nipple and the skin flaps and to avoid insertion of excessively large implants, which may cause compression of the vascular pedicle and lead to venous congestion.

**MANAGING ISCHEMIA OF THE NIPPLE AREOLAR COMPLEX**

When circulatory compromise of the nipple and areola is recognized early, either in the operating room or in the immediate postoperative period,
urgent steps should be undertaken to reduce permanent tissue loss. Recognition of irreversible ischemia of the nipple may be hard to determine by clinical criteria alone. Intravenous fluorescein has been used to assess viability of the nipple.\textsuperscript{9} Indocyanine green videofluorography\textsuperscript{10} is a newer technique that can be used to evaluate NAC viability intraoperatively. Advantages of this technique include repeated use during the same operation and ability to evaluate both the arterial microcirculation and venous outflow. Intraoperative detection of NAC nonviability is an indication to convert to a full-thickness graft. In cases whereby there is irreversible ischemia of the nipple, conversion of the nipple from a pedicle flap to a full-thickness graft can result in a satisfactory aesthetic outcome.\textsuperscript{11} However, before making the decision to convert the nipple to a full-thickness graft, it is prudent to wait until the circulatory changes related to tissue cooling and the intraoperative use of epinephrine have subsided. If it is elected to convert to a graft, it is crucial that the recipient site have an excellent blood supply. This requirement precludes grafting onto breast tissue or fat; the graft must be affixed to a healthy dermal bed.

Conversion of the nipple to a graft is indicated only rarely and in dire cases. In most circumstances whereby ischemia of the nipple is identified early, conservative measures are effective in reversing or at least ameliorating the problem (Fig. 4). Release of the dermal and subdermal sutures around the periphery of the areola may result in dramatic improvement in venous drainage with transformation of tissues from a violaceous hue to a pink color within a matter of minutes. The application of Nitroglycerin Ointment USP, 2\% (Nitro-Bid) may help by causing vasodilation and promoting drainage of blood. Steroids, such as a methylprednisolone (Medrol Dosepak), have also been recommended to reduce local tissue swelling and promote venous drainage. Leeches can also be used to improve venous drainage.\textsuperscript{12} Consideration should also be given to the use of hyperbaric oxygen therapy.\textsuperscript{13} The mechanism of action of hyperbaric oxygen therapy is to increase tissue oxygen tension, which results in production of reactive oxygen species and reactive nitrogen species that promote neovascularization and improve postischemic tissue survival.\textsuperscript{14}

The guiding principle in surgical management of ischemic complications of the NAC is to avoid aggressive treatment until the tissues have declared themselves. It is often difficult early in the acute phase to gauge which tissues will ultimately prove viable and which tissues will necrose (Fig. 5A–L). During the interim it is advisable to maintain patients on oral antibiotics to reduce the risk of infection. A wide variety of antimicrobials are available and include drugs such as penicillin VK 500 mg every 6 hours or cephalexin 500 mg.

![Fig. 4](image-url).

**Fig. 4.** (A) Venous congestion of NAC 48 hours after reduction mammoplasty; (B) appearance of NAC 72 hours after removal of skin and subdermal sutures; (C) improved appearance of NAC at POD No. 7; (D) further improvement in circulation at POD No. 10; (E) fat necrosis of underlying breast tissue treated by surgical debridement and delayed primary closure; (F) appearance 18 months after procedure.
every 6 hours. Consideration should be given to adding trimethoprim and sulfamethoxazole (Bactrim DS) twice a day to the regimen as prophylaxis against methicillin-resistant *Staphylococcus aureus*. In addition to systemic antibiotics, topical antimicrobials may be used to further reduce the chance of secondary infection. Several topical agents are commonly used for this purpose, such as...
as neomycin-polymyxin B-bacitracin (Neosporin) triple antibiotic ointment or 1% silver sulfadiazine (Silvadene cream).

Once the tissues have demarcated and it is clear how much of the NAC will survive and how much is necrotic, a decision can be made about appropriate surgical management. If the area of nonviable tissue is limited (partial loss of nipple, subtotal loss of areola), allowing the necrotic tissues to slough and the resulting defect to heal by secondary intention may be the most prudent approach. If the amount of necrotic tissue is more sizable, debridement and delayed primary closure may be indicated (Fig. 6). Regardless of whether the defect is allowed to close spontaneously or is closed surgically, there should be a delay before any reconstructive procedure is attempted. It is critical to give the injured tissues time to recover before proceeding with further intervention. A waiting period of 3 to 6 months is usually adequate to allow for resolution of inflammation, improvement in local circulation, and maturation and softening of scar tissue.

**RECONSTRUCTION OF THE NECROTIC NIPPLE AND AREOLA**

After a suitable waiting period has transpired, reconstruction of the defect may commence. The appropriate reconstructive procedure depends on the nature of the deficit. In some cases, the amount of missing tissue is negligible, which facilitates reconstruction. For example, if only a portion of the areola is absent, it may be possible to...
reconstruct the defect with a full-thickness graft from the contralateral areola. Likewise, if the areola is intact but part or even the entire nipple has been lost, a composite graft from the opposite nipple may be indicated (assuming there is adequate tissue for sharing). In some cases there is residual nipple and/or areola, but the degree of tissue damage or tissue loss is so extensive that the best approach is to discard the remaining tissue and perform de novo nipple areolar reconstruction. In such cases, or when the NAC has been completely lost, there are many excellent techniques for recreating a natural-appearing nipple.

A host of operations have been described for reconstruction of the mammary papilla or nipple. Composite grafts, such as the pulp of the toe, or the earlobe, have been used to reconstruct the missing nipple. However, even when these grafts take successfully, they do not match the texture or pigmentation of a normal nipple. Composite grafts from the contralateral nipple can yield an excellent aesthetic result provided there is adequate nipple on the intact side to serve as a donor site. More commonly, the papilla is reconstructed with local tissues. These procedures typically consist of some type of random flap, which is elevated and rotated or folded to create a projecting structure of the desired size and shape. Among the operations that have been described are the star flap, the double opposing tab flap, and the double opposing periareola flap. Most of these techniques are derivatives of the skate flap, which has proven to be a safe and reliable technique for reconstruction of the nipple. The skate flap is popular because it is relatively easy to learn and results are predictable. The skate flap has a hardy blood supply, which ensures survival of the tissue and promotes maintenance of long-term projection of the reconstructed nipple (Fig. 7).

It is important to remember that reconstruction of the nipple in patients who have had ischemic necrosis of the native NAC differs substantially from reconstruction of the nipple in mastectomy patients. Unless mastectomy patients have been irradiated, the skin at the site of NAC reconstruction is generally in good condition; it is typically supple, unscarred, and has a good blood supply. This condition facilitates successful reconstruction of the nipple with any of a variety of local flaps and provides a well-vascularized recipient site for application of either full-thickness or composite grafts. Patients who have lost their NAC as a result of ischemic complications are more likely to have scarred, poorly vascularized tissues at the site of the proposed reconstruction. When planning nipple reconstruction, it is important to consider the quality of the local tissues in designing pedicles to ensure the best chance of flap survival (Fig. 8).

With regard to reconstruction of the areola, the most natural-appearing areola is created using a full-thickness skin graft from the contralateral breast. The feasibility of using the opposite areola as a donor site depends of course on how much tissue is available for harvesting. Fortunately, the areola tends to be a very elastic structure; if a washer-shaped piece of pigmented skin is harvested from the periphery of the intact areola, the residual pigmented skin will usually stretch enough so the donor areola maintains a reasonable size. Other sites that have been used for areolar reconstruction include full-thickness grafts from the labia minora and the upper inner thigh. Although the early results of these grafts are often very pleasing, there is a tendency for the grafted skin to lose pigmentation over time. Frequently after an interval of 2 to 3 years following reconstruction, the pigmentation has completely faded and the only indication of areolar reconstruction is a circular scar around the periphery of the

Fig. 8. (A) A 23-year-old woman who previously had bilateral augmentation mammaplasty and circumareolar mastopexy presents with dissatisfaction due to persistent breast ptosis and disfigured NACs; (B) design for vertical mastopexy with superior pedicle for transposition of nipple; (C) intraoperative view after nipple has been mobilized, note relatively short distance nipple needs to be raised and thick (3 cm) superior pedicle; (D) appearance of the breast at completion of procedure, both NACs appear viable; (E, F) appearance 4 days after procedure significant venous congestion of NACs, right side worse than left side, dermal sutures released, and nitroglycerine paste applied; (G, H) appearance 10 days after procedure, necrotic eschar separating revealing partial survival of areola bilaterally; (I, J) appearance 24 days after procedure, central band of tissue on left side has survived but only tiny amount of tissue on right side is viable; (K) 6 weeks after procedure, open areas characterized by healthy granulation tissue, and patient undergoes delayed primary closure of wounds bilaterally; (L) by 4 months after delayed closure, both breast have healed; (M) at 6 months tissues have softened and scars have matured, and patient is ready for reconstruction; (N, O) 3 months following bilateral NAC reconstruction, nipple has been created using a modified skate flap with care taken to incorporate residual pigmented tissue into reconstructed papilla, and areolae have been reconstructed from full-thickness skin grafts from upper inner thigh.
reconstructed nipple. For this reason, intradermal tattooing has gained great popularity for areolar reconstruction. Tattooing can be used either with or without preliminary skin grafting. The tattooed areola may also fade over time, but touch up tattooing is a relatively easy way to restore the desired pigmentation. When the nipple is reconstructed from local tissue (e.g., skate flap or other local flap), it does not match the color of the intact contralateral nipple. Tattooing of the papilla is the easiest way to achieve the desired color match. Because symmetry is such an important component of successful nipple reconstruction, it may be advisable to also tattoo the intact NAC to achieve the best possible color match between the two sides.

Necrosis of all or part of the NAC after reduction mammoplasty or mastopexy is a devastating complication. It is not only disappointing for patients but can also be disheartening for the surgeon. However, with properly timed and well-executed reconstructive procedures, it is possible in most cases to restore a very natural-appearing NAC.

REFERENCES