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Autologous microvascular breast reconstruction

Postoperative strategies to improve outcomes

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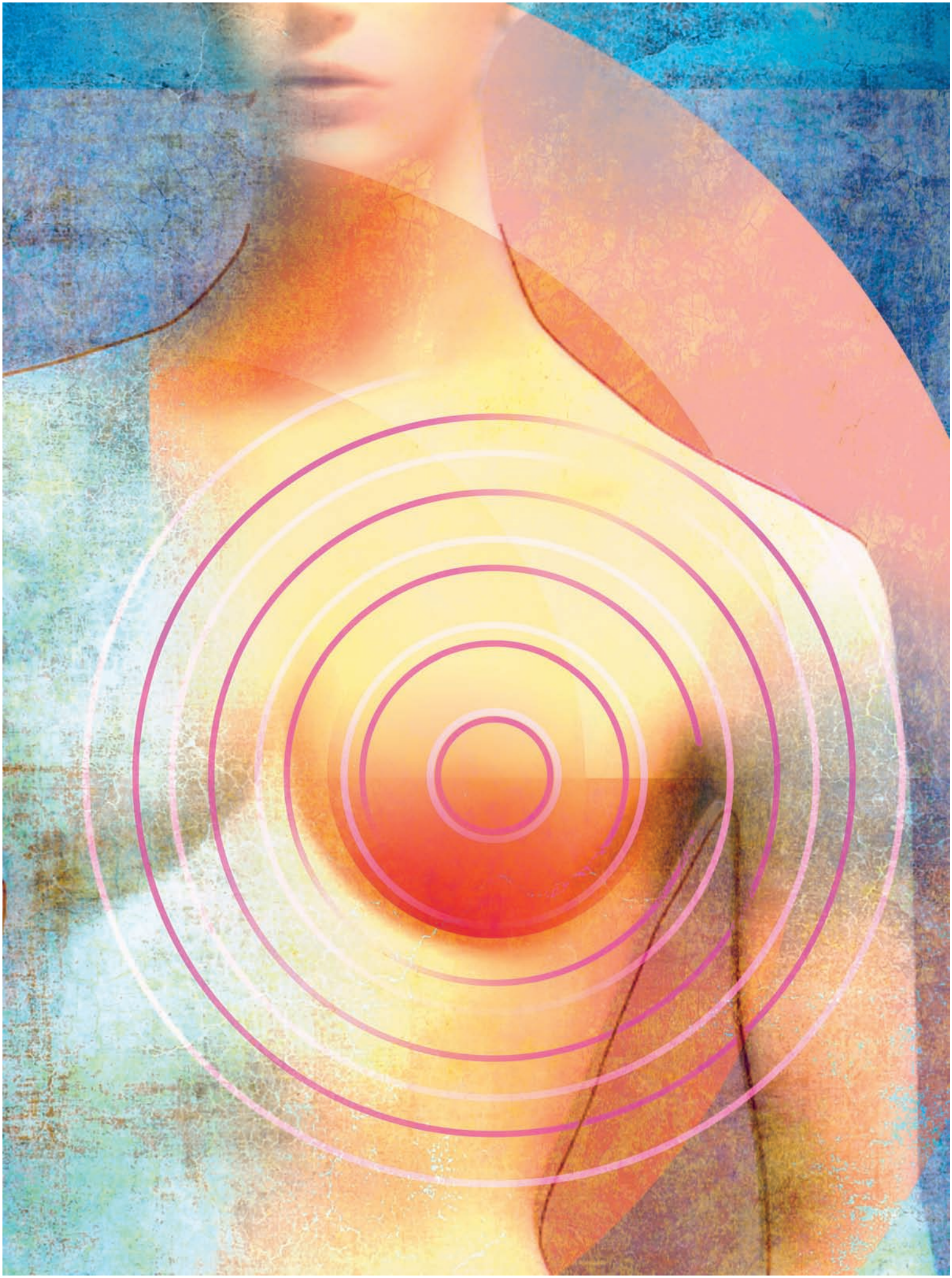
BREAST RECONSTRUCTION after total mastectomy is an important consideration for many women. It can restore quality of life, improve body image, and enhance self-esteem after therapeutic or prophylactic mastectomy. Despite these benefits, currently only 42% of women will pursue breast reconstruction.[1]

Prosthetic implants and autologous tissues are the two methods generally used for breast reconstruction. According to the American Society of Plastic Surgeons, about 80% of those undergoing breast reconstruction will have implant-based reconstruction and 20% will have autologous reconstruction.[2] Although autologous reconstruction is used less commonly in the United States, some women choose this option because they're ideal candidates or because the procedure is less likely to require future revision. Ideal candidates have plenty of tissue at the planned donor site such as the abdomen.[3] Others will be advised to opt for this approach because they've had prior implant failure, many scars, or radiation therapy.[3] Ideal candidates for prosthetic reconstruction have a body mass index (BMI) of less than 30 and wish to have a shorter recovery time.[3] Some women are discouraged from prosthetic reconstruction if they've had prior radiation

Roy Scott



therapy with severe skin changes or if they have multiple comorbidities, use tobacco, or are morbidly obese.

This article focuses on autologous microvascular breast reconstruction because the nurse's role is exceptionally important with this approach. Appropriate postoperative nursing considerations can increase the likelihood of a successful patient outcome. This article focuses on nursing care for a patient undergoing autologous microvascular tissue breast reconstruction, including flap care. Commonly used free flaps are reviewed as well as some monitoring tools.

Flap facts

Tissue transferred from one region of the body to another is known as a flap. (See *Terms of reconstruction*.) These flaps include skin, fat, and sometimes muscle that can be rotated on a vascularized pedicle from an adjacent area near the breast or transferred from a remote area as a free tissue transfer. Donor sites include the abdomen, gluteal region, thighs, and back.[4-19] The most commonly considered donor site is the abdomen. The benefits of using abdominal tissue are the ability to shape the tissues to recreate the breast, as well as to contour the abdomen for an abdominoplasty-type effect. The other donor sites listed are usually secondary sites and associated with a lesser amount of tissue; these are sometimes used in conjunction with an implant.

Flaps rotated on a pedicle (latissimus dorsi and transverse rectus abdominis musculocutaneous [TRAM] flaps) aren't detached from the body, and their blood supply remains intact; these flaps are at low risk for vascular compromise when properly harvested.[18,19] These flaps, which don't require the same degree of monitoring by the nursing staff, aren't discussed in this article.

Free tissue transfer is a more complex procedure requiring a microvascular anastomosis between the recipient site and donor site artery and vein after they've been transferred.[20] Perforator flaps are named based on the blood vessels that perforate the adjacent muscle. The perforating vessels are dissected free from the muscle. These flaps are at higher risk for vascular compromise and require closer postoperative monitoring. The use of perforator or muscle-sparing flaps, a newer procedure, has become common because these flaps don't require the sacrifice of the entire accompanying muscle and can minimize donor site morbidity, such as weakness, bulge, and hernia.

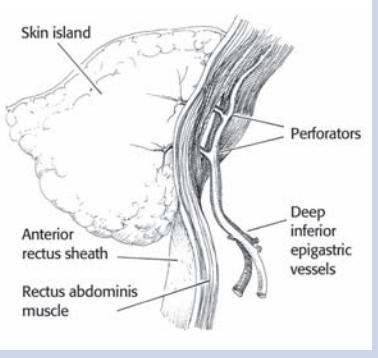
All free flaps require an anastomosis to a recipient site artery and vein. In the case of breast reconstruction, the recipient site vessels usually include the internal mammary or the thoracodorsal artery and vein.[21] Free flaps must be closely monitored postoperatively to ensure that the arterial and venous anastomosis remains patent and that the flap is well perfused. Anastomotic disruption, a true surgical emergency requiring a return to the OR, can result in total flap failure if it's not detected and treated early. For details on free flaps commonly used for breast reconstruction, see *Understanding types of flaps*.

Postoperative patient care

Immediately following free flap breast reconstruction, the patient is transported to the postanesthesia care unit (PACU) or ICU. Priorities include ensuring the patient's recovery from anesthesia and maintaining optimal perfusion of the flap. Several postoperative factors can result in anastomotic failure, including systemic hypotension, hypothermia, externally applied pressure, patient position, infection, and medications such as vasopressors.[22,23]

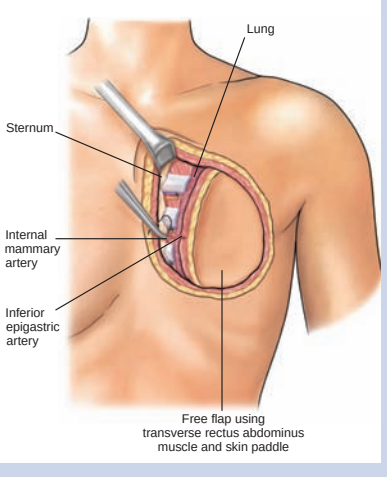
Understanding types of

- **The DIEP flap.** The deep inferior epigastric perforator (DIEP) flap is the most common free flap used for breast reconstruction.[5,6] This flap is composed of skin and fat from the lower abdomen but doesn't include any of the underlying rectus abdominis muscle. The deep inferior epigastric artery and vein are dissected away from the



muscle, preserving the continuity and innervation of the rectus abdominis. The DIEP flap typically includes one to three perforating vessels that communicate with the deep inferior epigastric artery and vein.[5,6]

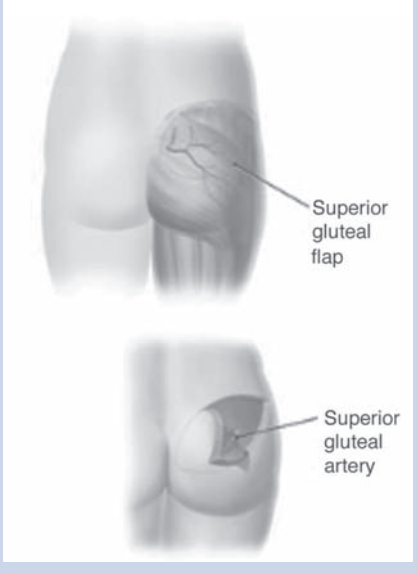
- **Muscle-sparing free TRAM flap.** The muscle-sparing (MS) free transverse rectus abdominus myocutaneous (TRAM) flap is similar to the DIEP flap except that it includes a small segment of the rectus abdominis muscle.[7-9] The benefit of this flap is that it typically includes more perforating arteries and veins within the muscle segment,



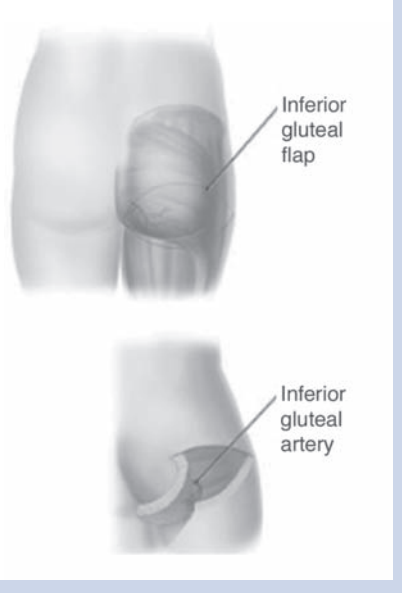
flaps for breast reconstruction

which optimizes perfusion. This flap is chosen when the flap volume requirements exceed the perfusion capacity obtained from one or two perforating vessels or when the patient is obese and the thickness of the flap precludes using a DIEP flap that will be thoroughly perfused. Obese patients with a very thick fat layer require a more robust perfusion.[7-9]

- **SIEA flap.** The superficial inferior epigastric artery (SIEA) perforator flap isn't a true perforator flap because the superficial inferior epigastric artery and vein don't perforate any muscle; however, it's similar to the DIEP and the MS free TRAM flaps in that the same lower abdominal skin and fat are used.[10,11] The SIEA flap doesn't violate the integrity of the anterior rectus sheath or the rectus abdominis muscle. Although functionally desirable, this flap is used less often because the artery and vein aren't present in all patients and when present, are less predictable because of their smaller caliber.[20] The SIEA flap can therefore perfuse only a limited portion of the abdominal territory necessitating a smaller flap that's associated with a higher degree of adverse events related to the anastomosis because of the smaller caliber of these vessels.[10,11]
- **SGAP flap.** The superior gluteal artery (SGAP flap) is a true perforator flap that derives its blood supply from the superior gluteal artery and vein.[12,13] The flap territory or donor site is located along the upper buttock. This flap is considered one of the more difficult to harvest because the superior gluteal vessels are thin and short, have multiple branches, and traverse deep through the gluteus maximus and medius muscles. The incision is generally oriented transversely or obliquely to capture the perforators and to generate enough volume. A closed suction drain is used to prevent postoperative seroma.[12,13]



- **IGAP flap.** The inferior gluteal artery (IGAP flap) is also a true perforator flap that derives its vascularity from the inferior gluteal artery and vein.[12-14] In contrast to the SGAP flap, the IGAP is associated with a longer vascular pedicle and the skin territory is along the lower gluteal region and often along the gluteal crease. In general, the adipocutaneous component of this flap is slightly less than that of the SGAP flap. Other considerations with the IGAP flap are that the sciatic nerve is often exposed during this dissection, which may result in sciatic nerve injury.[12-14,20]



- **PAP flap.** The profunda artery perforator (PAP) flap is becoming the preferred second option for many surgeons.[15] This flap derives its blood supply from the profunda femoris artery and vein, which have several associated perforators within the posterior compartment of the thigh. The gluteal donor site is often considered as an alternative to the abdomen; it's ideally suited for women with small to moderate-sized breasts who have mild-to-moderate lipodystrophy in the posterior thigh. The flap is harvested transversely from the upper posterior thigh and the incision is typically concealed within the gluteal crease. This flap offers advantages over gluteal flaps and medial thigh flaps: lymphedema risk is minimal, pedicle length is increased, and gluteal contour isn't affected.[15]
- **TUG/DUG flap.** The transverse upper gracilis (TUG) flap is designed from the upper medial thigh. When it's oriented diagonally, it's called a diagonal upper gracilis (DUG) flap.[16,17] Typically the gracilis artery is associated with a venae comitantes.[46] The saphenous vein is included into the flap for additional venous drainage if necessary. Candidates for these flaps include women with insufficient abdominal tissue who have an excess of skin and fat in the medial thigh region.[16,17]

Wolters Kluwer sources: *DIEP flap:* Makary MA, Cooper MA. *Surgery Review.* 3rd ed; 2014. *TRAM flap:* Fischer JE, Jones DB, Pomposelli FB, et al. *Fischer's Mastery of Surgery.* 6th ed; 2012. *SGAP and IGAP flaps:* Feig BW, Ching DC. *The M.D. Anderson Surgical Oncology Book.* 5th ed; 2011. *TUG flap:* Strauch B, Yu H-L. *Atlas of Microvascular Surgery.* Vol. 2. 4th ed.

Consider using Enhanced Recovery After Surgery (ERAS) protocols.[24] (See *What's Enhanced Recovery After Surgery?*) Monitor the patient's vital signs carefully. Assess for hypotension and hypothermia and compare with preoperative values. Prevention of hypotension (<90/50) and hypothermia (<36° C or 96.8° F) is important to maintain adequate blood flow through the anastomosis. Notify the surgeon immediately of any significant deviation from normal to help prevent flap necrosis, flap failure, and removal of the flap.

A fresh microvascular anastomosis may be predisposed to thrombus formation when blood flow is sluggish. If a patient becomes hypotensive, administer fluid resuscitation as prescribed. Epinephrine-containing solutions aren't advised because they can cause vasoconstriction and reduce blood flow through the anastomosis. The patient's room temperature is usually maintained at approximately 70°F (21°C); however, some surgeons may prefer to keep the room warmer to prevent vasoconstriction and promote blood flow.

Anticoagulation in the form of I.V. heparin or dextran isn't usually necessary following free flap reconstruction.[25] Studies show no benefit in terms of optimizing flap survival, but indiscriminate use may increase the incidence of postoperative bleeding or hematoma formation. However, subcutaneous heparin may be indicated, especially in women with a BMI over 30, to help promote good blood flow through the venous system.[26]

The nurse's role is exceptionally important in autologous microvascular breast reconstruction.

Terms of reconstruction

- **Bulge** – protrusion or abnormal contour of the abdominal donor site without a fascial defect.
- **Flap** – human tissue consisting of skin, fat, and sometimes muscle that includes an artery and vein.
- **Free tissue transfer** – a flap of tissue that's detached from its original location and transferred to a new site by reattaching the artery and vein of the recipient site to the donor site.
- **Hernia** – protrusion or abnormal contour of the abdominal donor site with a fascial defect.
- **Muscle-sparing flap** – tissue consisting of skin, fat, and a small segment of the muscle.
- **Pedicle** – the artery and vein associated with a flap.
- **Perforator flap** – tissue consisting of skin and fat only without muscle.

Patient positioning is another important nursing consideration. After any of the abdominally based free flaps, position patients in bed with the head of the bed at 30 degrees or higher to minimize the stress placed on the abdominal closure. Never place patients in the prone position because doing so may compromise circulation to the flap and jeopardize the anastomosis. In addition, when the thoracodorsal artery and vein have been used as recipient site vessels, patients should avoid lying on the surgical side to prevent compression of the anastomosis located in the axillary region. Following the implant of a gluteal or thigh-based free flap, patients may be positioned supine or in a lateral decubitus position for comfort.

Internal compression on the anastomosis or vessels from fluid collection can occlude the anastomosis. Monitor drain output closely to ensure that the patient hasn't developed a hematoma or seroma. If an abnormal amount of edema appears on the surgical side, the healthcare provider should be notified to rule out a hematoma, seroma, or compromised flap perfusion.

An abdominal binder or fitted garment may be applied postoperatively for support and comfort when the abdomen is used as the donor site. Following implantation of a gluteal free flap, apply a girdle, as prescribed. After procedures involving a thigh-based flap, a supportive and mildly compressive garment is recommended.

Pain management strategies typically include using patient-controlled analgesia and, sometimes, ERAS protocols using a multimodal analgesia strategy.[24] Patients are typically instructed to ambulate on POD 1 and encouraged to sit in a chair. Early mobilization helps to reduce the risk of deep vein thrombosis and to improve pulmonary function.[3] Following abdominal flap reconstruction,

advise patients to ambulate slightly flexed at the waist for a few days until the skin's elasticity improves. The surgical dressings are typically removed on POD 2. Patients are encouraged to shower on POD 3. Most patients are discharged home on POD 3, although some require a longer length of stay when adverse events occur. Fast-track protocols have reduced typical lengths of stay from 5 or 6 days to 3 or 4 days.[27]

Postoperative flap monitoring

One of the most critical aspects of free flap breast reconstruction is proper monitoring of the flap during the acute postoperative period that typically ranges from immediately postoperative to 3 days. The flap is typically monitored every 15 minutes for the first 4 hours while the patient is in the PACU and then every hour for the next 20 hours while on a specialized unit where close monitoring can be performed. On POD 2 and 3, flap monitoring is usually performed every 2 to 4 hours based on surgeon preference.

The critical period for flap monitoring is the first 24 hours because most anastomotic complications occur during this time (although they can also occur after that time frame).[28] Venous complications are responsible for about 80% of anastomotic issues. Problems are more common with venous rather than arterial anastomosis because the venous system is a lower pressure system that's subject to compression and kinking.

When performing a physical assessment, assess for skin color, capillary refill time, skin turgor, and skin temperature.

- **Skin color** should be the patient's natural skin tone. A pale or ashen and cool flap indicates arterial occlusion; notify the surgeon immediately of this emergency. Compromised venous circulation results in a congested flap characterized by mottled or purplish discoloration, dark bleeding with pinprick, and normal capillary refill time. (See *Congested flap*.)
- Normal **capillary refill time** is less than 2 seconds.[29] Increased capillary refill time may indicate poor perfusion.
- **Skin turgor** refers to the degree of elasticity or hydration. If the skin is pinched, well-hydrated tissue will usually immediately return to its normal flat state when the pinch is released; dehydrated tissues may have reduced turgor and return to a normal shape more slowly.[30]
- **Skin temperature** is a function of arterial inflow and venous outflow. A warm flap suggests good arterial inflow; a cool flap suggests poor arterial inflow or superficial vasoconstriction. A soft flap suggests good venous outflow; a tense flap suggests poor venous outflow. Increasing the room temperature or using a forced air patient warming system is recommended if vasoconstriction is suspected.

Special monitoring techniques

Besides physical assessment, flap monitoring may include use of external monitoring devices. External flap monitoring can be performed with various equipment such as a handheld vascular Doppler device, implantable Doppler flow probe, or near-infrared spectroscopy (NIRS).[31–40] The handheld Doppler is used by most nurses and healthcare providers to assess the perfusion of a free flap.[32,33] When using this device for monitoring free flaps postoperatively, nurses and healthcare providers must be able to differentiate the arterial and venous signal. A biphasic signal indicates an artery; a monophasic signal indicates a vein. Both must be heard when using this device. (Visit Nursing2016.com for supplemental

What's Enhanced Recovery After Surgery?

Enhanced Recovery After Surgery, or ERAS, is a multimodal perioperative care pathway designed to achieve early recovery for patients undergoing major surgery. Use of the ERAS pathway has been shown to reduce care time by more than 30% and reduce postoperative complications by up to 50%.

ERAS represents a paradigm shift in perioperative care in two ways. First, it re-examines traditional practices, replacing them with evidence-based best practices when necessary. Second, it's comprehensive in its scope, covering all areas of the patient's journey through the surgical process.

The key factors that keep patients in the hospital after surgery include the need for parenteral analgesia, the need for I.V. fluids secondary to gut dysfunction, and bed rest caused by lack of mobility. The central elements of the ERAS pathway address these key factors, helping to clarify how they interact to affect patient recovery. In addition, the ERAS pathway provides guidance to all involved in perioperative care, helping them to work as a well-coordinated team to provide the best care. The ERAS Society is a global network of experts that examines the literature for best care and provides evidence-based guidelines for such pathways.

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Congested flap

Note the mottled appearance and purplish discoloration. The leech marks and pinpricks exude dark venous blood due to the compromised venous circulation. (Photo courtesy of Maurice Y. Nahabedian, MD, FACS)

online content of an audio recording of the arterial and venous Doppler signals.)

Changes in Doppler signal intensity provide valuable information about blood flow. Common practice is to delineate the precise location of this signal on the flap surface in the OR and to mark it with a superficial suture or surgical skin marker. After a microvascular anastomosis, the flap usually needs 45 to 60 minutes to equilibrate in terms of perfusion, so a strong Doppler signal may not be audible initially on the skin surface.

On the monitoring unit, nurses can use this landmark for frequent flap evaluations. Be sure to evaluate the ultrasound findings along with clinical assessment findings.

Venous augmentation maneuvers can also be used to ensure adequate flap drainage. This is easily assessed with the handheld Doppler by pressing on the flap at a point remote from the Doppler signal and listening for an exaggerated or augmented venous signal. This can be performed by the physician or the nurse.

Implantable Doppler flow probes have become more popular in free flap reconstruction, especially when the free flap is buried, such as with a nipple-sparing mastectomy.[34–36] An implantable Doppler composed of a fiberlike probe is placed adjacent to the microvascular anastomosis. As with the handheld Doppler, this device produces audible monophasic and biphasic signals. Once the critical period of flap monitoring is complete, the probe is pulled out or cut at the level of the skin at the physician's discretion.

NIRS for monitoring free flaps has received considerable attention over the past several years.[37-40] This technology permits continuous monitoring of oxygen saturation within the flap's cutaneous layer. A flat surface probe that emits near-infrared light

Changes in Doppler signal intensity provide valuable information about blood flow.

is placed on the skin. This probe can detect the hemoglobin content in the surface vessels. The light has a maximum penetration depth of 2 cm (0.8 in). The probe is linked to a computer that translates the data into a linear measurement. This measurement should be relatively constant for a given flap. The device measures oxygen saturation and signal strength. Oxygen saturation varies from patient to patient; what's important is that it remains constant. The device can detect alterations in venous or arterial flow immediately, usually before clinical signs of altered flap perfusion become evident. An abrupt drop in saturation from baseline represents an alteration in perfusion and requires notifying the surgical team. Real-time oxygen saturation is updated every 4 seconds, and oxygen saturation over time is recorded graphically.[37-40]

Clinical application of NIR has been encouraging. Keller has used NIR in 145 patients and 208 flaps. All patients were monitored intraoperatively and for 36 hours postoperatively.[40] Of the 208 flaps, 5 demonstrated abnormalities in the spectroscopy measurements. All of these flaps were salvaged in part because of the early diagnosis of altered perfusion.

Treating compromised flaps

When alterations in perfusion occur, the patient is prepared for surgical exploration. A musculocutaneous flap has about a 2-hour window of ischemia before muscle fibers are irreversibly damaged.[41] With a perforator flap, this window is increased to 3 to 6 hours due to the lack of muscle.[41] Because the metabolic activity of skin and fat is less than that of muscle, these tissues can better tolerate ischemia for a longer period.[41]

Flap salvage has been demonstrated to be best when compromised flow occurs within the first 24 hours of the anastomosis (83.7%).[42] Successful salvage is less between days 1 and 3 and beyond 4 days.[42] In the OR, the artery and vein are exposed and the anastomosis is evaluated visually and with a handheld Doppler. Any fluid collection is evacuated. The pedicle is inspected for bleeding, twisting, or kinks. An occluded vein will be tense and dilated. An occluded artery will be pulseless. The suture line may need to be taken down and redone to correct the impaired anastomosis. An embolectomy catheter can help to remove a venous or arterial thrombus. Fibrinolytic agents may be administered directly into the artery of the flap to improve arterial perfusion within the flap.[43] A secondary or accessory venous anastomosis may be needed to augment venous drainage. If perfusion isn't possible or if the ischemic changes

are too advanced, the flap is removed and the skin is closed.

In the event of sluggish or insufficient venous outflow, medicinal leech therapy, or hirudotherapy, may be considered and implemented when the patient is back on the unit.[44] Leeches are considered only after the patient is returned to the OR where sluggish venous outflow is confirmed. Medicinal leech therapy is used to relieve venous congestion resulting from poor venous outflow in the presence of adequate arterial inflow.[45] Leech saliva contains a potent anticoagulant, hirudin, which causes continuous oozing from the skin puncture sites. (For more information, see "Medicinal Leech Therapy: New Life for an Ancient Treatment," in the November issue of *Nursing2015*.)

Patient education

Educating patients before and after these procedures is an important nursing responsibility. Preoperative education and information focus on what to expect during and after the surgery. Patients can become depressed due to the stress of surgery and the loss of the natural breast. Weight control issues are common in the immediate postoperative period because of fluid shifts but will subside in a week or so. Tightness around the abdominal area and incision is common, and patients typically walk with the waist flexed about 30 degrees for a few days following reconstruction using an abdominal flap. Drainage catheters will be present for about 1 week, so instruct patients about drain care, emphasizing the importance of accurate documentation of output. Follow-up visits are usually scheduled for 1 and 5 weeks after the reconstruction, and secondary procedures such as contour modification and nipple reconstruction are usually scheduled at the 3-month mark if needed.

Educate patients about prescribed medications such as opioids, antiemetics, stool softeners, and antibiotics, which are usually needed for a few days. Also review surgical site care. Butterfly closures are usually placed over the incisions and are usually removed or fall off by POD 7. After that, the incisions are usually left open to air.

Patients are instructed to limit their physical activity and to avoid heavy lifting for 4 to 6 weeks. They can usually resume their usual diet the day after surgery.

Nursing care is key

Nurses play an integral role in the postoperative management of the patient with a free tissue transfer. They monitor the progress of a flap with both physical assessment and special monitoring techniques. Early identification of compromised perfusion is critical to ensure the patient's prompt return to the OR for flap salvage. ■

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