Consensus Review of Optimal Perioperative Care in Breast Reconstruction: Enhanced Recovery after Surgery (ERAS) Society Recommendations

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Background: Enhanced recovery following surgery can be achieved through the introduction of evidence-based perioperative maneuvers. This review aims to present a consensus for optimal perioperative management of patients undergoing breast reconstructive surgery and to provide evidence-based recommendations for an enhanced perioperative protocol.
Methods: A systematic review of meta-analyses, randomized controlled trials, and large prospective cohorts was conducted for each protocol element. Smaller prospective cohorts and retrospective cohorts were considered only when higher level evidence was unavailable. The available literature was graded by an international panel of experts in breast reconstructive surgery and used to form consensus recommendations for each topic. Each recommendation was graded following a consensus discussion among the expert panel. Development of these recommendations was endorsed by the Enhanced Recovery after Surgery Society.
Results: High-quality randomized controlled trial data in patients undergoing breast reconstruction informed some of the recommendations; however, for most items, data from lower level studies in the population of interest were considered along with extrapolated data from high-quality studies in non–breast reconstruction populations. Recommendations were developed for a total of 18 unique enhanced recovery after surgery items and are discussed in the article. Key recommendations support use of opioid-sparing perioperative medications, minimal preoperative fasting and early feeding, use of anesthetic techniques that decrease postoperative nausea and vomiting and pain, use of measures to prevent intraoperative hypothermia, and support of early mobilization after surgery.
Conclusion: Based on the best available evidence for each topic, a consensus review of optimal perioperative care for patients undergoing breast reconstruction is presented. (*Plast. Reconstr. Surg.* 139: 1056e, 2017.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, V.

Recovery can be improved in breast surgery.[1] Enhanced recovery after surgery represents evidenced-based care elements that have revolutionized perioperative care in colorectal surgery,[2] thereby reducing morbidity and length of stay, and improving survival.[3–5] This guideline (Table 1) was developed by an international expert panel of physicians under the guidance of the Enhanced Recovery after Surgery

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Table 1. ERAS Society Enhanced Recovery after Surgery Recommendations for Perioperative Care in Breast Reconstruction

Item	Recommendation	Evidence Level	Recommendation Grade
1. Preadmission information, education, and counseling	Patients should receive detailed preoperative counseling.	Moderate	Strong
2. Preadmission optimization	For daily smokers, 1 mo of abstinence before surgery is beneficial. For patients who are obese, weight reduction to achieve a BMI ≤30 kg/m^2 before surgery is beneficial. For alcohol abusers, 1 mo of abstinence before surgery is beneficial. For appropriate groups, referral should be made to resources for these behavior changes.	Moderate (smoking) High (obesity) Low (alcohol)	Strong Strong Strong
3. Perforator flap planning	If preoperative perforator mapping is required, CTA is recommended.	Moderate	Strong
4. Perioperative fasting	Preoperative fasting should be minimized and patients should be allowed to drink clear fluids up to 2 hr before surgery.	Moderate	Strong
5. Preoperative carbohydrate loading	Preoperative maltodextrin-based drinks should be given to patients 2 hr before surgery.	Low	Strong
6. Venous thromboembolism prophylaxis	Patients should be assessed for venous thromboembolism risk. Unless contraindicated, and balanced by the risk of bleeding, patients at a higher risk should receive low-molecular-weight heparin or unfractionated heparin until ambulatory or discharged. Mechanical methods should be added.	Moderate	Strong
7. Antimicrobial prophylaxis	Chlorhexidine skin preparation should be performed and intravenous antibiotics covering common skin organisms should be given within 1 hr of incision.	Moderate	Strong
8. Postoperative nausea and vomiting prophylaxis	Women should receive preoperative and intraoperative medications to mitigate postoperative nausea and vomiting.	Moderate	Strong
9. Preoperative and intraoperative analgesia	Women should receive multimodal analgesia to mitigate pain.	Moderate	Strong
10. Standard anesthetic protocol	General anesthesia with TIVA is recommended.	Moderate	Strong
11. Preventing intraoperative hypothermia	Preoperative and intraoperative measures, such as forced air, to prevent hypothermia should be instituted. Temperature monitoring is required to ensure the patient's body temperature is maintained above 36°C.	Moderate	Strong
12. Perioperative intravenous fluid management	Overresuscitation or underresuscitation of fluids should be avoided and water and electrolyte balance should be maintained. Goal-directed therapy is a useful method of achieving these goals. Balanced crystalloid solutions, rather than saline, is recommended. Vasopressors are recommended to support fluid management and do not negatively affect free flaps.	Moderate	Strong
13. Postoperative analgesia	Multimodal postoperative pain management regimens are opioid-sparing and should be used.	High	Strong
14. Early feeding	Patients should be encouraged to take fluids and food orally as soon as possible, preferably within 24 hr after surgery.	Moderate	Strong
15. Postoperative flap monitoring	Flap monitoring within the first 72 hr should occur frequently. Clinical evaluation is sufficient for monitoring, with implantable Doppler devices recommended in cases of buried flaps.	Moderate	Strong
16. Postoperative wound management	For incisional closure, conventional sutures are recommended. Complex wounds following skin necrosis are treatable with débridement and negative-pressure wound therapy.	High (sutures) Moderate (NPWT)	Strong
17. Early mobilization	Patients should be mobilized within the first 24 hr after surgery.	Moderate	Strong
18. Postdischarge home support and physiotherapy	Early physiotherapy, supervised exercise programs, and other supportive care initiatives should be instituted after discharge.	Moderate	Strong

BMI, body mass index; CTA, computed tomographic angiography; TIVA, total intravenous anesthesia; NPWT, negative-pressure wound therapy.

(ERAS) Society (www.erassociety.org) to formalize enhanced recovery after surgery protocols for breast reconstruction.[1,6]

METHODS

An international team of breast reconstruction experts teleconferenced monthly from January through June of 2015. Guideline items were developed and the MEDLINE and Cochrane databases were searched from 1965 through January of 2015. Key words included "breast cancer," "mastectomy," "breast neoplasm," and "breast carcinoma"; combined with "reconstruction," "reconstructive surgery," "implant," "flap," "expander," "acellular dermal matrix," "mesh," and "graft." The resulting citations were combined with additional topic-specific key words. Reference lists of all eligible articles were handsearched for additional studies.

All titles and abstracts were screened to identify potentially relevant articles. Any discrepancies in the interpretation of articles were resolved during working group meetings. Where available, randomized controlled trials and systematic reviews in patients undergoing breast reconstruction were used. Lower level data were considered where no high-level data were available. Only the most recent, highest level evidence is cited. Study quality was assessed using the criteria developed by the Centre for Evidence Based Medicine (Oxford, England).[7]

Recommendations were developed using an evidence-based consensus approach. Using the results of the systematic review, the panel provided expert interpretation of the evidence and discussed and modified each recommendation until no further modifications were required and consensus was reached. Recommendations were graded as "weak" or "strong" according to the Grading of Recommendations, Assessment, Development and Evaluation system.[8]

EVIDENCE BASE AND RECOMMENDATIONS

ERAS Items

Preadmission Information, Education, and Counseling

Providing surgical and anesthetic information preoperatively improves recovery by reducing fear and anxiety.[9] Information about the procedure assists patients in reaching postoperative milestones and has been shown to reduce complications by improving perioperative feeding, pain control, and respiratory physiotherapy.[10]

Women value presurgical education about breast reconstruction,[11] yet many feel that they do not receive adequate information,[12] leading to dissatisfaction with their reconstruction decisions.[13,14] Patient involvement in co–decision-making about breast reconstruction leads to higher satisfaction, independent of the reconstruction type.[15] Sufficient information improves knowledge and lessens decision regret.[16,17] Preconsultation educational group interventions are one method of reducing decisional conflict.[17]

1. **Summary and recommendation:** Patients should receive detailed preoperative counseling.
2. **Evidence level:** Moderate.
3. **Recommendation grade:** Strong (low harm).

Preadmission Optimization

Smoking predisposes women to postmastectomy reconstruction complications,[18–20] including mastectomy skin flap necrosis, abdominal flap necrosis, and hernias.[21] Former smokers (i.e., those who quit 3 to 4 weeks preoperatively) and nonsmokers have similar complication rates.[22,23]

Obesity (i.e., body mass index >30 kg/m^2) increases flap loss and donor-site morbidity.[24–27] National Surgical Quality Improvement Program data of 2899 women with free flap reconstructions have revealed a strong correlation between obesity and surgical-site infections, venous thromboembolism, and other complications.[28,29] Patients should therefore be encouraged to lose weight before surgery. Muscle-preserving abdominal flaps [i.e., deep inferior epigastric perforator (DIEP) flap] reduce abdominal wall complications compared with non–muscle-sparing flaps [i.e., free or pedicle transverse rectus abdominis musculocutaneous (TRAM) flap] in obese patients.[27,30]

Regarding diabetes, National Surgical Quality Improvement Program data on 29,736 women with breast reconstruction have linked type 2 diabetes mellitus to surgical complications (OR, 1.51) and type 1 diabetes mellitus to medical (OR, 1.82) and overall complications (OR, 1.85).[31] Poor glycemic control is associated with worse outcomes in primary closure of surgical wounds in high-risk patients.[32]

Heavy alcohol consumption (five or more drinks on each of 5 or more days in the past 30 days)

is also associated with poor outcomes, particularly attributable to surgical-site infections. National Surgical Quality Improvement Program data on 9315 patients undergoing immediate reconstruction have revealed heavy alcohol consumption as an independent risk factor for surgical-site infections.[33]

1. **Summary and recommendation:** For daily smokers, 1 month of abstinence before surgery is beneficial. For patients who are obese, weight reduction to achieve a body mass index less than or equal to 30 kg/m^2 before surgery is beneficial. For alcohol abusers, 1 month of abstinence before surgery is beneficial. For appropriate groups, referral should be made to resources for these behavior changes.
2. **Evidence level:** Moderate for smoking; high for obesity; low for alcohol.
3. **Recommendation grade:** Strong for all (high benefit, low harm).

Perforator Flap Planning

Meta-analysis has shown the benefit of computed tomographic angiography over Doppler ultrasonography in mapping the dominant DIEP perforators; benefits include reduced flap complications, donor-site morbidity, and operative times.[34] Risks include potential contrast allergy, nephrotoxicity, and exposure to radiation.[35] Modern computed tomographic angiography scanning protocols have reduced radiation exposure.[36] Magnetic resonance angiography avoids radiation, but image quality remains a challenge that is improving with a variety of technical refinements.[37–39]

1. **Summary and recommendation:** If preoperative perforator mapping is required, computed tomographic angiography is recommended.
2. **Evidence level:** Moderate.
3. **Recommendation grade:** Strong.

Preoperative Fasting

A Cochrane review of 22 randomized controlled trials has shown that drinking clear fluids 2 hours preoperatively is safe and does not increase the risk of regurgitation or aspiration.[40] Existing ERAS guidelines recommend a 6-hour fast for solid foods and a 2-hour fast for clear liquids before general anesthesia.[41] Recommendations have not been applied to patients at increased risk of delayed gastric emptying.

1. **Summary and recommendation:** Preoperative fasting should be minimized and patients should be allowed to drink clear fluids up to 2 hours before surgery.
2. **Evidence level:** Moderate (based on extrapolated data).
3. **Recommendation grade:** Strong.

Preoperative Carbohydrate Loading

Taken 2 hours before surgery, maltodextrin-based drinks (400 ml) specifically designed and tested for preoperative use have positive metabolic effects, such as increasing insulin sensitivity and reducing preoperative thirst and anxiety.[42–44] Carbohydrate loading reduces the catabolic effects of surgery, including losses of nitrogen and protein, lean body mass, and muscle strength,[45–48] which has translated into shorter hospital stays.[49] In patients with well-controlled type 2 diabetes, a carbohydrate drink given up to 3 hours before surgery alongside their normal medication does not appear to delay gastric emptying and will allow glucose concentrations the additional time required (i.e., 180 minutes versus 120 minutes in healthy subjects) to return to baseline.[50]

1. **Summary and recommendation:** Preoperative maltodextrin-based drinks should be given to patients 2 hours before surgery.
2. **Evidence level:** Low (based on extrapolated data).
3. **Recommendation grade:** Strong (low risk of harm) in the general patient population.

Prophylaxis against Venous Thromboembolism

National Surgical Quality Improvement Program data on 68,285 patients have shown that venous thromboembolism in reconstruction patients approaches twice that of lumpectomy or mastectomy alone (0.41 percent versus 0.13 percent and 0.29 percent; $p < 0.0001$).[28] Retrospective reviews have reported rates as high as 3.4 percent.[51,52] Nationwide Inpatient Sample data on 35,883 patients undergoing autologous reconstruction have revealed a lower rate of venous thromboembolism (0.13 percent); however, the rate of venous thromboembolism was highest for TRAM flap reconstruction at 0.26 percent.[52] Immediate breast reconstruction is an independent risk factor for venous thromboembolism.[53]

Patients undergoing mastectomy and immediate reconstruction meet the criteria for "higher" risk of venous thromboembolism and may be

considered "highest" risk if they are obese or elderly, according to the American Society of Plastic Surgeons Executive Committee–approved Caprini Risk Assessment Module.[54,55] For this patient population, pharmacologic anticoagulation with or without mechanical methods (i.e., intermittent pneumatic compression) is recommended.[55,56] Prophylaxis should begin before surgery and continue for at least 7 to 10 days.[57] Extended prophylaxis up to 4 weeks reduces the risk of radiologically confirmed venous thromboembolism following major abdominopelvic surgery.[58] A prospective cohort and two large retrospective cohorts on low-molecular-weight heparin did not report increased bleeding risk[58–60]; however, in breast surgery specifically, some studies have shown that low-molecular-weight heparin has a higher bleeding risk than unfractionated heparin.[61,62]

1. **Summary and recommendation:** Patients should be assessed for venous thromboembolism risk. Unless contraindicated, and balanced by the risk of bleeding, patients at a higher risk should receive low-molecular-weight heparin or unfractionated heparin until they are ambulatory or discharged. Mechanical methods should be added.
2. **Evidence level:** Moderate.
3. **Recommendation grade:** Strong.

Antimicrobial Prophylaxis

Infection rates following mastectomy are higher than those expected for clean surgery (i.e., 3 to 15 percent versus 2 percent).[63,64] The risk of infection is further increased with the addition of a prosthesis or a flap.[65–67] National Surgical Quality Improvement Program data on 2899 patients with flaps and 12,163 patients with tissue expanders have revealed that patient factors such as hypertension, body mass index, and smoking increase infection risk after breast reconstruction.[29,68]

Prophylactic antibiotics reduce surgical-site infections.[69] Antibiotics against common skin organisms (i.e., cephalosporins) should be administered 1 hour before incision.[70,71] The majority of data support the perioperative use of prophylactic antibiotics.[64,65,70–72] Despite the common practice to use postoperative antibiotics until drains are removed, data from a well-conducted systematic review have shown that more than 24 hours of antibiotics appears to be associated with higher rates of surgical-site infections in acellular dermal matrix reconstructions.[65] It should be noted that this was a meta-analysis of observational studies and not randomized controlled trials. Aside from this meta-analysis, there are no other published data to inform duration of antibiotic use, and further research is needed. Prolonged use of antibiotics beyond 24 hours has not been proved beneficial.[73–75]

Chlorhexidine-based antiseptics immediately before surgery decrease surgical-site infections.[76,77] In implant reconstruction, bacterial burden can be reduced through antibiotic irrigation of the breast pocket, which may decrease capsular contracture but has not been proven to decrease surgical-site infections.[78] Methicillin-resistant *Staphylococcus aureus* infections are increasing; however, a Cochrane review did not support a switch to glycopeptide antibiotics (i.e., vancomycin).[69]

1. **Summary and recommendation:** Chlorhexidine skin preparation and intravenous antibiotics covering common skin organisms should be given within 1 hour of incision.
2. **Evidence level:** Moderate (based on extrapolated data).
3. **Recommendation grade:** Strong.

Preoperative and Intraoperative Prophylaxis against Postoperative Nausea and Vomiting

A meta-analysis demonstrated the superiority of 5-hydroxytryptamine-3 receptor antagonists over placebo in reducing postoperative nausea and vomiting in breast surgery.[79] Steroids reduce postoperative nausea and vomiting and pain, and a combination of 5-hydroxytryptamine-3 antagonists and steroids is superior to either alone.[80–82] Neurokinin-1 receptor antagonists provide even further reduction in postoperative nausea and vomiting compared with 5-hydroxytryptamine-3, but must be given preoperatively.[83–88]

1. **Summary and recommendation:** Women should receive preoperative and intraoperative multimodal medications to mitigate postoperative nausea and vomiting.
2. **Evidence level:** Moderate.
3. **Recommendation grade:** Strong (high benefit, low harm).

Preoperative and Intraoperative Analgesia

Gabapentin[89–91] reduces postoperative analgesic requirements and pain in women undergoing mastectomy. Nonsteroidal antiinflammatory drugs offer effective analgesia given preoperatively or intraoperatively, and decrease chronic breast pain without

increasing bleeding complications.[92,93] Perioperative cyclooxygenase-2 inhibitors have a similar beneficial effect.[94] Bupivacaine infiltration in the area of planned surgical incision for mastectomy decreases pain intensity and opiate demand after surgery.[95]

Adenosine,[96] systemic magnesium,[97] venlafaxine,[98] and clonidine[99] are effective analgesics given preoperatively. Preoperative ketamine does not moderate postoperative pain.[100] The majority of data were extrapolated from breast surgery, but for longer duration operations such as free tissue transfer reconstructions, the preoperative advantage may be diminished; thus, these medications may be best given intraoperatively.

1. **Summary and recommendation**: Women should receive multimodal analgesia to mitigate pain.
2. **Evidence level**: Moderate (based on extrapolated data).
3. **Recommendation grade**: Strong (high benefit, low harm).

Standard Anesthetic Protocol

Retrospective data have suggested that the use of regional anesthesia, compared with general anesthesia, lowers the recurrence of subsequent breast cancer,[101] potentially through natural killer T cells.[102] Similar early findings in prostate and colorectal cancer have led to a large prospective, multicenter, randomized, controlled trial that is currently investigating this hypothesis for breast cancer patients.[103–105] The findings from this study, when completed, may have a major impact on the choice of anesthetic technique.

There are three common modalities for maintenance of anesthesia during breast surgery, including general anesthesia with total intravenous anesthesia, general anesthesia with a volatile anesthetic, and regional anesthesia. Regional anesthesia decreases postoperative narcotic use[106–108] but does not decrease pain, nausea, sedation, time to ambulation, or hospital stay duration.[107] General anesthesia is the most frequently used modality of anesthesia for breast surgery; general anesthesia under total intravenous anesthesia decreases postoperative nausea and vomiting compared with a volatile anesthetic.[109,110]

1. **Summary and recommendation**: General anesthesia with total intravenous anesthesia is recommended.
2. **Evidence level**: Moderate.
3. **Recommendation grade**: Strong.

Preventing Intraoperative Hypothermia

Maintaining a core body temperature over 36°C reduces multiple complications.[111] The Surgical Care Improvement Project linked hypothermia with impaired wound healing, prolonged hospitalization, and three-fold higher wound infection rates.[112] A systematic review in multiple surgery types showed that warming decreases wound infection.[1] Attention to active thermal therapy is required when using intermittent pneumatic compression devices, which move cooled extremity blood to the core.[113] Preoperative patient-warming strategies augment intraoperative warming strategies.[114,115] Simply prewarming the operating room itself is not enough.[116]

Forced-air warming has an excellent safety profile and efficacy in a systematic review of multiple randomized controlled trials.[117] Forced air is superior to resistive underbody warming.[118,119] Circulating water garments,[120] thermal mattresses,[121–123] and circulating-water leg wraps[124] offer some increase in temperature; however, the safety, low cost, and ease of use of forced-air warming supplant other systems.

Warmed intravenous fluid reduces hypothermia in short surgical procedures,[125] but in orthopedic surgery, warming irrigation fluid is insufficient to prevent hypothermia.[126] In liver transplantation, humidification of inspired gas warms the patient effectively.[127] Amino acid and magnesium infusions reduce shivering.[128,129]

1. **Summary and recommendation:** Preoperative and intraoperative measures, such as forced air, to prevent hypothermia should be instituted. Temperature monitoring is required to ensure the patient's body temperature is maintained above 36°C.
2. **Evidence level**: Moderate (based on extrapolated data).
3. **Recommendation grade**: Strong.

Perioperative Intravenous Fluid Management

A randomized controlled trial demonstrated that a restricted IV fluid regimen decreases complications in abdominal surgery by 59 percent.[130] Optimizing fluid balance begins by taking clear fluids orally up to 2 hours preoperatively. Goal-directed therapy (i.e., intensive monitoring and aggressive management of perioperative hemodynamics) improves length of stay and complication rates[131–134]; however, a recent meta-analysis showed that the benefit of goal-directed therapy was muted in patients managed in an enhanced recovery after

surgery setting.[135] Measurement of venous oxygen saturation has utility in major surgery, but its use in breast surgery has not been established.[136] Balanced crystalloid solutions are superior to 0.9% saline for electrolyte balance.[137,138]

Overresuscitation contributes to cardiopulmonary events, wound infection, poor wound healing, and increased length of hospital stay.[139–141] It is especially harmful in microvascular reconstruction.[142–145] Underresuscitation increases postoperative microvascular thrombosis.[137] Vasopressors to maintain blood pressure have been historically avoided in flap patients, but have been found to be safe in normovolemic patients.[146–149] Dextran-40, traditionally used to reduce the risk of microvascular thrombosis, lacks efficacy and has a high complication rate.[150]

1. **Summary and recommendation:** Overresuscitation or underresuscitation of fluids should be avoided, and water and electrolyte balance should be maintained. Goal-directed therapy is a useful method to achieve these goals. Balanced crystalloid solutions rather than saline is recommended. Vasopressors are recommended to support fluid management and do not negatively affect free flaps.
2. **Evidence level**: Moderate for all (based on extrapolated data).
3. **Recommendation grade**: Strong.

Postoperative Analgesia

Postoperative pain control needs to be adequate to facilitate early mobilization. Reducing the contribution of opioids to the analgesic regimen reduces postoperative nausea and vomiting and constipation, effectively facilitating early mobilization. A meta-analysis of intravenous acetaminophen (paracetamol) has shown that it reduces pain in only 37 percent of patients.[151] Although acetaminophen alone is less effective than nonsteroidal antiinflammatory drugs,[152] Cochrane data from three randomized controlled trials have demonstrated that the combination is more effective than either alone.[153]

Nonsteroidal antiinflammatory drugs reduce the need for narcotics with minimal surgical-site bleeding risk in multiple randomized controlled trials.[154–156] Cyclooxygenase-2 inhibitors reduce the potential for gastrointestinal tract bleeding and surgical-site bleeding[157–159] but can increase the risk of stroke or myocardial infarction in patients with ischemic heart disease.[160] Preoperative or postoperative gabapentin reduces narcotic requirements.[161–163]

Regional or local blocks minimize pain and sedation. Continuous bupivacaine infusion catheters reduce opioid requirements in several studies.[164–166] Randomized controlled trial evidence shows that transversus abdominis plane blocks decrease abdominal donor-site pain in flap patients.[106,167] A single injection of liposomal bupivacaine lasts for several days, potentially avoiding the need for catheter-based infusions.[168] Randomized controlled trial data on pulse electromagnetic field therapy in TRAM flap patients have shown decreases in pain and narcotic use.[169]

1. **Summary and recommendation**: Multimodal postoperative pain management regimens are opioid-sparing and should be used.
2. **Evidence level**: High.
3. **Recommendation grade**: Strong.

Early Feeding

An early oral or enteral diet within 24 hours of surgery is safe and associated with improved wound healing, reduced infection, and reduced hospital stay.[170] The benefits of early refeeding[171] need to be weighed against the rare risk of a potential urgent return to the operating room, whereby a fed patient is at risk for aspiration. The urgent return arises in 2 to 5 percent of patients who develop a microvascular thrombosis in their free flap breast reconstruction.[172–174] Modern anesthetic techniques should mitigate the risk of aspiration in this uncommon scenario.[175]

1. **Summary and recommendation:** Patients should be encouraged to take fluids and food orally as soon as possible, preferably within 24 hours after surgery.
2. **Evidence level**: Moderate (based on extrapolated data).
3. **Recommendation grade**: Strong.

Postoperative Flap Monitoring

Microvascular thrombosis occurs in the anastomosis of the free flap in 2 to 5 percent of cases and usually occurs within the first 72 hours.[172–174] Most commonly (60 to 74 percent), a microvascular thrombosis will occur venously.[173,176] Salvage of a compromised free flap is improved with earlier exploration and return of flow[176,177]; therefore, routine frequent monitoring, including clinical observation (i.e., color, temperature, and capillary refill) and use of devices, is highly warranted.

Hand-held Doppler is an extension of clinical observation, as it is noninvasive and inexpensive and has widespread use.[178] Frequent monitoring is required in the first 72 hours and a reasonable monitoring protocol may include hourly monitoring for the first 24 hours, every 2 hours for the next 24 hours, then every 3 to 4 hours for the next 24 hours.

Implantable Doppler monitors have excellent sensitivity in detecting flap compromise, but can detach and thus carry a higher false-positive rate than clinical observation.[179] Studies comparing clinical observation with or without implantable Doppler monitors, are equivocal in terms of improved flap salvage.[181,182] For buried flaps, implantable Doppler monitoring offers the only objective measure.[178] Other methods of monitoring flaps include a venous coupler with an embedded implantable Doppler device, laser Doppler monitoring, infrared spectroscopy, tissue oximetry, and microdialysis.[183–185]

1. **Summary and recommendation**: Flap monitoring within the first 72 hours should occur frequently. Clinical evaluation is sufficient for monitoring, with implantable Doppler monitoring recommended in cases of buried flaps.
2. **Evidence level**: Moderate.
3. **Recommendation grade**: Strong (low harm).

Postoperative Wound Management

Breast and abdominal incisions following breast reconstruction are generally closed with layered intradermal absorbable sutures.[186] Antimicrobial-coated versus plain sutures do not show a significant reduction in surgical-site infections in randomized controlled trials.[187,188] Other randomized controlled trials evaluating the skin adhesive octyl-2-cyanoacrylate in breast surgery show patient preference for the adhesive but no objective difference in cosmesis or complications.[189–192] A surgical skin closure film has been found to be faster than sutures, but with no difference in complication rates.[193] An ongoing randomized controlled trial is evaluating the effect of dressing wear time (1 day versus 6 days) on surgical-site infections.[194]

Complex wounds associated with mastectomy flap, DIEP flap, or abdominal skin necrosis are recognized complications of breast reconstruction.[195,196] Negative-pressure wound therapy is an effective aid in wound management after surgical débridement, with a systematic review of breast wounds showing that 97 percent receiving negative-pressure wound therapy in conjunction with débridement healed completely.[197]

1. **Summary and recommendation:** For incisional closure, conventional sutures are recommended. Complex wounds following skin necrosis are treatable with débridement and negative-pressure wound therapy.
2. **Evidence level**: High for sutures; moderate for negative-pressure wound therapy.
3. **Recommendation grade**: Strong.

Early Mobilization

Early in-hospital mobilization improves muscle strength[198] and reduces pulmonary embolism, pneumonia, and decubitus ulcers. Early mobilization decreases length of hospitalization and improves psychological well-being.[199–205] Conversely, prolonged bed rest has been shown to reduce work capacity.[206] Prolonged inactivity combined with a catabolic state (i.e., postoperative stress) exacerbates strength and lean muscle loss.[207]

1. **Summary and recommendation**: Patients should be mobilized within the first 24 hours after surgery.
2. **Evidence level**: Moderate (based on extrapolated data).
3. **Recommendation grade**: Strong (low risk).

Postdischarge Home Support and Physiotherapy

Early physical rehabilitation improves physical and emotional recovery after mastectomy and axillary dissection.[208,209] Postoperative physical rehabilitation programs in breast cancer patients improve mobility, reduce pain, and improve quality of life.[210] Randomized controlled trial data on the effect of early supervised exercise have demonstrated that exercise leads to quicker recovery, earlier mobility, and enhanced patient comfort, but fails to improve lymphedema.[208,211]

Qualitative studies show that visiting nurses play an important role in providing physical care and delivering education and psychosocial support following TRAM flap reconstruction.[212,213] Postdischarge telephone and mobile application support are “virtual” adjuncts to in-home nursing visits and outpatient visits.[210,214]

1. **Summary and recommendation:** Early physiotherapy, supervised exercise programs, and other supportive care initiatives should be instituted after discharge.

2. **Evidence level**: Moderate (based on extrapolated data).
3. **Recommendation grade**: Strong (low harm).

CONCLUSIONS

The literature surrounding breast reconstruction has evolved from establishing oncologic safety and optimal timing, refining surgical techniques, and improving cosmesis, to the point where we now use patient-reported outcome measures[215,216] to evaluate what matters to patients. Patient-reported outcome measures show that despite our optimization of procedures, recovery is suboptimal across reconstruction types.[15]

An enhanced recovery experience has been realized in major abdominal surgery through the introduction of ERAS guidelines.[217,218] Most of the recommendations in the colorectal guideline are directly relevant and can be extrapolated to breast reconstruction. Practitioners now avoid long fasting periods, attend to patient temperature, and use multimodal pain and postoperative nausea and vomiting prevention strategies.[219,220]

These 18 recommendations represent a synthesis of the current body of literature by an international group of experts and can be applied to most patients, with the goal of providing a rapid recovery with low complication rates and decreased care time. As with any practice guideline, clinicians should use independent judgment of an individual patient's clinical circumstances to direct care. This consensus guideline is not intended to be leveraged as a rationale for funding bodies to restrict payment for care based on hospital length of stay. Rather, patient safety must be considered first and these practices should be implemented in a measured, thoughtful, and studied manner.

To effectively change practice, guidelines must be supported by strong data. Many of these recommendations can be strengthened with data from patients undergoing breast reconstruction in the setting of an ERAS protocol. For women undergoing implant-based breast reconstruction, the recently demonstrated benefits of an ERAS protocol include reduced length of stay and better quality of recovery, with no differences in complication rates or emergency room visits.[221] Minimizing care time and complications is the goal for this group of women and can be measured through audit of infection rates, deep venous thrombosis, and other outcomes; however, the recovery experience is also important and should be assessed through validated outcome measures, such as the Quality of Recovery-15 scale.[222]

These recommendations will require revision as new evidence emerges. Each recommendation alone is unlikely to change the recovery process, but bundled together and applied with good sense and care, these recommendations may transform the recovery experience for patients and for the health care system.[218]

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