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Guidelines of care for liposuction

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DISCLAIMER

Adherence to these guidelines will not ensure successful treatment in every situation. Furthermore these guidelines should not be deemed inclusive of all proper methods of care or exclusive of other methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding the propriety of any specific therapy must be made by the physician and the patient in light of all the circumstances presented by the individual patient.

INTRODUCTION/METHODOLOGY†

A task force of recognized experts was convened to determine the audience for the guideline, to define the scope of the guideline, and to identify important issues in the performance of liposuction surgery. The task force employed an evidence-based model and performed a comprehensive literature search of English-language articles and articles with English-language abstracts. The literature was evaluated and rated on the basis of the strength of the evidence

†A technical report that provides a complete description of the methodology is available at our Web site, www.aad.org, or by request at the reprint request address.

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(Table I). The task force reviewed the evidence reports and relevant articles. Recommendations were drafted and discussed, followed by a vote of all members. The draft guideline was submitted to an extensive review process, as described in the Administrative Regulations of the Guidelines/Outcomes Committee. This review includes the opportunity for review by the entire membership of the American Academy of Dermatology (AAD), followed by final approval by the AAD Board of Directors.

SCOPE

This guideline addresses the current areas of controversy related to the performance of liposuction in the United States. It is designed to provide guidance on the safe performance of tumescent liposuction surgery to dermatologists who perform this procedure. It may also inform the public debate on the safe performance of liposuction.

DEFINITIONS

Liposuction is the surgical removal of subcutaneous fat by means of aspiration cannulas, introduced through small skin incisions, assisted by suction. Synonyms include liposuction surgery, suction-assisted lipectomy, suction lipoplasty, fat suction, blunt suction lipectomy, and liposculpture.

Tumescent liposuction refers to the refinement of the procedure that was introduced in 1986. This technique involves subcutaneous infiltration of high volumes of crystalloid fluid containing low concentrations of lidocaine and epinephrine followed by suction-assisted aspiration of fat, by using small aspiration cannulas. The term *tumescent liposuction* specifically excludes the use of any additional anesthesia medications at dosages that have a significant risk for impairing the protective airway reflexes or for suppressing the respiratory drive. It is a method for performing liposuction surgery with the patient under local anesthesia.

Table I. Strength of recommendation and level of evidence

Recommendations	Strength of recommendation*	Level of evidence†	Reference Nos.
Physician qualification			
The physician performing liposuction has completed residency training or is board certified in a specialty that is recognized by the American Board of Medical Specialties and that provides education in liposuction and training in cutaneous surgery.	Unanimous task force opinion and weak evidence	L6	1-8
The physician has documented liposuction training in residency or documented training or experience at the surgical table under the supervision of an appropriately trained and experienced liposuction surgeon.	Unanimous task force opinion		
In addition to the surgical technique, training includes instruction in fluid and electrolyte balance, potential complications of liposuction, and tumescent anesthesia and other forms of anesthesia employed.	Unanimous task force opinion		
Facility			
Liposuction can be performed safely in a physician's office surgical facility, an ambulatory surgical facility, or a hospital operating room.	Unanimous task force opinion and weak evidence	L6	1, 4, 9-15
All liposuction surgeons and designated operating room staff have training in the management of acute cardiac emergencies.	Unanimous task force opinion		
Hospital privileges should not be required to perform tumescent liposuction, but a written plan for management of medical emergencies, including possible transfer, should be in place.	Unanimous task force opinion		
Preoperative evaluation			
Liposuction is contraindicated in patients with severe cardiovascular disease, severe coagulation disorders including thrombophilia, and during pregnancy.	Unanimous task force opinion		
A thorough medical history that gives special attention to any history of bleeding diathesis, emboli, thrombo-	Unanimous task force opinion and weak evidence	L6	17-19

*Recommendations are based on the following: unanimous task force opinion supported by strong to moderate levels of evidence, majority task force opinion supported by strong to moderate levels of evidence, unanimous task force opinion supported by limited or weak scientific evidence, majority task force opinion supported by limited or weak scientific evidence, unanimous task force opinion only, majority task force opinion only.

†The criteria for rating the level of evidence of a particular article is dependent on whether the study and/or the research question relates to diagnosis, prognosis, or treatment and prevention.

The rating criteria for studies on diagnosis are (1) it is a good diagnostic test, (2) there are good diagnostic criteria, (3) the test and criteria are reproducible, (4) there is proper patient selection, and (5) there are at least 50 cases and 50 controls.⁵¹ Studies that meet at least 4 of these 5 criteria are rated level 1 (all 5 criteria) or level 2 (4 of the 5 criteria) and are considered strong evidence. Studies that meet 3 of the 5 criteria are rated level 3 and are considered moderate evidence. Studies that meet fewer than 3 criteria are rated level 4 (2 criteria) or level 5 (1 criterion) and are considered limited or weak evidence.

The rating criteria for studies on prognosis are as follows: (1) it is a cohort study, (2) with good inclusion/exclusion criteria, (3) with follow-up of at least 80% of the cohort, (4) with adjustment for confounders, and (5) with reproducible outcome measures.⁵¹ Cohort studies that meet all of the 4 remaining criteria are rated level 1, and cohort studies that meet any 3 of the remaining 4 criteria are rated level 2. Level 1 and level 2 ratings are considered strong evidence. Level 3 ratings (cohort studies that meet any 2 of the remaining 4 criteria) and level 4 ratings (cohort studies that meet any 1 of the remaining 4 criteria) are considered moderate evidence. A study is rated level 5 if it is a cohort study that does not meet any of the remaining 4 criteria. Level 5 is considered limited or weak evidence. Level 6 ratings are given when there is no cohort study, for example, case reports or case series. Level 6 is considered weak evidence.

Studies on treatment and prevention are rated level 1 if there are several randomized controlled trials (RCTs) that demonstrate a significant difference, level 2 if there is an RCT that demonstrates a significant difference, and level 3 if there is an RCT showing some difference.⁵² Levels 1, 2, and 3 are considered strong evidence. A nonrandomized controlled trial or subgroup analysis of an RCT is rated level 4 and a comparison study with some kind of control/comparison is rated level 5.⁵² Levels 4 and 5 are considered moderate evidence. Case series without controls are rated level 6, and case reports with fewer than 10 patients are rated level 7.⁵² Levels 6 and 7 are considered limited or weak evidence.

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Table I. Cont'd

Recommendations	Strength of recommendation*	Level of evidence†	Reference Nos.
Preoperative evaluation—cont'd			
phlebitis, infectious diseases, poor wound healing, and diabetes mellitus is taken. Patients with a medical history of these conditions receive medical clearance before undergoing liposuction. The history also includes prior abdominal surgery and problems from past surgical procedures that may influence complications.			
The use of all medications, vitamins, and herbs is documented with particular attention to medications that affect blood clotting (eg, aspirin, nonsteroidal anti-inflammatory agents, vitamin E, anticoagulants). Drugs that may interact with lidocaine, epinephrine, or sedative and anesthetic agents are noted.	Unanimous task force opinion		
Physical evaluation includes assessment of the general physical health to determine if the patient is a suitable candidate for surgery, and examination of specific sites under consideration for liposuction to check for potential problems.	Unanimous task force opinion and weak evidence	L6	16
Psychosocial evaluation includes inquiries about diet and exercise habits; history of weight gain and loss; familial body shape; and evaluation of the patient's emotional ability to endure the procedure and of their understanding of the limitations of liposuction, and whether the patient has realistic expectations.	Unanimous task force opinion and weak evidence	L6	20
Selection of preoperative laboratory studies to be performed depends on the type and extent of the anticipated liposuction procedure and the conditions revealed in the history and physical examination.	Unanimous task force opinion		
If indicated by history, system review, or extent of anticipated liposuction procedure, a complete blood cell count with quantitative platelet assessment, prothrombin time, partial thromboplastin time, chemistry profile including liver function tests, and pregnancy test for women of childbearing age are sufficient for most liposuction procedures.	Unanimous task force opinion		
Type of anesthesia employed			
Lidocaine is the preferred type of local anesthetic.	Unanimous task force opinion and weak evidence	L6	19
If a patient takes medications that inhibit the metabolism of lidocaine, the medications should be discontinued before liposuction, or the total dosage of lidocaine should be reduced.	Unanimous task force opinion		
The recommended maximum dose of lidocaine is 55 mg/kg for most patients. Recommended lidocaine dosages are dependent on appropriate epinephrine concentration in the tumescent solution.	Unanimous task force opinion and weak evidence	L6	6, 12, 13, 21-30
The recommended concentration of epinephrine in tumescent solutions is 0.25 to 1.5 mg/L. The total dosage of epinephrine should be minimized and usually should not exceed 50 µg/kg.	Unanimous task force opinion		
If the surgeon anticipates that the maximum dose will be exceeded, consideration may be given to dividing the liposuction into separate procedures.	Unanimous task force opinion		

Table I. Cont'd

Recommendations	Strength of recommendation*	Level of evidence†	Reference Nos.
Type of anesthesia employed—cont'd			
Oral anxiolytics, sedatives, or narcotic analgesics at dosages that are not associated with respiratory depression may be used with tumescent liposuction.	Unanimous task force opinion and weak evidence	L6	7
Intramuscular anxiolytics, sedatives, or narcotic analgesics may be used with caution with tumescent liposuction, since dose-response can vary widely and may be associated with respiratory depression.	Unanimous task force opinion		
Intravascular anxiolytics, sedatives, or narcotic analgesics may be associated with increased risk of mortality and morbidity if not used properly and in a setting such as an accredited surgical facility or hospital operating room and monitored by appropriately trained and credentialed personnel.	Unanimous task force opinion		2, 33
The use of inhalational (general) anesthesia for tumescent liposuction is not recommended.	Unanimous task force opinion and weak evidence	L6	2, 31-34
Surgical technique/procedure			
Performing liposuction with other procedures should be done with caution unless all procedures are done with the patient under local anesthesia and the recommended dosage for tumescent lidocaine is not exceeded.	Unanimous task force opinion and weak evidence	L6	2, 9, 10, 24, 35-41
The recommended cannula size for liposuction is no larger than 4.5 mm in diameter.	Unanimous task force opinion and weak evidence	L6	42
The recommended volume of fat removed is in proportion to the fat content and/or size and/or weight of the patient being treated, and the recommended volume of fat removed generally does not exceed 4500 mL in a single operative session.	Unanimous task force opinion and weak evidence	L6	13, 42-45
The dry technique is contraindicated.	Unanimous task force opinion and weak evidence	L6	11, 32, 46-48
Liposuction in treatment of obesity is experimental at this time and is not recommended.	Unanimous task force opinion and weak evidence	L6	42, 43, 49
Intraoperative and postoperative monitoring			
Baseline vital signs, including blood pressure and heart rate, are recorded preoperatively and postoperatively.	Unanimous task force opinion		
For procedures removing >100 mL of aspirate, there is the capability of continuous blood pressure monitoring, cardiac monitoring with pulse oximetry, and the availability of supplemental oxygen.	Unanimous task force opinion and weak evidence	L6	2, 13, 19, 28, 37, 50
Sedated patients have postoperative monitoring until fully recovered and ready for discharge.	Unanimous task force opinion		
A plan for medical emergencies is in place.	Unanimous task force opinion		
Postoperative compression			
Specialized compression garments, binders, and tape help to reduce bruising, hematomas, seromas, and pain. Antiphlebitis support hose may be valuable for cases involving the lower legs.	Unanimous task force opinion		
The duration of compression is dictated by physician judgment, the location of the surgery, and the rate of recovery.	Unanimous task force opinion		

ISSUES

The task force identified the following as issues of current controversy that may or may not affect the outcome of liposuction surgery:

- Physician qualifications to perform the procedure
- The type of facility in which the procedure is performed and medical emergency preparedness
- The preoperative medical and psychosocial evaluation of the patient
- The type and dosage of anesthetic employed and perioperative administration of anxiolytics, sedatives, and analgesics
- The surgical technique/procedure including the performance of concomitant additional surgery, the size of the cannulas employed, the length of time of the procedure, and the volume of fat extracted per session and by body weight
- The type of intraoperative and postoperative monitoring
- Postoperative compression

The issues of anesthesia, surgical technique, and intraoperative monitoring are intertwined. For example, additional procedures or large volume aspiration may influence the choice of anesthetic agent and the intraoperative monitoring required.

Physician qualifications

Recommendations

1. The physician performing liposuction has completed residency training or is board certified in a specialty that is recognized by the American Board of Medical Specialties and that provides education in liposuction and training in cutaneous surgery.
2. The physician has documented liposuction training in residency or documented training and experience at the surgical table under the supervision of an appropriately trained and experienced liposuction surgeon.
3. In addition to the surgical technique, training includes instruction in fluid and electrolyte balance, potential complications of liposuction, and tumescent anesthesia and other forms of anesthesia employed.

Discussion

The literature to answer the question of whether or not there is evidence to support or refute an association between physician training and/or physician specialty and patient outcomes consists of a claims data analysis, a case report of 5 deaths, and 3 surveys by specialty societies of their individual members in which respondents self-reported outcomes of their liposuction procedures. These types of studies are considered weak evidence as defined in the notes to Table I.

The claims data analysis reported 257 malpractice claims involving liposuction between 1995 and 1997, of which 89.7% were against plastic surgeons; 7.5% against general surgeons; 1.6% against obstetricians/gynecologists; and 0.8% each against dermatologists and general/family practitioners.¹ The 5 mortality cases reported plastic surgeons as the attendings for 4 of these patients and a general surgeon for one.² There were two surveys conducted by dermatologists. One by the American Society for Dermatologic Surgery reported no deaths or serious complications from 15,336 liposuction procedures performed by member respondents.³ An earlier survey of 55 dermatologists reported 7 systemic complications, 288 local complications, 81 sequelae, 3 hospitalizations, and 1 unrelated death among 9478 liposuction patients.⁴ A survey of members of the American Society of Plastic and Reconstructive Surgeons reported complication rates of major liposuction (not defined) based on 75,591 procedures. The complications reported were mortality (2); cerebrovascular accident or transient ischemic attack (1); pulmonary thromboembolism (9); fat embolism (1); major skin loss (5); anesthesia complication (23); transfusion complication (10); and deep vein thrombosis (25).⁵

We also asked the question of evidence of an association between number of procedures performed by a liposuction surgeon and patient outcome. In a series of 100 patients followed up to a year after liposuction and grouped chronologically, the re-do rate decreased progressively as experience was gained.⁶ Another study reported fewer revisions required to improve the result, but the author was unsure if this decrease could have been due to technique, smaller cannulas, or increased experience of the physician.⁷ One study of 53 patients undergoing lipoplasty of the calves and ankles reported insignificant improvement in cosmetic result in the first patient, but a good cosmetic result in almost all of the subsequent patients.⁸

The task force unanimously agreed that the literature did not provide adequate evidence to support or refute an association between patient outcome and physician training/specialty or number of procedures performed. Nevertheless, the overwhelming majority of the literature on liposuction is from physicians with training in cutaneous surgery, that is, dermatologists and plastic surgeons.

Facility in which the procedure is performed and availability of emergency care

Recommendations

1. Liposuction can be performed safely in a physician's office surgical facility, an ambulatory surgical facility, or a hospital operating room.

2. All liposuction surgeons and designated operating room staff have training in the management of acute cardiac emergencies.
3. Hospital privileges should not be required to perform tumescent liposuction, but a written plan for management of medical emergencies, including possible transfer, should be in place.

Discussion

Four articles that evaluated morbidity in the outpatient setting in terms of none or few hospital admissions provided some evidence to refute an association between morbidity and performance of the procedure in an outpatient facility.^{4,9-11}

The remaining articles consist of analysis of claims data and case reports or case series. The claims data analysis reported 257 malpractice claims involving liposuction. Seventy-one percent of these procedures were performed in a hospital, 21% in a physician's office, and 8% in a surgery center, hospital outpatient facility, or other outpatient facility.¹

One study reported no significant complications among 100 consecutive patients undergoing liposuction as an office surgery procedure.¹² Another study, which focused on type of anesthesia employed, also reported that 20 consecutive patients whose surgery was performed in an office setting had no significant complications.¹³ Two articles presented case reports of deaths at 25 days and at 9 days after outpatient liposuction.^{14,15}

The task force unanimously agreed that there was some evidence to support the safety of performing liposuction in an office setting. There was also agreement that the facility should be prepared to provide immediate emergency medical management and have in place written plans for transfer to an acute care facility.

PREOPERATIVE MEDICAL AND PSYCHOSOCIAL EVALUATION OF THE PATIENT

Recommendations

1. Liposuction is contraindicated in patients with severe cardiovascular disease, severe coagulation disorders including thrombophilia, and during pregnancy.
2. A thorough medical history that gives special attention to any history of bleeding diathesis, emboli, thrombophlebitis, infectious diseases, poor wound healing, and diabetes mellitus is taken. Patients with a medical history of these conditions receive medical clearance before undergoing liposuction. The history also includes prior abdominal surgery and problems from past surgical procedures that may influence complications.
3. The use of all medications, vitamins, and herbs is documented with particular attention to medications that affect blood clotting (eg, aspirin, non-steroidal anti-inflammatory agents, vitamin E, anticoagulants). Drugs that may interact with lidocaine, epinephrine, or sedative and anesthetic agents are noted.
4. Physical evaluation includes assessment of the general physical health to determine whether the patient is a suitable candidate for surgery and examination of specific sites under consideration for liposuction to check for potential problems.
5. Psychosocial evaluation includes inquiries about diet and exercise habits; history of weight gain and loss; familial body shape; and evaluation of the patient's emotional ability to endure the procedure, his or her understanding of the limitations of liposuction, and whether the patient has realistic expectations.
6. Selection of preoperative laboratory studies to be performed depends on the type and extent of the anticipated liposuction procedure and the conditions revealed in the history and physical examination.
7. If indicated by history, system review, or extent of anticipated liposuction procedure, a complete blood cell count with quantitative platelet assessment, prothrombin time, partial thromboplastin time, chemistry profile including liver function tests, and pregnancy test for women of child-bearing age are sufficient for most liposuction procedures.

Discussion

In a case series of 333 patients who were all physically fit, 93% of the first 200 patients were surveyed and found to be satisfied with the cosmetic result.¹⁶ One study was designed to determine whether suction-assisted liposuction predisposed patients to thromboembolic sequelae. Ten patients with no risk factors of thromboembolic disease, by history, had preoperative and postoperative hematologic assays. The study concluded that a change in assay values did not predispose these patients to either a hypercoagulable state or an increased risk of thromboembolic sequelae.¹⁷

A case was reported of a patient with a significant surgical history who had an intestinal perforation and peritonitis subsequent to liposuction.¹⁸ A patient with a known history of isovaleric acidemia experienced malignant ventricular dysrhythmias during liposuction under general anesthesia and the use of bupivacaine.¹⁹

In a series of 101 patients in which a survey of patients revealed a generally high level of satisfaction, the author associated this result with proper

education of the patient as to realistically expected results and with consideration of the patient's emotional and psychologic condition.²⁰

On review of the literature and based on the collective experience of the task force on patient factors that may influence the outcome of liposuction, the task force unanimously agreed on specific recommendations on preoperative patient evaluation.

Type of anesthesia employed and perioperative administration of anxiolytics, sedatives, and analgesics

Recommendations

1. Lidocaine is the preferred type of local anesthetic.
2. If a patient takes medications that inhibit the metabolism of lidocaine, the medications should be discontinued before liposuction, or the total dosage of lidocaine should be reduced.
3. The recommended maximum dose of lidocaine is 55 mg/kg for most patients. Recommended lidocaine dosages are dependent on appropriate epinephrine concentration in the tumescent solution.
4. The recommended concentration of epinephrine in tumescent solutions is 0.25 to 1.5 mg/L. The total dosage of epinephrine should be minimized, within these limits, and usually should not exceed 50 µg/kg.
5. If the surgeon anticipates that the maximum dose will be exceeded, consideration may be given to dividing the liposuction into separate procedures.
6. Oral anxiolytics, sedatives, or narcotic analgesics at dosages that are not associated with respiratory depression may be used with tumescent liposuction.
7. Intramuscular anxiolytics, sedatives, or narcotic analgesics may be used with caution with tumescent liposuction, since dose-response can vary widely and may be associated with respiratory depression.
8. Intravascular anxiolytics, sedatives, or narcotic analgesics may be associated with increased risk of morbidity and mortality if not used properly and in a setting such as an accredited surgical facility or hospital operating room and monitored by appropriately trained and credentialed personnel.
9. The use of inhalational (general) anesthesia for tumescent liposuction is not recommended.

Discussion

A single case report of severe ventricular arrhythmia occurred in a patient with a history of isovaleric acidemia.¹⁹ The tumescent solution that was formu-

lated consisted of bupivacaine and epinephrine in lactated Ringer's solution, and the author speculated that the patient's carnitine deficiency may have lowered the threshold for bupivacaine-induced cardiotoxicity. There are no studies to support the use of alternatives to lidocaine in the formulation of the tumescent solution.

There is some disagreement in the literature on the composition of the solution and significant disagreement over the concomitant use of intravenous or general anesthesia. The usual tumescent solution used by dermatologic surgeons is 0.05% to 0.1% lidocaine and epinephrine at 1:1,000,000 to 1.5:1,000,000.

There is strong agreement, although weak evidence, that the introduction of tumescent solutions has resulted in a significant decrease in blood loss and postoperative pain as compared with other techniques. There is also agreement that recommended doses of lidocaine, when used in these dilute solutions (0.05%-0.1% lidocaine and epinephrine at 1:1,000,000-1.5:1,000,000), exceed the manufacturer's recommended dose for undiluted local injection.^{6,12,13,21-29} Lidocaine toxicity was noted in 1 of 7 consecutive liposuction patients using a solution of 300 mL of 33% lidocaine with epinephrine at 1:300,000.³⁰

With the current state of knowledge, the task force agreed that 55 mg/kg is the maximum safe dosage for most patients, within appropriate lidocaine and epinephrine concentrations for tumescent anesthesia. There are patients in whom a lower dose may be appropriate.

The optimal concentration of epinephrine depends on the relative vascularity of the targeted compartment of subcutaneous fat.

A case series of 100 patients undergoing tumescent liposuction with concomitant use of oral sedation (94 patients) or no sedation (6 patients) reported no complications or untoward effects.⁷

Two deaths were reported of patients who had liposuction with intravenous sedation.²

Two deaths were reported of patients who had liposuction under general anesthesia and adjunctive intravenous anesthetics.² There was a single case report of pulmonary edema occurring after liposuction under general anesthesia and use of a tumescent solution,³¹ and a case report of adult respiratory distress syndrome associated with a fat embolism in a patient under general anesthesia only.³² In a case series of 147 liposuction patients under intravenous sedation or inhalation anesthesia and a tumescent solution, no complications, other than a mild cellulitis, were reported.³³ The authors cautioned readers of the potential for fluid overload with the administration of intravenous fluids and use of a tumescent

solution. One study to assess lidocaine toxicity in 5 liposuction patients under general anesthesia and using a tumescent solution reported no evidence of systemic toxicity.³⁴

There have been no reports of significant morbidity and no mortalities associated with liposuction when performed under tumescent local anesthesia alone, with or without oral sedation. Deaths and significant morbidity have been reported when liposuction is performed with the patient under general anesthesia, conscious sedation, and/or use of intravenous anesthetics.

Surgical technique/procedure including the performance of concomitant additional surgery, the size of the cannulas employed, the duration of the procedure, and the volume of fat extracted per session and by body weight

Recommendations

1. Performing liposuction with other procedures should be done with caution unless all procedures are done with the patient under local anesthesia and the recommended dosage for tumescent lidocaine is not exceeded.
2. The recommended cannula size for liposuction is generally no larger than 4.5 mm in diameter.
3. The recommended volume of fat removed is in proportion to the fat content and/or size and/or weight of the patient being treated, and the recommended volume of fat removed generally does not exceed 4500 mL in a single operative session.
4. The dry technique for liposuction is contraindicated.
5. Liposuction in the treatment of obesity is experimental at this time and is not recommended.

Discussion

Additional procedures. The literature to support or refute an association between patient outcome of liposuction and the performance of additional procedures consists of 11 articles with weak evidence.

Associated with performance of liposuction in addition to other procedures in an operative session is the use of other anesthetics in addition to local anesthetics. Eight of the 11 articles reported combined procedures that were performed with the patient under general anesthesia,^{2,9,24,35-39} and 2 of these studies included patients who had regional blocks instead of inhalational anesthesia.^{37,39} In one of the 11 studies all patients had regional blocks,⁴⁰ and we could not ascertain the type of anesthesia used in one study.⁴¹ Only one study involved the performance of tumescent liposuction with the patient under local anesthesia only in combination with mini-abdominoplasty.¹⁰ This study suggested that the combination of these 2 pro-

cedures, with the use of local anesthesia alone, results in decreasing the morbidity that is often associated with the use of general anesthesia.

Although there was only one case report in the literature of the death of a patient undergoing liposuction and bilateral augmentation mammoplasty with the use of general anesthesia, this may not represent the actual mortality incidence.² Sealing of court records or settlement agreements may contribute to an underestimation of mortality of liposuction and combined procedures with the use of general anesthesia.

Cannula size. One study reported use of an 8-mm cannula, then continuing with 4- to 5-mm cannulas. Seromas developed in 12 of 120 patients, and the authors noted that with a larger diameter cannula, more bleeding than normal was noted.⁴² The task force also noted that there is increased pain with larger diameter cannulas.

Length of time of the procedure. There were no articles that specifically addressed the issue of length of time of the procedure. Under local anesthesia alone, length of time is not a significant factor.

Volume by body weight. There was no literature that specifically addressed the amount of fat in relation to body weight. This is part of the assessment that is used in determining volume removal.

Volume per session. The literature provides weak evidence that there is increased morbidity associated with large volume liposuction under general or regional anesthesia,⁴²⁻⁴⁴ than when done with the patient under local anesthesia alone.^{13,45} It should be noted that when local anesthesia was used alone, only one patient had more than 4.5 L aspirated.¹³ Under general anesthesia, volumes aspirated ranged from 3 to 23 L.

In the course of the review of the evidence, several articles reported on the use of the dry technique, which is necessarily performed with the patient under general anesthesia. This technique is associated with producing aspirates that are 30% to 40% blood by volume.^{11,46-48} A patient developing adult respiratory distress syndrome after liposuction using the dry technique has also been described.³² Because of increased morbidity, including life-threatening bleeding, this technique is contraindicated.

Although there are reports of treating obesity with liposuction, this is currently an experimental use of the procedure.^{42,43,49}

Type of intraoperative and postoperative monitoring

Recommendations

1. Baseline vital signs, including blood pressure and heart rate, are to be recorded preoperatively and postoperatively.

2. For procedures removing more than 100 mL of aspirate, there is the capability of continuous blood pressure monitoring, cardiac monitoring with pulse oximetry, and the availability of supplemental oxygen.
3. Sedated patients have postoperative monitoring until they are fully recovered and ready for discharge.
4. A plan for management of medical emergencies is in place.

Discussion

There were few articles that specifically mentioned monitoring personnel and monitoring parameters. One article reported 5 deaths² during which an anesthesiologist was present during the procedures. Two of these deaths occurred during the procedure. There was one report of an intraoperative cardiac arrest of a patient under general anesthesia and whose blood pressure was monitored.⁵⁰ One study described a patient who had pulse and electrocardiographic monitoring and in whom severe tachycardia developed intraoperatively. An anesthesiologist was in attendance and the patient responded to emergency management.¹⁹

Other articles merely mention the types of monitoring employed during the procedure (eg, continuous pulse and cardiac monitoring, periodic blood pressure, electrocardiography).^{13,28,37,50}

In the interests of patient safety, the task force unanimously agreed to specific monitoring recommendations.

Postoperative compression

Recommendations

1. Specialized compression garments, binders, and tape help to reduce bruising, hematomas, seromas, and pain. Antiphlebitis support hose may be valuable for cases involving the lower legs.
2. The duration of compression is dictated by physician judgment, the location of the surgery, and the rate of recovery.

Discussion

There were no articles that specifically addressed the issue of compression. Recommendations are made on the collective experience of the task force.

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