Fatal Outcomes from Liposuction: Census Survey of Cosmetic Surgeons

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Troubling reports of adverse outcomes after liposuction prompted a census survey of aesthetic plastic surgeons. All 1200 actively practicing North American board-certified ASAPS members were polled by facsimile, then mail, regarding deaths after liposuction. Patient initials together with case summaries precluded data replication yet assured patient anonymity and preserved surgeon privacy. Incomplete returns or ambiguous findings were authenticated, where feasible, by direct follow-up. Total number of lipoplasties performed by plastic surgeons was interpolated from the ASPRS procedure database for the survey time frame of 1994 to mid-1998. Lacking reliable annual case volume estimates, deaths from lipoplasties performed by non-ABPS surgeons were excluded from the actual mortality rate computation but were included in cause-of-death ranking statistics.

Responding aesthetic plastic surgeons (917 of 1200) reported 95 uniquely authenticated fatalities in 496,245 lipoplasties. In this census survey, the mortality rate computed to 1 in 5224, or 19.1 per 100,000. A virtually identical 20.3 per 100,000 mortality rate was obtained in a 1997 random survey commissioned by the parent society. Pulmonary thromboembolism remains as the major killer (23.4 ± 2.6 percent); lacking consistent medical examiners’ toxicology data, the putative role of high-dose lidocaine cardiotoxicity could not be ascertained. Where so stated, many deaths occurred during the first night after discharge home; prudence suggests vigilant observation for residual “hangover” from sedative/anesthetic drugs after lengthy procedures.

Taken together, these two independent surveys peg the late 1990s mortality rate from liposuction at about 20 per 100,000, or 1 in every 5000 procedures. Set beside the 16.4 per 100,000 fatality rates of U.S. motor vehicle accidents, liposuction is not an altogether benign procedure—at times with little more physician training than a weekend hands-on seminar. Little surprise then that, in the competition for patients, liposuction has become trivialized and commercialized into a routine ambulatory office procedure, holding out to the American public gratifying cosmetic benefits at minimal risk. As liposuction is performed largely outside the hospital—distant from peer review, incident reporting and medical examiner scrutiny—the extent of complications from the 293,000 (estimated) lipoplasties performed in 1996 may well be underreported.

Adverse national media publicity about liposuction—disfiguring outcomes, dubious ethics, and even deaths—has raised the profession’s concern about the safety of the procedure. Even so, the few highly visible cas-
es may represent just the tip of an iceberg, for the authors have personal knowledge of several-score deaths after liposuction. The recent worrisome rise in deaths and near-deaths associated with liposuction spurred us to determine whether these represent tragic but random incidents or a troubling national trend.

As we shall show, liposuction is not trivial surgery, is not always benign, and is not quite as safe as intimated in glossy office brochures.

Census Survey Design

Cohort

We selected as census participants a reasonably homogeneous and manageably compact subset of plastic surgeons, the members of the American Society of Aesthetic Plastic Surgery (ASAPS). For any other attempt at identifying the highly fractionated set of diverse North American liposuction practitioners and, worse, of estimating the number of procedures they performed, would have been patently futile. The 1250-plus ASAPS members all are American Board of Plastic Surgery (ABPS), or Canadian equivalent, diplomats who have practiced primarily cosmetic surgery for several years before election. The parent American Society of Plastic and Reconstructive Surgeons (ASPRS), moreover, maintains a robust, periodically updated, statistical clearinghouse that served as a credible source for projecting the number of lipoplasty surgeries performed by North American plastic surgeons over the 41/2-year sample period. To eliminate the nagging uncertainties introduced by random sampling of a given target population, we queried every ASAPS member listed as having both residence in the United States or Canada and an active practice of lipoplasty surgery; only inactive, foreign, or honorary ASAPS members were excluded from the census count.

Questionnaire

We designed the questionnaire to be similar in scope and construct to the 1977 Grazer and Goldwyn survey template, so as to permit comparison of now-and-then death rates and causations. To foster optimal reply, we held the questionnaire length to one page and assured patient anonymity and responder confidentiality (Fig. 1). The opening branch question was whether the physician had personally encountered, or was aware of, recent liposuction-related death(s) in the community; we asked that the questionnaire be returned—whether the answer was NO or YES—to ensure statistical response accountability.

Identifying Case Replication

Because the questionnaire inquired not only about personally encountered fatalities but also those of other physicians in the community, the issue of excluding hearsay case replication by two or more local responders, or by one physician responding to both facsimile and mail inquires, became a critical tabulation consideration. Mindful of the emotionally charged and litigious setting of death from elective surgery, we required nevertheless a foolproof identification mechanism to weed out multiple references to the same fatality. We addressed that issue, without invading physician, patient, or judicial privacy, by requesting both patient initials and case summary for unique case identification. Many respondents voluntarily added date of death and other specifics for additional clarification.

Census Survey Methods

Cognizant of the dismal response rate of blind survey mailings (where 10 percent is considered a “good” response rate and 30 percent is considered a “remarkable” response rate), we twice polled the entire active practice 1200-census ASAPS cohort, first by facsimile in May of 1998 and then, 2 months later, by prepaid return mail (Table I).

Inclusion Criterion

The operand consideration for the practicing ASAPS membership was whether the respondent personally experienced, or knew of, one or more recent deaths after liposuction in the local community or urban region. With the introduction of liposuction using high-dose lidocaine (“tumescent”) anesthesia, we also were on the lookout for a new category of potential perioperative complication, “death attributable to lidocaine toxicity.”

Exclusion Criterion

Our original intent was to stratify deaths by physician specialty, anticipating hospital and medical community grapevine information about deaths in the participant’s urban region. Eventually, the hearsay taint of such information, the insular office-based setting, the variability in catch-basin size, and the lack of nationwide procedure frequency estimates forced
YOUR REPLY (return envelope enclosed) CAN HELP SAVE A LIFE!

Dear Fellow Colleagues:

Death from pulmonary thrombo-embolism remains a fortunately rare, yet enduring, problem in aesthetic surgery. Lately there has been an alarming increase in deaths reported after liposuction surgery, as ever increasing volumes of fluid and ever larger doses of lidocaine are being used by ever more physicians — some with little or no surgical training. My colleagues and I wonder whether high-dose lidocaine formulations may have contributed to this recent rise in post-lipectomy mortality.

Since publication of the Grazer/Goldwyn survey (P&RS, 1977) I have served as an informal sounding board for complications related to aesthetic surgery. I now have on file information on over one hundred deaths after liposuction. As liposuction is receiving adverse media publicity, the profession must address these patient care issues incisively, and with the credibility of solid data.

Last month we faxed a questionnaire to 1200 ASAPS members, yielding over 300 replies; still, we’d like to reach a truly representative sample of Academy members. Telefax may not have been the optimal communication medium as we haven’t heard from you as yet. Hence we are mailing the original questionnaire (stamped return envelope enclosed) to non-respondents. I trust that you will help us in counteracting the negative publicity created by several high-profile cases.

We would be grateful if you’d share with us any information you may have about recent (within the past 4 years) deaths following liposuction in your own practice, your hospital or your community. As some of these unfortunate outcomes may be known to more than one contributor, and since some are in the process of litigation, we use patient initials as a means for anonymous, yet unique, identification.

Even if you have not encountered a fatal complication, please reply to at least the first question for statistical purposes. YOUR NAME WILL NOT APPEAR IN THE DATABASE.

1)  Do you know of any recent (1994 or later) deaths after liposuction -- alone or combined? ______
2)  Was liposuction performed in hospital, ambulatory surgery center or office? __________________________
3)  Was operator a plastic surgeon, dermatologist, or other (specify if you can)? ____________________
4)  Time of death: intraoperatively ______; within 24 hours postop ______; later _______________________
5)  Was lidocaine used _____? If so how much (Liters and %, or total milligrams) ___________________
6)  Was lidocaine the sole anesthetic _____, or supplemental to general anesthesia? ________________
7)  To preserve anonymity, yet avoid duplication, please provide patient initials ___________________
8)  Autopsy details? Thrombotic or fat embolism? Forensic toxicology (lidocaine levels)? ____________

Comments: ________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

Thanks ever so much for the courtesy of your reply.       Fred Grazer, MD  (ASAPS President 1985/86)

Fig. 1. Follow-up survey letter mailed to active ASAP members (see text).
us to reconsider and tighten the criterion. For the actual computation of mortality rates, we entered only those deaths that occurred in the practices of board-certified plastic surgeons, thus excluding from the computation the implicit category of deaths attributed to “other physicians.” We did, however, use the unstratified total fatality count population sample (“All Physicians,” as in Table II) to rank-order the main causes of death after liposuction, as no assumptions other than uniqueness were demanded.

**Time Frame**

We defined “recent” death(s) as occurring from 1994 inclusive to date of questionnaire receipt. As the second survey was timed for July mail delivery (Table I), we consider the term “present” to reflect death reports through June of 1998 (i.e., the first-half of 1998).

**Unique Case Authentication**

Where patient initials were lacking or ambiguous, or unique case identification by date or death cause was in question, area code (for return facsimile identification) and/or postal cancellation code (for return mail) pointed to the region of origin of the report. As the senior author has long served nationwide as an informal sounding board for cosmetic surgery complications—thus was cognizant of nearly all death reports—the responder could be traced and contacted for off-the-record verification, in most instances. Only authenticated (by direct surgeon contact or from material on file with the senior author) deaths following liposuction by an ABPS-certified surgeon were counted in computing mortality rates. (To protect family and surgeon privacy, questionnaires and other identity-compromising materials were shredded upon manuscript publication.) One hurdle to full autopsy disclosure proved to be that nearly all deaths are, or will be, before the bar, making it all but impossible to obtain death-related disclosures from reluctant authorities.

**Measurements**

Death attributable directly to liposuction surgery served as the sole criterion for adverse procedure outcome. Determination of direct causation rarely presented difficulty, as patients for elective cosmetic surgery are in good general health on the whole, other than for obesity (whether imagined or real). In most instances, obese surgical candidates have stabilized on diet and exercise and have been cautioned that liposuction is intended for body contouring, not as a means of weight loss. Nev-
ertheless, we did not request a ranking for obesity for lack of accepted office-based standards (body mass index seems to be little used in nonacademic settings).

Estimating the denominator of the mortality rate (i.e., the total number of lipoplasties performed during the $4\frac{1}{2}$-year survey period) proved challenging, as elective cosmetic outpatient procedures are not subject to federal agency reporting. Because a firm procedure count falls outside the National Center for Health Statistics charter, we turned instead to the professionally operated ASPRS database, which provides biennial (annual, starting 1997) plastic surgery procedure estimates. From these, and by interpolation with derived annual growth rates, we projected the total number of lipoplasties performed by ASAPS members in the period from 1994 to mid-year 1998 (see Results section). Not all Board-certified cosmetic surgeons are ASAPS members, hence the actual number of lipoplasties performed by the census cohort may be somewhat smaller (and the mortality rate correspondingly higher).

**RESULTS**

Polling first by facsimile and then by return mail, repeat sampling drew a total of 917 replies from the 1200-surgeon cohort for a raw response rate of 76.4 percent. Eliminating 76 postal returns that duplicated previously returned facsimile replies netted 841 singular nonduplicate questionnaires, an adjusted survey response rate of 70.1 percent (Table I). Of the 155 affirmative (i.e., reporting one or more deaths) nonduplicate returns, 103 uniquely identified, with initials and case summary, 116 patient deaths. Of these 116 fatalities, 23 had replicate initials or death causes or both, leaving 93 authenticated singular death reports (see Unique Case Authentication).

In the 52 nonduplicate affirmative returns with equivocal patient or cause of death entries, three returns, each alluding to an otherwise unspecified death in the community, were discarded outright. The remaining 49 ambiguous returns included 6 replies, each reporting 2 deaths, accounting for 55 raw death reports (Table I). Sixteen of these 55 deaths clearly were replicates (based on initials, death cause, or history), whereas two unresolved replicate case reports were counted as 2 (rather than as 4) deaths. Thus, 37 ($55 - 16 - 2$) deaths could be identified uniquely (see Unique Case Authentication) in the aforementioned 49 incomplete affirmative replies, for a total of 130 (93 + 37) singular deaths (Table I).

**Cause of Death**

The aggregate total of 130 authenticated singular liposuction-related deaths comprised the “All Physicians” category (as this category is drawn from a population sample rather than from a census count, the statistics of rates and proportions apply). A definitive death cause could be established for 93 of these 130 cases; cause of death for the remaining 37 (28.5 percent) was not known, not entered, or considered confidential and not released (Table II). We collected insufficient survey data to permit death stratification by either gender or age.

The major cause of death was pulmonary thromboembolism, accounting for 23.1 ± 2.6 percent of the fatalities. Next, rather jarringly, was abdominal wall with or without organ perforation (Table II). Lacking compelling toxicology documentation, we had to eliminate from consideration the projected category of “death attributable to lidocaine toxicity” (as yet, not all medical examiners perform routine lidocaine screening after a liposuction fatality).

Most deaths (77.7 percent) occurred in outpatients, either from a physician’s office (47.7 percent) or an ambulatory surgery center (30.0 percent); approximately 1 in 6 (16.9 percent) deaths occurred after hospital-based surgery; 5.4 percent died in an unspecified setting (Table III). Although the ASPRS database provides estimates of overall cosmetic surgery practice locations (Table III), these are not further subcategorized by procedure.

**TABLE III**

<table>
<thead>
<tr>
<th>Lipoplasty Procedure Sites (All Physicians*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure Site</td>
</tr>
<tr>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Physician’s office surgery</td>
</tr>
<tr>
<td>Ambulatory surgery unit</td>
</tr>
<tr>
<td>Hospital operating room</td>
</tr>
<tr>
<td>Unknown/unspecified location</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

* Total fatalities authenticated unique; prior to specialty stratification (i.e., plastic surgeons and others).
† The 95-percent confidence range for observation estimates in this random sample grouping is ±2.6 percent.
‡ ASPRS “Member Profile,” 1997 press release (NB: practice locations for all cosmetic procedures).
Procedure Count

To place the death count in proper perspective ("What is my risk of dying from liposuction?") additionally requires the gross procedure volume. Lacking reportable procedure statistics (most lipoplasties are outpatient surgeries), we had to turn to estimates of the annual caseload. The nearest approximation derives from the National Clearinghouse of Plastic Surgery Statistics database,3 projected from random surveys of plastic surgeons. Because this database embeds the cohort’s practice patterns, we used it to compute the period caseload.

We calculated an annual liposuction growth rate of 43 percent from the 1994 to 1997 Clearinghouse statistics3 and projected that datum to estimate the 1998 statistics from the 1997 case counts. The 1994 and 1996 data were interpolated for the interval years to estimate the aggregate number of suction-assisted lipectomies ("liposuction") performed by ABPS-accredited plastic surgeons during the 41⁄2-year survey period from 1994 to mid-1998 (Table IV).

Mortality Rate

Of the aggregate total of 130 nonduplicate liposuction fatalities reported here, 95 occurred in the practices of ABPS-certified plastic surgeons whose professional activities, as noted, are tabulated in the ASPRS Clearinghouse statistics database. Having established both death count and case volume for the 41⁄2-year survey period, we readily computed the patient mortality rate for Board-certified plastic surgeons; for statistical comparison, we also normalized these data to deaths per 100,000 liposuction procedures (Table V).

<table>
<thead>
<tr>
<th>Year</th>
<th>Lipoplasties</th>
<th>Deaths</th>
<th>Incidence Rate*</th>
<th>Rate/100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994–98†</td>
<td>496,245</td>
<td>95</td>
<td>1 in 5,224</td>
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</tr>
<tr>
<td>1997‡</td>
<td>24,295</td>
<td>5</td>
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* Mortality rate normalized to standard population denominator.
† Present survey of ABPS-accredited surgeons; case volume projection from Table IV.
‡ From ASPRS Task Force on Lipoplasty survey of ABPS-accredited surgeons.

DISCUSSION

Comparative Death Rates

We observed a liposuction fatality rate of 19.1 per 100,000 cases (1 in 5224) for the period 1994 to mid-1998. Though daunting, that finding is corroborated by a 1997 random survey of lipoplasty complications contracted by the ASPRS Task Force on Lipoplasty (Tables V and VI). That survey sampled a 1,500-physician random selection of the 5200-plus ASPRS members, reporting 5 deaths following 24,295 (1 in 4859) lipoplasties, for a normalized mortality rate of 20.6 per 100,000.11

Although the 7 percent difference between death rates in the two surveys may be borderline significant (z = 1.84; p = 0.07), the disparity is negligible clinically. Likewise, even though entirely different endpoints and sampling techniques were used in querying Board-certified plastic surgeons, the fatality rates proved virtual matches. One may infer, then, that the rounded mortality rate for liposuction surgery in the late 1990s hovers near 1 in 5000 (20 per 100,000).

At first glance, the 20 per 100,000 death rate seems to be a substantial improvement over the dismal 162 per 100,000 statistic reported by the senior author in 1977 (Table VI). Yet by 1988, shortly before tumescent liposuction came into vogue, the mortality rate had bottomed to 12.7 per 100,000 (Table VI), only to rise again since.12 As discussed below we, as do others, attribute the recent upward trend in lipoplasty mortality rate to overly zealous surgery, to very large volumes of wetting solution,1 to progressive trivialization of the procedure, to the entry of lesser-trained physicians into the surgeon pool, and possibly to lidocaine and/or epinephrine cardiotoxicity from high-dose tumescent anesthesia.

So high a mortality rate, approximately 20 deaths per 100,000 elective outpatient procedures, should give pause. Adult herniorrhaphy

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† Present survey of ABPS-accredited surgeons; case volume projection from Table IV.
‡ From ASPRS Task Force on Lipoplasty survey of ABPS-accredited surgeons.
by comparison, a mostly elective outpatient surgical procedure of the lower abdominal wall, carries a manyfold smaller mortality incidence of just 3 per 100,000 (Table VI). More sobering perhaps is comparison with traffic deaths—a common killer of largely healthy Americans—at a rate of 16.4 per 100,000 in 1996 (Table VI).

We do not know, of course, how many deaths went unreported by the 30 percent nonresponders. Although we requested a reply even if there was no fatality to report, we suspect that most surgeons aware of a liposuction-related death in their practice would have replied, so that nonresponders, more likely than not, fell in the former (no-death) category. Whatever, the deaths reported here represent a minimum for the ASAPS membership. The converse consideration—inadvertent inclusion of replicate incidents—was eliminated to the best of our knowledge by erring consistently on the side of caution, as detailed in Methods and Results.

**Pulmonary Embolism**

Disquieting is the 1 in 2210 morbidity rate resulting from pulmonary embolization (thrombus 6, fat 5) unveiled by the Task Force on Lipoplasty survey, a rate not appreciably bettered when set against the Grazer and Goldwyn survey incidence of 1 in 1,750, more than 20 years earlier. No surprise then that, in the present survey, pulmonary thromboembolism ranked as the major killer (23.1 percent), accounting for 30 in 130 fatalities (Table II); that ranking is further buttressed by the 20 percent incidence of pulmonary thromboembolism in a recent presentation of five autopsies. Although we did not explicitly collect information on nonfatal surgical complications, pulmonary thrombus or fat embolism clearly continues to haunt postliposuction morbidity.

Considering the extensive subcutaneous fat mobilization by brisk suction lipoplasty, lipid macroglobulinemia may be expected and, in fact, is found consistently when more than 900 ml fat are aspirated. It is rather curious then that fat embolism—or worse, fat embolism syndrome—is far less common after multi-liter liposuction (8.5 percent, Table II) than it is after long-bone surgery. One explanation may be that fat is not highlighted by conventional hematoxylin and eosin staining, so that small fat globules are not readily appreciated in tissue sections (special stains such as Oil-Red-O or osmium tetroxide are called for). Moreover, the xylene solvent used for tissue clearing after paraffin embedding removes not only paraffin but triglycerides as well (R. K. Wright, University of Miami School of Medicine, personal communication). The “true” incidence of fat embolism (and of lidocaine cardiotoxicity) continues to remain elusive until medical examiners begin to appreciate more fully the unique scenario of liposuction surgery.

**Procedural Issues**

How could an elective procedure thought to be so safe prove to be so deadly? Perhaps causes other than training and experience—maybe even the procedure itself—need to be reassessed. Of all the technical refinements introduced since 1982, “wetting” and “tumescent anesthesia” tower as landmark challenges to surgical physiology. As cautioned by the ASPRS Task Force on Lipoplasty, “The increase in adverse events with lipoplasty has been associated almost exclusively with large volumes of preinjectate and aspirated tissue... the risk of complications is unavoidably higher as the volume of fluid exchange increases.” Having said that, we submit additionally that the cavalier practices of megadose lidocaine administration, lax postoperative supervision, and overly

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**TABLE VI**

Lipoplasty/Abdominoplasty Mortality Rates: Summary*

<table>
<thead>
<tr>
<th>Year (s)</th>
<th>Source</th>
<th>Reference</th>
<th>Rate (per 100,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994–1998</td>
<td>Grazer and de Jong (ASAPS)</td>
<td>Table V</td>
<td>19.1</td>
</tr>
<tr>
<td>1997</td>
<td>Lipoplasty Task Force (ASPRS)</td>
<td>Table V</td>
<td>20.6</td>
</tr>
<tr>
<td>1984–1987</td>
<td>Teimourian and Rogers (ASPRS)</td>
<td>#12</td>
<td>12.7</td>
</tr>
<tr>
<td>1975</td>
<td>Grazer and Goldwyn (ASPRS)</td>
<td>#7</td>
<td>162</td>
</tr>
<tr>
<td>1988</td>
<td>Hernioplasties (adult outpatients)</td>
<td>#13</td>
<td>3.0</td>
</tr>
<tr>
<td>1996</td>
<td>Motor vehicle fatalities, U.S. (all)</td>
<td>#14</td>
<td>16.4</td>
</tr>
</tbody>
</table>

* Normalized mortality rates computed from data as described or published.
hasty discharge to self-care fundamentally are incommensurate with the gravity of surgery.

**Fluid overload and third space shifts.** Hydration by hypodermoclysis, the subcutaneous injection of fluids, remains a venerable alternative to intravenous fluid replacement. Whether called wetting, superwetting, or tumescent solution, several liters of fluid are infiltrated rapidly under the skin. Although it is widely assumed that most of the injectate will be aspirated momentarily, that may not be entirely so, for aspirate contains both fat and fluid, leaving behind excess fluid (and lidocaine) to be absorbed.

Little surprise then that at least some degree of pulmonary edema commonly is observed at autopsy, as is a several kilogram postmortem weight gain (confidential autopsy records of postliposuction deaths before the bar; reviewed personally by the authors). In fact, subclinical pulmonary edema may be expected whenever more than a few liters of fluid are infiltrated subcutaneously and/or administered intravenously.

The seemingly limitless volume of solution that can be pumped in, the tiny incision(s) for the suction cannula, the virtually bloodless field, and the insidious ease of vacuuming fluid-softened fat cells gloss over the physiologic consequences of widely undermined skin and extensively traumatized subcutaneous tissues—a potential third space much like an internal burn—to be filled with body fluids. The homeostatic consequences of fluid dislocation after liposuction become evident clinically when more than 4 liters are aspirated (see Epinephrine and Megasuction); the potential for hypotension and venous stasis is altogether apparent.

**Lidocaine.** We remain ambivalent about the administration of enormous doses of lidocaine and epinephrine for so-called tumescent anesthesia. As it stands, a lidocaine dose of 35 mg/kg is considered a “safe” norm for infiltration anesthesia, and resorting to lidocaine doses of 55 mg/kg or more is not all that uncommon. (Note: the FDA-sanctioned upper dose limit for lidocaine with epinephrine remains at 7 mg/kg.) To be sure, limited-scale clinical studies are reassuring by demonstrating asymptomatic (less than 5 μg/ml) lidocaine blood levels peaking after 10 to 14 hours, and our survey provided no cogent documentation of lidocaine toxicity (although we personally know of several cases). Still, lacking in-depth longitudinal evaluation of the disposition kinetics and tissue-binding profile of high-dose lidocaine and its metabolites (MEGX, GX), we must remain vigilant until proven otherwise. (Although a recent widely publicized medical examiner’s report invoked lidocaine toxicity as contributing to at least three of five deaths during or after liposuction, that conclusion is not at all supported by the data presented; all the more in that the probability of lidocaine administration during terminal resuscitation was not addressed.)

**Epinephrine and megasuction.** The addition of epinephrine vasoconstrictor (1 mg of epinephrine per liter) to wetting solution has revolutionized liposuction from dauntingly bloody excisional lipoectomy origins to virtually bloodless suction-assisted lipoplasty. The deceptive sense of atraumatic surgery that is provided by a bloodless field lulls the operator into an illusory perception of safe and rather minor surgery that all too easily leads toward ever more extensive removal of subcutaneous fat. An aspirate of 3 to 5 liters is not uncommon, and more than 5 liters is not at all infrequent. Yet the physiologic consequences of the several milligrams of epinephrine so administered are rarely considered, nor are those of its metabolites.

Although megavolume liposuction might be expected to increase morbidity, we found no clear association in our survey between fat volume removed and fatal outcome. Nevertheless, as ASPRS (and others) caution, removal of more than 5 liters of fat demands skill, experience, prudence, and substantial postoperative vigilance. Recent fluid balance research pegs the watershed mark for clinically significant fluid imbalance lower yet, to as little aspirate as 4 liters, as does current editorial opinion, as expressed in this journal.

**Multiple procedures.** Even at the dawn of suction-assisted lipectomy, it was apparent that combining liposuction with other cosmetic surgeries increased the risk of major complications. In a 1983 survey of 1249 lipoplasties, there were no deaths but, as the authors footnoted, two deaths when liposuction was combined with adjunctive procedures. We believe that early observation still to hold true: combining liposuction with other cosmetic procedures might well escalate the risk of adverse outcomes.
buffered by fatty tissue binding, hence the slow lidocaine release pattern encountered in tumescent anesthesia and the apparent safety of high-dose regimens. By contrast, densely innervated sensitive areas (e.g., face and breast) require higher concentrations of lidocaine (0.2 to 0.5%) to attain satisfactory local anesthesia. The additional, now unbuffered, lidocaine exceeds the low-capacity tissue-binding safeguard, and lidocaine absorption reverts to the more usual clinical pattern of early and high blood level peaks. In this manner, combining other cosmetic procedures with tumescent liposuction unwittingly could set the stage for serious lidocaine toxicity, as a consequence of the unanticipated early and steep serum lidocaine peak.

Hasty discharge. It has become virtually routine to discharge ambulatory patients from medical supervision not long after completion of ever more extensive surgical procedures and correspondingly prolonged anesthesia or awake sedation. That practice is not necessarily in our patients’ best interests, for they are turned over to well-meaning amateurs, ill-equipped to diagnose—let alone treat—hidden fluid shifts, tenuous circulatory status, subtle respiratory depression, and wound contamination. Indeed, when reviewing the survey’s death reports (and near-death records in litigation), we noted a distinct trend for death to occur during the first night. This is not just idle speculation; 3 of 28 (10.7 percent) patients observed overnight in a study of fluid balance after large-volume (>4 liters) liposuction experienced hypovolemic hypotension after discharge from the recovery unit. Had these patients been sent home, the hypotensive episodes (readily correctable in hospital with intravenous fluid boluses) would have gone undetected, placing the patients at substantial and preventable risk.

We offer that patients recover from major liposuction (to be defined in terms of hours of surgery, liters of aspirate, or body surface area), and heavy sedation or prolonged anesthesia, under overnight medical supervision. Ideally, supervision would be provided by an extended care recovery facility or home nurse; alternately, a portable continuous monitor (e.g., battery-operated pulse oximeter) could provide home caretakers with a simple readout alert of respiratory and circulatory trends.

Site Location and Practice Scope

One indicator of the pervasiveness of ambulatory day surgery is that more than three-fourths (77.7 percent; Table III) of the fatalities reported here originated in a surgeon’s office or freestanding ambulatory surgery unit. Our finding that fewer than 17 percent of deaths followed hospital-based lipoplasty directly contradicts statements (founded on settled insurance liability claims) that hospital-based liposuction accounted for 71 percent of the malpractice claims—implying, by indirection, that office-based liposuction (21 percent of settled claims) inherently is less risky.

So as to bound the scope of our findings, accept that substantial numbers of lipoplasties are performed by non-ABPS-accredited physicians. The nearest estimate of nationwide case volume comes from 1996 survey data collected by the American Academy of Cosmetic Surgery (AACS), estimating a combined total of 292,942 liposuctions performed by all North American practitioners. Subtracting from that total case volume the 1996 ASPRS database procedure volume of 149,042 (leaving 143,900 “other physician” cases) demonstrates that our census survey of ABPS-certified cosmetic surgeons applies to more than one-half (50.9 percent) of the estimated annual total of North American liposuction procedures.

Conclusions

In a census survey spanning the years 1994 through mid-1998, ASAPS members encountered 95 liposuction-related fatalities in nearly half a million procedures, yielding a normalized mortality rate of 19.1 per 100,000. With the confirmatory finding by the ASPRS Task Force on Lipoplasty of a 1997 death rate of 20.6 per 100,000, the late 1990s liposuction mortality rate stands at a round 20 per 100,000. This less than optimal outcome calls for reconsideration of patient safety, procedural limitations, and postoperative discharge guidelines, as well as physician qualification and accreditation issues.

Outpatient elective liposuction may not be quite the safe procedure it is purported to be. There are definite risks, including death at a rate of approximately 1 in 5000 procedures. Major risk factors identified by us and others are multiliter wetting solution infiltration, megavolume aspiration causing massive third space fluid dislocation, multiple cosmetic pro-
cures in one sitting, sedative and anesthetic drug hangover threatening ventilation, and permissive postoperative discharge policies incommensurate with the major trauma of extensive surgery.

Additional, albeit still poorly understood, procedural risk factors are massive lidocaine dosing that might impair cardiac contraction and conduction, high-dose epinephrine administration with unknown effects on heart and circulation, and the application of a snug abdominal compression garment that could diminish venous return and impair diaphragmatic excursion.

Too many deaths occur at home during the first night after discharge from the surgical facility; instituting medically supervised overnight recovery after major surgery holds out the promise of early damage control. Timely discovery and prompt correction of a minor problem could well prevent a major catastrophe later on. The time has come to stop, look, and listen: the physician’s pledge of primum nocere may have been compromised.

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**REFERENCES**


