Original Article: Basic Science

American Academy of Cosmetic Surgery

The American Journal of Cosmetic Surgery
2020, Vol. 37(2) 69–74

DOI: 10.1177/0748806819883091
journals.sagepub.com/home/acs
SAGE

High-Definition Liposculpture in Males Using Power-Assisted Liposuction and Local Anesthesia

Roland Boeni, MD[1]

Abstract

In high-definition liposculpture, the body is being shaped in a manner that it creates an athletic appearance and defined, contoured look. Typical areas in the male patient include arms, pectoralis, the area over the serratus muscle, lower back, as well as lateral and medial abdomen. This is sometimes combined with fat grafting to areas over the deltoid muscle and/or pectorals. High-definition liposculpture poses a new challenge to local anesthesia using lidocaine alone. Sufficient analgesia has to be achieved in multiple areas, without reaching systemic toxic levels of lidocaine. To reduce the risk of systemic side effects, we added prilocaine to the tumescent solution. Prilocaine differs from lidocaine in its metabolizing pathway, and combining both anesthetics therefore allows for higher tumescent volumes. In a prospective study, 48 male patients underwent high-definition liposculpture. The mean injected volume was 9.4 L. There were no side effects resulting from the high volumes of tumescent solution. Minor complications included seroma (2); 3 patients required touch-up. To conclude, a combination of lidocaine and prilocaine enables treatment of the entire torso and arms in a single session. Potential systemic effects of each anesthetic, lidocaine and prilocaine, need to be known to the user.

Keywords

high-definition liposuction, high-definition liposculpture, local anesthesia, prilocaine, lidocaine

Introduction

Liposuction ranks among the most commonly performed aesthetic procedures today.[1] Independent predictors of major complications are combined procedures, procedures performed in a hospital, and the use of systemic anesthesia.[2-4]

Tumescent infiltration is a type of local anesthesia for cutaneous and subcutaneous surgery, where large amounts of dilute local anesthetic are subcutaneously administered, with either a blunt cannula or needles. It enlarges the target area, reduces pain and bleeding during and after surgery, and also has antibacterial properties.[5-7]

Tumescent liposuction under wide-awake local anesthesia was shown to be a safe method, provided it is performed by an experienced surgeon and the guidelines of care for liposuction are strictly followed.[1-3]

Estimated maximum safe dosages of tumescent lidocaine are 45 mg/kg.[8] Depending on the lidocaine concentration, this limits the total injection volume and hence the size of body area that can be treated in a single session.

The popularity of high-definition liposculpture (HDL) poses a challenge to liposuction when performed in local anesthesia. Typically, a number of areas are treated in a single session, including arms, pectorals, the area over the serratus muscle, lower back, as well as lateral and medial abdomen. This is sometimes combined with fat grafting to areas over the pectorals and over the deltoid muscle. To increase the total volume of the tumescent solution, and simultaneously keep lidocaine toxicity at bay, we added another amide-type anesthetic, prilocaine, to the solution. In a prospective study, 48 male patients underwent HDL in fully awake local anesthesia.

Materials and Methods

Between September 2018 and August 2019, 48 consecutive male patients underwent HDL. Only patients with good muscle tone, without excessive fat or skin laxity, were selected. All patients gave their written consent for surgery. The mean age was 43.8 years (range, 26-58 years). Hemoglobin levels were normal in all patients, and potential interaction with other prescription drugs was evaluated.

Markings were performed with patients in a standing position. To assist in the sculpting process, patients were asked to

[1]White House Center for Liposuction, Zurich, Switzerland

Corresponding Author:
Roland Boeni, White House Center for Liposuction, Mommsenstrasse 20, Zurich 8044, Switzerland.
Email: rolandboni@gmail.com

flex their abdominal musculature. The landmarks marked were the pectoralis major, serratus anterior, rectus abdominis, external oblique, iliac crest, and inguinal ligaments.[9]

The medial and lateral edges of the rectus muscle were marked at the linea alba and linea semilunaris. Transverse tendinous inscriptions (Intersectiones tendineae) of the rectus abdominis muscle were also marked separately. These lines are often not entirely symmetrical. The highest horizontal tendinous intersection is roughly following the downward angle of the thoracic arch. The lowest division is horizontal across the navel and is usually the most visible. On the section below the belly button, the vertical centerline is not as clear as on the "six-pack." Usually there is a separation only on the top part of that section, just below the belly button.

We followed the anatomy as closely as possible, thus not creating straight, but curvier lines. The patient was then turned to mark the love handles and following the anterior border of the latissimus dorsi muscle up to the armpit. This border is best visible if the patient pushes his extended arm on the observers shoulder.

To create an athletic look of the arms, anterior and posterior definition lines between deltoid muscle and biceps, as well as the groove between the long head of the triceps and the triceps tendon were marked, when required by the patient. Some patients required fat grafting to the upper pole of the pectoralis muscle.

To increase the volume of the tumescent solution without increasing the risk of potential systemic side effects of the anesthetics, we used a combination of lidocaine and prilocaine (Laboratorium Dr. G. Bichsel, Interlaken, Switzerland). This combination is still widely used by several liposuction surgeons, mainly in Germany.[10-12] We used a combination of saline, adrenaline, lidocaine (300 mg/L), and prilocaine (250 mg/L). Potential loss of body temperature due to the high tumescent solution volume was addressed by using preheated solution and heating blankets.

To reduce the risk of infection, antibiotic prophylaxis was performed with 200 mg of doxycycline daily for 7 days. Genital swelling from the tumescent solution was in most cases avoided by using a belt-like bandage.

We used an interconnected flow system with four 28-gauge needles (Vacuson 60 LP, Erlangen, Germany) to allow for more painless infiltration. The mean amount of tumescent fluid injected was 9.4 L (range, 6.8-12 L). This would take 30 to 45 minutes. Reciprocating power-assisted liposuction (MicroAire, Charlottesville, Virginia) using 1 straight 4-mm flared mercedes cannula and 1 bent 4-mm flared mercedes cannula was performed immediately after infiltration.

Puncture incisions of 3 mm were made in the mons pubis area at the lateral edge of the rectus. A stealth umbilical puncture was used for access to the linea alba and the lowest and middle rectus inscriptions. Stealth incisions on the anterior armpit crease were used to access the breast area below a marked line connecting the center of the areolae.

All layer debulking was performed starting from deep to superficial to subdermal liposuction on love handles, hypogastrium, the area over the serratus anterior, and the lower part over the pectoralis major. We then followed the marked straight line of the linea alba and s-shaped linea semilunaris. Using incisions where the normal skin meets the inferior part of the areolae and the navel incisions, the transverse intersections were created using the bent cannula. Once the bent cannula was inserted inside the tissue, the angle was controlled by flipping the cannula 180 degrees. The fat between the tendinous intersections was retained or, when a thicker fat layer was present, reduced to a 1-cm fat layer from the dermis.

The anterior armpit incisions were also used to create a more athletic look of the upper arm: using a bent or straight cannula, the groove between deltoid muscle and biceps was accessed. This sulcus continues on the back of the arm to a groove between the deltoid muscle and lateral head of triceps, which can be accessed from a stealth incision on the posterior armpit crease.

The fat equalization step (vibration without suction) after HDL is finished ensures smooth skin in the infraumbilical area.

Incisions were left open (open drainage technique). Foam pads (Epifoam, Biodermis, Henderson, Nevada) were used to enhance definition lines (to further define linea alba, semilunaris, and transverse intersections) and left on for 3 days. To limit methemoglobinemia due to the anesthetics, mainly from prilocaine, vitamin C (1000 mg) was given orally before the patient left our day clinic. Patients were wearing compression garments for 3 weeks. Lymphatic drainage was encouraged after 48 hours. Endermology was performed in most patients starting 1 month after surgery. Patients were able to reach our day clinic 24/7 using an emergency phone number. The surgeon (R.B.) called every patient the day following surgery. Follow-up was scheduled 1, 2, and 6 months after surgery.

Results

HDL resulted in a more athletic appearance and pronounced muscular definition (Figure 1). In some patients, HDL of the entire torso was combined with arm liposuction (Figure 2).

The mean volume injected was 9.4 L. There were no side effects due to the high volume of tumescent solution. The mean lidocaine dose was 33.2 mg/kg body weight (range, 25.9-41.5), and the mean prilocaine dose was 27.7 mg/kg body weight (range, 21.6-34.6) (Table 1).

Two patients had seromas, but responded well to percutaneous drainage. Two patients required touch-up surgery due to residual fat deposits in the hypogastrium. One patient required touch-up surgery over the pectorals.

Discussion

While traditional liposuction is focusing on fat extraction avoiding superficial aspiration, HDL is taking an artistic approach designed to emulate a more defined surface anatomy. The surgeon will retain fat in specific areas and

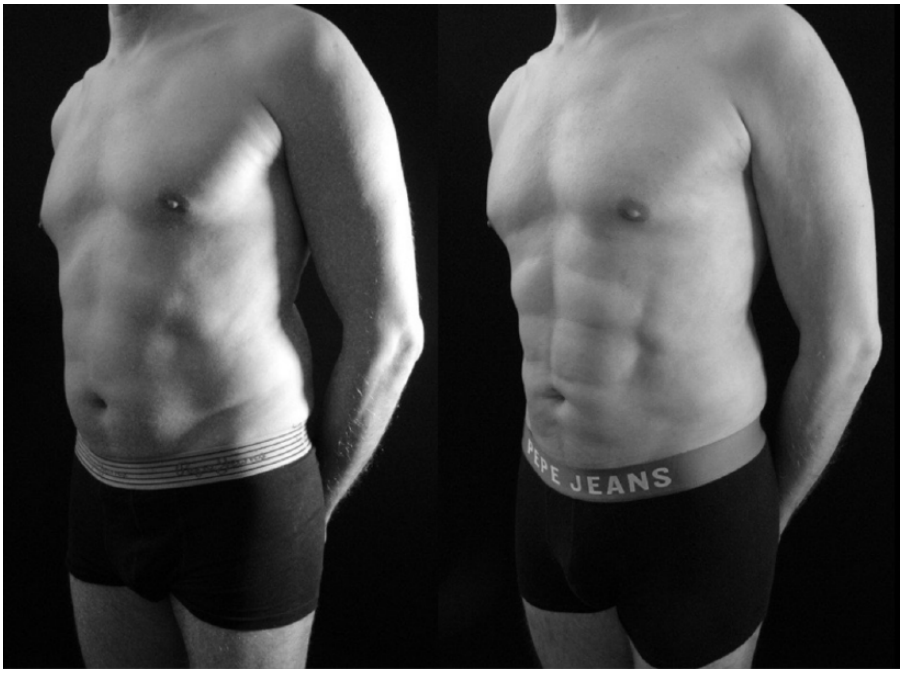

Figure 1. A 52-year-old patient who underwent HDL, 2-month post-op.
Note. HDL = high-definition liposculpture.

Figure 2. A 44-year-old patient who underwent HDL including liposculpture of the arms: definition lines between deltoid muscle and biceps, as well as the long head of the triceps muscle and triceps tendon, are now improved, 2 month post-op.
Note. HDL = high-definition liposculpture.

purposefully overresect in other areas to create an overall athletic appearance. Definition of the abdominal packs is achieved with (1) the fat that is retained and (2) the scar tissue that forms adhering the skin to the inscription.

Using a lidocaine tumescent solution in local anesthesia, the first authors to describe abdominal etching were limited to the anterior abdominal wall.[13] Incisions were made in the midline at the upper 2 rectus inscriptions.[13] The use of bent

Table 1. Number of Patients (n = 48) Undergoing HDL, Age, Weight, Total Volume of Tumescent Solution and Calculated Lidocaine and Prilocaine Levels per Kilogram Body Weight.

No.	Age	Weight, kg	Total volume	Lidocaine, mg/kg	Prilocaine, mg/kg
1	35	81	10	37	30.1
2	26	99	12	36.4	30.3
3	33	86	11.9	41.5	34.6
4	58	87	9	31	25.9
5	42	88	9	30.7	25.6
6	39	98	10.7	32.8	27.3
7	50	76	9.6	37.9	31.6
8	35	86	10.5	36.6	30.5
9	56	94	10	31.9	26.6
10	47	73	8.4	34.5	28.8
11	38	101	12	35.6	29.7
12	44	86	8.2	28.6	23.8
13	43	84	8.4	30	25
14	37	82	9	32.9	27.4
15	41	90	8.2	27.3	22.8
16	23	98	10.9	33.4	27.8
17	55	72	8.2	34.2	28.5
18	55	75	9	36	30
19	53	78	9	34.6	28.8
20	52	82	9.5	34.8	28.9
21	41	84	9.3	33.2	27.6
22	55	85	9	31.8	26.5
23	51	80	9.2	34.5	28.7
24	50	87	10.4	35.9	29.9
25	49	98	10.2	31.2	26
26	32	90	9.2	30.7	25.6
27	51	81	10.4	38.5	32.1
28	41	74	8.2	33.2	27.7
29	29	76	8	31.6	26.3
30	52	81	7	25.9	21.6
31	38	75	7.2	28.8	24
32	46	92	9	29.3	24.5
33	31	95	11	34.7	28.9
34	49	88	9.4	32	26.7
35	27	77	9.6	37.4	31.2
36	44	99	11.6	35.2	29.3
37	42	80	8.5	31.9	26.6
38	55	95	11	34.7	28.9
39	56	82	10.4	38	31.7
40	36	65	7.6	35.1	29.2
41	53	92	10.7	34.9	29
42	51	114	11.1	29.2	24.3
43	30	80	9	33.7	28.1
44	54	99	10	30.3	25.2
45	52	75	6.8	27.2	22.7
46	38	62	6.8	32.9	27.4
47	40	96	10.8	33.8	28.1
48	51	88	9.3	31.7	26.7
Mean	43.8	85.5	9.4	33.2	27.7

cannulas makes these clearly visible incisions unnecessary. To create transverse sections, bent cannulas are inserted from the stealth umbilical puncture and the incisions hidden in the areolae. Inside the tissue the angle can be controlled by flipping the cannula 180 degrees.

It was only later recognized that to create an overall athletic appearance, the entire torso and sometimes the arms (as well as the legs) need to be addressed, as they all are giving us visual clues regarding the physical state of a person.[9] Therefore, HDL is usually performed in general anesthesia, as sufficient analgesia is difficult to achieve with a lidocaine tumescent solution alone.

The American Academy of Dermatology states in their recommendations for tumescent local anesthesia that a combination of lidocaine and prilocaine may reduce the risk of toxicity of either drug and might be favorable in cases where a large volume of tumescent local anesthesia is needed.[14] Using a combination of lidocaine and prilocaine, a higher tumescent volume can be applied and their toxic effects are less pronounced due to the fact that

1. their peak serum levels differ (prilocaine 5-6 hours, lidocaine 12-14 hours)[8,12];
2. they are metabolized in different areas of the body (prilocaine: lung, liver, kidneys; lidocaine: mainly liver)[12]; and
3. prilocaine is less cardiotoxic than lidocaine.[15]

In this series of 48 male patients, we achieved sufficient analgesia and were able to perform HDL on the entire torso and arms in a single session. An important feature of the tumescent technique is that some amount of fluid is still left behind at the end of the procedure, which ensures anesthesia in the first few hours post-op.

The median volume in our series was 9.4 L. None of the patients experienced symptoms of fluid overload. We used local anesthesia only (no intravenous access), and open drainage technique, which results in large amounts of the tumescent solution leaking out immediately after liposuction, as soon as compression is applied.

The mean calculated lidocaine dose was 33.2 mg/kg body weight (range, 25.9-41.5), and the mean prilocaine dose was 27.7 mg/kg body weight (range, 21.6-34.6) (Table 1). There were no adverse effects from either one of the two anesthetics.

As lidocaine is widely used, there is ample literature regarding its guidelines: maximum estimated safe dosages of tumescent lidocaine are 45 to 55 mg/kg. Peak serum concentrations are between 8 and 12 hours. If no liposuction is performed, maximum safe dosages are 28 mg/kg.[8] Slow administration of more dilute concentrations of local anesthetic decreases the risk of local anesthetic systemic toxicity.[16]

With a calculated peak lidocaine level of 41.5 mg/kg body weight, we never exceeded the limit for lidocaine.

Despite the fact that a lidocaine-prilocaine tumescent solution has been widely used for decades in Germany,[10-12] there are only few studies or guidelines available regarding prilocaine use. Maximum safe dosages were described to be 35 mg/kg body weight, and doses as high as 38 mg/kg body weight have been used.[10-12] Peak serum concentrations are reached between 5 and 6 hours.[8]

In our series, mean prilocaine levels were 27.7 mg/kg body weight, with the highest level at 34.6.

Potential side effects of lidocaine include central nervous effects (nausea, dizziness, drowsiness, vision changes, tremors) and cardiotoxic effects. Prilocaine is less cardiotoxic than lidocaine, but its main adverse effects are methemoglobinemia (cyanosis, tachypnea, hypotension, tachycardia, confusion). The first clinical sign, acrocyanosis, develops with a delay of several hours after the peak serum concentration is reached, as prilocaine first has to be hydrolysed into alpha-toluidine, which inhibits the reduction of methemoglobin and induces methemoglobinemia.[17,18] The enzyme that reduces methemoglobin is glucose-6-phosphate dehydrogenase. Treatment of methemoglobineamia consists of oxygen therapy, intravenous methylene-blue, and vitamin C.[17]

In our series none of the patients developed clinical signs of methemoglobinemia.

Careful history of any regular intake of prescription drugs that may interact with the anesthetics and knowledge of possible anemia and glucose-6-phosphate-dehydrogenase insufficiency are a prerequisite to ensure patient's safety. One needs to be cautious, as patients do not always provide an accurate clinical history.

To conclude, we found that the combination of lidocaine (300 mg/L) and prilocaine (250 mg/L) provided sufficient analgesia and allowed for higher tumescent solution volumes, without exceeding toxic levels of the two anesthetics. This solution, combined with slow infiltration with needles, allows for HDL of the entire torso and arms in a single, almost painless session.

Tumescent solutions containing more than one anesthetic combined with high volumes should only be used by experienced, highly trained experts. They should have in depth knowledge of potential adverse effects such as fluid overload and methemoglobinemia, central nervous, as well as cardiotoxic effects.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Roland Boeni https://orcid.org/0000-0002-9732-6116

References

1. The American society for aesthetic plastic surgery's cosmetic surgery national data bank: statistics 2018. *Aesthet Surg J*. 2019;39:1-27.

2. Kaoutzanis C, Gupta V, Winocour J, et al. Cosmetic liposuction: preoperative risk factors, major complication rates, and safety of combined procedures. *Aesthet Sure J*. 2017;37:680-694.
3. Halk AB, Habbema L, Genders RE, Hanke CW. Safety studies in the field of liposuction: a systematic review. *Dermatol Surg*. 2019;45(2):171-182. doi:10.1097/DSS.0000000000001707.
4. Boeni R. Safety of tumescent liposuction under local anesthesia in a series of 4,380 patients. *Dermatology*. 2011;222:278-281.
5. Williams BJ, Hanke CW, Bartlett M. Antimicrobial effects of lidocaine, bicarbonate, and epinephrine. *J Am Acad Dermatol*. 1997;37:662-664.
6. Gajraj RJ, Hodson MJ, Gillespie JA, Kenny GN, Scott NB. Antibacterial activity of lidocaine in mixtures with Diprivan. *Br J Anaesth*. 1998;81(3):444-448. doi:10.1093/bja/81.3.444.
7. Miller MA, Shelley WB. Antibacterial properties of lidocaine on bacteria isolated from dermal lesions. *Arch Dermatol*. 1985;121:1157-1159.
8. Klein JA, Jeske DR. Estimated maximal safe dosages of tumescent lidocaine. *Anesth Analg*. 2016;122(5):1350-1359. doi:10.1213/ANE.0000000000001119.
9. Hoyos AE, Millard JA. VASER-assisted high-definition liposculpture. *Aesthet Surg J*. 2007;27(6):594-604. doi:10.1016/j.asj.2007.08.007.
10. Rudlof K, Rüffert H, Wehner M. Tumeszenzlokalanästhesie bei dermatologischen Eingriffen. *Anästhesist*. 2007;56:785-789.
11. Mang WL, Materak J, Kuntz S, Sawatzki K, Arnold W. Liposuktion in Tumeszenzlokalanästhesie—Grenzen der Prilocaindosierung. *Z Hautkrankheiten*. 1999;74:157-161.
12. Sattler G. Tumeszenz-Lokalanästhesie: Untersuchungen zur Pharmakokinetik von Prilocain. *Z Hautkr*. 1997;7:522-527.
13. Mentz HA III, Gilliland MD, Patronella CK. Abdominal etching: differential liposuction to detail abdominal musculature. *Aesthetic Plast Surg*. 1993;17(4):287-290.
14. Augustin M, Maier K, Sommer B, Sattler G, Herberger K. Double-blind, randomized, intraindividual comparison study of the efficacy of prilocaine and lidocaine in tumescent local anesthesia. *Dermatology*. 2010;221:248-252.
15. El-Boghdadly K, Pawa A, Chin KJ. Local anesthetic systemic toxicity: current perspectives. *Local Reg Anesth*. 2018;11:35-44.
16. Holt NF. Tumescent anaesthesia: its applications and well tolerated use in the out-of-operating room setting. *Curr Opin Anaesthesiol*. 2017;30:518-524.
17. Higuchi R, Fukami T, Nakajima M, Yokoi T. Prilocaine- and lidocaine-induced methemoglobinemia is caused by human carboxylesterase-, CYP2E1-, and CYP3A4-mediated metabolic activation. *Drug Metab Dispos*. 2013;41(6):1220-1230. doi:10.1124/dmd.113.051714.
18. Yildirim B, Karagoz U, Acar E, et al. A case report of prilocaine-induced methemoglobinemia after liposuction procedure. *Case Rep Emerg Med*. 2015;2015:282347. doi:10.1155/2015/282347.

Author Biography

Roland Boeni, MD, is affiliated with White House Center for Liposuction, Zurich, Switzerland.