

КЛИНИЧКИ ИСТРАЖУВАЊА

ТУМЕСЦЕНТНАТА ТЕХНИКА КАКО РЕГИОНАЛНА АНЕСТЕЗИЈА

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Тумесцентната техника е техника на инфилтрација во супкутаното ткиво на голем волумен пуферизиран физиолошки раствор во кој е потопена мала концентрација лидокаин заедно со адреналин. Овој раствор лесно и безболно се инфилтрира и доведува до анестезија на поткожното ткиво од одредени телесни регии како абдоментот, натколелото, обезбедува помало крвавење за време на интервенциите изведувани на кожата и поткожното ткиво. Тумесцентната локална анестезија (ТЛА) е многу лесна и сигурна процедура, која широко се употребува во многу хируршки гранки. Целта на трудот беше да се направи проценка на вредноста на тумесцентната локална анестезија кај липосукција. Материјал и методи: Беа евалуирани 16 пациентки со средна возраст од 32 години (24-46), кај кои беше извршена липосукција на една до три регии, односно на вкупно 27 регии. Во тек на интервенцијата се употреби тумесцентната техника; инфилтрација на раствор од 0,075% лидокаин со 1:1.000.000 адреналин и 25 мл 8,4% бикарбонати во 1000 мл физиолошки раствор, средно инфилтриран раствор од 2506 мл (1600-5000), средна доза на лидокаин 25,9 мг/кг (18,9-50,6 мг/кг), вкупно средно инфилтриран лидокаин од 2010 мг (1360-4000 мг). Резултати: ТЛА беше успешно реализирана; 68,8% (11) од пациентките беа среќни и задоволни, 12,5% (2) од пациентките имаа главоболка и вртоглавица, кај 12,5% (2) од пациентките беше соопрена интервенцијата поради силни болки, кај едната на една регија, кај другата на втората регија и кај 6,3% (1) од пациентките имаше лесни знаци за интоксикација со лидокаин. Немаше компликации кои бараа третман или хоспитализација, а немаше и смртен исход. Заклучок: Самостојно употребена тумесцентна локална анестезија во доза од 18-50 мг/кг лидокаин кај правилно избрани пациенти е сигурна техника за регионална анестезија за процедури на поткожното масно ткиво.

CLINICAL SCIENCE

TUMESCENT TECHNIQUE AS REGIONAL ANESTHESIA

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Tumescient technique is a technique of infiltration a large volume of buffered low concentration of lidocaine and adrenaline in the subcutaneous tissue. This solution that is easily and painlessly infiltrated, anesthetizes a large area of subcutaneous tissue in particular body areas like: abdomen, thigh or arms; it provides less bleeding during procedures performed on the skin and subcutaneous tissue. The tumescient local anesthesia (TLA) is a very simple and save procedure, widely used in many surgical branches. The aim of the paper was to assess the value of the tumescient local anesthesia during liposuction. Material and methods: Sixteen patients with a mean age of 32 years (24-46) underwent liposuction of one to three body areas, using tumescient technique, wide-awake. Total of 27 procedures were performed, with infiltration of solution of 0.075% lidocaine with 1:1,000,000 adrenaline and 25 ml of 8.4% sodium bicarbonate in 1000 ml normosaline, mean infiltrated solution of 2506 ml (1600-5000), mean dosage of lidocaine 25.9 mg/kg (18.88-50.6 mg/kg), total amount of lidocaine 2010 mg (1360-4000 mg). Results: TLA was successfully realized; 68.8% (11) of patients were happy and satisfied, 12.5% (2) of patients had headache and dizziness, in 12.5% (2) of patients the procedure was stopped because of a severe pain, one in the first region and one in the second region, and in 6.3% (1) of patients mild signs of lidocaine toxicity were observed. There were no complications that needed treatment or hospitalization; also, there were no lethal cases. Conclusion: Sole tumescient local anesthesia at a dosage 18-50 mg/kg lidocaine in prudent chosen patients seems to be safe regional anesthesia technique for the procedure of subcutaneous fat tissue.

Introduction

Tumescent local anesthesia (TLA) is a technique of infiltration of a large volume of tumescent solution in the subcutaneous area, swells and firms (tumescence) that area, produces anesthesia of large areas of skin and subcutaneous tissue, also named as regional anesthesia, while the patient is awake and can cooperate with the surgeon (changing the position) during the procedure, which is an important point for the esthetic procedures¹.

Tumescent solution is an isotonic solution with lidocaine (0.05% or 0.1%), epinephrine (1:1,000,000) and sodium bicarbonate 8.4%².

TLA has been widely used and studied not only in plastic surgery, but also in general surgery, gynecology, vascular surgery, orthopedics³.

Current technique was popularized and reintroduced in 1987 by Dr. Jeffrey A. Klein⁴, a dermatologist from USA; in fact, it is a variation of the much older technique known almost 110 years ago as "massive infiltration" or "hard infiltration." This technique used as regional anesthesia has less blood loss during operation and less painful infiltration of high acid solution of diluted lidocaine in combination with adrenalin⁵. This technique has been shown to be safe at high dose of lidocaine and regarding lidocaine adsorption and toxicity^{6,7}.

The aim of the paper was to assess the value of tumescent anesthesia in patients who underwent liposuction.

Material and methods

Sixteen women underwent liposuction with tumescent local anesthesia (TLA) between September 2018 and Mart 2019. The mean age of the patients was 32 years (range 24-46). All patients underwent routine preoperative assessment, investigation for CBC (complete blood count) and bleeding profile-INR, aPTT (activated partial thromboplastin time), platelets, BMI, menstrual cycle and breast ultrasound if needed. The examination also included use of all medications, vitamins, herbs, anticoagulants and contraceptive drugs as they may affect blood clotting. The usage

of most of these drugs was to be discontinued at least 2 weeks prior to surgery, so that they could not influence the bleeding time.

Preoperative marking session: After consulting with the patient and having a clear idea of what she wanted to accomplish, areas were marked in a standing position, the areas wanted to be reduced were marked in a circular fashion (circle within a circle), where the inner circle (inside with crossed lines) represented the highest elevation and the outer circle the flattest; marking the muscles of both arms and buttocks. This is particularly important prior to liposuction since there is often variation in what body part the patient refers to and what the surgeon sees. Small incisions for liposuction cannula should be very discrete, ideally hidden by the body's natural folds and contours, while simultaneously allowing sufficient access to the targeted treatment area, and communicating with the patient. Since the liposuction is done with the patient in a lying position, these markings are very important for shaping the underlying areas. The most important issue about the marking session is to confirm - the treatment plan with the patient. There was no premedication.

The following formula and components for tumescent solution was used: 500 ml normal saline solution at room temperature, 20 ml of 2% lidocaine (400 mg lidocaine), 0.5 ml of epinephrine 1:1000 and 12.5 ml of 8.4% sodium bicarbonate. The solution for lidocaine infiltration was preoperatively calculated by the patient weight - 20 mg/kg lidocaine. Therefore, if the patient had 70 kg, she was given about 1,400 mg lidocaine, and if 1000 ml tumescent has 800 mg, the calculated preoperative tumescent solution was about 2,000 ml; however, sometimes during the procedure a larger dose was needed, and so the initial dosage for lidocaine was 20 mg/kg. The estimated tumescent solution was prepared prior to the intervention in a separate place, near the treatment room.

Tumescent fluid infiltration and surgical procedure: Premedication or sedation during the intervention was not used. After establishing standard cleaning and

preparing the operating site, local infiltration was done using a blunt tipped liposuction needle of 3 mm width, which was introduced through very small skin incisions inserted with local anesthetic. The subcutaneous infiltration of a sufficiently large volume of solution produced a fine, tumescence and dimpled appearance of the skin texture that resembles the skin of an orange and blanching. It took 20-30 min for infiltration for each area. Usually the suction of the fat was started 5-8 minutes after the end of infiltration to allow a proper anesthesia of the area and proper vasoconstriction of the subcutaneous tissue, when the injected area is slightly firm and cool to the touch. Manual, power-assisted suction with a large cannula 4-5 mm was done for removing a large amount of the fat, followed by using a thinner 3 mm cannula for smoother results. The cannula is moved in a controlled back and forth fanning motion to dislodge fat. The excess fat is then sucked through the cannulae, vacuum system and collected in 3 liters medical containers, non-sterilized or sterilized when fat is used for grafting.

Postoperative management: After cleaning and dressing of the incision sites, a high compression elastic post-liposuction garment was worn. Patients were able to

leave the Clinic within 30 minutes to one hour after the completed procedure and were given advice for 24-hour rest, intake of 2-3 liters fluid and antibiotics for 5 days. The garment was worn 4 weeks. Two of the patients took low molecular heparin for 1 week. Monitoring of the patient is essential for the sake of onset of pain, numbness, dizziness, headache and blood pressure, within one hour after the procedure. Patients are also asked about the personal satisfaction from the procedure. Contact with the patient during the 24 hours after the procedure is always made by telephone to detect any early signs of complications that may develop.

Results

The study comprised 16 healthy women with a mean age of 32 years (range 24-46 years), mean body mass index (BMI) of 29.06 (range 27-35); of them 62.5% (10 patients) were overweight and the rest were obese. In the period 2018 - 2019 these patients underwent liposuction procedure, involving treatment of 27 body areas. In Table 3 all treated body areas are shown: in 68.8% (11 patients) of the cases one area was treated, in 18.8% (3 patients) two areas, in 12.5% (2 patients) three areas, and in 31.3% (5 patients) fat grafting was performed.

Table 1. Treated body areas

Localisation	Number
Double chin	1 (3.7%)
Arms	8 (29.62%)
Abdomen - Upper and lower	8 (29.62%)
Upper Abdomen	1 (3.7%)
Lower abdomen	/
Abdomen sides	1 (3.7%)
Love handles	1 (3.7%)
Back sides	1 (3.7%)
Hips	1 (3.7%)
Lower extremity	/
Fat grafting Buttocks	2 (7.40%)
FG Breasts	1 (3.7%)
FG Hands	1 (3.7%)
FG Hips	1 (3.7%)

Operating data: Table 2 gives data for each patient: the average amount of tumescent solution infiltrated was 2506 ml (range 1600-5000 ml) and the average lidocaine dosage was 25.96 mg/kg (range 18.88 mg/kg- 50.6 mg/kg) or total

amount per patient 2010 mg (range 1360 mg-4000 mg). The average aspirate volume was 1787 ml (range 1250-3500) and average amount of supernatant fat 1353 ml (400-2700 ml).

Table 2. Data for each patient regarding infiltrated tumescent solution, aspirate, supernatant fat, total amount of lidocaine and lidocaine in mg/kg.

	Tumescent solution in ml	Aspirate in ml	Supernatant fat in ml	Total amount of lidocaine in mg	Lidocaine mg/kg
1.	2000	1750	1500	1600 mg	21.6
2.	2000	1300	700	1600 mg	21.3
3.	1700	1450	1050	1360 mg	19.15
4.	2500	2300	1700	2000 mg	23,80
5.	2700	2200	1600	2160 mg	26.34
6.	3000	1600	1200	2400 mg	26
7.	2500	2000	1400	2000 mg	26.6
8.	2000	1700	1300	1600 mg	20.25
9.	3500	1700	1500	2800 mg	38.3
10.	2000	2100	1800	1600 mg	23
11.	2000	1400	1200	1600 mg	22.5
12.	5000	3500	2700	4000 mg	50.6
13.	2500	1600	1450	2000 mg	28
14.	1600	1500	1200	1360 mg	18.88
15.	1700ml+400ml for grafting	1250	950	1680 mg	21.26
16.	2500 ml + 500 ml for grafting	1250ml	400ml	2400 mg	27.9
mean	2 506 ml (1600-5000)	1787 ml 100% (1250-3500)	1353 ml (75.71%) (400-2700)	Mean 2010 mg (1360-4000 mg)	Mean 25.96 mg/kg (18.88-50.6 mg/kg)

Table 3 shows reactions of the patients during the intervention and reactions from tumescent solution: 68.8% (11 patients) were happy and satisfied, 12.5% (2 patients) had headache and dizziness, in 12.5% (2 patients) the procedure was stopped because of a severe pain, one in the first region and one in the second region, and in 6.3% (1 patient) of cases mild signs of lidocaine intoxication appeared. There were no complications requiring treatment or hospitalization, and there were no lethal cases.

Table 4 presents the late complications that could occur and the incidence encountered after the procedure. In only 6.3% (1 patient) of patients panniculitis in her upper arm developed, an inflammation of subcutaneous adipose tissue, treated successfully in a few days with antibiotics and local anti-inflammatory ointments. There were no complications that needed hospitalization, and no deaths occurred.

Table 3. Reaction upon intervention

	Number
Reaction upon intervention and signs of lidocaine intoxication	
Number of patients and percentages	8 (29.62%)
Happy	3 (18.75%)
Satisfied	8 (50%)
Headache	1 (6.25%)
Dizziness	1 (6.25%)
Numbness/Paresthesia, Dizziness, Collapse	1 (6.25%)
Painful (stopped in the first region or in the second region)	2 (12.5%)

Table 4. Complications from the intervention

Complications from the intervention	
1. Panniculitis – 1 needed treatment – antibiotic and local treatment	
2. Deep infection	- 0
3. Bowel perforation	- 0
4. Pulmonary embolism	- 0
5. Deep venous thrombosis	- 0
6. Fat embolism	- 0
7. Death	- 0

Discussion

To allow accurate safety of TLA during liposuction as exclusively used local anesthesia, prudent choice of patients was done: healthy women, no medication and medical history, procedures were performed during periovulatory phase. It was found that mean bleeding time at follicular phase was significantly shorter ($P < 0.05$) as compared to that at menstrual and luteal phases. Also, mean clotting time at follicular phase was comparatively less shorter than that at menstrual and luteal phases, but the difference was not significant ($P > 0.05$)^{8,9}. Meticulously were followed guidelines for preparing and administering of the TLA, whereas the safe maximum dosage of tumescent lidocaine (with epinephrine) is at concentrations between 45 mg/kg to 50 mg/kg¹⁰. Jeffry Klein in his study with 41 tumescent infiltration procedures among 14 volunteer subjects, with tumescent

lidocaine dosages ranging from 19.2 to 52 mg/kg, divided procedures in two groups: with and without liposuction. He measured serum lidocaine concentrations over the 24-hour study period. It was concluded that preliminary estimates for maximum safe dosages of tumescent lidocaine were 28 mg/kg without liposuction and 45 mg/kg with liposuction¹¹. The recommendation by the American Academy of Dermatology Association, 2018, is usage of a maximum dose of 55 mg/kg of lidocaine with epinephrine that has been demonstrated to be safe and can be used for tumescent local anesthesia for liposuction in patients weighing 43.6 – 81.8 kg. In our study the average lidocaine dosage was 25.96 mg/kg (18.88– 50.6 mg/kg), which is lower than the recommended safe dosage. This might be a result of performing the procedure as an in-office. In the study of Klein¹¹ liposuction was done after allowing at least 1 hour of

detumescence for gradual dispersion of subcutaneous tumescent fluid. However, in our study liposuction was started 5-8 minutes after the end of infiltration to allow a proper anesthesia of the area and proper vasoconstriction of the subcutaneous tissue. In such a case the resorption of lidocaine and adrenaline in the blood is decreased and the safety of the procedure is higher. In our case effects of lidocaine were good; only in 12.5% (2 patients) the procedure was stopped because of onset of a severe pain, one in the first region and one in the second region; 68.8% (11 patients) were satisfied and happy, and the effects of the adrenaline were satisfactory because supernatant fat from the aspiration was with mean 75.8% (1353 ml). However, the procedure is also slow, taking 3-4 hours to perform and also, the amount of fat that can be extracted is usually limited to about 4-5 litres¹². In our study the maximum amount of fat aspirated was 3500 ml with mean aspirate of 1787 ml, because the body weight of the patients was mean 76.9 kg (69 kg-92 kg) and the amount of infiltrated solution depends from calculated safe dose of lidocaine on a body weight.

Roland Boeni¹³ analyzed the safety of tumescent liposuction performed under local anesthesia in a larger group of patients, between 2003 and 2010. A total of 4,380 consecutive patients underwent tumescent liposuction by the same surgeon. There were no serious complications requiring hospitalization. It was concluded that tumescent liposuction under local anesthesia is a safe method performed by an experienced surgeon and providing the guidelines of care for liposuction are strictly followed.

There is a study that proved safety of liposuction using exclusively tumescent local anesthesia in 3,240 consecutive cases¹⁴ involving treatment of 7,511 body area; the male to female ratio was 1:9, and the average age was 43 (range 16-81), much older than in this study - 32 years (range 24-46). The average amount of tumescent solution infiltrated was 3,689 mL (range 10-14,300 mL), and the

average lidocaine dosage was 33.6 mg/kg of body weight (ranging from 0.5 to 86 mg/kg). For tumescent solution was used buffered normosaline with adrenaline and with lidocaine from 400 mg-1000 mg in 1000 ml normosaline; concentration of lidocaine was 0.04%-0.1% of lidocaine. In this study, Louis Habbe-ma reported that no deaths occurred, there were no complications that needed hospitalization, and no legal claims were initiated, although there were a number of complications that needed further action (generalized edema, allergic reaction to penicillin, small skin necrosis, hematoma, panniculitis. In our study toxicity from tumescent was observed in 6.3% (1 patient). She was 24 years old, BMI 30 (79 kg/161sm), infiltrated with 5000 ml tumescent solution 0,075% lidocaine, 4000 mg lidocaine, or 50.6 mg/kg, aspirated 3500 ml from two body areas - abdomen and arms; the entire procedure lasted 3 and a half hour and no signs of intoxication were observed. Half an hour after the completion of the procedure, the patient presented with mild signs of lidocaine toxicity- she felt paresthesia on her left arm, dizziness and she collapsed twice.. Blood pressure and pulse were in normal range. There was no need of medical treatment and hospitalization; just rest and fluid intake, hydration were advised. After 24 hours following the procedure all signs disappeared and she felt very satisfied. In 6.3% (1 patient) there was one complication from the procedure and that was panniculitis on the upper arm, an inflammation of subcutaneous adipose tissue, treated successfully in a few days with antibiotics and local anti-inflammatory ointments. There were no complications that needed hospitalization, and no deaths occurred. The results obtained in our study might be explained by the use of smaller amount of tumescent solution - average amount of tumescent solution infiltrated was 2506 mL (range 1600- maximum was 5000 mL), and the average lidocaine dosage was 25.96 mg/kg of body weight (ranging from 18.88-50.6 mg/kg) with constant concentration of lidocaine 800 mg in 1000 ml normosaline - 0.075% concentration of lidocaine

in the solution.

Tumescent anesthesia used exclusively for regional anesthesia, without iv sedation or general anesthesia increases the safety of TLA. General anesthesia with halothane plus nitrous oxide causes an elevation in lidocaine plasma concentrations. Systemic anesthesia can have two dangerous effects in the setting of tumescent liposuction, as follows: general anesthesia can lower the maximum safe dose of lidocaine, such a potentially dangerous drug interaction is likely to result from competition and inhibition of hepatic CYP3A4, as well as decreased hepatic blood flow. General anesthesia can suppress lidocaine-induced seizures, which might otherwise act as premonitory signs of impending cardiac toxicity, including fatal cardiovascular collapse¹⁵.

Conclusion

This study analyzed a series of 16 subjects who underwent liposuction with TLA as sole local regional anesthesia technique leading to following conclusion: prudent choose of patients and dosage of lidocaine makes TLA a safe technique; there were no evidence of lidocaine or epinephrine toxicity that needed medical treatment or hospitalization. This technique is very easy to be performed; provides good anesthesia to the region and is a safe procedure for in-office surgery. Tumescent anesthesia is used exclusively for regional anesthesia, without iv sedation.

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