

Liposuction and the Cutaneous Surgeon

Liposuction is one surgery in which a dermatosurgeon made a major contribution. In a series of path breaking articles, Dr. Jeffrey Klein, a Dermatologist from San Juan Capistrano, California introduced a radically new technique of anesthesia called tumescent anesthesia and through it a new method of liposuction called microcannular tumescent liposuction which made liposuction simpler, safer and revolutionized the technique. He did this first through a presentation in a conference of the American Academy of Cosmetic Surgery in 1985 (which made an exception to allow his presentation as the policy of the academy until then, had been not to allow non-members to present in the official congress) and subsequently through a publication in the journal of the same academy.^[1] It brought liposuction under the realm of a dermatosurgeon and out of the hospital in to a day care center.^[2-5] It rendered an in-patient surgery with major complications such as blood loss and embolism, a safe and out-patient surgery in which the patient could go home at the end of the surgery.^[6]

What Jeffrey Klein showed was that liposuction can be performed under local anesthesia, if higher doses of xylocaine are used under high dilution and the drug can be made to percolate throughout the subcutaneous fat uniformly. This needed a slow gradual infiltration through very small cannulae, of a very dilute solution of large quantities of lignocaine. Hitherto, it had been believed (and is still believed) that the maximum dose of lignocaine should not exceed 7 mg/kg weight. Official Food and Drug Administration (FDA) lidocaine dose limits were established by the FDA in 1948 at a time when the United States FDA did not require objective data before approving a drug company's dosage recommendations. The 7 mg/kg of lidocaine dose limit

was approved by the FDA without supporting scientific data. He suggested and also proved that dosages up to 45 mg/kg weight can be given safely in to subcutaneous fat^[2] and that such doses can work for the following reasons:

- i. Subcutaneous fat has a low volume of blood flow.
- ii. Lignocaine is lipophilic and is easily sequestered in fat.
- iii. Diluted epinephrine in saline solution ensures vasoconstriction, thus minimizing systemic absorption of lignocaine and bleeding.
- iv. The large volume of tumescent solution itself compresses blood vessels by hydrostatic pressure.
- v. The very low dilution of lignocaine in Klein's solution does not achieve the gradient required for systemic absorption.
- vi. Most of the solution is removed during aspiration, minimizing the quantity available for absorption.

The usual tumescent solution concentration used by dermatologic surgeons is 0.05-0.1% lignocaine. The concentration of epinephrine is at 1:1,000,000-1.5:1,000,000. About 10 mEq of sodium bicarbonate is added to 1 L of tumescent solution to raise pH and to prevent stinging, as the pH of lignocaine is acidic. The required lignocaine dosages are dependent on appropriate epinephrine concentration in the tumescent solution. The recommended maximum dose of lignocaine is 55 mg/kg for most patients. The recommended concentration of epinephrine in tumescent solutions is 0.25-1.5 mg/L. The total dosage of epinephrine should be minimized, within these limits and usually should not exceed 50 µg/kg.

In addition to producing adequate anesthesia, the technique also rendered the procedure safer by the addition of epinephrine to the fluid, which results in vasoconstriction and minimizes blood loss. Prior to the introduction of this concept, liposuction used to be associated with bleeding and often needed blood replacement. The stinging pain of acid pH of the solution was eliminated through the addition of sodium bicarbonate and the tachycardia caused by epinephrine through administration of pre-operative clonidine.

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Thus, Jeffrey Klein turned hitherto beliefs on their head. He could do this because he was a pharmacologist, an internist, biostatistician and a Dermatologist. He emphasized that the above sound scientific logic can work provided that the tumescence is done gradually, slowly allowing the fluid to percolate throughout the fat in all layers uniformly. He also emphasized that what is important in tumescent anesthesia is safety and the final outcome, not speed and quantity of extraction. It is also important to understand that the safety of the higher doses is maintained only if it is not combined with any other type of anesthesia such as general or intravenous sedation. Hence by definition, tumescent anesthesia is defined as "solely by tumescent technique."

The other revolutionary measure introduced by D Klein was the use of very small cannulae (not exceeding 3.5 mm) for extraction - this ensured minimal blood vessel damage and also smooth uniform extraction and a pleasing esthetic result.

Because of the limitations of upper limits of dosage and the use of microcannulae, the area that can be infiltrated is limited and the total quantity of fat removed is also limited. The safe upper limit of fat removed is up to about 5 L in about 4 h. Hence if larger amounts need to be removed and more than one areas need to be combined, these are better done over multiple sessions, than in a single session.

The safety and efficacy of the technique has stood the test of time and it is now the gold standard method of liposuction.^[7] It is important to note that not a single death has been reported after tumescent liposuction in ambulatory centers and all deaths have been reported after general anesthesia and in hospitals.^[8,9] Several subsequent studies and reviews have confirmed the safety profile of the surgery.^[10-18] Standard guidelines of care published have shown a high level of evidence for the procedure.^[19]

Tumescent liposuction has been applied to other indications too. A major application of the technique has been in to management of gynecomastia, a problem which causes much psychological trauma in young men. Previous treatments included mastectomy with an unacceptable scar. Liposuction can work even for severe gynecomastia, with a subareolar pull through technique and can give satisfactory with minimal scarring. Other non-cosmetic indications include axially hyperhidrosis and human immunodeficiency virus lipodystrophy.

Although modifications and advances such as powered liposuction, vaser and laser lipolysis have been introduced recently, it is significant that these retain the original concepts and principles of tumescent liposuction.

Powered liposuction, both with reciprocating cannulae and oscillating cannulae has helped to reduce surgeon effort, with some reduction in the duration of surgery and moderate enhancement in the amount of extracted fat. Laser and ultrasound lipolysis are yet to establish their full role and tumescent liposuction continues to be the gold standard.

A somewhat unexpected application of liposuction has been the use of extracted fat as natural filler. The technique of fat transfer has been rediscovered because of its obvious advantages; easy availability, large amounts of the fat, and its easy technique. However, there are several aspects of the technique, which continue to be debated, such as role of centrifugation, level of deposits, longevity etc., The presence of stem cells in the fat has enhanced the application of fat as filler and also the possible role of future stem cell technology.

Tumescent liposuction has thus served as a classic example of how evidence based medicine can be practiced in dermatosurgery. It started as a question of how to perform liposuction under local anesthesia, to enhance safety to avoid blood loss, leading to enunciation of sound scientific logic and gathering evidence of high quality to establish the role. As Dr. Jeffrey Klein has aptly remarked.^[5]

"Tumescent liposuction, as a surgical procedure, requires a combination of: (1) Practical application of pharmacological knowledge, (2) appreciation of beauty, (3) a perfection of workmanship, (4) skill attained through proper training and clinical experience. In tumescent liposuction, speed and volume of aspirate are not the criteria for excellence. The criteria for excellence are safety, patient comfort, finesse and quality of results. It is important to keep in mind that, as in any cosmetic procedure including liposuction, final safe and satisfactory result is far more important than quick results."

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