ISSN: 1607-8322, e-ISSN: 2220-5799 **Anaesthesia, Pain & Intensive Care**

Vol 25(1); February 2021 DOI: 10.35975/apic.v25i1.1434

HUMAN RESEARCH **TUMESCENT ANESTHESIA**

Tumescent local anesthesia as an alternative to general anesthesia in release of post-burn neck contracture and skin graft harvesting: A comparative study

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Abstract

Background: Anesthetic management of severe post burn neck contracture is difficult, demanding due to fixed flexion deformity of neck, incomplete oral occlusion and insufficient mouth opening leading to difficulty in intubation. Patients undergoing contracture release, skin graft harvest under general anesthesia (GA) were compared with patients undergoing the same surgery under tumescent local anesthesia (TLA) technique.

Methodology: Twenty-one patients with post burn neck contracture undergoing contracture release with split skin grafting under GA were compared with twenty-one patients undergoing the same surgery under TLA. Post-operative pain and satisfaction were assessed using 10 cm VAS (Visual Analogue Scale).

Results: Demographic profile was comparable in both groups. Changes in intra-operative vital parameters remained insignificant. The average volume of tumescent solution used was 254.76 + 49.05ml. Blood loss was significantly decreased, postoperative pain relief was more than sixteen hours in thirteen patients and extended beyond twenty-four hours in six patients in the TLA group. Time for the first rescue analgesia was significantly lesser in the GA group and the average dose of injection tramadol used in the GA group was significantly higher within the first 24 h. Overall satisfaction in the TLA group was significantly higher than in the GA group.

Conclusion: TLA can be used as sole technique for release of post burn neck contracture and harvest of split skin grafts with less blood loss and significantly better postoperative pain relief avoiding complications of general anesthesia.

Key words: Tumescent local anesthesia; Post burn neck contracture; Skin graft harvest; General anesthesia

Citation: Prasad MK, Jain P, Varshney RK, Khare A, Jheetay GS. Tumescent local anesthesia as an alternative to general anesthesia in the release of post-burn neck contracture and skin graft harvesting: A comparative study. Anaesth. Pain intensive care 2021;25(1):35–41. DOI: 10.35975/apic.v25i1.1434

Received: 18 February 2020, **Reviewed:** 16 March 2020, **Accepted:** 30 April 2020

1. Introduction

Post burn neck contractures, most of the time, represent a surgical as well as anesthetic problem. Reconstructive surgery often requires large skin grafts to achieve the same aesthetics and functions of neck. The removal of scar tissue creates a large exposed raw area, and harvesting of a large amount of skin leads to more raw area and hence more blood loss and pain.

Anesthetic management of severe post burn neck contracture for ages has remained a nightmare for anesthesiologists due to insufficient neck extension, inadequate mouth opening and incomplete oral occlusion, leading to difficulty in intubation. (Figure 1) This difficulty in managing airway can result in serious complications and sequelae.[1,2]

Tumescent local anesthesia (TLA) is a technique to achieve extensive regional anesthesia of the skin and subcutaneous tissue by direct infiltration of large volumes of dilute local Anesthetic solution into subcutaneous plane. Dr. Jeffrey Klein in 1987 first described the technique of tumescent local anesthesia when he used large volumes of a diluted solution of lignocaine with adrenaline for infiltration into fat before liposuction.[3] The use of TLA has become widespread, being implemented for several cosmetic and non-cosmetic dermatological procedures including laser surgery, brachioplasty, abdominoplasty, face-lift, breast augmentation, hair transplant, extraction of skin grafts.[4,5]

TLA along with ketamine sedation for the release of severe post burn neck contracture had previously been used in some cases.[6,7] Sedation without securing the airway at times can be catastrophic, especially in patients with restricted mouth opening, as sedation can lead to loss of compromised airway. In this study, TLA was used for post burn neck contracture release and skin graft harvest without using intraoperative sedation.

2. Methodology

The study was conducted in the Department of Anesthesia in a tertiary care center in North India after obtaining institutional Ethical Committee approval (TMMC/IEC/2017/023). Written informed consent was taken from all patients. The study period was from September 2017 to February 2019. A total of 51 patients of the American Society of Anesthesiologists Class I and II of both sexes between the age group of 18 – 65 years posted for post burn neck contracture with restricted neck extension posted for release and autologous split skin graft from the thigh were assessed for the study. The patients were divided into two groups, Tumescent Local Anesthesia (TLA) group and General Anesthesia (GA) group based on modality of anesthesia used. Randomization was achieved using chit and box method. Patients were explained regarding the use of VAS scale for pain. The visual analog scale is a 10 cm scale where '0 = no pain' and '10 = excruciating pain. Patients having history of surgical site infection, heart disease, previous incidence of local anesthetic allergy, renal disease and liver disease were excluded from the study.

In the GA group, patients undergoing contracture release under local anesthesia before attempting airway securement by endotracheal intubation or placement of supraglottic airway were excluded from the study. GA group patients were induced with intravenous propofol 2 mg/kg, fentanyl (2μg/kg) and vecuronium (0.1 mg/kg) and after that placement of supraglottic airway device or endotracheal tube was facilitated. Anesthesia was maintained with nitrous oxide and isoflurane 0.5%–1% in oxygen, vecuronium (0.05 mg/kg) and fentanyl infusion (1μg/kg/h). At the end of the procedure, the muscle relaxant was reversed using neostigmine (0.05 – 0.07 mg/kg) and glycopyrrolate (8 to 10 μg/kg).

The tumescent local anesthetic solution was prepared immediately before surgery using 30 ml of 2% lignocaine (Neon® Laboratories Limited, India) in 450 ml ringer lactate solution, adrenaline 1:1000000 [0.5ml (0.5mg) 1:1000 adrenaline per 1000 solution], 20 ml 7.5% sodium bicarbonate, and 1500 I U hyaluronidase. Solution prepared consisted of 0.12% lignocaine.

Preoperative laboratory results were reviewed before surgery. Face, neck area and both thighs were washed with antibacterial soap the evening before and in the morning of surgery. All patients were explained and counseled again about the procedure to allay their anxiety. They were premedicated with tablet diazepam 0.2 mg/kg per oral the night before and intravenous midazolam 0.04 mg/kg, glycopyrrolate 0.004 mg/kg, and metoclopramide 0.2 mg/kg just before surgery (Figure 1). In the operating room monitoring included heart rate, cardiac rhythm, oxygen saturation and blood pressure. Planned areas were outlined and marked. After sterile preparation of neck contracture and graft-harvesting site, skin and subcutaneous region were infiltrated using 20G 5 cm and 10 cm needle as required using a 10-ml syringe. The end point of tumescence anesthetic infiltration was pale and firm skin. Smetimes patients experienced pain during rapid infiltration of anesthetic solution hence infiltration rate was

Figure 1: Anterior and lateral views of the patient showing the extent of the contractures

titrated to patient's comfort. Other methods used to minimize pain were continual verbal distraction, reassurance and buffered anesthesia. To avoid pain during multiple needle pricks further injections were made through anesthetized area. Infiltration of tumescent solution was relatively easy in graft harvest area compared to the contracture site. The total amount of tumescent solution required was noted to be between 170 ml to 310 ml depending on size of contracture. The pin prick method was used to elicit adequacy of anesthesia and then excision started. Oxygen was supplemented with nasal prongs throughout the surgery (Figure 2). In both groups post-operative pain was assessed using Visual Analogue Scale (VAS). Each patient was instructed to mark the scale at the point where they felt their level of discomfort. According to our institute protocol, postoperative analgesia was provided in the form of intravenous paracetamol 1 g every 8 h starting just at the end of the procedure in both groups in both groups. Rescue analgesia in the form of intravenous tramadol 100mg with a maximum dose of 400 mg in 24 h was administered once VAS was 4 or higher. The quality of analgesia was assessed based on the overall satisfaction of the patient.

Figure 2: Release of contracture and dissection in progress

Various data collected were demographic (age, sex, weight), time between TLA application and starting of surgery, duration of surgery, total volume of tumescent solution used, hemodynamic parameters such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), the volume of blood loss by gravimetric method, post-operative pain, overall satisfaction, time of the first rescue analgesia, total dose of tramadol 24 h postoperatively and any complications such as local anesthetic (LA) toxicity, post-operative nausea and vomiting (PONV) and pruritus were recorded. All patients were followed up until discharge and later in outpatient departments for 1 month.

G*Power version 3.1.9.2 for Windows a free online software (University of Düsseldorf, Germany) was used to calculate the minimum sample size. Considering one-tailed significance ($\alpha = 0.05$) and power of the study ($1–\beta$) at 0.80, the total sample size calculated was forty-two (twenty-one in TLA and twenty-one in the GA group)

Time between TLA administration and beginning of surgery and volume of tumescent local solution was reported as mean ± SD. The parametric data including weight, age, duration of surgery, amount of blood loss during surgery, heart rate, systolic/diastolic/ mean blood pressure and satisfaction score were compared using Students 't' test as applicable. Statistical Package for Social Science (SPSS version 21 for Windows) was used for the analysis of data once it was recorded in Microsoft Excel spreadsheet. Statistical significance was considered at the level of $p \leq 0.05$.

3. Results

The consort diagram represents from assessment to analysis of study patients.(Figure1) Demographic data suggested no statistically significant difference between age, sex and weight. The average duration of surgery between TLA and GA groups was statistically insignificant. (Table 1)

The average time in minutes between TLA application and the start of surgery was 21.29 ± 2.55. Average volume of tumescent solution used in the TLA group was 254.76 ± 49.05 (range 160–330 ml).

The average volume of blood loss in the TLA group as estimated was 73.57 ± 12.62 ml (range 50–100 ml) compared to 308.10 ± 55.55 (range 210–450 ml) in the GA group. This difference was statistically significant (Table 2).

Out of 21 patients in TLA group 2 (9.52%) patients required rescue analgesia within 9 h while in rest 13 (61.91%) pain free period was extended for more than 16 h. In 6 (28.57%) patients pain free period extended beyond 24 h.

Time for the first rescue analgesia was significantly lesser in the GA group compared to the TLA group. The average dose of injection tramadol used in the control group (GA group) for post-operative analgesia was significantly higher than in the TLA group. The overall satisfaction of the patient was assessed with a 10 cm VAS ('no satisfaction' at 0 cm end and 'the best satisfaction' at 10 cm end). Satisfaction when compared between groups, patients of the TLA group were more satisfied (Table 2).

The hemodynamic variables (HR, SBP, DBP and MBP) were compared between TLA and GA groups. In both groups, there was no significant difference in HR at all time intervals during the perioperative period except at 5 min when it increased in the TLA group. SBP was statistically insignificant in both groups at all time intervals, except in

Table 1: Demographic characters and Duration of surgery of both groups

Parameters	Treatment Groups		P-value
	TLA	GA	
Age (years)	37.67 ± 12.50	39.90 ± 12.66	0.57*
Sex (M/F)	5/16	7/14	0.49*
Weight (kg)	52.52 ± 4.73	54.81 ± 5.16	0.14*
Duration of Surgery (minutes)	75.10 ± 10.17	77.48 ± 10.77	0.47*

** Non significant, TLA :Tumescent Local Anaesthesia GA: General Anaesthesia M: male F: female*

Table 2: Level of satisfaction and Amount of blood loss, time for first rescue analgesia, total tramadol used and overall satisfaction score

Parameters	Treatment group		P- value
	TLA	GA	
Volume of blood loss(ml)	73.57 ± 12.62	308.10 ± 55.55	**0.001***
Time for first dose of supplemental analgesia(hours)	15.19 ± 2.73	2.77 ± 0.61	**0.001***
Total amount of tramadol used (mg)	76.19 ± 53.90	338 ± 49.8	**0.001***
Satisfaction VAS	8.62 ± 0.97	5.05 ± 01.16	**0.001***

**p < 0.05 (Significant), VAS –Visual Analogue Score TLA :Tumescent Local Anaesthesia GA: General Anaesthesia*

5 min and 90 min during intraoperative period it was higher in the GA group. Changes in MAP and DBP were comparable in both groups at the time intervals. Three patients had nausea and two patients suffered vomiting in the GA group. None of the patients in the TLA group suffered from nausea or vomiting. No other side effects such as local Anesthetic toxicity or pruritus were observed in the TLA group. No incidence of hematoma, seroma or graft failure was recorded in either group. No other complications were reported in the follow-up period.

4. Discussion

This study emphasizes the importance of TLA in release of severe post burn neck contractures. Patients with severe post burn neck contractures usually present with restricted neck movements and minimal mouth opening. Anesthetic management either by mask ventilation or intubation is often challenging in such patients. Use of total intravenous anesthesia or local anesthesia for neck contracture release followed by intubation and continuation of surgery under GA is the usual technique used for such cases. Alternative techniques used to secure the airway such as LMA (Laryngeal Mask Airway), ILMA (Intubating Laryngeal Mask Airway), PLMA (Proseal Laryngeal Mask Airway), awake blind nasal intubation or fiberoptic intubation.[8,9,10] In few cases, regional blocks such as inferior orbital block and mental block were used for contracture release and widening of the mouth, followed by a general anesthetic for the rest of the procedure.[11] In one case report release of neck bands was done under local anesthesia followed by tracheostomy under sedation and surgery proceeded under GA.[12] with injection midazolam and injection propofol and check ventilation, the patient was considered for tracheostomy Awake fiberoptic intubation requires cooperation from patient and obviously expertise and experience of anesthesiologist. Moreover, fiberoptic bronchoscope is expensive and may not be available in all places.[10,13] Retrograde intubation is usually out of question because of the presence of scar and distorted anatomy. Mask ventilation though possible in some cases is not feasible because of its close proximity to the surgical field.

TLA has made it possible to anesthetize large superficial area of the body by using a large volume of local anesthetic solution. The vasoconstrictive effect of adrenaline in tumescent solution has three major consequences: (i) decreased surgical site bleeding, (ii) prolongation of anesthetic effects of lignocaine; and (iii) slow and delayed lignocaine absorption.[14] In this study, when compared with GA group intraoperative bleeding in the TLA group was significantly less. Intense vasoconstrictive effect of adrenaline virtually rendered surgical field bloodless in the TLA group (Figure 3).

Maximum safe dose of lignocaine when used in such large volumes has been debated. J. Klein found that lignocaine in doses of 35 mg/kg is not toxic when used for liposuction.[4] The maximum safe dose for TLA as recommended by the American Society of Dermatologic Surgery in 1997, is 55 mg/kg for most patients undergoing liposuction.[15] However, slow absorption from fat, persistent vasoconstriction from adrenaline, lignocaine removed in liposuction aspirates contributes to reduced risk of lignocaine toxicity.[16,17] When mega-dose lignocaine was used in concentration between 0.05- 0.4%, peak plasma level occurred between 4 and 14 h after infiltration. This peak plasma level never exceeded the toxic level of 5 µg/kg.[18] Ramon et al. found that local anesthesia with diluted lignocaine in dose 3.1 times higher than the currently recommended dose (7 mg/kg) administered with adrenaline yielded a peak plasma lignocaine level that was 72% below the level considered safe (5 µg ml-1).[19] In our study 0.12% lignocaine was used and none of the patients suffered lignocaine toxicity.

Post-operative analgesia was excellent in case of the TLA group compared with the GA group. In the GA group, almost all patients were administered rescue analgesia within 3 h in the postoperative period. Klein[4] found post-operative analgesia to be 18 h when tumescent anesthesia was used for liposuction. Bussolin in 2003 reported 24 h of postoperative pain free period in 26 out of 30 pediatric patients. These findings of Klein and Bussolin supported the findings of the TLA group in this study. In our study, 6 patients reported more than 24hours of postoperative pain relief. This longer period of analgesia is to some extent explained by Ramon et al.[19] When they exposed isolated nerve fibers with constant concentration of local Anesthetic, degree of block increased. Slow absorption of lignocaine due to the vasoconstrictive effect of adrenaline and low perfusion of skin and subcutaneous tissue prolongs the duration of action.

Raymond SA et al. found that not only slow absorption but also the length of the exposed nerve fibers contributes to a longer duration of post-operative analgesia.[20]

Hyaluronic acid viscosity is decreased by hyaluronidase, resulting in increased tissue permeability, which enhances the dispersion and delivery of the tumescent solution. This effect leads to minimal change in surface contour and enhanced ease of dissection through subcutaneous tissue planes.[21] These advantages of hyaluronidase were effectively shown in the TLA group where skin graft harvesting and scar removal did not pose any challenge to a reconstructive surgeon.

Injection pain is decreased by buffering tumescent solution with sodium bicarbonate.[22] Sodium bicarbonate also enhances the bacteriostatic properties of lignocaine.[23] The washout effect of tumescent local Anesthetic solution also leads to antibacterial effects.

In our study, there was a transient increase in heart rate in 3 patients, probably due to anxiety, which settled down on reassurance. SBP was increased within 5 min of surgery in the GA group showing pressure response due to intubation, which settled later on intraoperative period. Again, there was increase in SBP in 90 min in the GA group due to awakening and extubation of patients from GA. In the TLA group, there was no significant increase in hemodynamic parameters during anesthesia and surgery, which gives an added advantage in cardiorespiratory compromise patients where pressure response during laryngoscopy and intubation can be damaging.[24,25]

5. Limitations

One of the major limitations is the small sample size; however, in the study, we could achieve minimum sample size required for statistical analysis. Moreover, due to contrast of technique used in both groups blinding was not possible.

6. Conclusion

Tumescent local anesthesia can be used for post burn neck contracture release and split skin graft harvest as an alternative to general anesthesia in instances where airway manipulation and securement is difficult. Tumescent local anesthesia provides a bloodless surgical field with excellent postoperative analgesia and can be used in low resource settings. In the TLA group, there were no significant hemodynamic changes making tumescent local anesthesia a suitable technique in cases of cardiorespiratory compromise.

7. Conflict of interest

None declared by the authors

8. Authors' contribution

MKP: Concept, conduct of the study, manuscript editing

PJ, RKV: Concept, conduction of the study work

AK, GSJ: Conduct of the study, manuscript editing

9. References

1. Ninan S, Gupta AK, Ramkumar G. A technique e in positioning the neck during mentosternal contracture release. Burns. 2003;29:613-4. [PubMed] DOI: 10.1016/s0305-4179(03)00150-5
2. Nath S, Erzingatsian K, Simonde S. Management of postburn contracture of the neck. Burns. 1994 Oct;20(5):438-41. [PubMed] DOI: 10.1016/0305-4179(94)90038-8
3. Klein JA. The tumescent technique for lipo-suction surgery. Am J Cosmetic Surg. 1987;4:263-267. DOI: 10.1177/074880688700400403
4. Klein JA. Tumescent technique for regional anesthesia permits lignocaine doses of 35 mg/kg for liposuction. J Dematol Surg Onco. 1990;16:248 -263. [PubMed] DOI: 10.1111/j.1524-4725.1990.tb03961.x
5. Samdal F, Amland PF, Bugge JF. Plasma lignocaine levels during suction-assisted lipectomy using large doses of dilute lignocaine with adrenaline. Plast Reconstr Surg. 1994;93:1217-1223. [PubMed] DOI: 10.1097/00006534-199405000-00017
6. Agarwal P. Safe method for the release of severe post burn neck contracture under tumescent local anaesthesia and ketamine. Indian J Plastic Surg. 2004;37:51-54. [FreeFullText] DOI: 10.1055/s-0039-1699032
7. Ramani MN, Shah SK, Chadha IA. Release of Severe post burn neck contracture- Our experience with Tumescent Local Anaesthesia and Ketamine. Indian J. Burns 2006;14;42-43. [FreeFullText]
8. Kumar R, Prashast, Wadhwa A, Akhtar S. The upside-down intubating laryngeal mask airway: a technique of cases of fixed flexed neck deformity. Anesth Analg. 2002;95:1454-8. [PubMed] DOI: 10.1097/00000539-200211000-00066
9. Wakeling HG, Nightingale J. The intubating laryngeal mask does not facilitate tracheal intubation in the presence of a neck collar in simulated trauma. Br J Anaesth. 2000;84:254-6. [PubMed] DOI: 10.1093/oxfordjournals.bja.a013414

10. Govardhane BT, Patkar GA, Parikh DA, Tendolkar BA. Awake insertion of proseal laryngeal mask airway: A technique for cases of fixed flexed neck deformity. J Mahatma Gandhi Inst Med Sci 2017;22:22-5. [FreeFullText] DOI: 10.4103/jmgims.jmgims_37_16
11. Subramanyam KL. Anesthetic management of post-burn contracture chest with microstomia: Regional nerve blocks to aid in intubation. J Anaesthesiol Clin Pharmacol. 2015;31:250-2. [PubMed] DOI: 10.4103/0970-9185.155160
12. Vathulya M, Shukla S, Shukla N. Primary management of post-burn contracture neck with tracheostomy: A surgeon and an anaesthetist's perspective. Indian J Plast Surg. 2017;50:117-119. [PubMed] DOI: 10.4103/ijps.IJPS_154_15
13. Afilalo M, Guttman A, Stern E, Lloyd J, Colacone A, Tselios C. Fiber optic intubation in the emergency department: A case series. J Emerg Med. 1993;11:387-91. [PubMed] DOI: 10.1016/0736-4679(93)90239-4
14. Bussolin L, Busoni P, Giorgi L, Crescioli M, Messeri A. Tumescent local anaesthesia for the surgical treatment of burns and postburn sequelae in pediatric patients. Anesthesiology. 2003;99:1371–5. [PubMed] DOI: 10.1097/00000542-200312000-00020
15. Guiding principles for liposuction. The American Society for Dermatologic Surgery, February 1997. Dermatol Surg. 1997 Dec;23(12):1127-9. [PubMed]
16. Rohrich RJ, Beran SJ, Fodor PB. The role of subcutaneous infiltration in suction-assisted lipoplasty: A review. Plast Reconstr Surg. 1997;99:514-9. [PubMed] DOI: 10.1097/00006534-199702000-00031
17. Fodor PB, Watson JP. Wetting solutions in ultrasound-assisted lipoplasty. Clin Plast Surg. 1999 Apr;26(2):289-93. [PubMed]
18. Schwarz S, Bergfeld D, Sommer B. Pharmacology, Tumescent Local Anaesthesia. Hanke CW, Sommer B, Sattler G. (eds.) New York, Springer; 2001. p.24.
19. Ramon Y, Barak Y, Ullmann Y, Hoffer E, Yarhi D, Bentur Y. Pharmacokinetics of high-dose diluted lignocaine in local anaesthesia for facelift procedures. Drug Monit. 2007;29(5):644-7. [PubMed] DOI: 10.1097/FTD.0b013e3180eaa10a
20. Raymond SA, Steffensen SC, Gugino LD, Strichartz GR. The role of length of nerve exposed to local anaesthetics in impulse blocking action. Anesth Analg. 1989;68:563-70. [PubMed]
21. Clark LE, Mellette JR. The use of hyaluronidaseis an adjunct to surgical procedures. J Dermatol Surg Oncol. 1994;20(2):842-844. [PubMed] DOI: 10.1111/j.1524-4725.1994.tb03718.x
22. McKay W, Morris R, Mushlin P. Sodium bicarbonate attenuates pain on skin infiltration with lignocaine with or without epinephrine. Anesth Analg. 1989;66:572-574. [PubMed]
23. Craig SB, Concannon MJ, McDonald GA, Puckett CL. The antibacterial effects of tumescent liposuction fluid. Plast Reconstr Surg. 1999;103:666–70. [PubMed] DOI: 10.1097/00006534-199902000-00047
24. Shribman AJ, Smith G, Achola KJ. Cardiovascular and catecholamine responses to laryngoscopy with and without tracheal intubation. Br J Anaesth. 1987;59:295-9. [PubMed] DOI: 10.1093/bja/59.3.295
25. Rose DK, Cohen MM. The airway: Problem and prediction in 18,500 patients. Can J Anaesth. 1994;41:372-83. [PubMed] DOI: 10.1007/BF03009858