Original Article

Increasing the Safety Profile of Follicular Unit Extraction by Eliminating the Use of Bupivacaine and Nerve Block: Experience from a Tertiary Care Center of North India

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Abstract

Introduction: Follicular unit extraction (FUE) is a safe and effective procedure in the hands of an expert. Side effects, particularly those which can lead to significant morbidity or mortality, are unacceptable as the procedure is done purely for cosmetic reasons. Any modification that decreases the risk associated with the procedure should be promoted. **Aim and Objective:** The study was conducted to determine whether FUE can be carried out effectively with the elimination of nerve blocks and bupivacaine from the procedure. **Materials and Methods:** The study was conducted in 30 patients suffering from androgenetic alopecia. The donor areas was anesthetized using lignocaine with adrenaline just below the area to be harvested. The anesthetic was injected intradermally resulting in the development of wheals in continuity, forming a linear line. From our previous experience, we found intradermal administration of lignocaine to give better anesthetic effect as compared to subcutaneous administration, although the former is more painful. This was followed by injection of tumescent into the donor area and donor harvesting, which lasted for a couple of hours. The recipient area was anesthetized using a similar technique of linear injection of anesthetic just ahead of the proposed hair line. **Results:** The total amount of lignocaine with adrenaline consumed during the surgery ranged from a minimum of 6.1 ml to 8.5 ml, with an average of 7.6 ml. The average duration of the entire surgery was 6.5 h, ranging from 4.5 to 8.5 h. None of the patients experienced any pain during the entire surgery, and there were no significant side effects related to anesthetic administration in any patient. **Discussion:** We found lignocaine with adrenaline to be a very safe and effective anesthetic agent for field block anesthesia in FUE. The exclusion of bupivacaine and nerve blocks from the procedure of FUE can further increase the safety of the procedure, particularly for beginners and in cases where the area to be covered is not extensive (Norwood–Hamilton grades 3, 4, and 5).

Keywords: Bupivacaine, follicular unit extraction, nerve block, safety profile

Introduction

Hair transplant has gained overwhelming popularity in the recent years, particularly in the treatment of androgenetic alopecia. The procedure of hair transplant has come a long way since its introduction by the New York-based dermatologist Dr. Norman Orentreich in 1950s.[1] The technique of follicular unit extraction (FUE) has been an exceptional advancement in the field of minimally invasive surgical hair restoration; making the surgery safer, cosmetically appealing, and increasing the overall patient acceptance significantly. Described by Rassman *et al.* in 2002, the technique of FUE is based on the principles described by Masumi Inaba.[2]

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The procedure of FUE involves a field block anesthesia administered in the donor as well as recipient area using a mixture of lignocaine and bupivacaine.[3] Many surgeons administer nerve blocks to anesthetize the operating field, including zygomaticotemporal nerve, auriculotemporal nerve, lesser occipital nerve, greater occipital nerve, and retroauricular nerve, although supraorbital and

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supratrochlear nerve blocks are the most commonly employed ones.[4] The supraorbital and supratrochlear nerve blocks are believed to augment the anesthesia in the anterior half of the scalp and make it uniform and long-lasting.[5] Once the anesthesia has been administered, the operative field is infiltrated with tumescent fluid composed of normal saline, adrenaline 1:1000, and lignocaine 2% in the ratio of 200:10:1 (e.g. 250 ml of normal saline, 12.5 ml of lignocaine, and 1.25 ml of adrenaline). Some surgeons prefer to add bupivacaine to the tumescent solution to reinforce the field block.[5]

Lignocaine has an excellent safety profile and its side effects are rare unless toxic dose is exceeded. The dose of lignocaine, which can result in cardiovascular collapse, is 7.1 times higher than that needed to induce seizures.[6] The ratio is much higher than other local anesthetics meaning that in case of inadvertent administration of toxic doses, the advancement from neurological signs to full-fledged cardiovascular collapse is not rapid, providing a window period to prevent the progression. The use of bupivacaine has been promoted in order to prolong the duration of anesthesia, particularly with mega and giga sessions lasting for 10–12 hours or sometimes longer. Bupivacaine is 16 times more potent than lidocaine in prolonging the QRS complex. It is believed to be four times as potent as lidocaine but nine times as lethal.[7]

Nerve blocks are considered to be the most technically demanding and risky part of anesthesia. Complications of nerve block include laceration of nerves and vessels, ecchymosis, and temporary ptosis.[7]

FUE is a safe and effective procedure with minimal side effects when performed by an expert in a proper setup. FUE has made surgical hair restoration more acceptable to the patient as well as the physician. Side effects, particularly those that can lead to a significant morbidity or mortality, are unacceptable in case of a procedure that is done purely for cosmetic reasons. Any modification or omission that decreases the risk associated with the procedure should be incorporated and promoted. We conducted this study with an aim to determine whether FUE can be carried out effectively with the elimination of nerve blocks and bupivacaine from the procedure.

Materials and Methods

The study was conducted in patients suffering from androgenetic alopecia (AGA). The procedure was explained in detail to the patients and an informed consent was obtained after explaining the possibility of side effects. Routine investigations such as complete blood count, kidney function tests, liver function tests, lipid profile, fasting blood sugar, hepatitis B and C serology, retroviral serology, venereal disease research laboratory test, bleeding time, clotting time, prothrombin time, international normalized ratio, and electrocardiogram were performed in all patients. Dermoscopic examination was performed in all patients to confirm the diagnosis of AGA and rule out close mimics, particularly diffuse unpatterned alopecia. Assessment of donor as well as recipient area was done using dermoscopy. A lignocaine sensitivity test was performed in all patients 24 hours prior to the procedure in our theater, using lignocaine 2%. This involved dilution of the commercial solution to 1:10 ml and 0.1 ml of the diluted solution was administered intradermally on the flexor aspect of forearm. This was followed by administration of undiluted preparation after an interval of 10 min, provided there was no adverse reaction at the site of injection of diluted preparation. The patient was monitored for 30 minutes and sent home if there was no visible change at the site of injection. This helped to rule out immediate as well as delayed hypersensitivity, which can occur up to 24 h later.[8]

Inclusion criteria

Patients with AGA with a stable hairline for at least 1 year who were willing to undergo the procedure were included in the study.

Exclusion criteria

Patients with age less than 25 years, patients with abnormal baseline investigations, those with a known history of any systemic illness such as cardiovascular diseases and epilepsy, and patients allergic to lignocaine were excluded.

Lignocaine (2%) with adrenaline (1:200,000) was used for field block anesthesia in donor as well as recipient area. Tumescent solution was prepared using 200 ml of normal saline, 10 ml of lignocaine 2%, and 1 ml of adrenaline 1:1000. Continuous cardiac monitoring with pulse oximetry was used for monitoring during the procedure.

The donor area was anesthetized using lignocaine with adrenaline just below the donor area to be harvested. The anesthetic was injected intradermally resulting in the development of wheals in continuity, forming a linear line [Figure 1]. The anesthetic was administered by the Mantoux procedure using 30 G insulin syringes inserted almost parallel to the skin surface at an angle of 0–15°. Local anesthetic was injected in such amount as to form a clearly visible continuous wheal approximately 4–5 mm in width throughout its entire length. From our previous experience, we found intradermal administration of lignocaine to give better anesthetic effect as compared to subcutaneous administration, although the former is more painful. The amount of lignocaine consumed is also less with intradermal injection as compared to the subcutaneous route. This was followed by injection of tumescent into the donor area and donor harvesting, which lasted for a couple of hours. The tumescent was injected in the subcutaneous plane to ensure separation of the deeper blood vessels from superficial tissues as well as to ensure hemostasis and a turgid operative field. The recipient area was anesthetized using a similar

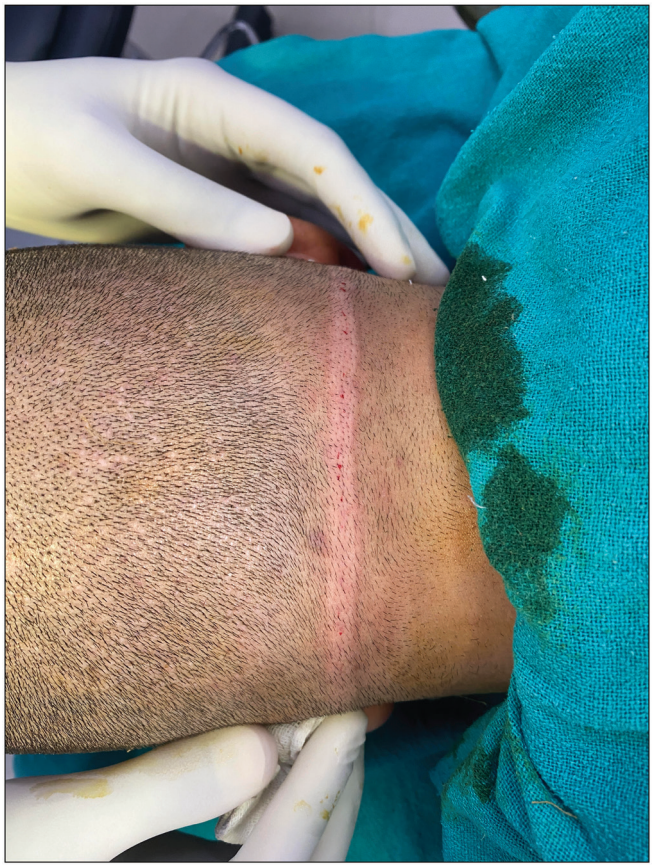

Figure 1: Continuous linear wheal following intradermal injection of local anesthetic in the donor area

technique of linear injection of anesthetic just ahead of the proposed hair line followed by tumescent injection into the recipient area. Recipient site creation and graft insertion followed, which lasted for a couple of hours as well. The maximum dosage of lignocaine with adrenaline that was allowed to be used was 420 mg calculated as 7 mg/kg (calculated for a 60 kg individual, 60 × 7 = 420). This amounts to 20 ml roughly (21.3 mg/ml). The maximum amount of lignocaine with adrenaline used was 20 ml, out of which 10 ml was used in preparing tumescent solution and another 10 ml was prefilled in 10 insulin syringes and no refilling was allowed. The entire tumescent solution was prepared in the beginning, and the maximum amount of tumescent used was 200 ml. This was done to ensure a high index for safety.

Results

The study included a total of 30 patients with AGA. The demographic and clinical characteristics of patients are presented in Table 1. The average number of grafts implanted in the patients were 1280, ranging from a minimum of 800 grafts to a maximum of 2000 grafts.

The average time duration for harvesting of grafts from the donor area was 3.15 h, ranging from 2 h to 4 h. The average amount of anesthetic administered in the donor area for field block was 3.7 ml, ranging from 3 ml to 4.3 ml. Adequate level of anesthesia was maintained during the entire duration in all patients. The cases requiring higher amount were those in whom the donor area extended to the temporal region in addition to the occipital region. No top-ups with additional injections of lignocaine with adrenaline were needed in any patient during the extraction phase.

Table 1: Patient characteristics

S. no.	Characteristic	Group	Percentage
1	Age group	25–30 years	63.33% (*n* = 19/30)
		31–35 years	26.67% (*n* = 8/30)
		36–40 years	6.67% (*n* = 2/30)
		41–45 years	3.33% (*n* = 1/30)
2	Norwood–Hamilton grade	Grade 3	33.33% (*n* = 10/30)
		Grade 4	46.67% (*n* = 14/30)
		Grade 5	20% (*n* = 6/30)

The average time duration for implantation of grafts in our patients was 3.3 h, ranging from 2.5 h to 4.5 h. The average amount of anesthetic consumed in the recipient area was 3.8 ml, ranging from 3 ml to 4.5 ml. The amount of local anesthetic needed for field block in the recipient area remained roughly the same. However, some of the patients needed a top-up of anesthetic in the recipient area, which resulted in a higher dose of lignocaine with adrenaline in these patients.

The total amount of lignocaine with adrenaline consumed during the surgery ranged from a minimum of 6.1 ml to a maximum of 8.5 ml, with an average of 7.6 ml. The maximum total dose of lignocaine with adrenaline thus consumed was less than 20 ml in all cases (including the 10 ml consumed in those cases where the entire tumescent solution was consumed). The average duration of the entire surgery was 6.5 h, ranging from 4.5 h to 8.5 h. None of the patients experienced any pain during the entire surgery and there were no significant side effects related to anesthetic administration in any patient.

Discussion

We found that the use of local anesthetic lignocaine with adrenaline was highly effective for administration of field block anesthesia in FUE in the donor as well as the recipient area. The use of tumescent solution containing lignocaine and adrenaline further enhanced the anesthetic effect in addition to other benefits such as hemostasis, turgidity, and separation of superficial tissue from underlying deeper blood vessels. All our patients tolerated the local anesthetic well, and we did not find the need to use bupivacaine for field block or tumescent anesthesia, even in cases that extended for long durations (up to 8.5 h). All our patients had good anesthesia even in the absence of any nerve block. The maximum safe dose of lignocaine with adrenaline that

we used in the study was calculated for a 60-kg man, although most of our patients weighed more than that; this was done for maintaining an adequate safe margin even when the entire amount of local anesthetic was consumed. An average amount of 4 ml of lignocaine with adrenaline was left unconsumed in our patients, which could have been used for top-up of anesthesia, should the need arise.

We used the intradermal route for administration of local anesthetic because, in our experience, it results in a consistent and better anesthesia as compared to subcutaneous administration. When administered intradermally, the amount of anesthetic required for field block remains more or less consistent across patients and depends majorly on the total area to be anesthetized. Literature finds mention of earlier onset as well as prolonged duration of action of local anesthetics when administered through the intradermal route as compared to the subcutaneous route.[9] This is believed to occur due to decreased diffusion into the surrounding tissues and reduced systemic absorption when administered via this route.[10] The abundance of vessels in the subcutaneous tissue also contributes to increased systemic absorption of local anesthetic when administered via the subcutaneous route. The intradermal route can be used for administration of infiltrative as well as field block anesthesia.[9]

Nerve blocks and the use of bupivacaine as adjuvant to lignocaine are believed to provide increased duration of anesthesia, but we did not find any difficulty in undertaking the procedure in our patients where both of these were not used. Although the average number of grafts extracted and implanted was on the lower side in our study, it had more to do with the limited experience of the operating surgeon. In the hands of a more experienced surgeon, more number of grafts can be implanted in the same time. It can be argued that the need for bupivacaine or nerve blocks may become evident in sessions lasting longer than the maximum duration of FUE in our study. However, it is pertinent to mention that even in our longest case, the maximum safe dose of lignocaine was not exceeded, and top-up anesthesia with lignocaine could be used in case of anesthetic effect wearing off.

Conclusion

We found lignocaine with adrenaline to be a very safe and effective anesthetic agent for field block anesthesia in FUE. The exclusion of bupivacaine and nerve blocks from the procedure of FUE can further increase the safety of the procedure, particularly for beginners and in cases where the area to be covered is not extensive (Norwood–Hamilton grades 3, 4, and 5). Although we could not perform any mega or giga sessions, the duration of our sessions could easily translate into such sessions in the hands of a seasoned FUE surgeon. Further large-scale studies could help confirm whether the fact holds true for mega and giga sessions as well.

Limitations

1) Vertex area transplantation was not done in any of our patients.
2) The limited experience of the operating surgeon made it difficult to perform mega and giga sessions despite the fact that the duration of some sessions extended up to 8.5 h.
3) Logistic restrictions limited the maximum duration of the sessions to 8–9 h roughly.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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