Effect of Controlled Breathing on Pain Tolerance during Local Anesthesia at Donor Site in Hair Transplant Strip Surgery—A Preliminary Study

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ABSTRACT

Introduction: Pain during administration of local anesthesia during donor strip surgery in follicular unit transplantation (FUT) can cause discomfort for the patient. Controlled breathing, as a component of various relaxation techniques, has been shown to have a beneficial effect in acute pain tolerance.

Objective: This study evaluates the relevance of controlled breathing as a technique to enhance pain tolerance throughout the administration of local anesthesia during donor strip excision in hair transplantation.

Methods: A prospective, comparative study was undertaken between two groups of 30 patients each undergoing hair transplantation by strip FUT technique under local anesthesia (LA). One group was trained to use controlled breathing prior to surgery and during administration of local anesthesia at the donor site. The other group used routine breathing and was used as the control. Pain tolerance was measured subjectively using Visual Analog Score (VAS) for pain and objectively using the Objective Pain Comfort Score (OPCS). In addition, pulse and blood pressure were monitored. The results were compared and analyzed statistically.

Results: The mean changes of VAS and OPC pain scores and vital parameters, such as pulse, in response to acute pain were significantly reduced in the test group, which used controlled and relaxed breathing, compared to the control group. However, there was no significant difference in blood pressure measurements between the two groups.

Conclusion: Our study suggests that controlled breathing prior to hair transplantation and during LA injection at the donor site results in better pain perception and tolerance and, therefore, greater patient comfort. Patients can easily be taught to practice controlled breathing. Additional studies using larger groups of patients are needed to establish the routine role of this modality in pain management during hair transplantation.

Keywords: blood pressure, controlled breathing, local anesthesia, pain, pulse

INTRODUCTION

Pain is a highly unpleasant physical sensation caused by a needle prick in a conscious patient. Pain tolerance to injection depends on various factors such as gender, site of injection, mental health, and pain threshold. In particular, the scalp is particularly sensitive to pain due to tightness of the skin and rich innervation. Hair transplantation involves harvesting of donor hairs by either removal of a strip of skin using a process called follicular unit transplantation (FUT) by strip dissection, or by extraction of individual follicular units, a process known as follicular unit excision (FUE).[1] Both procedures are done under local anesthesia and involve lidocaine infiltration in occipital scalp below the level of occipital protuberance. The procedure is painful as it involves injection at multiple sites, typically 15-30 sites depending on the amount of donor to be harvested. In particular, FUT is considered painful and causes much anxiety. This perception of the procedure as being painful has led to its decreased popularity and acceptance.

Pain management during FUT is hence a challenge to the hair transplant surgeon. Many techniques to prevent and manage pain, such as preoperative analgesic, anxiolytics, vibration, cold, local anesthetic creams, and the like, have been tried.[2] Distracting techniques, such as music and controlled breathing, have also been tried as adjuvants to alleviate the injection pain.[3-6] In addition, studies have demonstrated that with proper education and training controlled breathing can be used successfully to overcome preoperative, intraoperative, and postoperative patient anxiety, stress, and apprehension to injection pain.[5,6] However, as far as the authors are aware, controlled breathing has not been studied in hair transplantation, and hence this study was conducted.

METHODS

The study included 60 patients (1 female and 59 males) between the ages of 22 and 49 years undergoing hair transplantation by FUT technique. Exclusion criteria were the following: patients on long-term anti-anxiety and anti-depressants, patients with mental illness, patients using pain medication or psychotropic drugs, and patients having any systemic illness. Informed consent was obtained from all patients.

Study Design

The study was conducted from January through June 2018. Patients were divided into two groups of 30 patients each; every alternate patient posted for surgery was included in the test group. On arrival for surgery, patients in the test group were taught to breathe in a controlled manner, through demonstration by a doctor and also through video demonstration. The breathing consisted of three steps: 1) slow, prolonged inhalation for 6 seconds, 2) holding the breath for 2 seconds, and 3) slow, prolonged exhalation for 4 seconds. Patients were told to focus on their breath consciously, and to also mentally count the seconds to ensure compliance. This meant that each breath cycle was of 12 seconds duration, and patients would have 5 breath cycles in 1 minute. Patients were made to practice this prior to surgery for 10 minutes and were told to perform the controlled breathing as soon as they were put on the

operating table and to continue for 10 more minutes during the administration of local anesthesia in the donor area. Patients in the control group were not given any instructions regarding breathing and continued to breathe in their usual way. Pain was recorded both subjectively and objectively. Subjective pain assessment was by Visual Analog Score (VAS) on a score of 0-10, with 0 representing no pain and 10 representing the most severe excruciating and unbearable pain. Objective patient comfort score was recorded by the observer on a scale of 1 to 4 as described below:

1 = Patient looks calm, settled, cooperative
2 = Patient squeezes eyes, gentle squeeze of soft ball
3 = Patient tightly clinches ball, moves head and groans
4 = Patient tightly clinches ball, moves whole body and shouts

Vital parameters, such as pulse, blood pressure, and respiratory rate, were measured by an anesthetist at the 1-, 3-, 5-, 7-, and 10-minute interval in both groups, and the results were tabulated and compared.

Statistical Analysis

We used repeated ANOVA test for difference in mean interval of vital parameters. Paired student t-test was done to extract mean difference between the two groups.

RESULTS

Subjects

The mean age of the test group was 30.4 (range 22-49) and of the control group was 30.1 (range 22-42), and therefore they were well matched. The respiratory rate in the test group was 12 and in the control group it was 17.125. The mean and standard deviation of pain threshold to injection stimuli was as follows:

	Test (mean ± SD)	Control (mean ± SD)	P Value
VAS	43.5 ± 5.59	58.83 ± 12.78	0.0001
OPCS	2.63 ± 0.56	1.97 ± 0.18	0.0001

This data suggests a statistically significant difference in overall pain perception and tolerance between the two groups.

Table 1 shows variations in pulse and blood pressure at different time intervals in the two groups. At 10 minutes into surgery, mean pulse rates for the test group ranged from 76.6-87.3, while the same in the control group ranged from 79.62-94.41. On applying repeated ANOVA test, the difference in the mean pulse rate at various time intervals was found to be statistically significant. However, mean systolic and diastolic blood pressures in the two groups at different time intervals did not show any statistically significant differences.

DISCUSSION

Pain during hair transplantation surgery and other dermatologic surgeries is an important issue, particularly during administration of local anesthesia.[7] While several techniques such as preoperative analgesic, anxiolytic use, vibration, cold, local anesthetic creams, and distraction by talking have been tried to prevent and manage pain, there is need for more effective methods to manage the pain during anesthesia.[8-10]

TABLE 1. Variations in Pulse and Blood Pressure at Different Time Intervals

	Cases		Control		P Value
	Mean	SD	Mean	SD	
Pulse					
preassesment	76.66	±10.860	79.62	±9.390	0.25
preinjection	76.45	10.568	80.55	10.256	0.19
during inj.	83.31	11.305	87.69	10.050	0.1
1 min	86.03	10.151	92.97	11.515	**0.01**
3 min	87.24	8.999	94.07	13.253	**0.01**
5 min	88.00	9.377	94.83	14.477	0.06
7 min	87.31	9.918	96.07	15.255	**0.008**
10 min	87.03	10.712	94.41	15.263	**0.03**
SBP					
preassesment	122.28	9.331	122.76	8.305	0.85
preinjection	122.28	8.843	122.83	7.883	0.7
during inj.	127.31	8.041	127.45	8.567	0.88
1 min	125.86	8.228	129.10	8.169	0.13
3 min	126.14	8.331	128.90	8.873	0.17
5 min	126.03	7.571	128.76	8.357	0.13
7 min	126.34	6.025	128.28	8.137	0.30
10 min	125.79	7.218	127.93	9.629	0.30
DBP					
preassesment	77.93	6.403	78.69	4.994	0.5
preinjection	78.00	6.118	79.66	4.569	0.21
during inj.	82.48	6.016	83.66	4.723	0.43
1 min	83.93	5.085	85.03	5.895	0.36
3 min	83.45	5.475	86.55	5.730	**0.04**
5 min	83.59	4.014	84.90	5.171	0.16
7 min	84.00	4.721	85.52	4.128	0.13
10 min	83.66	4.410	85.10	4.195	0.17

Controlled breathing, also referred to as deep and slow breathing (DSB) or pranayama in the ancient Indian system of yoga, has been shown to affect pain processing and pain perception. It may act by decisively influencing autonomic nervous system through its effects on baroreceptors.[11] Baroreceptors are pressure-stretch receptors located within the aortic arch, carotid sinus, and lungs that are involved in autonomic regulation including pulse and blood pressure. Stimulation of the baroreceptors produces a generalized inhibitory effect on the central nervous system (CNS), which includes a reduction in nociception. Slow controlled breathing is associated with potentiation of both the depressor and the cardio-inhibitory components of the arterial baroreflex and thereby reducing pulse and blood pressure.[12] Controlled breathing has been used for both chronic[11] and acute pain relief such as for pain during labour or dental surgery and for postoperative pain.[3,5,6,13]

Our study demonstrates the beneficial effect of controlled breathing in hair transplantation surgery. The test groups showed significantly less pain perception and reported more comfort. The study also showed reduction in pulse rate as a response to pain, but it did not show any significant difference in blood pressure between the two groups. The short duration of controlled breathing adapted in the study may explain this observation. Patients could be trained easily to practice controlled breathing and no patient refused to train. Patients were in fact enthusiastic to learn the technique. However, the authors accept that the sample size was small and hence larger studies are needed to further establish the efficacy.

CONCLUSION

We found controlled breathing to be effective in reducing pain and enhancing patient comfort during administration of local anesthesia for donor strip dissection. It is easy to teach and learn, and it can therefore be easily adapted in practice. Further studies are needed to document its effect in routine management of pain during hair transplantation.

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Invited Commentary

Scott A. Boden, MD, FISHRS

This article regarding effect of controlled breathing on pain tolerance is a welcome addition to the hair transplantation literature. For many of our patients, pain and the associated anxiety and fear are the most challenging part of the hair transplant experience. Our patients, our staff, and we as physicians all benefit when we can reduce our patients' discomfort and anxiety.

Independent of breathing techniques, several basic principles of donor area anesthesia apply:

- Inject anesthetic agents slowly, and with the smallest possible needle (30 or 31 gauge).
- Avoid using pre-mixed lidocaine with epinephrine—the preservative lowers the pH and increases discomfort. Mix lidocaine with dilute epinephrine solution (~1:300,000) just prior to use.
- Consider buffering anesthetic with bicarbonate solution.
- Use nerve distraction techniques, including vibration and massage.
- Add longer-acting anesthetic agent (e.g., articaine, bupivacaine) after initial anesthetic.

The present article offers additional means to make anesthetic administration better tolerated by our patients. Effective diaphragmatic breathing techniques can be easily and quickly taught.

A recent study measured significantly lower salivary cortisol ("stress hormone") levels in 20 patients who had been taught diaphragmatic breathing techniques compared with 20 controls who did not receive similar training.[1] There was also a significant decrease in negative affect after diaphragmatic breathing compared with baseline.

Busch et al. studied the effects of deep and slow breathing on sympathetic arousal (as measured via skin conductance levels) and on pain thresholds for hot and cold stimuli, and they found significantly decreased sympathetic tone and increased pain tolerance in subjects who were trained in deep and slow breathing.[2]

The U.S. Navy incorporates a form of deep and slow breathing in the "Box Breathing" technique that is part of their training. This technique involves slowly inhaling to a count of four, holding the breath for four seconds, slowly and deeply exhaling for four seconds, and then holding the breath upon exhalation for four seconds. This training is a means to lower breathing rate, pulse, and response to painful stimuli.

A fascinating study by Bhasin et al. measured the physiologic expression of genes in practitioners with years of deep breathing and relaxation response (RR) training and found that the practice of RR (as counterpart to the stress response) evoked enhanced expression of genes "associated with energy metabolism, mitochondrial function, insulin secretion, and telomere maintenance, and reduced expression of genes linked to inflammatory response and stress-related pathways."[3]

I commend the present authors for their contribution. Using controlled diaphragmatic deep breathing during administration of local anesthesia is a means to reduce our patients' fear and discomfort. This technique could easily be incorporated into our daily surgical practice, and it will help to enhance the well-being and satisfaction of our patients.

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