Virtual painless hair transplant anesthesia

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Introduction

Although hair transplant surgery has dramatically improved in the past 10 years, anesthesia for hair transplant surgery has shown few improvements in the past 20 years as the surgery can still be painful for many patients.

Objective

Our version of ideal anesthesia for hair transplantation embraces seven expectations:

1. It must exercise safety.
2. The procedure should be painless.
3. The anesthesia should be long lasting.
4. There should be minimal blood loss because a clear, bloodless field is important.
5. There should be no nausea and vomiting.
6. The patient should be wide-awake and be discharged as soon as the surgery is finished.
7. Postoperative forehead swelling should be minimized.

Materials

The following materials are called for:

- Midazolam 1mg/ml
- Fentanyl 50mcg/ml
- Epinephrine (1:1000)
- 1% Xylocaine with Epinephrine (1:100,000)
- 2% Xylocaine plain
- Bacteriostatic 0.9% Sodium Chloride (contains sodium chloride 9mg and benzyl alcohol 9mg/ml)
- Tumescent solution (epinephrine 1ml (1:1000) + plain 2% xylocaine 10ml in 200ml of normal saline) (Final concentration = Epi 1:200,000, xylocaine 0.1%)
- Kenalog (Triamcinolone Acetonide) solution (20mg to 40mg kenalog in 20ml tumescent solution)

Methods

The procedure of painless hair transplant anesthesia involves several steps. The patient is hooked up to a monitor that shows a continuous pulse and oxygen saturation. Blood pressure is determined every five minutes. After the patient's vitals are taken, a heparin lock is started. The dorsum of the hand is cleaned with an alcohol pad, and then the skin is pre-numbed with bacteriostatic 0.9% saline with a 30G needle. A heparin lock is placed with a 22G IV cannula and secured. The patient is given 1ml (1mg/ml) of midazolam and 1ml (50mcg/ml) of fentanyl. The fentanyl is optional. If a patient is prone to motion sickness, only midazolam is used. To limit side effects, the dose of fentanyl is limited to 100mcg. Midazolam (0.5-1mg) intravenous injection is repeated every 2-3 minutes. The oxygen saturation is monitored and the time is noted because it takes 10-15 minutes to get the patient adequately sedated.

Once the oxygen saturation has dropped 2-3 points, and the patient's eyes start to close or their language becomes slurred, the next step can begin. If the patient is still wide-awake or there is no change in the oxygen saturation, another 1ml of midazolam is pushed. Every patient responds differently. Older patients and Asian patients are usually more sensitive to the medication and need less. If the patient's oxygen saturation has dropped below 90, then it is important to instruct the patient to take some deep breaths. It is very rare in my practice to have this happen. This is why it is so important to monitor the oxygen saturation and deliver the medication slowly.

After adequate sedation is achieved, a supraorbital block is given in three steps. First, the skin is anesthetized by infiltration with bacteriostatic saline with a 30G needle. Next, a "pre-block" is given by injecting 1ml of 1% xylocaine with epinephrine on each side of the supraorbital notch with a 27G needle but only as deep as the subcutaneous tissue (no intention to numb the nerve at this point) because the actual nerve block is the painful part and the sedation is light. The purpose of this "pre-block" is to infiltrate the surrounding tissue only, and in the next 30 minutes to 1 hour the medication will gradually migrate and diffuse into the supraorbital nerve. It is important to inject the xylocaine into exactly the same spot as the bacteriostatic saline. This injection is given very slowly to minimize discomfort.

After the pre-supraorbital nerve block is given, we move to the donor area. The donor site is prepared and shaved 2cm in width. A line is drawn for the length of the donor and a dot is placed 1cm below the line and every 3cm (Figure 1). For example, 30cm would have 11 dots spaced 3cm apart.

Figure 1. The donor area is shaved and marked; the dots are 3cm apart.

While injecting medication into the donor site, a small vibrator is used to massage the skin below the injection site. This helps to disperse the medication and minimize some pain sensation through the pathway of the nerves.

There are 8 steps to numbing the donor area:

1. Every other dot is pre-numbed with bacteriostatic saline in a 3ml syringe with a 30G needle. To reduce the number of needle sticks, only every other dot is pre-numbed, thus a 30cm-long donor site only needs five injections. For the purpose of this paper, I have used an "X" to represent every other "dot" (Figure 2).
2. Next, 1% xylocaine with epinephrine in a 3ml syringe with a 27G needle is injected in the exact same spot as the bacteriostatic saline.
3. Tumescent solution is drawn into a 3ml syringe with a 25G 1½ inch needle (about 3.8cm in length). The injec-

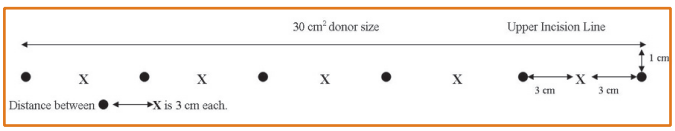

Figure 2. Step 1: Inject bacteriostatic saline to X 5times in a 30cm-long strip. Step 2: Inject 1% xylocaine to the X areas.

tions are at the same point where the previous injections were given. The adjacent two dots can be covered with one injection site by introducing the longer needle through the previously numbed spot, then directing left and right laterally to gradually create a continuous line of anesthesia along the entire inferior border of the shaved zone. Tumescent solution is injected deep into the subcutaneous tissue. It is delivered slowly; the syringe is pulled back and forth to get good distribution. If there is any resistance, draw back and change the angle to inject again. Never force an injection against a resistant spot. 1ml of tumescent is injected for every centimeter of donor (3ml between the dots). For a 30cm-long recipient site, this has to be repeated ten times.

4. Step 3 is repeated. Another round of tumescent is injected, 1ml for every centimeter of donor. So far every centimeter in length now has received 2ml of tumescent; 30cm has received a total of 60ml of tumescent.
5. 1% xylocaine with epinephrine (1:100,000) is injected. The xylocaine is injected through a 3ml syringe with a 25G 1½" needle into the subcutaneous tissue. The first round is into the subcutaneous to minimize tissue resistance and discomfort. The dosage is 0.5ml for every 1cm of donor (1.5ml to each side between the dots, 3ml for one injection site) (Figure 3).

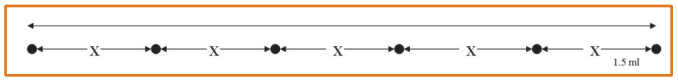

Figure 3. Step V: Inject 1% xylocaine with epinephrine from X. 1.5ml xylocaine to even distribute at 3cm distance. Total xylocaine: 15ml.

6. 1% xylocaine with epi is injected superficially and only 1/3ml for every 1cm. The dosage is less the second time around and it is more superficial. To make sure there is complete coverage, every dot is injected this time instead of every other dot (Figure 4).

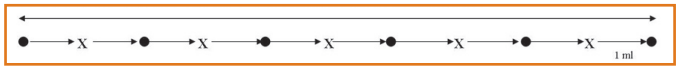

Figure 4. Step VI: Inject 1% xylocaine. 1ml xylocaine to even distribute at 3cm distance. So far, all the skin should be numb; to confirm total numbness, inject every X and • at same direction. Total 10 shots; total xylocaine, 10ml.

7. Tumescent solution is injected superficially until the tissue is firm enough for excision (approximately 0.5-1.0ml/cm).
8. Just prior to making the incision, tumescent solution (approximately 0.5-1ml/cm) is injected through a 1ml syringe with a 25G 1½ inch-long needle to the incision line to control bleeding. With this method, the field is extremely dry and allows the surgeon to see hair direction during excision.

Example of Dosages

For every square centimeter of donor, 3-4ml of tumescent is used and 5-6ml of 1% xylocaine. For example, for 30cm of donor length, 90-120ml of tumescent would be used and 25ml of 1% xylocaine. With this method, the amount of tumescent and xylocaine given can be calculated BEFORE THE SURGERY by the length of donor.

Once the donor site closure is completed, the REAL supraorbital nerve block is ready to be delivered. This time the needle is penetrated along the initial route but all the way to the bone and withdrawn a little bit to the supraperiostium level. Because of the pre-supraorbital nerve block, the patient should not feel this injection, but prior to the block, another 1ml of midazolam 1mg/ml is injected intravenously. The supraorbital nerve block consists of 1.5ml xylocaine 1% + 1.5ml bupivacaine 0.5% combined in a 3ml syringe with a 30G needle. The duration of xylocaine is only two hours. Bupivacaine will last about 3-4 hours.

To make sure there is complete anesthesia, 6ml of 1% xylocaine with epi is injected along the hairline. After this, kenalog solution (20-40mg kenalog in 20ml tumescent solution) is delivered into the recipient area (fanned out evenly; it works well for the prevention of post-op swelling). The amount used is determined by the size of the recipient area, but Kenalog is limited to 40mg total. Just prior to making the recipient sites in a particular area, a 1ml syringe with a 25G 1½" needle is used and tumescent solution is injected evenly and superficially to control the bleeding. It keeps the field extremely dry while the recipient sites are made.

If the surgery lasts longer than three hours after the supraorbital nerve block, we need to reinforce the block again with 1ml bupivacaine 0.5% to make sure the patients will not feel any pain for the rest of the surgery.

Discussion

1. When should we only use midazolam?

Midazolam is a tranquilizer that will give relaxation and amnesia, but too much midazolam will cause airway obstruction. Fentanyl is a narcotic and will reduce the sensation of pain, but on the other hand, it can cause nausea and vomiting. It is nice to use both, but we absolutely do not want nausea and vomiting during or after the surgery. We therefore screen every patient because experience with several thousand patients has allowed us to determine that if the patient has had nausea and vomiting at any prior surgery, or if the patient gets motion sickness very easily, then narcotics (fentanyl) should not be given.

If only midazolam is used, the patients might not remember the pain of injection, but they still feel it and might develop tachycardia and hypertension. If this situation occurs, I always give heavier sedation; I inject the tumescent slower and sometimes even give medication to control heart rate and blood pressure. For coronary artery disease patients, there is a greater risk for myocardial infarction. Blood pressure and pulse rate must be monitored so tachycardia and hypertension can be prevented or treated immediately.

2. How much midazolam and fentanyl should we use?

Everyone's response is different and the dose range is huge. For midazolam, the average dose is from 3-5mg. My maximum dose for fentanyl is never more than 2ml (100mcg).

The point is not to hurry. Take 10-15 minutes to induce it, give a little bit then wait 2-3 minutes to see the response and give a little bit again; repeat this until you see the oxygen saturation drop 2-3% or the patient's eyes close and the patient is slow to respond to your oral command. When I started using I.V. sedation 15 years ago, I had to hold the airway from time to time to prevent oxygen saturation drops below 90%. But now I do not even remember the last time I had to do it. If needed, Romazicon (flumazenil) is the antidote

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for midazolam, the onset of action is rapid and usually effects are seen within one to two minutes, but we have never used it in our office.

3. Why not heavily sedate the patient and let the patient sleep during the whole procedure?

Heavy sedation increases the chance of airway obstruction, nausea, vomiting, and aspiration, and it is very dangerous without adequate training and equipment. Additionally, hair transplantation is a very long procedure and it is safer to have the patient awake to notify us of any symptoms or even an uncomfortable position (especially the neck) that we can correct right away.

4. Why do we use bacteriostatic saline?

Bacteriostatic saline is a physiological saline solution containing the bacteriostatic agent benzyl alcohol as a 0.9% solution. It is used mostly for diluting and dissolving drugs for I.V. injection and as a flush for intravascular catheters. It also has local anesthetic properties and when injected intradermally, the duration of anesthetic action is only less than 5 minutes. Since it is less painful than xylocaine upon injection, we utilize it to initially partially anesthetize the skin.

5. How do we make efficient use of time?

To use time efficiently, the patient's vitals are confirmed and the heparin lock is started. The first dose of midazolam and fentanyl are given immediately. Tumescent solution is mixed while inducing the I.V. sedation to save time and then the patient's response is checked and the increment dose of midazolam is given until ideal sedation is achieved. The procedure seems very tedious, but from the start of the I.V. to the donor site harvesting, it usually does not take more than 30 minutes.

6. Why do we encourage I.V. sedation?

Twenty percent of our patients go without I.V. sedation in our clinic; the only reason being that they have to drive home by themselves. In this situation, the only change is at the donor site. Instead of numbing five spots at one time, I only inject one spot, and through it, I inject the subcutaneous tissue toward the second spot and then come back to numb the second spot. It will slow me down a few minutes and once in a while I will see a vasovagal reflex, something I never see with I.V. sedation, which is always encouraged in our office.✧

A Survey of Pain During Procedure Using Our Method

We surveyed 100 of our hair transplant recipients immediately after surgery. The intensity of pain was graded on a score of 0 to 10 with 0 being no pain, 3 is equivalent to a paper cut, 5 the same as having blood drawn, 8 as a toothache and 10 as severe pain. None of our patients referred to the pain as more than that of a paper cut (Figure 5). At the same time, we wrote down the patients' levels of consciousness. They were relaxed, even sleepy, but at all times were able to respond to oral commands.

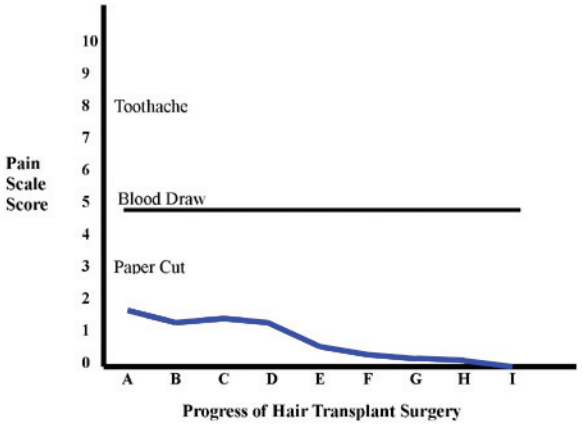

Figure 5. Pain score at different times (A-I) during surgery in 100 patients (A: starting I.V.; B: nerve nlock; C: donor anesthesia; D: frontal anesthesia; E: removing donor; F: suturing; G: making slits; H: implanting; I: end of surgery).