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Review Article

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The Reyes' Solution an Anesthetic Formula for Small Aesthetic Surgeries

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The need and my desire to work in a clean surgical field in which I could perfectly see the anatomy, appropriate to my characteristics as a surgeon led me to look for an anesthetic formula that would allow me to operate safely avoiding trans operative bleeding especially in nose surgery, rhinoplasty approach or closed technique; since the visual space is very small and the bleeding never allowed to see the anatomical structures well.

I needed a tumescent local anesthesia that would maintain the anesthesia for longer, suitable for surgery with greater safety and comfort for my patient. Another of my great concerns was to prevent the complications of postoperative bleeding, as well as to ensure the viability of the tissues once the anesthetic and ischemic effect of the Reyes solution had passed."

In Reyes' solution I combined Ropivacaine as a local anesthetic that gives me up to 4-8 hrs. Of anesthetic effect on the infiltrated tissue, Tranexamic Acid which is a substance that significantly reduces Trans and postoperative bleeding by selectively altering the fibrinolytic system; it inhibits the formation of plasmin temporarily preventing the dissolution and degradation of fibrin clots, therefore it also has an anti-inflammatory effect as plasmin is responsible for various inflammatory activities. On the other hand, adrenaline plays a very important role by producing a local vasoconstrictor effect at the site of infiltration of this Reyes 'solution, achieving the vasoconstriction necessary to visualize the anatomical structures mainly in surgery of the nose, eyelids, ears and face.

One of the challenges that cosmetic surgeons encounter is being able to perform cosmetic surgeries with the use of a local anesthesia that allows them to perform the procedure safely and avoiding discomfort in the patient.

Various types of anesthetic combinations have been tried and published mostly for short-term surgeries and what can be performed with proper local anesthesia and small oral sedation of the patient.

This monograph will present the results obtained with the formula of Dr. Pilar Reyes associating various products allows us to perform a safe surgery

Reyes' solution is a mixture of elemental compounds used separately in different surgeries: aesthetic, gynecological, orthopedic, etc., which when used together generate less pain, minimize the risks of bleeding, and favour the dissection of tissues, leading to safe surgery.

To prepare the Reyes' Solution combine the following compounds:
1 ml Epinephrine (racemic) 1 mg/ml
40 ml Ropivacaine 7.5 mg/ml 1ml Tranexamic Acid 500mg /5ml
Hartmann solution (Ringer's lactate) q.s.p. 100ml or (saline solution 0,9%
Reyes' solution can be used as tumescent local anesthesia in surgeries of small areas anywhere on the body in different specialties such as cosmetic surgery, plastic and reconstructive surgery, head and neck surgery, ENT surgery, gynaecological surgery, orthopedic surgery, proctologic surgery, etc.

Reyes' solution is the creation of my experience performing facial surgeries. is a mix of elemental compounds used separately which when used together eliminate pain, minimize the risks of bleeding, and favour the dissection of tissues, leading to safe surgery.

History

A.V. Vishnevsky a physician from Russia, published in 1916 a book The Local Anesthesia by The Method of Gradual Infiltration.
In his book he highlights certain concepts regarding the use of

infiltrative local anesthesia that are worth rescuing, because they are the same concepts that we continue to use today.

"The hydraulic preparation of the tissues"
"The first and most important rule is to wait after the infiltration, until the anesthesia arrives"
"Anesthesia for the operation is as important as the execution technique"
"Local anesthesia is a sui generis issue; it is linked to the individual perception of the sensation of pain of each person"
"In the operation room, every anesthetic can have its contraindications. The most valuable will be the one who accuses the least amount of them."
"The blind introduction of strong solutions cannot be indifferent, as for intoxication."

The main scientific and practical activities of A.V. Vishnevsky took place in Kazan and Moscow. This paper presents little-known facts from the creative life of A.V. Vishnevsky, with a focus on his contribution to the development of local anesthesia and Novocain blockade in his country (Russia).

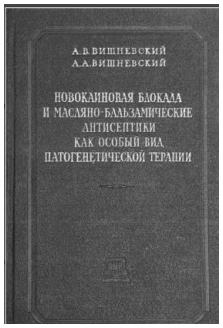



Fig. 1. Academician A.V. Vishnevsky

The technique of tumescent local anesthesia has become throughout the years and thanks to the research work of J. Klein in local anesthesia commonly used and safe in surgical procedures, especially those performed in localized and superficial areas of the human body.

These concepts were rescued by Jeffrey Klein MD who in 1987 began to present at congresses his tumescent local anesthesia technique with concepts very similar to those of A. V. Vishnevsky [1].

Jeffrey Klein MD conducted all scientific studies to demonstrate the limits of use of tumescent local anesthesia with the use of lidocaine, such as the maximum dosage to be used, the time of metabolization of lidocaine with this technique, pharmacokinetics, pharmacological interactions that ensure the plasma level of lidocaine and the side effects because the lidocaine intoxication [2].

In a paper published in the American Journal of Cosmetic Surgery 3/2007 over the Safety of tumescent liposuction compared with liposuction in systemic sedation or general anesthesia.

A review of the literature 396,457 cases

No fatalities with Tumescent anesthetic solution

Fatalities (110) was reported when use systemic sedation or general anesthesia

Safety: dosage of Lidocaine is 35 mg/kg/d

For safety reasons if the patients needed remove of large fat volumes should be performed in more than one procedure.

Using the ideas provided, I have developed a local anesthesia with the principles of tumescence using other drugs in the search for better results in the facial surgeries of my patients.

Tumescent lidocaine anesthesia consists of subcutaneous injection of relatively large volumes (up to 4 L or more) of dilute lidocaine (≤1 g/L) and epinephrine (≤1 mg/L).

Tumescent lidocaine anesthesia (TLA) was developed for performing liposuction totally by local anesthesia with virtually no surgical blood loss.

TLA has been extended to a wide range of other surgical procedures involving cutaneous, subcutaneous, breast, and vascular tissues.

After the J. Klein's studies, knows that the maximum safe dosage of tumescent lidocaine for these procedures is between 35 to 44 mg/kg/day [3].

Solution causes the targeted tissue to become temporarily swollen and firm or tumescent. The resulting increased subcutaneous interstitial pressure spreads the TLA solution through adjacent tissues by bulk flow.

It is also important to take into consideration that the use of the tumescent technique changes the pharmacokinetics of anesthetic products, example normal lidocaine at 1 or 2% has a plasma peak at 45 minutes, while the tumescent solution the plasma peak is at 12 hours of introduction into the surgical area. Dilute epinephrine produces intense local vasoconstriction, slows systemic absorption of lidocaine, and thus reduces peak serum lidocaine concentrations, which reduces the risk of systemic lidocaine toxicity [4, 5].

Lactated Ringer's contains ions of sodium 130 mEq/L, potassium 4 mEq/L, calcium 2.7 mEq/L, chloride 109 mEq/L, and lactate 28 mEq/L. Lactated Ringer's has an osmolarity of 273 mOsmol/L, pH of 6.5, and caloric content of 9 kcal/L [6].

Ringer's lactate solution, or lactated Ringer's solution, is a type of isotonic, crystalloid fluid further classified as a balanced or buffered solution used for fluid replacement. The contents of Ringer's lactate include sodium, chloride, potassium, calcium, and lactate in the form of sodium lactate, mixed into a solution with an osmolarity of 273 mOsm/L and pH of about 6.5. [7].

In comparison, normal saline (NS) has an osmolarity of about 286 mOsm/L.

Ringer's lactate is largely used in aggressive volume resuscitation from blood loss or burn injuries; however, Ringer's lactate is a great fluid for aggressive fluid replacement in many clinical

situations, including sepsis and acute pancreatitis [8].

Being isotonic also means that when you get IV lactated Ringer's, the solution won't cause cells to shrink or get bigger. Instead, the solution will increase the fluid volume in your body.

Provides the body with sodium lactate: Sodium lactate is a bioenergetic fuel that the human body is designed to metabolize under ischemic conditions, thus decreasing cellular death from ischemia [9].

Tranexamic Acid

Tranexamic acid is a drug that is known to help promote blood clotting by inhibiting a natural process called fibrinolysis (dissolution of a clot).

Possibly, the most widely studied antifibrinolytic is tranexamic acid (TXA). TXA is a synthetic lysine analog that competitively inhibits the activation of plasminogen to plasmin. This for the moment prevents plasmin from dissolving fibrin clots and blocks plasmin- induced platelet activation, maintaining platelets for subsequent clot formation.

The only FDA-approved procedure for tranexamic acid (TXA) is for heavy menstrual bleeding and short-term prevention in patients with hemophilia; this includes tooth removals in patients with hemophilia as well as menorrhagia in these patients. Off-label uses of oral, topical, and intravenous TXA includes brutally bleeding patients requiring massive transfusion protocols or when hyper-fibrinolysis is demonstrated and combat trauma patients requiring at least one unit of blood within 24 hours of presentation. Another off-label intravenous use of TXA is in surgical operations to reduce blood loss [10].

Tranexamic acid intravenous solution (10 mg/mL-NaCl 0.7%; 100 mg/mL). This medication is frequently given just before the dental procedure, and daily for up to 8 days subsequently.

Few nonhormonal medical options exist for the treatment of heavy menstrual bleeding, and to reduce surgical bleeding during major gynecologic surgery.

Interest in Tranexamic acid to reduce surgical blood loss has been growing across many surgical specialties [11].

Tranexamic acid has been found to be an excellent reasonable nonhormonal treatment option for women with substantial menstrual bleeding and should be considered during gynecologic surgery.

James E T Wokes1, Matthias W H Erdmann , Neil R McLean talk in his paper about how "Tranexamic acid (TXA) can reduce intra- and postoperative bleeding as well as minimizing postoperative swelling and ecchymosis. It can be administered both intravenously and topically during surgery with minimal side effects. In their conclusions they said that TXA is a useful adjunct in aesthetic surgery."

In another paper significant decreases in intraoperative blood loss were found in 5 rhinoplasty studies. Three rhinoplasty and 2 rhytidectomy studies found significantly reduced postoperative edema and ecchymosis. One rhinoplasty and 1 rhytidectomy study reported reduced operative time and time to achieve hemostasis. One rhytidectomy study reported reduced postoperative drain output and faster time to drain removal. No studies reported an adverse outcome directly related to TXA [12].

Healing hemostasis is critical in aesthetic facial plastic surgery. Unbalanced intraoperative blood loss can increase operative periods and rise the need for transfusion, both of which add morbidity and growth rates of complications. Postoperative edema and ecchymosis are common sequela of aesthetic facial plastic surgery, which add emotional stress to patients and may avoid social interaction during recovery. Edema and ecchymosis also negatively alter the ability to evaluate surgical outcomes, both intraoperatively and postoperatively.

Topical and subcutaneously injected TXA in blepharoplasty and rhytidectomy are emerging routes of administration, although more data are needed to objectively evaluate their efficacy in these settings. The most compelling evidence for the use of TXA in rhytidectomy exists in administering TXA with injectable tumescent, although the quality level of this evidence is marginal. (13) This review also demonstrates the variance dosing when using TXA subcutaneously and highlights the need for further investigation to elucidate the ideal concentration for maximum benefit while ensuring a low-risk profile.

Usual Adult Dose for Bleeding:

Initial dose: 10 mg/kg intravenously, immediately before dental extraction
Maintenance dose: 10 mg/kg intravenously three to four times daily
Duration of therapy: 2 to 8 days

Comments:

Infuse no more than 1 mL/minute to avoid hypotension.
No interactions were found between adrenalin and tranexamic acid.
No interactions were found between tranexamic acid and ropivacaine.
While this reduction in blood loss is likely not hemodynamically significant, it may have the benefit of reducing operative time by enhancing hemostasis and improving surgical site quality. The literature suggests that TXA significantly reduces postoperative edema and ecchymosis following rhinoplasty and rhytidectomy, even though its effect may not differ from that of systemically administered corticosteroids, and the lack of validated edema and ecchymosis grading scales for rhytidectomy limits these conclusions. Topical and subcutaneously injected TXA in blepharoplasty and rhytidectomy are promising routes of administration, although more data are needed to objectively evaluate their efficacy in these settings. The most compelling evidence for the use of TXA in rhytidectomy exists in administering TXA with injectable tumescent, although the quality level of this evidence is marginal.

Certain rules must be considered when using the TXA

You should not use if you are allergic to tranexamic acid, or if you have:

- Problems with the blood vessels in your eyes.
- Color blindness (only if you are receiving the injectable form of tranexamic acid); or
- A history of stroke, blood clot, or bleeding in your brain.

Tell your doctor if you have ever had:

- Kidney disease
- A bladder or kidney infection; or
- Leukemia.

Tranexamic acid disease interactions

There are 5 disease interactions with tranexamic acid which include:

- Intravascular Clotting
- Subarachnoid Hemorrhage
- Color Vision Defect
- Convulsions
- Renal Dysfunction

One of the most significant things of a long-acting local anesthetic is to reversibly inhibit the nerve impulses, thus affecting a prolonged sensory or motor blockade appropriate for anesthesia in different types of surgeries.

Bupivacaine is a well-recognized long-acting regional anesthetic, which like all amide anesthetics has been linked with cardiotoxicity when used in high concentration or when accidentally administered intravascularly. Ropivacaine is a long-acting regional anesthetic that is structurally related to Bupivacaine. It is a pure S (-) enantiomer, unlike Bupivacaine, which is a racemate, developed for the purpose of reducing potential toxicity and improving relative sensory and motor block profiles [14].

The technological innovations have made it possible to develop Ropivacaine as an optically pure S (-) enantiomeric from the Parent chiral molecule propivacaine. It belongs to the group of local anesthetics, the pipecoloxylidides and has a propyl group on the piperidine nitrogen atom compared to bupivacaine, which has a butyl group [15].

Ropivacaine causes changeable inhibition of sodium ion influx, and in that way blocks impulse conduction in nerve fibers. This activity is potentiated by dose-dependent inhibition of potassium channels. Ropivacaine is less lipophilic than bupivacaine and is less likely to invade large, myelinated motor fibers; therefore, it has selective action on the pain-transmitting A δ and C nerves rather than Aβ fibers, which are implicated in motor function [16].

Ropivacaine is less lipophilic than bupivacaine and that, together with its stereoselective properties, contributes to ropivacaine having a substantially higher tolerance for cardiotoxicity and CNS toxicity than bupivacaine in animals and healthy volunteers [17].

The CNS effects observed previous than cardiotoxic symptoms during an intravenous (IV) infusion of local anesthetic (10 mg/min of ropivacaine or bupivacaine) in human volunteers and the infusion was stopped at this point. Major changes in cardiac function including the contractility, conduction time and QRS width occurred and the increase in a QRS width was found to be considerably reduced with ropivacaine than with bupivacaine [18].

Absorption and distribution the plasma concentration of ropivacaine depends on the total dose administered and the route of administration, as well as the hemodynamic and circulatory condition of the patient and vascularity of the administration site [19].

Like other anesthetics, ropivacaine has antibacterial activity in vitro, impeding the growth of Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa [20, 21].

Ropivacaine is bound to plasma proteins to an extent of 94%, mainly to α1-acid glycoprotein. The total plasma concentration increases during uninterrupted epidural infusion of ropivacaine is caused by an increase in the degree of protein binding and subsequent decrease in clearance of ropivacaine [22, 23].

Ropivacaine is metabolized significantly in the liver, predominantly by aromatic hydroxylation to 3′-hydroxy-ropivacaine by cytochrome P450 (CYP) 1A2 and N-dealkylation to 2′,6′- pipecoloxylidide by CYP3A4. The kidney is the main excretory organ for ropivacaine, accounting for 86% of the excretion of the drug in urine after a single intravenous dose administration [24].

A strict relationship exists between the lipid solubility of the local anesthetic and its potency and toxicity. According to minimum local anesthetic concentration (MLAC) studies, (which are based on effective analgesia in 50% of patients) ropivacaine has similar potency to bupivacaine at higher doses (e.g., doses required for peripheral nerve blocks for surgical anesthesia). Providing anesthesia or analgesia for most patients is more clinically relevant than the MLAC and, at higher doses used in clinical practice, this potency difference is not always evident.
Reactions to ropivacaine are characteristic of those associated with other amide-type local anesthetics Ropivacaine is generally well accepted whatever of the route of administration.

In a pooled analysis of data from controlled clinical trials adverse events that occurred in ≥5% of patients who received ropivacaine 0.125–1% via various routes of administration for surgery, labour, Caesarean section, postoperative pain management, peripheral nerve block or local infiltration (n=1,661) were hypotension (32%), nausea (17%), vomiting (7%), bradycardia (6%), and headache (5%).These events are a result of nerve block and occurred like incidence in patients (n=1433) who received bupivacaine 0.25– 0.75% for same indications (29%, 14%, 6%, 5%, and 5%, respectively).

The incidence of cardiotoxicity and central nervous system (CNS) toxicity because of inadvertent intravascular injection of ropivacaine appears to be low [25].

Based on animal and volunteer studies, it can be determined that ropivacaine seems to be less neurotoxic and cardiotoxic than bupivacaine.

Ropivacaine should be used with caution in patients getting other local anesthetics or agents physically related to amide-type local anesthetics, since the toxic effects of these drugs are additive.

Cytochrome P4501A2 metabolites ropivacaine to 3-hydroxy ropivacaine, the major metabolite.

Therefore, potent inhibitors of cytochrome P4501A2, such as fluvoxamine, given parallel during administration of ropivacaine, can interact with ropivacaine and thus lead to increased ropivacaine plasma levels. Caution should be exercised when administering CYP1A2 inhibitors. Possible interactions with drugs known to be metabolized by CYP1A2 via competitive inhibition such as theophylline and imipramine may also occur [26].

Peripheral nerve block is used for anesthesia for orthopedic surgery, and the onset and spread of local anesthetic is influenced by the site of injection. The long-acting sensory and motor block provided by ropivacaine is 0.5% or 0.75% for axillary, interscalene and subclavian perivascular brachial plexus block for hand or arm surgery compared favourably with bupivacaine 0.5% or levobupivacaine 0.5% (30- 45 ml bolus dose) with a similar quality of regional anesthesia. In lower limb surgeries where sciatic or combined femoral and sciatic block was given for knee, ankle, or foot procedures, ropivacaine 0.75% (25 ml) had a significantly faster onset of sensory and motor block than 25 ml bupivacaine 0.5%. Although ropivacaine had a considerably shorter duration of sensory block, the duration of motor block remained similar with both agents [27].

Patients who received mixed femoral and sciatic nerve block with ropivacaine to enable foot/ ankle surgery had similar or better postoperative pain relief and a longer duration of analgesia than recipients of mepivacaine [28].

Therefore, ropivacaine, with its efficacy, lower propensity for motor block, and reduced potential for CNS toxicity and cardiotoxicity, seems to be an important option for regional anesthesia and management of postoperative and labour pain.

Comments:

-The dose for major nerve blocks must be adjusted based on site of administration and patient status.

-Supraclavicular brachial plexus blocks may be associated with a higher frequency of serious adverse events.

Field Block (e.g., minor nerve blocks and infiltration):
0.5% concentration: 5 to 200 mg (1 to 40 mL); onset of action in 1 to 15 minutes with a duration of 2 to 6 hours

Infiltration (e.g., minor nerve block):
0.2% concentration: 2 to 200 mg (1 to 100 mL); onset of action 1 to 5 minutes with a duration of 2 to 6 hours
0.5% concentration: 5 to 200 mg (1 to 40 mL); onset of action 1 to 5 minutes with a duration of 2 to 6 hours
Use: For post-operative pain management

Being a very meticulous surgeon, I needed a tumescent local anesthesia that would maintain the anesthesia for longer, giving me adequate time for surgery and providing greater security to my patient, by keeping him pain-free during the procedure.

My training in Liposculpture and Lipoplasty and learning in the use of tumescent local anesthesia with Lidocaine, I took in 2008 to look for other amides with more anesthetic power for facial surgeries ... So, I started using Bupivacaine in Saline 0.9% + 1mg of Epinephrine, in order to use it in small facial interventions, but in 2009 due to bupivacaine poisoning in 2 cases with Cardiotoxicity that was reversed thanks to the use of intravenous lipids, I decided to look for another anesthetic medication

For amide anesthetic intoxications use lipid rescue protocol http://lipidrescue.squarespace.com/ [29].

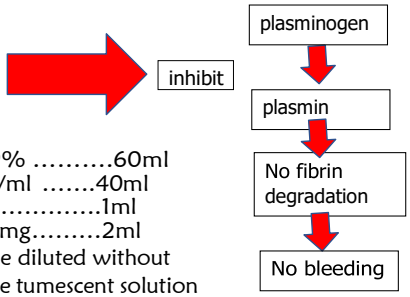
As of 2009, Change the formula: Ropivacaine 150mg
Saline solution 0.9% or Sun. Hartman Epinephrine 1mg

In 2017 he added to the formula tranexamic acid based on the work developed at that time by Dr Blugerman and Schavelzon. They use a physiological solution formula 20ml, lidocaine 400 mg, adrenaline 1ml/1mg and tranexamic acid 500 mg [30].

As tranexamic acid has a ph. 6.5, they have stopped using bicarbonate in their tumescent formulas for facial surgeries.

In the “Reyes solution” I masterfully combined Ropivacaine as a local anesthetic that gives me 6-8 hrs. Of anesthetic effect on the infiltrated tissue with this combination, Tranexamic Acid which is a substance that significantly reduces Trans and postoperative bleeding by selectively altering the fibrinolytic system; it inhibits the formation of plasmin temporarily preventing the dissolution and degradation of fibrin clots, therefore it also has an anti- inflammatory effect as plasmin is responsible for various inflammatory activities. On the other hand, Adrenaline (epinephrine) plays a very important role by producing a local vasoconstrictor effect at the site of infiltration of this Solution of Reyes, giving the necessary ischemia to visualize the anatomical structures mainly in surgery of the nose, eyelids, ears and face; in addition to slowing the rate of absorption of ropivacaine

Tranexamic ac.



- Solucion Salina 0,9% 60ml
- Ropivacaine 7.5mg/ml 40ml
- Epinephrine 1mg/ml.....1ml
- Ac. Tranexamic 200mg.....2ml

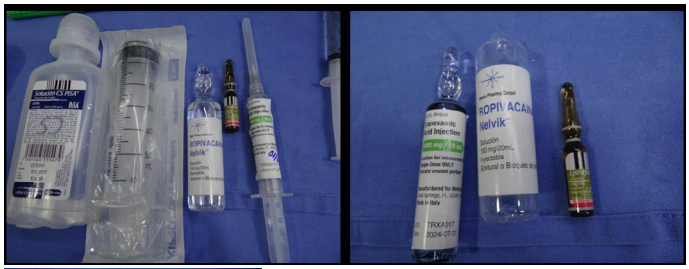
In the same way it can be diluted without altering the stability of the tumescent solution with Lactate Ringer

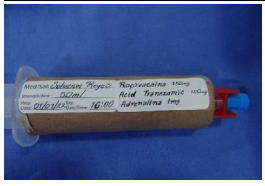
From December 2017 to January 2022 perform the following surgical procedures using the Reyes solution

Surgical procedures from 4/2017 to 5/2022
Total 693
Rhinoplasty 323
Mentoplasty 73
Bichectomy 137
Blepharoplasty 57
Rhytidectomy 37
Eyebrow lift 20
Cheiloplasty 9
Labiaplasty 10
Lingual frenectomy 2
Nipple eversion 1
Lipomas 8

In all these surgeries we have observed the non-need for the use of the vacuum during rhinoplasties, the minimum use of electrocautery in facial surgeries. Also, we noticed a marked decrease in postoperative edema, ecchymosis and bruising compared to our practice prior to the use of Ac. Tranexamic within the Reyes Solution (693 surgeries).

Figure

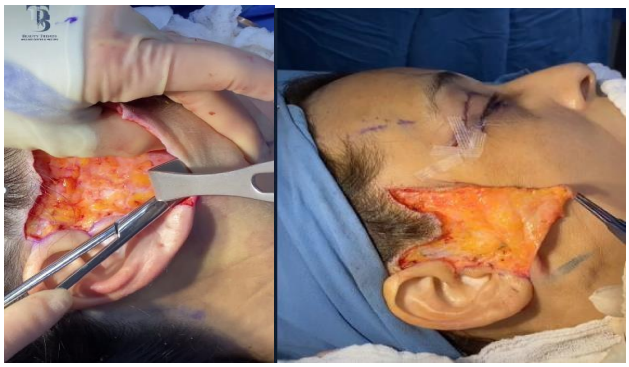


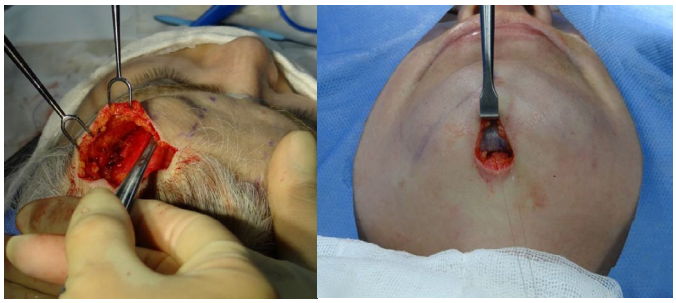


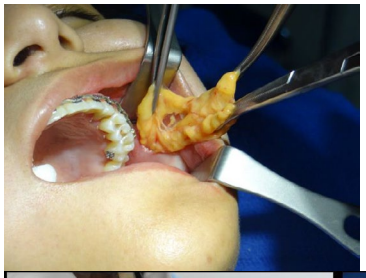
Sterile connector is used to transfer to 3ml syringes, 2.5 ml are loaded to keep track of the total amount in ml and mg of Ropivacaine.

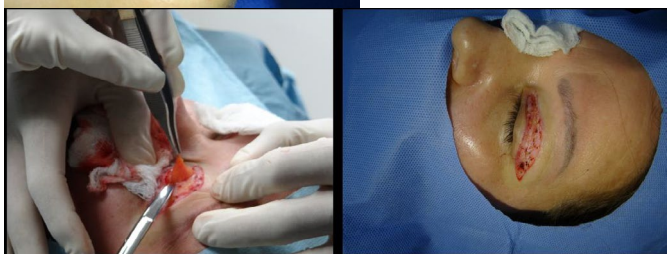
The "Reyes Solution" achieves much longer effects of anesthesia and trans operative hemostasis, favors the dissection of tissues during surgery for tumescence, generates better postoperative analgesia, and decreases the risk of bleeding Post Op, leading to a safe surgery.

Figures

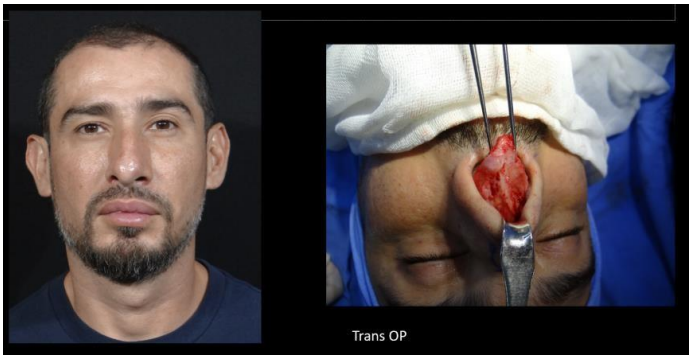








Secondary rhinoplasty



Complication

In these years and the large number of patients we have only had two cases that we interpret as anesthetic intoxication, the first was in a Labiaplasty (labia minora) and another in Rhinoplasty.

In the first case the patient was not sedated and presented:
-Anxiety
-Excitation
-Generalized tremor and fasciculations
-Arrhythmia
-Tachycardia.

In Rhinoplasty it was identified more by the monitor because the patient was sedated presenting Tachycardia, hypertension, and Ventricular Arrhythmias. In both cases the picture reversed with the use of intralipid IV.

When we checked the why we realized that we had used large volume syringes, 35 cc and needles which could have produced an intravascular injection. That's why we now use to infiltrate syringes of 3 cc luer lock.

Conclusions

Using the Pilar Reyes Solution, we have performed in these last five years 693 facial surgeries, obtaining good aesthetic and functional results with very few side effects (edema, ecchymosis, pain, <2%).

It is my idea that the development of this anesthetic solution called Solucion de Reyes fulfills the premises to achieve a satisfactory and safe result of facial aesthetic surgeries.

I think it is a solution that can be applied to other aesthetic surgeries such as women's aesthetic genital surgery.

The various scientific works presented endorse the therapeutic action of each of the components of the Solucion de Reyes and its synergistic action in the search for clean, safe surgeries that facilitate the work of the surgeon.

Among patients undergoing noncardiac surgery, the incidence of the composite bleeding outcome was significantly lower with tranexamic acid than with placebo [31].

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