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The WALANT Technique in Osteotomy and Bone Elongation for Brachymetatarsia: A Case Report

Valentina Magos Gamboa[1], Leidy Carolina Sosa Cachón[2], Luis Ángel Martínez Bravo[2], Alexis Emir Noguera Echeverría[3], María Fernanda Ibarra Guerrero[4], Víctor Manuel Ayuso Diaz[5], Ruz Alcocer Alison Mariel[6], Minerva Jiménez Reyes[6], Leonardo Jiménez Reyes[7].

[1]Anesthesiology Resident. Hospital Regional "Elvia Carrillo Puerto", ISSSTE. Facultad de Medicina de la Universidad Autónoma de Yucatán.

[2]Anesthesiologist. Hospital Regional "Elvia Carrillo Puerto", ISSSTE.

[3]Surgical Resident. Clínica Hospital Mérida, ISSSTE. Facultad de Medicina de la Universidad Autónoma de Yucatán.

[4]Pediatrics Resident. Clínica Hospital Mérida, ISSSTE. Facultad de Medicina de la Universidad Autónoma de Yucatán.

[5]MD. Universidad Marista de Mérida.

[6]MD. Universidad Anáhuac Mayab.

[7]Medical Student. Universidad Anáhuac Mayab.

ABSTRACT

Introduction: Brachydactyly (BD) is considered a genetic malformation that can cause disproportionately short fingers and toes. The incidence ranges from 0.0% up to 0.05%, with a predilection for females. On the other hand, the Walant anesthetic technique is safe and effective and uses epinephrine, lidocaine, and sodium bicarbonate.

Case presentation: A 50-year-old female diagnosed with BD was scheduled for an elective osteotomy with a bone elongator. During the procedure, we used the Walant technique, which does not require intravenous sedation or supplementary oxygen.

Clinical discussion: Hand surgery is one of the most common procedures and usually requires the use of a tourniquet for hemostatic control, creates pain and makes the use of sedation necessary. In this case, we explained how the Walant technique can be beneficial in cases with BD.

Conclusion: The Walant technique proves anesthesia and avoids the use of tourniquet and sedation, decreasing surgical times, optimizing surgical supplies, and decreasing costs and post-anesthetic recovery. It can be used as a first-line anesthetic option in selected procedures, including tendon repairs and carpal tunnel release.

KEYWORDS: Brachydactyly, genetic malformation, short fingers, females, Walant, epinephrine, lidocaine, sodium bicarbonate, osteotomy, hemostatic control, sedation, tourniquet, recovery.

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INTRODUCTION

Brachydactyly (BD) is a genetic malformation or congenital anomaly that causes disproportionately short fingers and toes. Brachymetatarsia and brachymetacarpia are uncommon pathological conditions with idiopathic congenital or acquired etiology. Both entities are characterized by the abnormal shortening of one or more metatarsals or metacarpals due to premature epiphyseal closure and slow growth during their morphogenesis. [1, 2]

These pathological conditions have an estimated incidence between 0.02% and 0.05%, predominantly affecting females (25:1). They can present themselves unilaterally or bilaterally and can affect one or more digits. Ordinarily, the first, fourth, or fifth metacarpal/metatarsal are the ones involved when the pathology affects only a single digit. When there are multiple

digits involved, the most commonly affected metacarpals/metatarsals are the fourth and fifth. These conditions tend to become evident after four years of age and tend to be isolated malformations. However, studies have shown they can be associated with syndromes such as Down, Albright, Turner, Larsen, and diastrophic dysplasia. [3]

Brachydactyly does not alter functionality, and its treatment is primarily cosmetic. Currently, the most common surgical intervention for this condition is the lengthening of the affected limb through callotasis with an external fixator; in more severe cases, digital lengthening techniques or even toe-to-hand transfers can be used to improve the clamp. Many of the surgical procedures performed on the extremities require the use of a tourniquet to avoid bleeding; this can generate hemodynamic changes and tissue damage starting from the first 30 minutes of the pneumatic cuff's inflation, as well as pain and discomfort for the patient. [4, 5, 6]

Lalonde was the first author to describe the Wide-Awake Local Anesthesia No Tourniquet (WALANT) technique as a safe and effective anesthetic method. Among the main advantages, this technique allows the active involvement of the patient during the surgical procedure and eliminates the need for a tourniquet due to the use of epinephrine, thereby avoiding associated postoperative complications. [7]

The WALANT anesthetic technique uses epinephrine as a vasoconstrictor agent to minimize bleeding, 1% lidocaine as a local anesthetic and sodium bicarbonate as a buffer, to decrease the pain associated with lidocaine injections, modifying lidocaine's acid pH. It is mainly used in upper limb surgeries, highlighting its frequent application in hand surgery. [5, 7]

This local anesthesia technique with no sedation and no tourniquet has been described as a viable option, accessible, safe, and efficient for surgical interventions of the hand. Initially, it was indicated for minor interventions, however, due to its favorable results and safety, its use has extended to more complex surgeries, proving to be a comfortable and friendly technique for the patients, with a good cost-effectiveness ratio for healthcare systems due to its effect in reducing hospital stay duration. [5, 8, 9].

CASE REPORT

A 50-year-old female patient without a history of chronic degenerative diseases, previous surgeries, or known allergies. She was diagnosed with brachydactyly of the middle right finger and was scheduled for an elective osteotomy with placement of a bone elongator.

In the preoperative area, the patient was monitored, with vital signs within normal parameters. For the preparation of the anesthetic solution, a 1 mg epinephrine vial (1ml) was used, it was diluted with 0.9% saline solution until reaching 10 ml, obtaining a concentration of 1:10000. From this dilution, 2 ml were extracted and added to 18 ml of 1% lidocaine, achieving a final epinephrine concentration of 1:100000. Finally, 2 ml of 8.4% sodium bicarbonate were added to the 20 ml epinephrine and lidocaine solution, resulting in a total of 22 ml per injectable solution, ready to be administered.

Asepsis of the dorsum of the right hand was carried out with povidone-iodine and denatured ethyl alcohol. At a site close to the surgical incision area, the skin was lifted between two fingers, gently squeezing and pinching it before introducing the needle. The 13 mm hypodermic needle was inserted perpendicularly to the skin. The injection was administered slowly, starting with 2 ml just below the skin, and advancing with 1-2 cm margins every 20 seconds until covering the entire back of the hand. A latency of 20 minutes was waited out before transferring the patient to the operating room **(Image 1)**.

Image 1. Right hand after infiltration of the anesthetic mixture. The marking of the infiltration sites can be seen.

The surgical protocol included monitorization, asepsis of the whole extremity, and placing of sterile fields, with a total latency time of 45 minutes, for the epinephrine to achieve its vasoconstrictor effect **(Image 2)**. Prophylaxis was administered with Ceftriaxone 1 g IV along with an anti-inflammatory prophylaxis consisting of Ketorolac 60 mg IV.

Image 2. Right hand after infiltration of the anesthetic mixture. A characteristic color change is observed in the WALANT technique, due to the effect of epinephrine.

The procedure was performed without complications. The mobility of the affected limb was properly evaluated, and the bleeding was minimal **(Image 3)**. No intravenous sedation or supplementary oxygen was required. The patient remained hemodynamically stable and said she felt ‘’comfortable’’ during the entirety of the procedure. After the surgery, the patient remained in the recovery room for approximately 15-20 minutes without hemodynamic changes and was discharged to continue with medical management and follow-ups in an ambulatory manner **(Image 4)**.

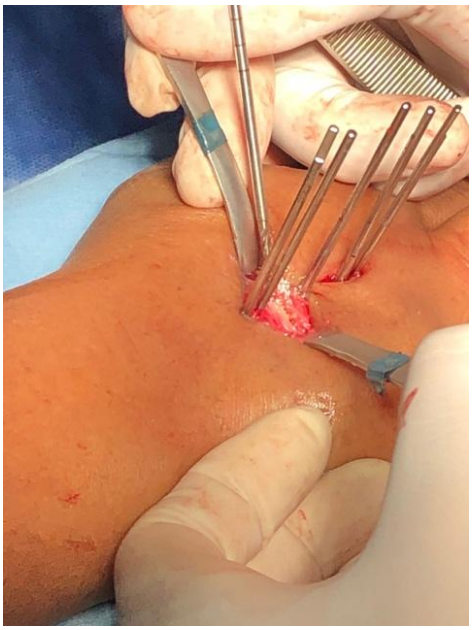

Image 3. Transanesthetic photo, showing the absence of bleeding from the right hand.

.Image 4. Control X-ray at the end of surgery

DISCUSSION

Brachymetacarpia is a medical condition in which metacarpal bones are abnormally short. Brachymetacarpia can be caused by a variety of syndromes, childhood diseases or idiopathically. Its incidence is less than 1 in 1000, and its rate of occurrence is 5 times higher in women than in men. [4]

A variety of methods are used to elongate the metacarpals, and each method exhibits certain advantages. Some authors recommend elongation by gradual distraction, arguing that this technique offers a higher rate of cosmetic success rate, as well as a lower complication rate. These repetitive surgeries are the main reason for scar formation in the dorsal skin. Another disadvantage of the callus elongation is that it requires a long-term treatment. Age has to be taken into account when contemplating elongation via callotasis. If the patient presents as an adult, this treatment is usually unnecessary. In contrast, other authors recommend a one-stage elongation with a bone graft since this does not require the use of an external fixator in the patient's hand for a prolonged period. [4]

Hand surgeries are a very common practice in surgery rooms; the advantage is that they can be performed with local anesthesia, however, their association with the use of a tourniquet for hemostatic control creates pain and makes the use of sedation by an anesthesiology team necessary, which in turns elevates the surgical time and cost. [10]

The WALANT technique provides anesthesia and avoids the use of a tourniquet and sedation, therefore decreasing surgical times by eliminating the systemic anesthesia component, allowing the evaluation of active mobility arcs intraoperatively. It optimizes the use of surgical supplies and decreases costs and post-anesthetic recovery time by eliminating the need for sedation. [10]

Tumescent anesthesia consists of the subcutaneous infiltration of a high volume of diluted solution from a local anesthetic mixed with a vasoconstrictor and other additives. This allows for anesthesia of large areas with a lesser anesthetic dose, avoiding local toxicity and facilitating the dissection of subcutaneous tissue. [11]

Local anesthetics (LAs) work by blocking voltage-gated sodium channels in the axonal membrane, therefore decreasing the action potential depolarization rate, which in turn prevents nerve transmission through the anesthetized fiber. The action of LAs is dependent on different factors such as: liposolubility (the more lipophilic molecules will have a more lasting effect), protein binding (the greater the binding, the longer the duration of the effect), the pH of the anesthetized tissue (tissues with more acidic pH, for example in infected tissues, the anesthetics are less effective), and the diffusibility in the tissues (in areas with greater blood supply there will be a faster absorption, and therefore a faster onset of action). [11]

The addition of vasoconstrictors to an anesthetic solution (topical or local), is possibly the most common use of adjuvants, with commercialized solutions existing nowadays. Its use is based on two main benefits: firstly, it induces local vasoconstriction that reduces the systemic absorption of LAs, therefore prolonging their effect; secondly, it reduces local bleeding during surgery. Nevertheless, these drugs can, in some patients, result in symptoms such as palpitations, anxiety, hypertension or arrhythmias; especially when administered in high volumes or high concentrations. Moreover, these symptoms can also appear when used in mucosal tissue, or when patients present with hypersensitivity to these drugs or cardiovascular instability. Because of this, the use of LAs combined with vasoconstrictors should be carefully evaluated in the aforementioned situations, aiming for the lowest effective concentration.

Traditionally, the use of epinephrine in combination with lidocaine has been avoided based on the belief that it could

cause ischemia and necrosis when used in areas of peripheral circulation, such as the fingers. However, it has been demonstrated that the use of anesthesia combined with epinephrine in peripheral circulation does not increase the risk of ischemia or necrosis, keeping in consideration the application site and the volume used. [10]

Epinephrine is added to the solution to prolong its effect. However, caution is recommended, especially when epinephrine is administered to parts of the body with terminal arteries, meaning arteries that are the only ones irrigating that particular organ or tissue (for example, fingers and toes). Epinephrine can narrow arteries, resulting in a decrease of irrigation to the affected tissues, which in turn can cause complications. [12]

A maximum concentration of 1:100,000 of epinephrine has been proposed for solution volumes less than 50 ml; in case of larger volumes being required (50 - 100 ml), the solution should be diluted until reaching concentrations of 1:200,000 of epinephrine. For volume requirements between 100 and 200 ml, the epinephrine concentration should be that of 1:400,000. In this way, an adequate control of local bleeding is achieved. [10]

Buffering or regulating the pH of the anesthetic solution to be infiltrated offers two fundamental benefits: first, the reduction of pain during administration of the injection, since LAs are acidic solutions with a pH of 5.0 to 7.0; and secondly, a more rapid onset of anesthesia, since nerve diffusion is greater and a lower minimum concentration is required to block nerve conduction. In order to do this, sodium bicarbonate is generally used in a proportion of 1:9 or 1:10 of the total volume, at a concentration of 1 mEq/ml, adding this to lidocaine. [11]

Sodium bicarbonate is an adjuvant to lidocaine that reduces injection-related pain, as well as the onset time of nerve blockage; it brings the anesthetic's acid solution closer to its pKa before administering it to the patient, which reduces the latency period. [13]

WALANT (Wide Awake Local Anesthesia No Tourniquet) technique offers multiple advantages over tourniquet use in hand surgery. As opposed to the tourniquet, WALANT eliminates pain and discomfort associated with the pneumatic cuff's pressure, and it allows for a better intraoperative experience for the patient, who can actively participate and receive education from the surgeon during the procedure. Moreover, this technique avoids hemodynamic complications, as well as the tissue damage that can occur with the prolonged use of a tourniquet. [14, 15]

Nonetheless, WALANT is not exempt from disadvantages. Some patients might experience pain during the local anesthetic infiltration, even though this can be mitigated with proper infiltration techniques. Additionally, the technique requires full cooperation from the patient, which can prove difficult especially when dealing with anxious or uncooperative individuals. [16, 17]

The reproducibility of the WALANT technique in other patients with hand surgeries is high, as long as strict protocols are in place and proper training of surgical staff is performed. This technique has been successfully implemented in various types of hand surgeries, such as carpal tunnel release and tendon repairs, demonstrating consistency in their results. [18]

WALANT technique can be indicated as a first-line anesthetic option in procedures where the goal is to minimize recovery time, avoid complications associated with the tourniquet and sedation, and maximize patient interaction and education during surgery. This includes ambulatory surgeries of the hand and procedures where the visualization of the intraoperative active movements is crucial for surgical success. [19]

CONCLUSION

The WALANT technique represents a significant improvement in the anesthetic management of hand surgeries, compared to that of tourniquet use. One of the main advantages is the elimination of pain and discomfort caused by the tourniquet, as well as the hemodynamic complications and tissue damage that can occur after its prolonged use. Studies have demonstrated that WALANT provides a more comfortable surgical experience for the patient, who remains conscious and can actively participate during the surgery, providing real-time feedback to the surgeon. This interaction can improve the surgical results, specifically in procedures that require an immediate evaluation of hand function.

However, this technique also presents with limitations. The anesthetic solution infiltration can be painful due to lidocaine's acidic properties, although this can be mitigated by the addition of sodium bicarbonate to the solution. Moreover, the correct administration of anesthesia requires experience and detailed anatomical knowledge by the surgeon to ensure proper distribution and avoid complications such as local infections. The reproducibility of the WALANT technique in other patients with hand surgeries has been well documented in the literature. Its simplicity and lack of need for specialized equipment make it a viable option in various clinical configurations. Numerous studies have demonstrated its efficacy and security in procedures such as carpal tunnel release and tendon repair surgery, highlighting its consistency in achieving good clinical results.

The WALANT technique can be used as a first-line choice for anesthetic care in hand surgery cases that require precise control of the bleeding, and where the patient's active participation could result in a better surgical outcome. This includes tendon repairs, carpal tunnel release, and procedures that aim to minimize recovery time and avoid complications associated with tourniquet use and sedation. In addition, its good cost-effectiveness ratio and the reduction in hospital length of stay, make it an attractive option for healthcare systems.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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