

Postoperative Pain and Preemptive Local Anesthetic Infiltration in Hallux Valgus Surgery

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Abstract

Background: Several techniques of anesthesia are used in foot surgery. Preemptive analgesia helps to prevent the development of hypersensitivity in the perioperative period. The aim of our study was to assess the role of preemptive local anesthetic infiltration and postoperative pain after hallux valgus surgery.

Methods: We evaluated 118 patients who underwent modified chevron and miniinvasive Mitchell–Kramer bunionectomy of the first distal metatarsal. After spinal anesthesia each patient randomly received an infiltration of local anesthetic or the same amount of normal saline 10 minutes before the skin incision. We measured the intensity of pain 4, 8, 12, 16, 24, and 72 hours after the release of the tourniquet using a visual analogue scale (VAS). Rescue analgesia and all other side effects were noted.

Results: Preemptive analgesia resulted in less pain during the first 24 hours after surgery. The decrease of VAS score was significantly lower in the study group during all the short postoperative periods measured. The rescue analgesia was administered in 11.9% of patients in the injected group and 42.4% in the placebo group ($P < .05$). In the injected group we did not observe significant difference in VAS score between patients post–chevron and miniinvasive Mitchell–Kramer osteotomy of the first distal metatarsal. No systemic adverse effects were noted. One persistent injury of dorsomedial cutaneous nerve was observed.

Conclusion: Preemptive local anesthetic infiltration was an efficient and safe method to reduce postoperative pain after hallux valgus surgery. The analgesic effect was satisfactory in both traditional and minimally invasive techniques.

Level of Evidence: Level I, prospective randomized study.

Keywords: preemptive analgesia, hallux valgus anesthesia, postoperative pain, local anesthetic infiltration

The traditional approach to hallux valgus surgery is often connected with significant postoperative pain.^{15,36,38} Adequate control of pain is essential for patient satisfaction and improves the outcome of the procedure.¹⁸ Regional anesthesia is advocated, because of the efficiency and safety.^{1,36} Various nerve blocks (popliteal, saphenous, femoral) give excellent postoperative pain control.^{13,15,27,33,38} However, motor blockade or technical difficulties are limitations of these methods.¹⁸ Patient-controlled analgesia (PCA) acts on the central nervous system and is not sufficient to diminish maximal pain.¹⁸

Multidrug local injection is convenient and widely used after knee and hip arthroplasty.^{3,16,20,22,26,30,39} It also exerts a beneficial effect after a bunion surgery.¹⁸ Multimodal analgesia is effective in pain control and minimizes side effects.^{6,8,13,15,27,28,31,33,38} Preemptive analgesia helps prevent the development of hypersensitivity in the perioperative period.^{10,12} Local anesthetic infiltration before the skin

incision leads to a reduction of peripheral sensitization.¹² It is used in laparoscopy, lumbar discectomy, or carpal tunnel syndrome release and relieves pain after surgery.^{4,5,14} The aim of our study was to assess the role of preemptive local anesthetic administration and postoperative pain after hallux valgus surgery.

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Table 1. Clinical and Radiological Data.

	Injected Group (n = 59)	Placebo Group (n = 59)	P Value
Height (cm)	165.0 ± 7.1	163 ± 7.2	.834
Weight (kg)	61.2 ± 6.4	59.6 ± 5.9	.345
Body mass index (kg/m ²)	22.8 ± 2.0	22.2 ± 1.8	.478
Preoperative hallux valgus angle (degrees)	27.1 ± 5.4	28.0 ± 4.9	.567
Preoperative intermetatarsal angle (degrees)	14.3 ± 1.9	14.5 ± 2.1	.987
Duration of spinal anesthesia (hours)	5.3 ± 2.3	5.1 ± 2.5	.453

Methods

Between July 2008 and October 2012, 125 subcapital first metatarsal osteotomies were performed. All patients had unilateral procedures. Seven declined to participate in this study. The inclusion criteria were: mild to moderate hallux valgus deformity with pain, difficulty with shoe wear or both. We excluded patients with peripheral circulatory disorders, diabetes and rheumatoid diseases, metatarsalgia, skin lesions of the foot, allergy of local anesthetic and patients using analgesics 10 days prior to surgery. Both the patient and the surgeon were blinded regarding the composition of the injected solution. Only the circulating nurse was aware of the content of the injected solution. All patients underwent a chevron or a miniinvasive Mitchell–Kramer procedure and were discharged from the hospital on the next day. The first surgeon performed all Mitchell–Kramer, while the second surgeon did all chevron operations as a method of choice based on their personal experience. In all patients spinal anesthesia was used (12.5 mg bupivacaine 5 mg/mL) and then each patient received an infiltration of local anesthetic (4 ml of 0.25% bupivacaine and 3 ml of 2% lidocaine) or the same amount of normal saline 10 minutes before skin incision. The injections were performed in the line of the operative approach, widely and deeply to the periosteum, medial capsule, and a small amount directly into the first metatarsophalangeal joint (MTP I). Mean age was 47.8 (22 to 63) years and 84% were females. The average body mass index (BMI), height, weight, and preoperative and postoperative hallux valgus (HVA) and intermetatarsal (IMA) angles were similar in both groups ($P > .05$) (Table 1). Moreover, we did not observe a significant statistical difference in HVA (25.9 vs 27.2 degrees, $P > .05$) and IMA (14.5 vs 13.8 degrees, $P > .05$) between 2 groups of patients who underwent chevron and miniinvasive Mitchell–Kramer first metatarsal subcapital osteotomies. We noted a similar total tourniquet time in both groups (44.3 ± 5.3 minutes in injection group and 45.6 ± 4.9 minutes in placebo).

We used a medial approach in all operations. Twenty-five minutes after spinal anesthesia, we injected either an infiltration of 7 ml volume of placebo or the test mixture in line with the skin incision, gradually advancing the injection subcutaneously, intracapsularly, periosteally, and at

the end of the injection into MTP I joint (approx 2 ml). After 10 minutes, the tourniquet was inflated and the procedure was started. In 53 patients we performed a modified chevron distal osteotomy, lateral release with the same skin incision and screw stabilization. In 65 patients we did a miniinvasive Mitchell–Kramer subcapital first metatarsal osteotomy with percutaneous Kirschner wire stabilization.¹¹ The length of the skin incision and soft tissue exposure was different in both techniques and averaged 6.1 cm in the chevron and 1.5 cm in the miniinvasive Mitchell–Kramer. After release of the tourniquet, we controlled hemostasis, closed the skin, and applied an elastic bandage. We used a hallux valgus shoe allowing heel and lateral margin of the foot weight-bearing the day after surgery. We routinely administered intravenously ketoprofen (dose 100 mg) and paracetamol (dose 1000 mg) 3 times after surgery before discharge from the hospital starting 4 hours after the end of the procedure. For rescue analgesia, intramuscular injection of morphine sulphate, 7.5 mg was allowed. The patients estimated their pain intensity using a visual analogue scale (VAS), according to which 0 means lack of pain, while 10 is the worst. Intensity of pain was measured at 4, 8, 12, 16, and 24 hours after the release of the tourniquet and 3 days postsurgery in our outpatient clinic at their follow up visits. If rescue analgesia was requested by the patient, pain intensity was evaluated before the injection. The duration of spinal anesthesia was measured. All side effects were also noted. Data were collected by assistants who were blinded to the results of randomization. A power analysis was performed by a statistician before commencing the study.

Results

Preemptive analgesia resulted in less pain during first 24 hours after the operation (Table 2). The average duration of spinal anesthesia was 5 hours and 20 minutes (Table 1). The difference in VAS was the smallest at 4 hours and the greatest at 8 hours after the tourniquet release (1.4 vs 4.0) but statistically significant during all the short postoperative periods. Three days after surgery we did not observe a difference in VAS score between groups (Table 2). The rescue analgesia was administered in 7 patients in the injected group and 25 in the placebo group (11.9% vs 42.4%, $P < .05$).

Table 2. Pain Intensity Measured by VAS in Injected and Placebo Group.

Time From Tourniquet Release	Injected Group	Placebo Group	P Value
4 hours	0.8 ± 0.5	2.2 ± 0.7	<.0001
8 hours	1.2 ± 0.9	5.2 ± 1.8	<.0001
12 hours	1.5 ± 1.0	4.5 ± 2.5	<.0001
16 hours	1.7 ± 0.7	4.2 ± 1.1	<.0001
24 hours	1.3 ± 1.1	3.0 ± 0.9	<.0001
3 days	1.2 ± 0.5	1.5 ± 0.3	>.05

Table 3. Comparison of Pain Intensity Measured by VAS in Injected Group Between Miniinvasive Mitchell–Kramer and Chevron Subcapital First Metatarsal Osteotomies.

Time From Tourniquet Release	Miniinvasive Mitchell–Kramer (n = 31)	Chevron (n = 28)	P Value
4 hours	0.8 ± 0.5	0.7 ± 0.6	.741
8 hours	0.8 ± 0.2	1.5 ± 0.6	.083
12 hours	1.0 ± 0.3	1.7 ± 0.5	.111
16 hours	1.5 ± 0.4	1.9 ± 0.6	.236
24 hours	1.3 ± 0.7	1.5 ± 0.7	.456
3 days	1.0 ± 0.2	1.2 ± 0.3	.678

We did not observe a difference in the postoperative HVA (14.6 vs 13.7 degrees, $P > .05$) and IMA (9.5 vs 9.3 degrees, $P > .05$) between the chevron and Mitchell–Kramer groups. The comparison of pain intensity (VAS score) revealed less pain in the percutaneous method but was not statistically significant ($P > .05$) (Table 3). The statistical power of analysis was almost 80% and the results had statistical significance. No patient had any systemic adverse effects: nervousness, nausea, vomiting, dizziness, tinnitus, tremor, seizure, drowsiness, dyspnea, arrhythmia, hypotension, or cardiac arrest. In 2 patients after the miniinvasive Mitchell–Kramer and 1 after the chevron procedure, we observed an injury of the dorsal cutaneous nerve. Symptoms resolved after 2 weeks spontaneously, but 1 had a persistent area of numbness after the minimally invasive Mitchell–Kramer procedure. No deep infection occurred. In 1 case after the miniinvasive Mitchell–Kramer procedure we removed the Kirschner wire after 3 weeks due to signs of infection. After oral antibiotics and elastic bandage stabilization we achieved full union with correct position without any sign of deep infection.

Discussion

Local anesthetic infiltration is widely used in foot and ankle surgeries. Intracapsular injection of bupivacaine was effective up to 12 hours after Keller's operations.^{8,31} Short-term

effects of analgesia were observed after intraarticular postoperative 0.5% bupivacaine injection in ankle arthroscopy.²⁸ Good postoperative pain control was achieved after popliteal nerve block,^{13,15,27} however this method has disadvantages: technical difficulty, risk of intravenous or intraarterial injection with possible systemic complications of local anesthetics, and time for the onset of the sensory block.¹⁸ Bupivacaine ankle block can reduce the need for rescue analgesia compared to the lidocaine block.³⁸

Postoperative pain can be amplified by central neuroplasticity due to operative nociception.¹⁰ Preemptive analgesia is an antinociceptive treatment that prevents establishment of altered central processing of afferent input from the site of injury/surgery.^{12,32} Effective antinociception before injury can prevent development of central sensitization during the inflammatory phase.³² Use of local anesthetic injection, opioid, or NMDA receptor antagonists can inhibit afferent pathways and interrupt pathologic pain cycles.¹⁰

Preemptive local anesthetic wound infiltration is widely used in general surgery, gynecology or neurosurgery.^{2,23,24,35} For example, the preoperative local infiltration of bupivacaine reduces pain and opioid use and, consequently, the incidence of nausea or vomiting in the first 24 hours after inguinal hernia surgery.²⁹ Moreover, this method of preemptive analgesia decreases postoperative pain sensation, limits the amount of fentanyl use during surgery, and reduces the demand for opiates in patients undergoing mastectomy in breast cancer.⁴⁰ A significant reduction in fentanyl consumption and pain during the earlier postoperative period was achieved in laparoscopic gastrectomy after pre- and intraoperative lidocaine injection.¹⁹ Preemptive long-acting local anesthetic injection provides good analgesia in open carpal tunnel release.⁵ Epidural injection of ropivacaine or bupivacaine with tramadol before lumbar spine surgery was safe and effective for postoperative pain relief.^{17,34} However in 1 of the studies, lidocaine used subcutaneously before the skin incision had no analgesic effect.⁹ We hypothesize that one of the most important factors in preemptive local anesthetic infiltration is the antinociceptive action in deep tissues like muscles, articular capsule, peritoneum or neural root.^{7,14,17,19,29,34} The efficiency of postoperative pain reduction seems to be more connected with the blockade of the deep tissue nociceptors rather than superficial ones.

To our knowledge preemptive local anesthesia has not been reported in hallux valgus surgery before. Significant reduction of pain was observed after the operation and remained at the same enhanced level for up to 24 hours. A slight difference in VAS score (but still statistically significant) was measured 4 hours after the tourniquet release and it can be explained by the prolonged duration of the spinal anesthesia. The difference in pain relief in the injected group was much more significant during the remaining 24 hours. Only 7 patients needed rescue analgesia in the postoperative

period. We suppose that incomplete anesthesia of the deep soft tissues and joint capsule was the reason.

One of the potential benefits of a minimally invasive correction of hallux valgus is decreased pain. The results of percutaneous bunion surgery are still controversial.^{21,25,37} It emphasizes the influence of small and gentle skin exposure and soft tissue dissection on faster recovery and decreased rehabilitation time;^{11,21,25} however there is still a lack of high quality and randomized studies.³⁷ We have observed slightly lower pain intensity (VAS score) after miniinvasive Mitchell–Kramer compared to the chevron procedure but without statistical significance. The minimally invasive approach requires less dissection and exposure and theoretically causes less pain. Preemptive local anesthesia significantly reduced postoperative pain to 1–2 points in the VAS score. Such an insignificant level of pain is probably responsible for the small difference in the VAS score between chevron and miniinvasive Mitchell–Kramer groups. Presumably a worse analgesic effect could result in a greater difference in the postoperative pain level. Moreover, the length of the skin incision is not as important a factor as exposure of the deep soft tissues and bone damage in reducing postoperative pain. The results of the study suggest that the good effect of preemptive local anesthesia seems to be related to deep nociceptors blockade. The role of deep tissue receptors in the origin and degree of postoperative hallux valgus pain is paramount.

One of the limitations of the infiltration prior to skin incision is edema of the soft tissues and possible iatrogenic destruction of anatomic structures. Visualization of the dorsal cutaneous nerve can be difficult during surgery, but damage, when the medial approach is used, is not very common. Because of the standard discharge time from the hospital after a hallux valgus surgery, we were able to observe patients during the first 24 hours postsurgery. Pain intensity measured by VAS 3 days postsurgery was minimal and suggested a prolonged effect of preemptive local anesthetic infiltration resulting presumably from inhibiting the development of central sensitization.

Conclusion

Preemptive local anesthetic infiltration before the skin incision was efficient and safe in the reduction of postoperative pain after hallux valgus surgery. The enhanced analgesic effect was seen in both the traditional and minimally invasive hallux valgus surgeries.

Declaration of Conflicting Interests

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