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The Use of Targeted MicroCurrent Therapy in Postoperative Pain Management

Allen Gabriel, MD, FACS
Rachel Sobota, RN
Shelby Gialich, LPN
G. Patrick Maxwell, MD, FACS

Effective postoperative analgesia is a prerequisite to enhance the recovery process and reduce morbidity. The use of local anesthetic techniques is well documented to be effective, but single-dose techniques (infiltration, peripheral blocks, neuraxial blocks) have been of limited value in major operations because of their short duration of analgesia. Recent advances in technology have led to the development of a noninvasive device, targeted Micro-Current Therapy, which enhances postsurgical recovery by stimulating the body's natural healing process. This therapy transmits gentle, short bursts of electrical current targeted to the tissue cells at the surgical site. This article reviews recent clinical experience and evidence of this device in plastic and reconstructive surgery.

Postoperative pain management is a crucial part of any surgical procedure and may directly impact patient satisfaction and outcome. Numerous new techniques and medications are continuously being developed in an attempt to streamline the process. These will invariably lead to shorter postoperative stay and less dependence on narcotic pain medications. Traditional systemic methods of pain control are not without their potential adverse effects, including altered mental status, narcotic dependence, nausea, constipation, depressed respiratory drive, and emesis. The potential to minimize these adverse effects is one of the many advantages to alternative forms of pain control in the critical first 1–7 days postoperatively.

Postoperative pain, or any pain for that matter, can be managed by five different approaches. The first approach is the central approach, wherein pharmacologic agents (e.g., narcotic analgesic agents) are administered systemically and act by altering the perception of pain in the central nervous system. This method has all of the disadvantages and risks associated with the use of these pharmacologic agents (e.g., sedation, respiratory depression, nausea, and vomiting; Kehlet & Liu, 2007). The second approach involves the use of neuraxial blockade (i.e., spinal or epidural analgesia), which acts by blocking or altering the transmission of pain impulses from the spinal cord to the brain. The disadvantages of this method include sympathetic blockade leading to possible hypotension, motor blockade possibly interfering with ambulation, urinary retention, the risk of spinal headache, and the risk of respiratory depression with the use of narcotics. The third approach is peripheral nerve blockade, such as axillary block or femoral nerve block, which acts by blocking the transmission of nerve signals to the central nervous system. The disadvantages of these methods include

Allen Gabriel, MD, FACS, is Director of Research, Department of Plastic Surgery, Loma Linda University Medical Center, Loma Linda, California. Dr Gabriel is a board certified plastic surgeon and the assistant professor at Loma Linda University Medical Center. He is also the chief of plastic surgery at Peacehealth Southwest Medical Center.

Rachel Sobota, RN, is a licensed RN at Peacehealth Plastic Surgery, Vancouver, Washington.

Shelby Gialich, LPN, is a licensed LPN at Peacehealth Plastic Surgery, Vancouver, Washington.

G. Patrick Maxwell, MD, FACS, is a board-certified plastic surgeon and Clinical Professor of Surgery, Department of Plastic Surgery, Loma Linda University Medical Center, Loma Linda, California.

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Address correspondence to Allen Gabriel, MD, FACS, 505 NE 87th Ave, Suite 250, Vancouver, WA 98664 (e-mail: gabrielallen@yahoo.com).

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the complexity of performing these procedures, the risk of neuropathy with the prolonged presence of a catheter and/or local anesthetic in proximity to a major nerve, and the risks of the blocks themselves (e.g., phrenic nerve block and elevated hemidiaphragm with interscalene block). The fourth method is the application of local anesthetic at the site of injury, which blocks the transmission of pain signals at the local level. This method is safe and free of systemic adverse effects. The only risk associated with this method is that of local anesthetic toxicity should excessive amounts of local anesthetic be infused. The fifth method is the application of advanced modalities such as targeted MicroCurrent Therapy (tMCT).

Targeted MicroCurrent Therapy has been used successfully in various clinical applications over time, including surgical wound healing, chronic wounds, and treatment of pain. Now there is significant laboratory and clinical validation for the mechanism of action of the targeted MicroCurrents (Rohde, Chiang, Adipoju, Casper, & Pilla, 2010; Strauch, Herman, Dabb, Ignarro, & Pilla, 2009).

This therapy emits a pulsed signal, which cannot be felt or seen, which, in turn, deposits an electrical current in tissue that interacts with the basic electrochemistry of the body. These MicroCurrents accelerate the body's natural recovery processes by improving blood flow, increasing local tissue perfusion and revascularization, reducing edema, reducing pain, and promoting faster tissue regeneration and wound healing (Grana, Marcos, & Kokubu, 2008; Heden & Pilla, 2008; Strauch et al., 2009; Weintraub, Herrmann, Smith, Backonja, & Cole, 2009).

SCIENCE OF tMCT

Targeted MicroCurrent Therapy (SofPulse; IVIVI Health Sciences, San Francisco, CA) is a noninvasive therapy that sends targeted pulsed electrical MicroCurrents into the soft tissue and stimulates the body's natural healing process, which speeds wound healing. These MicroCurrents accelerate the natural anti-inflammatory "cascade" to significantly reduce edema and pain, while decreasing both recovery time and the use of pain medication and other pharmacologic agents (Pilla et al., 2011; Rohde et al., 2010; Strauch et al., 2009). The mechanism of action involves the acceleration of a well-understood electrochemical process, which in turn increases anti-inflammatory nitric oxide (NO) production. Scientific data demonstrate the increasing efficacy for specifically configured therapy signal designed to modulate Ca^{2+} binding to calmodulin (Pilla, Muehsam, Markov, & Sisken, 1999), an early step in the anti-inflammatory cascade involving the signaling molecule NO (Pilla et al., 1999; Strauch et al., 2009). Indeed, analgesic agents containing NO donors have shown promising clinical results on acute pain reduction (Michael Hill et al., 2006). Tuning the drug-free tMCT signal for the NO cascade provides an immediate stimulus independent of pharmacokinetics because the time-varying field appears instantaneously in all compartments of the target tissue (Strauch et al., 2009). These technologic advances have allowed economical, light-weight, and disposable tMCT devices to become available. To date, there are no known adverse effects or complications reported in the literature associated with tMCT treatment; it is immediately effective and targeted to the surgical site.

CLINICAL APPLICATIONS IN PLASTIC SURGERY FOR SofPulse tMCT

Targeted MicroCurrent Therapy treatments increase microvascular blood flow, enhance circulation, reduce edema, and stimulate the growth of new blood vessels. It has significantly increased angiogenesis and tissue perfusion in a validated animal model (Strauch et al., 2009). Clinical applications for tMCT in plastic and reconstructive surgery include, but are not limited to, breast reduction, breast reconstruction with implants or flaps, breast augmentation, abdominoplasty head and neck flap reconstruction, and facial plastic surgery.

In a recent case of breast reduction, patients treated with this therapy in the immediate postoperative period had significantly less pain and used fewer narcotics (Rohde et al., 2010). Inflammation was objectively measured by sampling wound exudates and measuring the level of interleukin-1β, which is an objective marker of inflammation. A 55% reduction in postoperative pain was reported at 1 hr and a 300% decrease at 5 hr (Rohde et al., 2010). This therapy was also utilized in another group of patients and was clinically validated in a double-blind, placebo-controlled, randomized pilot study (N = 42; Heden & Pilla, 2008). Patients in the active group treated postoperatively with tMCT had a significantly faster reduction in pain (270%) as reported by visual analog scores and significantly less pain medication (60%) by postoperative day 3 (Heden & Pilla, 2008).

Clinical observation indicates that prolonged inflammation contributes to edema and a greater likelihood of capsular contracture. By accelerating the body's natural anti-inflammatory response, tMCT reduces prolonged edema. By allowing the body to move forward in the healing process, the incidence of prolonged inflammatory response is greatly reduced (Strauch et al., 2009).

Reducing the use of narcotic pain medications will also have a direct influence on the incidence of adverse events in hospitalized patients and postdischarge complications. Among Medicare patients in acute care hospitals, 31% of adverse events and 42% of temporary harm events were related to medication (U.S. Department of Health and Human Services, 2010). Adverse drug events represent the most common postdischarge complication (Agency for Healthcare Research and Quality, 2011). Targeted MicroCurrent Therapy has the potential to decrease morbidity, reduce adverse events, and improve the quality of patient care.

CONCLUSION

Apprehension about postoperative pain is sometimes an important contributing factor in otherwise-motivated patients for postponing or avoiding surgical procedures. Adding local anesthesia, even during procedures performed under general anesthesia, considerably reduces postoperative pain for a long term (Metaxotos, Asplund, & Hayes, 1999). Identifying innovative technologies for improving postoperative comfort is important here, as it is for all types of surgical procedures. This is particularly so in patients wherein the immediate and long-term adverse effects from the use of pharmacologic analgesic agents in the home setting can contribute to patient morbidity (Rawal, Hylander, Nydahl, Olofsson, & Gupta, 1997).

The non-invasive tMCT can be placed in the operated area over the dressings directly following the procedure. Once activated, the unit delivers the microcurrent regimen automatically, requiring minimal patient involvement. The device can also be placed directly over the skin.

As this body of evidence grows and clinical experience widens, the gaps in the current knowledge (especially concerning optimal treatment regimens for specific conditions) will be filled. At the same time, we anticipate that improved signals and products that are more effective and more ergonomically designed will be developed, and that other electrochemical pathways will be targeted for additional indications. In the meantime, surgeons have at hand a powerful tool for the adjunctive management of postoperative pain and edema reduction.

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