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Nanotechnology Pain Patch Relieves Chronic Back Pain: A Case Report

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Background: Low back pain is a debilitating symptom that may develop into a refractory chronic condition, resistant to physical, medical, psychological, and/or interventional therapy options. We would like to share the first report of a nanotechnology pain patch providing > 90% chronic back pain relief for 3 months.

Case Report: A 75-year-old man with chronic low back pain secondary to L2-L3 disc herniation suffered from pain for > 35 years. He found physical therapy, baclofen, low-dose opioids, and lumbar epidural steroid injection ineffective. A trial of a nanotechnology pain patch (nCAP Signal Relief Patch) worn daily provided the patient with consistent 90% to 100% back pain relief and enabled the patient to have significant functional improvement.

Conclusions: This case report demonstrates that the nCAP Signal Relief Patch could be a simple, safe, noninvasive, and effective treatment option for those affected by chronic low back pain.

Key words: Pain patch, nanotechnology, chronic low back pain, case report

BACKGROUND

Low back pain is an unpleasant condition thataffects about 80% of the population (1). When an acute episode of back pain occurs, activity modification, rest, nonsteroidal anti-inflammatory drugs (NSAIDs), and/or physical therapy can often relieve symptoms. For a small percentage of patients, low back pain can continue > 12 weeks, and become chronic. Chronic pain can be more difficult to effectively manage and often involves a multidisciplinary approach, which could include physical, medical, psychological, and interventional therapies (2). However, when a multitude of traditional treatment modalities fail, some consider trying an evolving scientific field, called nanotechnology, to manage pain. A new, noninvasive, nonpharmacological pain patch exists on the market that utilizes this nanotechnology to help patients. However, limited clinical studies are available at this time. So far, most reports about this patch have been anecdotal. We share the first report of a nanotechnology pain patch providing > 90% chronic back pain relief for 3 months.

The patient provided verbal and written informed consent for publication of this report.

CASE PRESENTATION

A 75-year-old man with past medical history of obesity, hypertension, and colon cancer presented with chronic low back pain. Thirty-five years prior to presentation, the patient injured his back while moving books, which resulted in L2-L3 disc herniation. For many years after this injury, the patient experienced back pain several times a year that would last for several weeks at a time, but would each time be partially alleviated with physical therapy. However, for the last 3 years, the patient's back pain became more severe, no longer obtaining relief with physical therapy. He described the pain as a constant dull sensation located at the lower central part of his back. He rated the pain as 8 out of

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10 on the Numeric Rating Scale. The pain also radiated to the legs, which the patient described as a constant dull pressure and stiffness located on the anterior side of both thighs. The back pain was exacerbated by standing, walking, and sleeping, with at times the pain awakening the patient from sleep.

As time advanced, physical therapy became less effective for management of pain. The patient tried lidocaine 5% patch, diclofenac sodium ointment, and NSAIDs; however, these medications did not provide significant relief. The patient found baclofen and low-dose opioids to be ineffective, and his mental status was affected. The patient received a lumbar epidural steroid injection, with 2 weeks of back pain relief, followed by return of baseline pain. The constant pain was causing a significant strain on his life, affecting his mood, ability to work, sleep, and interact with family members.

A noninvasive, nonpharmacological, nanotechnology pain patch (nCAP Signal Relief Patch) was offered as a trial to the patient. The patient was instructed to place the patch near or on the location of the pain and wait several minutes to see if there was an effect. If the patient felt some type of pain relief, the patient was instructed to attach the patch with paper tape to the skin or shirt. The patient was told that if he did not feel any effect from the pain patch, he was to move the patch several inches and wait a few minutes. The patient was advised that he could wear the patch as long as desired if found helpful.

The patient reported that within one minute of moving the patch on various locations on his back, he was able to locate a spot that provided 100% pain relief. He then secured the patch directly to his skin and wore the patch daily, only removing for showering. While wearing the patch, the patient had no sensations or side effects from the patch. During the first few weeks of wearing the patch daily, the patient consistently experienced 90% to 100% pain relief with significant functional improvement, which included the ability to stand for a prolonged period of time, walk the dog, and walk hundreds of yards without pain. However, with removal of the patch, the patient reported a gradual return of pain.

After about 3 weeks of daily patch wearing, the patient developed pruritus, soreness, and a small blister at the patch site (Fig. 1). The patient was then advised to secure the patch over a T-shirt if he chose to continue wearing the patch. Within a few days, the patient's skin irritation healed, and the patient continued wearing the patch over his T-shirt (Fig. 2). The patient reported that the patch was 90% as effective over the T-shirt during the day, in comparison to direct skin application, and significantly less effective while sleeping given that his shirt moved with changing positions during sleep.

After 3 months of continuous patch application, the patient reported resolution of his back pain. The patient chose to stop wearing the patch at that time. Two weeks later, the back pain returned. The patient reapplied the patch, and within a day, the pain was again resolved.

DISCUSSION

Nanotechnology is a field of science and technology that deals with the design, production, and application of materials and devices on a nanoscale level. It has the potential to revolutionize many areas of health care, including pain management. There are various nanotechnology modalities available, including drug delivery via carriers and patches, nerve blocking, tissue regeneration, and diagnostic tools (3).

Nanoparticles reduce the need for systemic administration and minimize adverse side effects. Liposomes are spherical, lipid-based nanoparticles used to deliver opioids, NSAIDs, and other pain medications directly to the site of pain. Nerve-blocking nanoparticles can also be used to interrupt signals that transmit pain. For example, poly(lactic-co-glycolic acid) nanoparticles loaded with an anesthetic agent have been used to block nerve signals in animal models of pain (4). Nerve-blocking nanoparticles can also be nonpharmacological and work by physically blocking the nerve fibers by forming a coating around them. These nanoparticles can further reduce pain by stimulating tissue regeneration and repairing damaged tissues. For example, nanofibers made from polycaprolactone have been shown to promote the regeneration of damaged nerve tissue by providing a supportive environment for the nerve cells to regenerate (5).

A pain patch, like the nCAP Signal Relief Patch, utilizes nanotechnology. These nanotechnology pain patches can be nonpharmacological or pharmacological. Nanotechnology nonpharmacological pain patches are unique in that they do not rely on medications to provide pain relief but rather interact with the body's nervous system. Like many things in medicine, the exact analgesic mechanism of the pain patch is unknown. However, it is theorized that the patch provides pain relief because it is made up of multiple tiny capacitors. Like a battery, a capacitor is able to store electrical energy, but a capacitor is much simpler than a battery as it

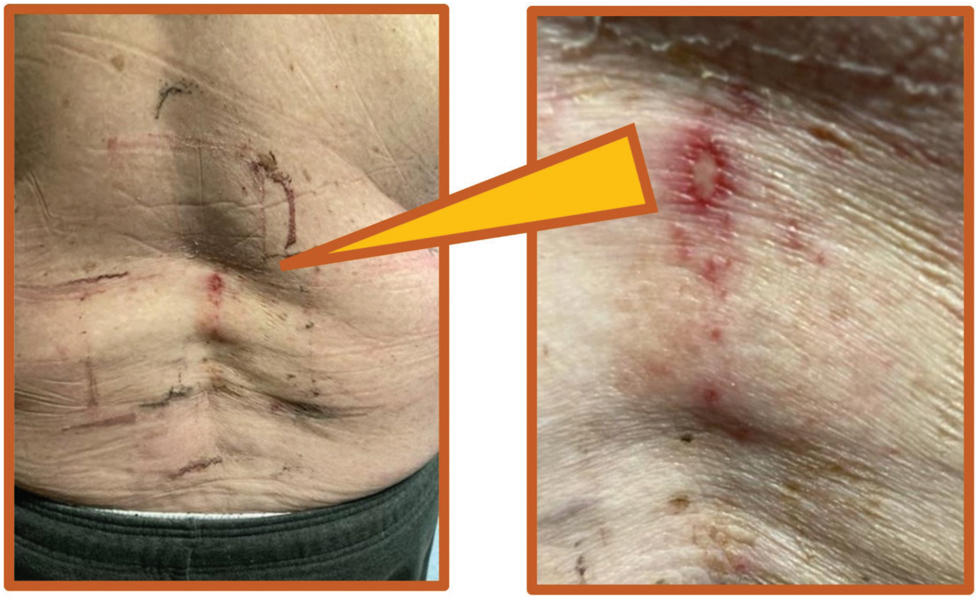

Fig. 1. The skin irritation that resulted after wearing the nanotechnology pain patch secured directly to the skin for 3 weeks.

Fig. 2. The nanotechnology pain patch secured to the patient's T-shirt.

cannot produce new electrons - it can only store the electrons. When the pain patch encounters the radiation of ambient energy emitted from the body's natural or nociceptive-related electrical charges, the pain patch discharges billions of capacitors that are contained within the patch. This causes electrical signals to be sent along the body's nervous system pathway. It is theorized that along the nociceptive pathway, there is poor signaling. The poor signaling charges the capacitors inside the pain patch and influences the axons along the body's pathway. This forms a "bridge" over the part of the pain pathway where electrical disruption is occurring. The patch likely does not block the pain pathways, but enhances the signal/communication along the pain pathway and nervous system. This reaction, for some patients, results in long-term pain reduction after the patch is removed, where pain does not immediately return to baseline once the patch is removed. Some also believe that the patch could also promote the body's natural healing process for some patients (6,7).

There is much that still needs to be investigated about utilizing nanotechnology for pain management, but based on our experience with a single patient that we followed for > 3 months, the patient experienced significant pain relief from this technology, with only temporary skin irritation as an adverse effect that got relatively quickly resolved. However, analyzing our patient's experience with this patch, it appears that like with other therapies, patients might eventually experience tolerance to these nanotechnology patches. It appears that as the patch is worn for an extended period of time, the pain signals are able to overcome the interruption created by the nonpharmacological pain patch and pain returns. When the patient receives a temporary break from the patch, it appears that the electrical signals reset and the patch is able to inhibit pain transmission once again.

Looking to the future, there are several avenues for further development and use of these patches. Large randomized clinical trials would be beneficial to further explore the effectiveness and safety profiles of nanotechnology-based pain patches (3). Current obstacles exist preventing the commercial scale-up of this technology. There are significant costs that must be overcome in conducting these clinical trials (8). Overall though, the future is bright for therapies using nanotechnology as we are progressing toward an exciting reality of potentially revolutionizing pain treatment.

CONCLUSIONS

Chronic low back pain is often difficult to manage with physical/occupational therapy, analgesic medications, and invasive procedures. These treatment options are not void of adverse reactions and do not always work. Although there is limited data surrounding nanotechnology pain relief patches, this case demonstrates that this type of patch could be a simple, safe, noninvasive, and effective treatment option for those affected by chronic low back pain.

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