New Pain Management Modality:

Adenosine – A2aR signaling pathway activated by Electric Field Stimulation

Chronic pain is one of the most prevalent, debilitating and costly condition, yet it is often treated inadequately. In the US, an estimated 50 million suffer from chronic pain. Pain costs Americans an estimated $100 billion each year. In spite of advances in pain management over the past decades, chronic pain remains a significant problem. In the US, an estimated 50 million suffer from chronic pain. Pain costs Americans an estimated $100 billion each year. In spite of advances in pain management over the past decades, chronic pain remains a significant problem.1

The first-line of pharmacologic agents for the treatment of mild to moderate pain is acetaminophen or nonsteroidal anti-inflammatory drugs (NSAIDs). While efficient in pain management, NSAIDs have been associated with deleterious side effects when used over long period of time. Cardiovascular, nephrotic and gastrointestinal side effects from NSAIDs are severe, they cause over 20,000 deaths annually in US.

Another important class of drugs is opioids. Opioids are proven to be efficient in controlling even the strongest pain, but are linked to high rates of posttreatment addiction. Over the last decades the opioid addiction became a national emergency. To overcome it, new creative solutions are required.

In addition to pharmaceuticals, pain management usually includes physical therapies (e.g., superficial heat or cold, massage, exercise, and electroanalgesia) that supplement the pain-relieving effects of analgesics and provide some additional health benefits.1

One of the most important types of pain is chronic low back pain (LBP) - the most common cause of disability in the industrialized nations. About four out of five Americans will experience back pain at some point in their lives. Whereas acute back pain resolves within 4-6 weeks in 90% of patients, chronic pain persists in the remaining population. LBP has many causes (e.g., trauma, musculoskeletal spasm, arthritis, herniated disc with nerve compression, spinal stenosis, etc.)1.

Management options for chronic LBP include medications, exercises and physical approaches (e.g., electroanalgesia, heat and cold) and, in some cases, acupuncture, manipulation. None of these approaches, though, offers long-term relief from chronic pain.

Recently discovered Adenosine – A2aR signaling pathway opens new opportunities in pain management. Recognized as a major regulator of immune system, the pathway naturally downregulates inflammation and boosts restoration of tissues damaged by inflammation. It provides short-term pain relief by inhibiting production of prostaglandin E2 - a major pain mediator, whereas the long-term pain relief is contributed to by restoration of damaged tissues. Adenosine – A2aR pathway does not produce any side effects, local or systemic.
Adenosine – A2aR signaling pathway can be upregulated by two possible ways: increase of concentration of adenosine (or adenosine like drugs) in intercellular space and/or increase of density of adenosine A2a receptors on the cellular membranes. Whereas systemic administration of adenosine like drugs produces unwanted hemodynamic side effects, the increase of density of A2aRs has none.

It was recently discovered that the density of A2aRs on cellular membranes can be upregulated by electric field (EF) stimulation. The amplitude, duration and distribution of the pulsed EF should meet several specific requirements.

These two discoveries created a foundation for a new modality of pain management: upregulation of A2aR anti-inflammatory pathway by providing local EF stimulation. This modality has a physical therapy component – EF stimulation, that increases A2aR densities on the cellular membranes, and a pharmacological component – upregulation of A2aR pathway, that reduces inflammation and restores the damaged tissues.

The NovoPulse® device is based on this novel pain management technology and designed for management of low back pain, including deteriorated discs and facet joints. It can be used also for pain management in other joints affected by inflammation.

In NovoPulse® device a unique four-coil system is designed to generate high EF and deliver it to intervertebral discs and facet joints with adequate amplitude, direction and distribution. In addition to the EF stimulation, NovoPulse® provides thermal stimulation (TS), which is synergistically combined with EF stimulation. The Computer controlled TS is delivered by four heating pads utilizing the energy of the stored magnetic field at the end of each pulse. TS of the joint increases blood flow around the joint, promotes diffusion of nutrients in and the waste product out of the joint. Notably, according to the Gate theory of pain, TS also blocks the pain signals from reaching the spine, thus providing instant analgesic effect. But the most important aspect of using TS is the generation of so called “heat shock proteins” (HSPs). The biological function of HSPs is to preserve cell survival by maintaining the vital functions of proteins. Improved protein function leads to 4-7 fold increase in production of the extracellular cartilage matrix that significantly accelerates its repair and contributes to long-term pain relief in the joint.

Summary:

NovoPulse® technology is a new pain management modality intended for treatment of low back pain and osteoarthritic joints. It is based on combination of electric and thermal stimulations and provides long-term pain relief by suppressing inflammation and restoring damaged tissues.
Literature References


