Neuromodulation, and more specifically spinal cord stimulation (SCS,) gradually developed into a treatment tool in clinical practice as a direct result of the mechanisms proposed by Melzack and Wall for the “gate control theory.” This theory was based on the idea that excitation of large afferent fibers activate pain control mechanisms, which helped in the rapid advancement of neuromodulation for treating various types of pain. The gate control theory also accelerated the pursuit of modern pain research to explore how the ubiquitous plasticity of the nervous system plays a vital role in the generation, maintenance, and modulation of pain.

This presentation will describe methods used in research that are aimed to explore mechanisms in neuromodulation. A fundamental requirement is to gain knowledge of physiological mechanisms as the medical profession strives to move toward evidence-based therapies. The detailed mapping of mechanisms is also necessary for the further development of the techniques used in neuromodulation.

Spinal cord stimulation has been used to treat neuropathic pain of peripheral origin as well as ischemic pain states, vasospastic conditions, therapy-resistant angina pectoris and visceral diseases. The physiological mechanisms of action for SCS are slowly emerging but still are in the adolescent stage. This presentation will be used to discuss research methods and basic studies that have been conducted to explore these mechanisms in normal healthy animals, as well as the use of animal models exhibiting different neuropathic, vasculopathic, and other pathological conditions. Brief discussions will address human experimental and clinical studies. The results of these studies have shown that SCS is effective in some pain syndromes otherwise resistant to treatment. The mechanisms of SCS differ between the pathologies treated. 1) Studies using neuropathic pain models have revealed that stimulation-induced suppression of central hyperexcitability of spinal neurons appears to critical for relieving pain. 2) In ischemic pain syndromes, such as peripheral arterial occlusive disease, studies have shown that SCS inhibits sympathetic outflow and antidromically activates small afferent fibers leading to the production of peripheral vasodilation. 3) Research has also revealed that SCS may have its primary effect on improving organ function as well as the ability to reduce pain associated with the disease. Depending on where along dorsal columns of the neuro-axis the electrode for producing SCS is placed, stimulation can be used to control autonomic and viscero-somatic reflex activity involved in a specific syndrome, thereby alleviating the disease symptoms.

SCS is a safe therapy, which is minimally invasive, reversible and has few side effects compared with chronic pharmacotherapy. At the present time it is firmly believe that SCS is an underutilized treatment modality. Furthermore, it is important to vigorously pursue “evidence-based” and “mechanism-based” therapies. This pursuit requires us to expand our knowledge through research projects aimed at further exploration of physiological mechanisms that are activated using neuromodulation . The results of these studies will lead to improvement and expansion of future neuromodulation therapies that will be of benefit to patients.

SUGGESTED REFERENCES:


