

The sympathetic nervous system in acute pain and in a human model of complex regional pain syndrome

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The PhD dissertation was accepted by the Faculty of Health Sciences of the University of Aarhus, and defended on January 6, 2006.

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Dan Med Bull 2006;53:x-x.

ABSTRACT

The PhD project was carried out at Danish Pain Research Center, Aarhus University Hospital.

Complex Regional Pain Syndrome (CRPS) is a chronic pain condition formerly known as reflex sympathetic dystrophy. These patients have autonomic disturbances, and the sympathetic nervous system may play a role in their pain. Moreover, there is evidence to indicate that immobilization could be an important factor for the development of CRPS and regional autonomic disturbances. The main objective was to investigate the role of the sympathetic nervous system in acute pain and in human forearm immobilization.

Effects of sympathetic activation induced by mental and cold pressor tests were investigated on acute experimental pain and a nociceptive withdrawal reflex (NWR). It was evaluated whether the NWR is a quantitative measure of acute experimental pain. It was examined whether cast immobilization in healthy subjects affects 1) thermal and mechanosensation and 2) efferent sympathetic activity as evaluated by skin temperature, skin perfusion, and vasoconstrictor activity.

Results: Study I: Cold pressor test applied to the contra lateral hand (heterotopic modulation) inhibited pain and a NWR, whereas cold pressor test applied to the contra lateral foot (segmental modulation) inhibited pain but failed to affect the reflex. Study II: Distraction induced by a mental pressor test increased heart rate and inhibited pain but failed to affect withdrawal reflex responses, whereas attention had no effect on either parameter. Study III: Four weeks of upper limb immobilization in healthy subjects induced movement-induced pains, cold and heat hyperalgesia, joint hyperalgesia, and diffuse distal increased skin temperature.

Conclusion: Sympathetic activations induced by mental and cold pressor test relieved acute experimental pain, probably via endogenous pain modulatory systems. The differential effects of the conditioning stimuli on pain and the NWR suggest involvement of different mechanisms. Attention did not inhibit the reflex or the pain. This suggests that psychological distraction following mental and cold pressor test and attention affect pain perception differently. The inconsistent inhibition of the NWR suggests that the spinal reflex is not a quantitative measure of pain in these test conditions.

Four weeks of forearm immobilization in healthy subjects induced movement-induced pain, thermal and mechanical hyperalgesia, and diffusely increased skin temperature; thereby fulfilling the diagnostic criteria for CRPS type 1 (Merskey and Bogduk, 1994).

These findings are of great importance because CRPS patients often have been immobilized before or during the pain condition. Therefore, experimental forearm immobilization may be a human model of CRPS.