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Differential processing of nociceptive input within upper limb muscles

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Abstract

The cutaneous silent period is an inhibitory evoked response that demonstrates a wide variety of responses in muscles of the human upper limb. Classically, the cutaneous silent period results in a characteristic muscle pattern of extensor inhibition and flexor facilitation within the upper limb, in the presence of nociceptive input. The aims of the current study were: 1) to primarily investigate the presence and characteristics of the cutaneous silent period response across multiple extensor and flexor muscles of the upper limb, and 2) to secondarily investigate the influence of stimulation site on this nociceptive reflex response.

It was hypothesized that the cutaneous silent period would be present in all muscles, regardless of role (flexion/extension) or the stimulation site. Twenty-two healthy, university-age adults (14 males; 8 females; 23 ± 5 yrs) participated in the study. Testing consisted of three different stimulation sites (Digit II, V, and II+III nociceptive stimulation) during a low intensity, sustained muscle contraction, in which, 7 upper limb muscles were monitored via surface EMG recording electrodes. Distal muscles of the upper limb presented with the earliest reflex onset times, longest reflex duration, and lowest level of EMG suppression when compared to the more proximal muscles, regardless of extensor/flexor role. Additionally, the greatest overall inhibitory influence was expressed within the distal muscles. In conclusion, the present study provides a new level of refinement within the current understanding of the spinal organization associated with nociceptive input processing and the associated motor control of the upper limb. Subsequently, these results have further implications on the impact of nociception on supraspinal processing.

Introduction

The cutaneous silent period (CSP) serves as nociception triggered inhibition that provides momentary inhibition of voluntary muscle activity, in response to nociceptive activity transduced via Aδ and/or nociceptive C-afferent fibers to the spinal motoneuron pool through direct or indirect synaptic connections [1–4]. This action presents a reciprocal action to the nociceptive flexor withdrawal response (FWR) which serves as an ‘excitatory reflex’ increasing