Spinal and Supraspinal Control of Reflexes: In health, under general anesthesia, and in Parkinson's disease

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Reflexes have been used extensively for over a century both in the clinic and laboratory as a tool to assess functional connectivity within the spinal cord. In order to support the co-ordinated movement of muscles, the reflex arc is continuously under the
In this review, experimental studies focusing on the spinal and supraspinal mechanisms associated with pain at and below level will be discussed. In this review, I will discuss experimental studies that focus on the spinal and supraspinal mechanisms associated with at- and below-level neuropathic pain. Pain of musculoskeletal, radicular, visceral, or psychogenic origins all are significant in the clinical sequela of spinal injury. These pain syndromes are discussed elsewhere [6–11]. Nociceptive reflexes, like tail-flick and hindpaw withdrawal, are

The Hoffmann (H)-reflex is an electrically induced reflex that is analogous to the mechanically evoked stretch reflex. In this thesis we studied the H-reflex and related pathways under different conditions, such as during contraction, under general anesthesia and in Parkinson’s disease, to evaluate the effect of each condition on different spinal circuits. The thesis begins by systematically characterizing the time-course of post-activation depression in the soleus muscle of healthy participants using paired-pulse reflexes. We compared the recovery of an H-reflex to a reflex root evoked potential (REP) that is elicited following transcutaneous stimulation of the lumbar spine. Each type of response (i.e., H-reflex or REP) was conditioned by either an H-reflex or an REP. Transcutaneous spinal stimulation is a relatively new technique used to augment motor activity following neurological injury. To identify the influence of muscle activation, tests were conducted in both contracted and resting states. While there were many similarities between the H-reflex and REP, transcutaneous spinal stimulation produced more post-activation depression when it was assessed using paired pulse REPs, suggesting that the pathway mediating the spinally-evoked response was more susceptible to being inhibited. Using transcranial magnetic stimulation (TMS), we also demonstrated that descending input can virtually eliminate post-activation depression of the H-reflex and REP. These studies revealed that the soleus H-reflex and REP recruit an overlapping population of afferents and are similarly modulated by volitional drive and descending input. Evidence here also suggests that the scientific theory describing the mechanism of post-activation depression as a depletion of neurotransmitter is less likely. This thesis then describes how the removal of post-activation depression of the H-reflex through corticospinal input was adapted for use in the operating room. The technique was used to monitor motor pathways and reduce the risk of injury to the spinal cord in anesthetized patients undergoing spine surgery. The technique could be administered without producing the noticeable patient movement that is typically observed using conventional motor evoked potential (MEP) monitoring techniques. Finally, we describe a pilot study where the H-reflex and related descending and peripheral pathways were examined in a group of individuals with Parkinson’s disease (PD). These series of experiments demonstrated that the transmission of signals within the spinal cord may be abnormal in people with PD and may be normalized, to some degree, through parkinsonian medication and deep brain stimulation (DBS). In summary, this thesis investigates how the H-reflex is modulated by both peripheral and descending connections within the spinal cord in both healthy individuals and pathological states. The research here aims to contribute to current studies in the clinic and laboratory on human spinal cord circuitry.

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regulated by segmentally organized spinal mechanisms and are present in spinalized animals. Lick and guard responses to nociceptive input depend on spino-bulbo-spinal circuits and are present in decerebrate animals [19].