

Public Abstract

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Title:Sensory integration during blood loss in conscious rabbits

Blood loss is the second most common cause of death following traumatic injury. Thus, treatment of blood loss in humans and other animals is an important medical problem. In the real world, blood loss is often associated with simultaneous stress and/or pain, yet almost nothing is known about how these sensory inputs affect the physiological response to blood loss.

The central nervous system is critical for integrating sensory information and orchestrating the physiological responses to stress, pain and blood loss. Two studies presented in this dissertation explore the potential role of the midbrain periaqueductal gray in modulating the response to sensory stimulation. Conscious rabbits were instrumented with electrodes implanted in the midbrain that allowed us to record changes in neuronal activity during simulated hemorrhage and exposure to a variety of internal and external sensory stimuli such as increases and decreases in blood pressure, a burst of sound, or a flash of light. Neurons in the periaqueductal gray responded to simulated blood loss, changes in blood pressure and alerting stimuli. These results suggest that this brain region may play an important role in integration of sensory input during traumatic blood loss.

Another set of studies address questions related to understanding the physiological response to blood loss in the presence of pain and stress. We know from previous studies from this laboratory and others that stress alters the response to blood loss and that pain alters cardiovascular control. Therefore, we anticipated that the combination of stress and pain would alter the response to blood loss. Colorectal distension was used as a model of visceral pain in conscious, chronically instrumented rabbits. Experiments were designed to test the hypothesis that simultaneous pain and stress would increase tolerance to blood loss in conscious rabbits. Results revealed that visceral pain may decrease tolerance to blood loss in females, but does not change tolerance to blood loss in males. The presence of concurrent psychological stress and pain increased tolerance to blood loss in males and females.

To our knowledge, these are the first studies in conscious animals to: 1) demonstrate that individual neurons in the periaqueductal gray respond to multiple internal and external sensory stimuli; and 2) evaluate the effect of concurrent pain and stress on the response to blood loss. Furthermore, the results of these studies provide insight into potential sex differences in the response to concurrent stress, pain and hemorrhage. The model and experimental design used in these studies may be useful for evaluation of clinical interventions for treatment of traumatic blood loss in conscious animals, including humans.