

Suspension Trauma

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Objectives: Suspension syndrome describes a potentially life-threatening event occurring after prolonged, free hanging in a rope. The pathophysiological mechanism behind the suspension syndrome is not fully understood and the correct treatment not known. The most widespread hypothesis assumes a venous pooling in the lower limbs, leading to a reduction in cardiac preload and subsequently a decrease in cardiac output and tissue perfusion. The aim of our study was to elucidate the pathophysiology of suspension syndrome in order to eventually give recommendations for prevention and treatment.

Methods: Twenty healthy volunteers were freely suspended on a rope in a sit harness for a maximum of 60 minutes. During the suspension, heart rate, blood pressure and stroke volume were continuously and non-invasively monitored with Nexfin®. Left ventricular end-systolic and end-diastolic diameter was determined by intermittent transthoracic echocardiography and near-infrared spectroscopy (NIRS) was used to monitor cerebral oxygen saturation. Venous pooling was assessed by measuring the diameter and flow in the superficial femoral vein (SFV) with ultrasound and by monitoring lower leg tissue oxygenation (StO₂) with NIRS. Using a crossover design, each study participant was randomized to accomplish the test once with and once without climbing in a moderate intensity for ten minutes prior to suspension. The two tests were performed on different days. Signs and symptoms during suspension as well as time to pre-syncope were recorded.

Results: In twelve (30%) out of forty tests, pre-syncopal events were observed. Mean time to pre-syncope was 44.4 min. Signs and symptoms observed included nausea, light-headedness, sweating and pale skin. In the initial minutes of suspension, a marked increase in diameter of the SFV and a decrease in StO₂ were observed. Subsequently, no significant further increase in SFV-diameter was measured, however, StO₂ continued to decline at a slow rate. Heart rate, blood pressure and stroke volume did not change significantly during the suspension, except for a few minutes proceeding pre-syncope. There, a marked decrease in heart rate, blood pressure and stroke volume was observed.

Conclusion: During suspension a gravitational shift of blood to dependent body regions takes place. However, the pre-syncopal episode, observed in 30% of tests, resembled the signs of a vasovagal syncope. No argument was found to treat patients with suspension syndrome other than according to ALS guidelines. Rescue teams should be aware of the risk of a sudden cardiovascular collapse of the victim anytime during passive hanging and evacuate the patient as soon as possible.

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