

Pulse-Synchronous Intramuscular Pressure Oscillations

Clinical and experimental studies

Akademisk avhandling

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- I. Nilsson, A., Zhang, Q., & Styf, J. **Evaluation of a fiber-optic technique for recording intramuscular pressure in the human leg**, Journal of Clinical Monitoring and Computing, 2015;1-7.
- II. Nilsson, A., Zhang, Q., & Styf, J. **The amplitude of pulse-synchronous oscillations varies with the level of intramuscular pressure in simulated compartment syndrome**. Journal of Experimental Orthopaedics, 2015;2(1):3.
- III. Nilsson, A., Zhang, Q., & Styf, J. **Using the Amplitude of Pulse-Synchronous Intramuscular Pressure Oscillations When Diagnosing Chronic Anterior Compartment Syndrome**. Orthopaedic Journal of Sports Medicine, 2014;2(11):2325967114556443.
- IV. Nilsson, A. & Styf, J. **The Amplitude of Intramuscular Pressure Oscillations in Compartment Syndrome**. Manuscript. Submitted, 2015.



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Background: Intramuscular pressure (IMP) is measured in studies of tissue nutrition and in the diagnosis of compartment syndromes. Patients with compartment syndromes have an elevated IMP due to increased volume in a muscle compartment. In patients with exercise-induced leg pain, the measurement of IMP is commonly regarded as the gold standard in diagnosing chronic anterior compartment syndrome (CACS). However, recent studies have reported that IMP as a parameter in diagnosing CACS needs to be improved.

Oscillations of the IMP deriving from arterial pulsations have previously been detected in muscles with abnormally elevated IMP. The relationship between the amplitude of the IMP oscillations and the absolute IMP is, however, unknown.

Aims: The aims of the thesis were therefore to investigate the relationship between the IMP and the amplitude of the pulse-synchronous IMP oscillations and to evaluate the potential of using pulse-synchronous IMP oscillations in diagnosing compartment syndromes.

Methods: Pulse-synchronous IMP oscillations were studied at normal levels of IMP at rest, during experimental models of abnormally elevated IMP and at rest after exercise. The amplitude of the oscillations was measured in healthy subjects, patients with CACS and in patients with leg pain for reasons other than CACS.

Results: The amplitude of the IMP oscillations was higher for the CACS patients compared with the control subjects and patients with leg pain for reasons other than CACS.

During simulated compartment syndrome, the oscillations were observed in the entire IMP range seen in patients with chronic and acute compartment syndromes. The amplitude of the IMP oscillations varied with the absolute level of the IMP. The largest amplitudes were recorded when the level of the IMP was close to the level of the mean arterial pressure and the local perfusion pressure approached zero. The amplitude of the oscillations is a parameter with high sensitivity and specificity that may lend support when diagnosing CACS.

Among the CACS patients, women had an 11 mmHg lower IMP at rest after exercise compared with men ($p < 0.01$). The magnitude of the difference may be of clinical importance. The amplitude of the IMP oscillations did not differ significantly between men and women ($p > 0.5$).

The fluid injections used with traditional needle-injection techniques influences the measured IMP. Even small amounts of saline constitute a measurement problem, rendering an overestimated IMP reading. Fiber-optic pressure-measurement techniques may therefore improve IMP measurements.

Conclusion: The amplitude of the pulse-synchronous IMP oscillations reflects the IMP and the pathophysiological foundation in compartment syndromes. The patency of the catheter and the validity of the IMP measurement is assured when pulse-synchronous IMP oscillations are recorded. The amplitude has high sensitivity and specificity in identifying CACS patients. It may be an additional parameter in both research and diagnosing compartment syndromes.

Keywords: compartment syndrome, chronic anterior compartment syndrome, intramuscular pressure, pulse-synchronous oscillations in intramuscular pressure, intramuscular arterial pulsations, fiber-optic technique

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