

Titre: Modelling compartment syndrome
Title:

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Purpose:

Compartment syndrome's devastating complications have made it a topic of interest for research, yet its heterogenous clinical course has made it difficult to study. Indeed, one key issue of this condition is the current limitations to clinically diagnose Acute Compartment Syndrome (ACS), which delay or limit fasciotomy leading to higher morbidity and mortality rates. Previously our lab has developed a wireless, ultra-low-power, Micro-Electro-Mechanical Sensor (MEMS) to continuously and accurately monitor muscle compartment pressures. Among the various models of compartment syndrome developed to mimic elevated compartment pressures, we investigated a common saline infusion model in cadavers using our novel continuous MEMS pressure sensor. The objective of this work is to show the reliability of the MEMS sensors in a human model while further defining and validating the model to expand clinical utility.

Method:

Pressure controlled saline infusion pump and inline pressure sensor were hooked to IV tubing and 14g catheters and placed in the four compartments of the lower leg in a thawed fresh frozen cadaver. Continuous compartment pressure monitoring was achieved with MY01 devices placed in each compartment. Placement confirmation and compartment diameters were taken by ultrasound. Sequential infusion and stabilization at >30 mmHg of each compartment was performed followed by sequential fasciotomies of each compartment. Sequences were alternated between the two legs studied.

Results:

Using this model, stable pressures above 30 mm Hg were able to be achieved in the discrete compartments of the lower leg. These pressures were confirmed using a novel, validated continuous pressure sensor (MY01). The inline pressure sensor of the infusion system provided useful feedback for the saline pump but was not representative of the compartment pressure measured by the MY01 devices. This should bring into question models that use the backpressure at the infusion site as the compartment pressure. Standard fasciotomies of the compartment model resulted in decrease in pressures to well below compartment syndrome levels in all compartments. When switching the order of infusion for the anterior and lateral compartments, a large decrease in relative volume

was seen for the second compartment infused. The change in diameter decreased for the lateral, but not the anterior compartment when infused second (Table 1).

Table 1: Infusion sequence vs. Δ Diameter and % Volume		
% Total Volume	Infused 1st	Infused 2nd
Lat	20.60%	3.20%
Ant	18.70%	6.70%
% Diameter Δ		
Lat	210%	136%
Ant	152%	172%

Conclusion:

The general trends and patterns of variability suggest the anterior-lateral, and posterior-deep compartments do not behave completely independently. Additionally, we demonstrated that measuring pressure inline to the infusion is not an accurate measure of compartment pressure. Planned future studies on additional cadaver legs with alterations in infusion/release sequence will hopefully better elucidate the relationship.