The Deep Posterior Compartment Is Not Functionally Discrete in an Updated Lower Leg Acute Compartment Syndrome (ACS) Model

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Purpose: Our objectives were: (1) to provide an update to the lower leg compartment syndrome model through continuous pressure monitoring, and (2) to understand the functional relationships between the 4 anatomical compartments during pressurization and surgical release. We hypothesized that there are not 4 functionally discrete compartments in the lower leg.

Methods: Tests were performed on 6 thawed fresh frozen human cadaver lower legs. Pressure-controlled saline infusion pump with inline pressure sensor terminated as 14-gauge catheters placed into the 4 compartments of each lower leg. Novel pressure microsensor devices (MY01) were placed in each compartment and placement confirmed with ultrasound. Sequential infusion and pressurization to >30 mm Hg of each compartment was performed followed by sequential fasciotomies of each compartment. Ultrasound was used to both ensure catheter/sensor placement and measure the compartment diameters after infusion of each compartment. The sequence of infusion and release was alternated between legs.

Results: Continuous-pressure monitoring was demonstrated in a saline infusion model using a continuous pressure microsensor. Pressures tracked the baseline, saline infusion, and surgical release timing. Additionally, the pressure measured inline at the infusion pump was significantly inaccurate. The deep posterior compartment was unable to be pressurized to ACS threshold levels when infused in isolation. It could only sustain an elevated pressure when an adjacent compartment was pressurized. Furthermore, deep posterior compartment pressures were found to decrease to <10 mm Hg once fasciotomy was performed in adjacent compartments.

Conclusion: As postulated in the literature, continuous tracking of pressure changes in lower leg compartments enhances our ability to model compartment syndrome. This allows us to further explore the relationships between compartments to improve diagnostic and treatment strategies. The behavior of the deep posterior compartment suggests that it may not be functionally discrete in ACS. This finding warrants further study into the necessity of a 4-compartment release during fasciotomy. Additionally, the significant difference between the pressure measured inline to the infusion and the pressure measured inside the compartment should bring into question models that measure compartment pressure as the infusion backpressure.