Non-operative Treatment For Compartment Syndrome With Phenylephrine and Dobutamine

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Introduction: Acute compartment syndrome (CS) of the extremity describes increased pressure within the osseofascial compartment, leading to compromised circulation, hypoxia, and ultimately muscle and nerve necrosis. Current treatment for acute extremity symptomatic CS is fasciotomy. However, surgical treatment has associated morbidity and may delay the recovery of the patients. The goal of this study is to investigate the feasibility of a novel non-surgical treatment for acute compartment syndrome by increasing blood pressure using a dog CS model. We hypothesize that pharmacological treatment that raises the blood pressure will improve limb perfusion and tissue oxygenation, thus rescue muscle from CS.

Methods: All procedures were approved by the Institutional Animal Care and Use Committee at ISIS Services. Under general anesthesia, CS was induced in the anterolateral compartment on bilateral legs in 10 animals (4 treated and 6 non-treated) via Hespan infusion with a goal pressure of 30mmHg above diastolic blood pressure (ΔP=30mmHg). Polarographic oxygen measurement electrodes were placed percutaneously into the anterolateral compartment. Intramuscular tissue oxygenation, compartment pressure, and blood pressure were recorded every 30 seconds. In the treated group, pharmacological treatments began at 1 hour after the compartment syndrome is induced. Infusion of intravenous phenylephrine was initiated at 25mcg/min and titrated up to 100mcg/min as needed to increase the diastolic blood pressure 30mmHg above the baseline (ΔP=0mmHg). Intravenous dobutamine at 60mcg/min was initiated 2 hours later. Six to seven hours after treatment, fasciotomy was performed on one leg of the animals and the skin was closed 1 hour later. In the non-treatment group, similar procedures were performed except that neither pharmacological nor fasciotomy was performed. Animals were euthanized 2 weeks postoperatively at which point muscle biopsies were performed. Tissue viability was assessed by MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay as previously described. This is a validated technique in which the normalized tissue viability index is expressed as a percentage of control (quadriceps muscle).

Results: Pharmacological treatment significantly increased PmO2 in the anterior compartment muscle. The PmO2 in the treatment group was 18.8 ± 4.3 mmHg (mean ±SE) during the experiment. In contrast, PmO2 in the non-treated group dropped to 0 mmHg soon after the compartment syndrome was induced. Fasciotomy increased the PmO2 to 35.7 ± 15mmHg. Two weeks after surgery, the muscle viability index in pharmacological treated, pharmacological plus fasciotomy and non-treated groups were 128 ± 15%, 94.3 ± 8.3%, 41.8 ± 17% (mean ± SE) respectively. There was no significant difference between pharmacological treated and pharmacological plus fasciotomy groups (P=0.09). However, both treated groups have higher tissue viability compared to the non-treated group (P<0.01) (Figure 1).

Discussion: Our results showed that non-surgical pharmacological treatment significantly increases muscle oxygen and viability and may represent an alternative, less morbid treatment for acute compartment syndrome than fasciotomy. Phenylephrine is often used for trauma patients in the perioperative setting to maintain blood pressure and could serve as initial therapy in patients with possible compartment syndrome. However, in our study, the effect of phenylephrine decreased over time, and a second line drug (dobutamine) was needed after the first few hours. We are currently testing this treatment strategy in more animals. Future works include titrating drug dosing, long-term effect follow up, muscle histology and functional analysis.

Significance: Keeping the blood pressure at a high level using pharmacological agents (phenylephrine/dobutamine combination) may serve as an alternative to surgical treatment for acute compartment syndrome.

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