THE USE OF HYPERBARIC OXYGEN AS AN ADJUNCT TREATMENT IN SEVERE FROSTBITE

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Objectives
Treatment of severe frostbite injury has been rapidly changing over the past 20 years with the advent of thrombolytic therapy. While thrombolitics (tPA) is now standard of care for frostbite management, the nature of frostbite injury excludes many patients from receiving this therapy. Numerous case reports detail positive outcomes utilizing hyperbaric therapy for frostbite injury. Tissue injury from frostbite is in two phases, the freezing injury and the reperfusion injury, which both lead to increasing tissue hypoxia. Hyperbaric oxygen (HBO) therapy aims to decrease this injury by increasing tissue oxygenation and decreasing immune mediated damage. In this preliminary report we detail the outcomes of frostbite patients who received HBO therapy as an adjunct to thrombolytic therapy or as a stand-alone treatment for severe frostbite injury.

Methods
Following Human Subjects Research Institutional Review Board approval, we identified all patients admitted to our ABA verified Burn Unit with severe frostbite injury. Between the years 2012 - 2016 providers at our institution incorporated HBO to standard of care in cases of severe frostbite that were ineligible for thrombolytic therapy (N=9). More recently, patients treated with tPA also received HBO (N=6). Control cases (N=30) without HBO treatment were matched in a hierarchical fashion: tPA, time to tPA, Hennepin Frostbite Score, and age. The Hennepin Frostbite Scores were calculated based on bone scan perfusion deficits and operative reports to calculate salvage rates for comparison between these groups.

Results
There were no significant differences between the HBO and no HBO in gender, age, comorbidities, or social factors associated with frostbite injury. Thrombolytics were given in 40% of HBO and no HBO. The time to tPA in these patients were also similar. The salvage rates of both groups was not significantly different, however it was higher in the no HBO treatment group. Within the HBO alone cohort, the patients had an average age of 50 while the HBO with tPA group had an average age of 37. Also the HBO with tPA group was 50% female which is a large proportion of females than typically observed in the literature. Using the Hennepin Frostbite Score, the salvage rate for the HBO alone group was 59%. Meanwhile the salvage rate in the HBO with tPA group was 32%. When we compared the amount of tissue with perfusion defects, the HBO with tPA group had more tissue impacted by frostbite than the HBO alone group (15 vs 8, p=0.051).

Conclusions
This study demonstrates that hyperbaric oxygen may be used as an adjunctive treatment to tPA or stand alone treatment in those who are outside the standard thrombolytic treatment window. In this preliminary report, the salvage rate of the HBO cohort remained lower than the historical controls. Many of these patients had severe injury with significant delays in presentation for medical care. Unfortunately, due to the nature of frostbite injury, it is extremely challenging to obtain details of injury prior to medical care in order to case match more effectively. The patients who received HBO alone had relatively high salvage rates using the Hennepin Frostbite Score that make this a promising possible treatment for patients outside the standard tPA treatment window. Future studies assessing HBO as an adjunctive treatment to lytic therapy and as the primary treatment for patients ineligible for tPA are warranted.