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Comments
Abstract of poster presented at the 2014 UMass Center for Clinical and Translational Science Research Retreat, held on May 20, 2014 at the University of Massachusetts Medical School, Worcester, Mass.

Oksana Babchenko participated in this study as a medical student in the Senior Scholars research program at the University of Massachusetts Medical School.

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Perfusion Changes by Hyperspectral Imaging in a Burn Model

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BACKGROUND: Early excision and skin grafting of full-thickness and deep-dermal burns is therapeutically advantageous. However, while full-thickness burns are clinically evident, differentiating between superficial versus deep partial-thickness burns presents a diagnostic challenge, with only 50-75% accuracy. Superficial-dermal burns heal, while deep-dermal burns often require excision and skin grafting. Decision of surgical treatment is often delayed until burn depth is definitively identified. This study’s aim is to establish a thermal burn model in mice in order to assess the ability of Hyperspectral Imaging (HSI) in differentiating burn depth.

METHODS: Burns of graded severity were generated on the dorsum of seventy-six hairless mice with a brass rod heated to 50, 60, 70, 80, or 90°C. Perfusion and oxygenation parameters of the injured skin were measured with HSI, a non-invasive method of wide-field, diffuse reflectance spectroscopy at 2 minutes, 1 hour, 24 hours, 48 hours, and 72 hours after wounding. Burn depth was measured histologically (n=44) at 72 hours post injury using Masson’s trichrome staining.

RESULTS: Three discrete levels of burn depth were verified histologically, as follows in order of increasing depth: intermediate-dermal, deep-dermal, and full-thickness injury. At 24 hours post injury, total hemoglobin increased by 67% and 18% in intermediate and deep dermal burns, respectively. In contrast, total hemoglobin decreased by 64% in full-thickness burns. Differences in deoxygenated hemoglobin, total hemoglobin, and oxygen saturation for all group comparisons were statistically significant (p<0.05) as early as 1 hour after injury.

CONCLUSION: HSI was able to differentiate among three discrete levels of burn injury. This is likely due to its correlation with skin perfusion: superficial burn injury causes an inflammatory response and increased perfusion to the burn site, while deeper burns destroy the dermal microvasculature and a decrease in perfusion follows. This study supports further investigation in the use of HSI in early burn depth assessment.