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Perfusion Changes by Hyperspectral Imaging in a Burn Model

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Comments

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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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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.