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REAL-TIME CLINICAL PERFUSION MEASUREMENTS USING LASER SPECKLE IMAGING OF PORT-WINE STAIN BIRTHMARKS DURING PHOTODYNAMIC THERAPY

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Background: Port-wine stain (PWS) birthmarks affect approximately ~400,000 individuals annually and are characterized by potentially deleterious psychosocial and physical complications. The current standard of care treatment, photocoagulation using lasers, achieves unacceptable PWS lightening in >85% of subjects even after multiple treatments. We and other research groups have studied PDT as a promising alternative or supplement to laser phototherapy of PWS. However, proper light dosimetry during PDT remains a significant hurdle to enable maximally efficacious but safe treatment.

Study: To address this shortcoming, we developed a real-time perfusion measurement system for use during PDT treatment of PWS. This system utilizes laser speckle imaging to provide wide-field quantitative maps of cutaneous blood flow immediately before, during, and immediately after PDT (0.75–1.00 mg/kg dosage of Talaporfin Sodium and light dosage of 50 J/cm^2 at 664 nm). Using this system, we quantified cutaneous blood flow changes within PWS birthmarks before, during, and after PDT, and related these dynamics to treatment efficacy in a pilot study of seven patients. We performed colorimetric assessment to quantify treatment efficacy 12 weeks post-treatment by computing the change in the color difference between each treatment spot and non-PWS birthmark skin in the L*a*b colorspace (?E).

Results: We found moderate correlations between the maximum change and the standard deviation of the changes in PWS perfusion during PDT (R2 = 0.68 and 0.69, respectively).

Conclusion: By focusing on specific changes in the dynamics or magnitude of perfusion in PWS using our system, the clinicians' ability to quantitatively determine when treatment should cease and maximize treatment efficacy and safety, is enhanced. This reduces the risk of under- or over-treating PWS, improving the outcome of PWS phototherapy on an individualized basis.

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