Correlation Between Lymphedema Disease Severity and Lymphoscintigraphic Findings: A Clinical-Radiological Study

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INTRODUCTION: Lymphoscintigraphy is the gold-standard test for diagnosing lymphedema, and is 96% sensitive for detecting the disease. The major abnormal lymphoscintigraphic findings on the test include delayed transit time to the inguinal or axillary lymph nodes (>1 hour) and dermal backflow. A universal protocol for the test does not exist, our protocol obtains images at 1, 2, and 4 hour intervals to confirm diagnosis of the disease and to achieve a measure of the severity of lymphatic dysfunction (e.g., a patient with a transit time of 4 hours to regional lymph nodes would have worse dysfunction compared to a patient with a transit time of 2 hours). The purpose of this project was to determine if lymphoscintigraphy results correlate with clinical presentation.

METHODS: Patients treated in our Lymphedema Program between 2009 and 2017 were reviewed. Diagnosis of lymphedema was determined by history, physical examination, and lymphoscintigraphy. Severity was defined by increased volume of the limb: mild (<20%), moderate (20–40%), severe (>40%). Candidate variables included location (arm, leg), age, duration of symptoms, infection history, and lymphedema type (primary, secondary). An association between lymphedema severity and lymphoscintigraphy findings was determined using the Pearson chi-square test and multivariate logistic regression.

RESULTS: One hundred thirty-four patients with 181 affected extremities (24 upper, 157 lower) were included. Clinical severity was: 54% mild, 30% moderate, and 16% severe. Delayed tracer transit to the regional nodes was: 45 minutes (34%), 2 hours (18%), and ≥ 4 hours (48%). Thirty-six percent of extremities demonstrated dermal backflow. Abnormal transit time or dermal backflow was identified in 97% of extremities by 45 minutes and in 3% of limbs by 2 hours. Transit time and dermal backflow were not predictive of clinical severity when adjusting for candidate variables (p > 0.1).

CONCLUSION: Clinical severity of lymphedema is not associated with lymphoscintigraphy findings. A lymphoscintigram should be interpreted as normal or abnormal, and does not need to exceed 2 hours.

Revolutionizing Remote Monitoring of Free Flaps with Laser Doppler Flowmetry and Smart Devices

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PURPOSE: The purpose of this presentation is to demonstrate an innovative method for remote free flap monitoring using laser Doppler flowmetry and smart devices.

INTRODUCTION: Newer generation of free flap monitoring device using tissue oximetry offers web-based capability for transmission of recordings to the smart phone. However, remote monitoring capability does not currently exist for the Perimed laser Doppler (Perimed AB, Järfalla, Sweden) when used without connection to a computer. Using an existing tablet and a free app (application), the smart device can be converted into a Wi-Fi camera, which can be placed adjacent to the laser Doppler monitor to allow instant, real-time monitoring remotely. Multiple apps are currently available which can convert a smart phone or tablet (e.g. iPad) into a remote camera, which can then be linked to the provider’s smartphone over the internet.

METHODS: We present our preliminary experience with this smart device app to a well-established modality, laser Doppler flowmetry, for monitoring free flaps. We employed the AtHome app from the app store which converted a used iPad into a camera and multiple smart phones into independent viewers. No patient identifier was transmitted with this remote monitoring set-up.

RESULTS: We monitored 9 head and neck free flaps, each for 4–6 days remotely with near 100%
reliability. We had minor mechanical issues: capturing angle of smart device getting displaced; device getting knocked off the table; and charge cord dislodging. Auto-lock needs to be turned off on the capturing smart device. On one occasion, the camera app needed restarting due to automatic software update. These glitches were each corrected by a phone call to the nurse or by the provider in person. For one flap, nursing over-sedated the patient leading to profound hypotension. The steady decline in the laser Doppler reading witnessed by the surgeon remotely allowed him the opportunity to rapidly return to the ICU to resuscitate the patient, thus avoiding anastomotic thrombosis from hypoperfusion.

CONCLUSION: Remote monitoring of the laser Doppler readings by multiple providers on the team for all 9 flaps was successful for the duration of 4–6 days. The ability to remotely look at your patient’s laser Doppler numbers (or recordings from any monitoring modality) in real-time can be provided by a simple, inexpensive, and reliable adaptation of smart device and app technology.

Reference Citations:
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Quantifying Indocyanine Green Concentration to Measure Direct Tissue Perfusion

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INTRODUCTION – Indocyanine green (ICG) dye fluorescence angiography has become a widely used prognostic tool that measures tissue perfusion. Dye-tagged blood plasma transiting through tissue is viewed as a sequence of grayscale images, wherein bright areas correlate with perfused tissue; conversely, darker areas are less perfused. At present, these images denote only relative differences in tissue perfusion. Currently, there is no way to extract quantified tissue perfusion data from the images. We propose developing a method for determining the concentration of ICG dye in circulating blood to serve as a calibration reference, thereby making possible absolute quantification of dye concentration in any area of the angiogram image sequence.

METHODS – Subjects for this study are prospectively selected from patients undergoing surgical procedures during which ICG fluorescence imaging is already planned to determine tissue perfusion using a SPY-Elite (Novadaq Technologies, Inc.). After injection of the ICG dye, a blood sample is collected at about one minute after injection of the dye. The blood sample is then analyzed using a spectrophotometer set at 805 nanometers wavelength to accurately determine the concentration of ICG dye in the sample. That measured ICG concentration is then compared to a calculated estimate that is derived by dividing the known amount of dye injected by the subject’s total blood volume, as predicted by an algorithm based on the subject’s sex, height, and weight.1

RESULTS – To date, 10 patients (8 women and 2 men) have been enrolled, and the ICG concentrations have been both spectroscopically measured and calculated to determine if there is a reasonable correlation between those values. Currently, there appears to be poor correlation using this method with a resulting trend line of y=0.24x+2.15 and R² value of 0.0813.

CONCLUSION – At this time, there is no validated method for determining ICG concentration in circulating blood short of withdrawing and analyzing a blood sample. Additional patients will be enrolled to determine if there is a correlation using our current method to convert the measured ICG concentration as detected by the fluorescence imaging software to the actual concentration of ICG in a selected tissue sample. If we are able to accurately determine the ICG concentration in the tissue, then it will be possible to quantify tissue perfusion and threshold for tissue survival.

Reference Citations:
1. Nadler SB, Hidalgo JH, Bloch T. Prediction of blood volume in normal human adults. Surgery. 1962; 51: 224 - 232.