detect non-palpable small lymph nodes (LNs) surrounded by adipose tissue under the wavelength of visible light. A newly developed near-infrared camera with InGaAs element is able to capture photographs using light at >1000-nm wavelength, at which the difference in absorbance between water and lipids is large. This study investigated the ability to detect non-visible small LNs using light at 1300-nm wavelength.

Methods: Following retrieval of LNs through axillary LN dissection obtained from 20 patients with breast cancer, residual specimens were simultaneously photographed using light at 970-nm, 1070-nm, 1200-nm, 1300-nm, 1450-nm, and 1600-nm wavelengths. A total of 45 specimens were observed pathologically at the selected portions in which the 1300-nm light was absorbed (high absorbance group, n = 25) and those in which the 970-nm light was absorbed instead (low absorbance group, n = 20).

Results: All specimens categorized in the high absorbance group detected the LNs, whereas none of those categorized in the low absorbance group detected a LN. The sensitivity and specificity in the identification of a LN were 1.0. The LNs detected using this camera were significantly smaller than those detected by surgeons (3.00±2.93 mm vs. 5.90±3.91 mm, P< 0.01). Metastasis was observed in five of the 28 LNs detected in the second examination. In two of them metastasis was observed only in the second examination.

Conclusion: The light at 1300-nm wavelength was absorbed by axillary LNs. This newly developed camera detected LNs which were undetectable by surgeons. This novel technology may be applied to lymphatic microsurgery and contribute to the development of a minimally invasive LN dissection method.

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Standardizing Upper Extremity Indocyanine Green Lymphography In A Lymphedema Outpatient Setting

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Purpose: Indocyanine green (ICG) lymphography is increasingly used for upper extremity lymphedema diagnosis in the outpatient settings. Still, it has no internationally accepted standardized protocol. The purpose of this study was to determine the injection location and combination, and the time of visualization that would produce an optimal upper extremity lymphatic imaging.

Methods: ICG lymphography was performed on healthy upper extremities. optimal ICG injection pattern was determined by injecting ICG to the sub-dermis in 6 different combinations that included up to 2 locations in the interdigital web spaces or wrist ulnar border. Optimal ICG imaging was determined by comparing lymphatic visualization at 5, 30- and 60-minutes following injection. Outcome measures included number of visualized lymphatic pathways, lymphatic vessels and lymph nodes.

Results: ICG injection to the 1st and 3rd web spaces Compared with other injection patterns was associated with higher lymphatic vessel count in the wrist (5.3±1.3 vs. 3.1±0.9, p=0.001), forearm (4.4±1.2 vs. 2.4±0.9, p<0.001), antecubital fossa (4.5±1.8 vs. 2.9±1.0, p=0.04) and the upper arm (3.1±1.4 vs. 1.9±0.7, p=0.01), and achieved better visualization of dual lymphatic pathways in the wrist (80% vs. 32%, p=0.001), forearm (76% vs. 32%, p=0.002), upper arm (64% vs. 28%, p=0.011), and the complete upper extremity (44% vs. 0%, p<0.001), and the axillary lymph node (100% vs. 68%, p=0.002). Imaging at 30 minutes compared to 5 minutes after ICG injection had significantly higher visualization of lymphatic vessel number in the wrist (4 vs. 3, p=0.028), antecubital area (4 vs. 2, p<0.001), and upper arm (3 vs. 1, p=0.001), and more frequent visualization of medial (48% vs. 84%, p=0.016) and lateral (60% vs. 92%, p=0.018) arm lymphatic pathways, and axillary lymph nodes (100% vs. 16%, p<0.001). No significant visualization differences were observed between 30 and 60 minute time points.

Conclusion: ICG lymphography provides a detailed view of the upper extremity lymphatic system, allowing a direct assessment in an outpatient settings. ICG Injection pattern of 1st and 3rd web spaces together with imaging time points at 5 and 30 minutes, provided the optimal lymphatic visualization in normal upper extremity.

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Microsurgical Induced Angiogenesis

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