

Introduction

The correlation between lymphatic function and clinical severity is still unclear. It will be much easier to evaluate the early treatment goal and subsequent outcome when the association between clinical severity and lymphatic function during lymphedema becomes clear. This clinico-functional correlation was determined after examining lymphatic function, via indocyanine green (ICG) lymphography in patients with breast cancer lymphedema, and the severity of edema and degree of fibrosis, via ultrasound, bioimpedance, and arm circumference measurements

Methods

For a total of 35 breast cancer patients who underwent a mastectomy, the subcutaneous thickness of five areas of the upper extremity were examined using ultrasound examination, compression ratio, and shear wave velocity.(Figure 1) Extracellular fluid volume measurement by multiple frequency bioelectrical impedance analysis (MFBIA) was done. The limb index ratio (LIR) was derived by comparing the impedance values between the affected and unaffected. R0 ratio (R0 U/L) by comparing the impedance values between the upper and lower extremities on the affected side was calculated. In addition, ICG lymphography was performed to evaluate the lymphatic function, and grading was conducted through a dermal backflow (DB) consisting of five stages; the first, second, third, fourth, and fifth stages were linear pattern, splash pattern, stardust pattern, diffuse pattern, and ICG not moving proximally to the injection side, respectively.(Figure 2)

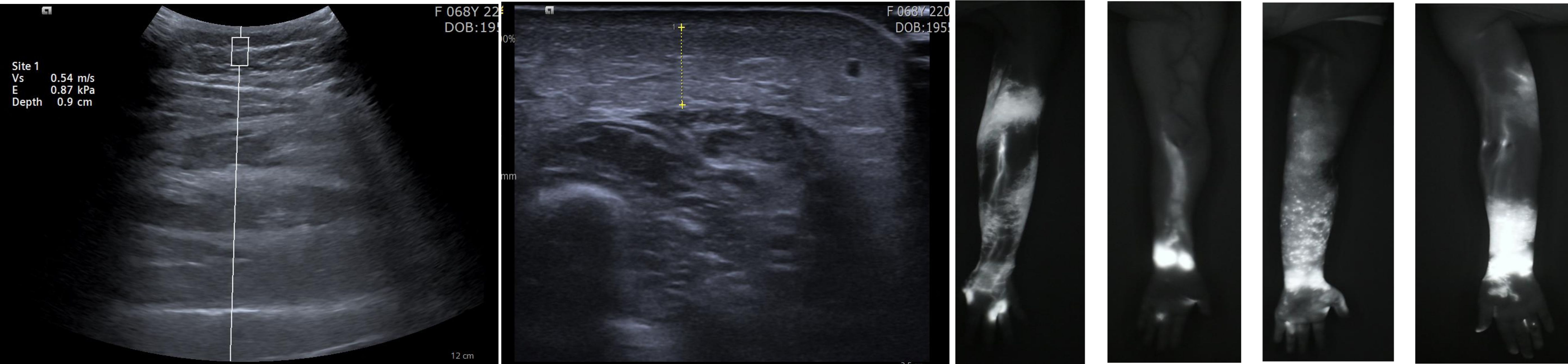


Figure 1. Shear wave velocity and subcutaneous thickness measurement using ultrasonography

Figure 2. ICG lymphography findings in each patients

Results

In our study, significant correlation of ICG DB stage with subcutaneous thickness, limb index ratio, and the extracellular fluid accumulation in the affected side in forearm and hand. R0 value showed significant correlation with ICG stage in all area. However, there was correlation between ICG DB stage and parameters related to fibrotic changes of the lesion, including regional resistance to compression (RC) and shear wave velocity . Therefore, the status of DB could predict the severity of edema but not the regional fibrotic change after lymphedema. The gap in time between regression of the lymphatic vessels and onset of fibrosis may be explained by the length of time taken for the lymphatic regression in lymphedema, followed by the chronic inflammatory response in lymphedema.

Table 1. Correlation between ICG lymphography stage and ultrasonography finding

	Subcutaneous thickness Ratio (rho)	RC affected side (rho)	RC ratio (rho)	Shear wave velocity affected (rho)	Shear wave velocity ratio (rho)
ICG stage UL	0.099	0.160	0.177	0.076	0.201
ICG stage UM	0.026	-0.17	0.120	-0.109	0.302
ICG stage LL	<u>0.468*</u>	0.026	0.071	0.102	0.100
ICG stage LM	0.186	0.129	-0.310	0.318	0.131
ICG stage Hand	<u>0.319*</u>	0.016	-0.034	-	-

Table 2. Correlation between ICG lymphography stage and BIA

	R0(U/L)	1kHz LIR	5kHz LIR
ICG stage UL	<u>0.252*</u>	-0.003	0.036
ICG stage UM	<u>0.256*</u>	-0.065	0.001
ICG stage LL	<u>0.415*</u>	0.297	0.312
ICG stage LM	<u>0.439*</u>	0.318	0.300
ICG stage Hand	<u>0.570*</u>	<u>0.405*</u>	<u>0.565*</u>

Significant difference (P<0.05)*

Conclusion

In lymphedema, lymphatic function had a significant correlation with subcutaneous edema and extracellular fluid accumulation. Approaches promoting the preservation of lymphatic function for edema reduction will be valuable indicators for identifying symptom at the affected site.

