
Category III-A. Ultrasound

Breast Cancer-related Lymphedema: A Comparative Ultrasound Study of Shear Wave Elastography and B-mode Measurements for Assessing Lymphaticovenous Anastomosis

Zohaib Lakhani, Samuel Jang, Matthew W. Urban, Vahe Fahradyan, Nho Tran, Luiz Vasconcelos, Kate Knoll, Jenny Bradt, Matthew Johnson, Christine Lee

Mayo Clinic, Minnesota, USA

Objective: Lymphedema grading relies on subjective and indirect objective measures. Ultrasound shear wave elastography (SWE) provides a quantitative, non-invasive assessment of tissue stiffness (Young's modulus, E), which may reflect disease severity and improve objectivity in staging lymphedema. This pilot study (NCT 05613946) evaluates the utility of SWE and B-mode skin and subcutaneous thickness for grading upper extremity lymphedema in patients with treated breast cancer undergoing lymphaticovenous anastomosis (LVA) surgery.

Materials and Methods: Nine patients with upper extremity lymphedema secondary to breast cancer underwent ultrasound preoperatively (baseline) and six months following LVA. Soft tissue thickness and stiffness were measured in the affected limb and contralateral unaffected limb (control).

Imaging findings were correlated with routinely collected objective metrics, including limb volume and bioimpedance spectroscopy.

Results: At baseline, the affected limb demonstrated slightly lower soft tissue stiffness than the unaffected limb (mean dermal E: 75.4 ± 10.6 kPa vs. 78.0 ± 12.8 kPa; mean subcutaneous E: 40.8 ± 17.7 KPa vs. 45.5 ± 19.5 KPa). At six-month follow-up, dermal and subcutaneous stiffness increased, on average more in the untreated limb. Post-operative changes in stiffness showed weak to moderate positive correlation with changes in arm volume (dermal E: slope (m) = 0.02, $R^2 = 0.37$, subcutaneous E: slope (m) = 0.01, $R^2 = 0.14$) and no correlation with electrical impedance.

Baseline dermal and subcutaneous thickness were similar between limbs. At six-month follow-up, dermal and subcutaneous thickness also increased in both arms.

Treated limb volume decreased (mean Δ : -276.3 ± 326.1 mL) and impedance increased (mean Δ : $+14.7 \pm 22.3$ Ohms), consistent with clinical improvement.

Conclusion: Postoperative increased in dermal stiffness and soft tissue thickness were not intuitive. Potential confounders that could explain this result include increased patient weight or variability in sonographic technique. The increasing trend for subcutaneous stiffness is noted in the literature and may be due to underlying chronic fibrosis. Additional research is warranted to clarify the role of SWE and B-mode measurements in lymphedema assessment.

Keywords: Lymphedema; B-mode measurements