THE POTENTIAL USE OF MACHINE LEARNING IN LYMPHATIC VESSEL ULTRASOUND

Moroz O.

Huazhong University of Science and Technologies, Tongji Hospital

Lymphedema remains a debilitating condition with significant impacts on patient quality of life, affecting 43–94% of post-surgical cases [1]. While clinical diagnosis based on symptom history and limb measurements is straightforward, precise identification of lymphatic vessels for targeted therapies like Lymphaticovenous Anastomosis (LVA) and Complete Decongestive Therapy (CDT) remains challenging due to the lymphatic system's complexity, equipment limitations, and operator dependency. Current techniques require specialized expertise and often struggle with small-caliber vessel (<0.3 mm) detection. Recent advances in machine learning (ML) for medical imaging, particularly in ultrasound, offer transformative potential to overcome these barriers. Building on proven successes in thyroid cancer diagnosis [2] and real-time breast lesion detection [3], we propose an ML framework to enhance lymphatic vessel identification in contrast-enhanced ultrasound (CEUS), using SonoVue® as a key contrast agent. These contrast-enhanced images provide clear visualization of lymphatic vessels (Fig. 1), capturing essential features such as vessel diameter, branching patterns, and contrast dispersion dynamics.

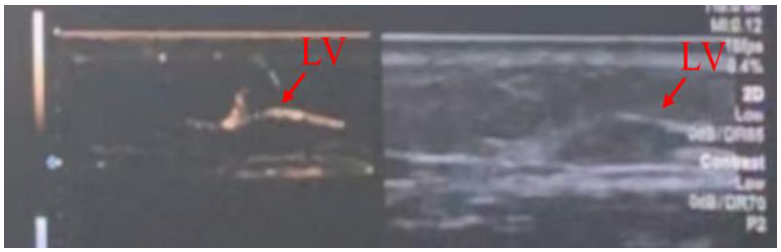

Fig.1. Detecting of lymphatic vessels (LV) with CEUS: with a contrast agent (left) and without (right)

By training neural networks on a comprehensive dataset of these annotated images, we can create an AI-assisted diagnostic tool that helps physicians overcome two major challenges: limited personal experience and inadequate equipment availability. The ML model would learn to identify characteristic patterns of lymphatic vessels, including their typical anatomical locations (e.g., subcutaneous tissue below superficial fascia), non-collapsibility under pressure, and consistent diameter - features that are often difficult for less experienced clinicians to recognize. This approach could improve diagnostic accuracy and optimize treatment planning for lymphedema patients.

References:

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