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Reliability of Ultrasound Elastography Strain Measurement: Solid Gel Pad vs Liquid Gel Medium

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Introduction

- Ultrasound elastography have started to measure the characteristics of lymphedema.
- It is measuring the stiffness of subcutaneous tissue using ultrasound.
- However, ultrasound measurement itself is a technique that can vary in accuracy depending on the proficiency of the operator, so it is important to strive for ways to minimize this variability.
- We aimed to investigate whether the properties of the medium (solid gel pad vs liquid gel) and the strength of manual compression during ultrasound elastography strain measurement are factors that affect reliability.

Methods

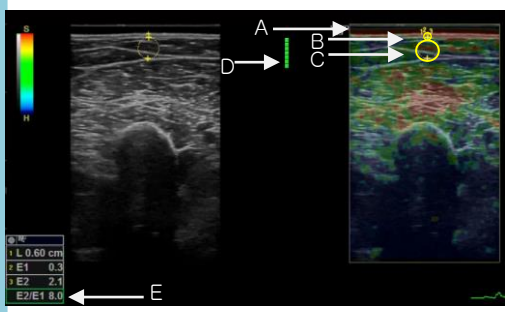
- We conducted a study on a healthy single volunteer, a 29-year-old woman.
- We used ultrasound (LOGIQ E9, GE Healthcare, US) and a 9L linear probe.
- Examiners A, B, and C performed the manual compression ultrasound elastography examination while the patient was sitting and the forearm was supinated, using dermal strain (E1) and subcutaneous strain (E2) to calculate the E2/E1 ratio on the ventral side of the subject below the elbow (7cm from elbow) and above the elbow (10cm from elbow).
- At this time, the examiners needed to adjust an appropriate pressure to satisfy the gauge indicating the proper pressure on the machine.
- At the first, examiners measured minimum force strain data using a solid gel pad, and second, measured peak force strain data using a solid gel pad.
- During the third examination, they measured minimum force strain data using a liquid gel.
- The examiners repeated each process three times.
- The use of peak force strain with a liquid gel was limited due to the characteristics of the examination, which required maintaining an appropriate gel thickness.

(A) (B)

(C) (D)

- **Figure 1**, Solid gel pad(A,B) and liquid gel(C,D)

Results



- **Figure 2,** Ultrasound elastography
  (A) : Layer of medium
  (B) : Dermal strain (E1)
  (C) : Subcutaneous strain (E2)
  (D) : Appropriate pressure
  (E) : Calculated E2/E1 ratio

- The Intraclass correlation coefficients (ICC) for E2/E1 ratio measured using **solid gel pad with minimum force strain** was 0.655 (p=0.016).
- The ICC for E2/E1 ratio measured using solid gel pad with peak force strain was <0.001 (p=0.999).
- The ICC for E2/E1 ratio measured using liquid gel with minimum force strain was <0.001 (p=0.602).
- The measurement values for each test are summarized in table 1.

- **Table 1,** Intraclass correlation coefficients of each exam.

Medium	Technique	Variables	Examiner A	Examiner B	Examiner C
Solid gel pad	**Minimum force strain**	E2/E1 ratio	6.57±2.42	5.15±2.04	3.97±1.92
		ICC		0.655	
		p-value		**0.016***	
	Peak force strain	E2/E1 ratio	8.63±2.92	6.27±2.25	5.40±1.89
		ICC		<0.001	
		p-value		0.999	
Liquid gel	Minimum force strain	E2/E1 ratio	3.15±3.49	0.85±0.34	1.69±1.00
		ICC		<0.001	
		p-value		0.602	

ICC; Intraclass correlation coefficients, **p*-value <0.05

Conclusions

- It was unreliable to test with liquid gel medium or peak force using a solid gel pad in the ultrasound elastography strain measurement test.
- To increase the reliability of the test, it is recommended to perform the test with minimal force using a solid gel pad.