# Assessment of radial strain in ultrasonographic model of left ventricle using speckle tracking ultrasound technique and multislice computed tomography.

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## Aims and objectives

The aim of this study was to verify suitability of sonographic model of LV (left ventricle) in CT (computed tomography) environment and to compare in vitro radial strain calculations obtained by two different techniques: speckle tracking ultrasonography and multislice CT.

**Images for this section:**

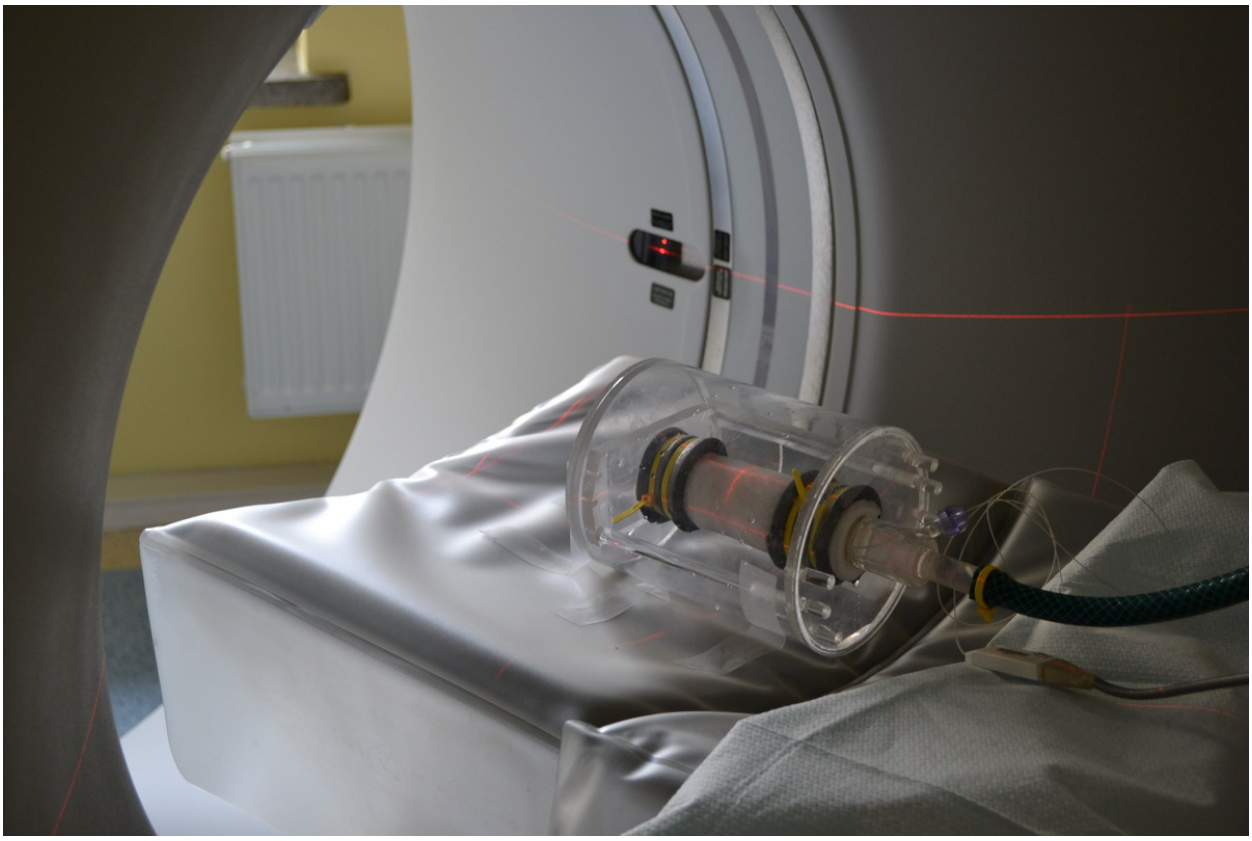


**Fig. 2:** LV phantom during CT scanning.

# Methods and materials

Model of the LV was made from solution of POLY(VINYL ALCOHOL). Pulsatile filling of the LV phantom was driven by automatic and computer controlled hydraulic piston pump (Vivitro Inc., Canada) with stroke volume of 20 ml and the frequency of 60 impactions per minute. Part of LV phantom was exposed to drying process to imitate pathologic changes in LV model wall. Acoustic properties of the phantom were similar to that of the real tissue.

The LV phantom immersed in water was examined using Artida 4D echocardiograph (Toshiba Medical Systems, Tokyo, Japan) from the sternum projection on the short axis M-mode.

For the purpose of CT scanning LV model was filled with diluted iodine contrast medium - iodixanol 320 mgI/mL (Visipaque 320, GE Healthcare). Retrospective ECG-gated multislice CT acquisition (Discovery CT750HD, GE Healthcare) was performed with 0,6 mm slice thickness. The data were reconstructed every 10% of the R-to-R interval of the ECG.

**Images for this section:**

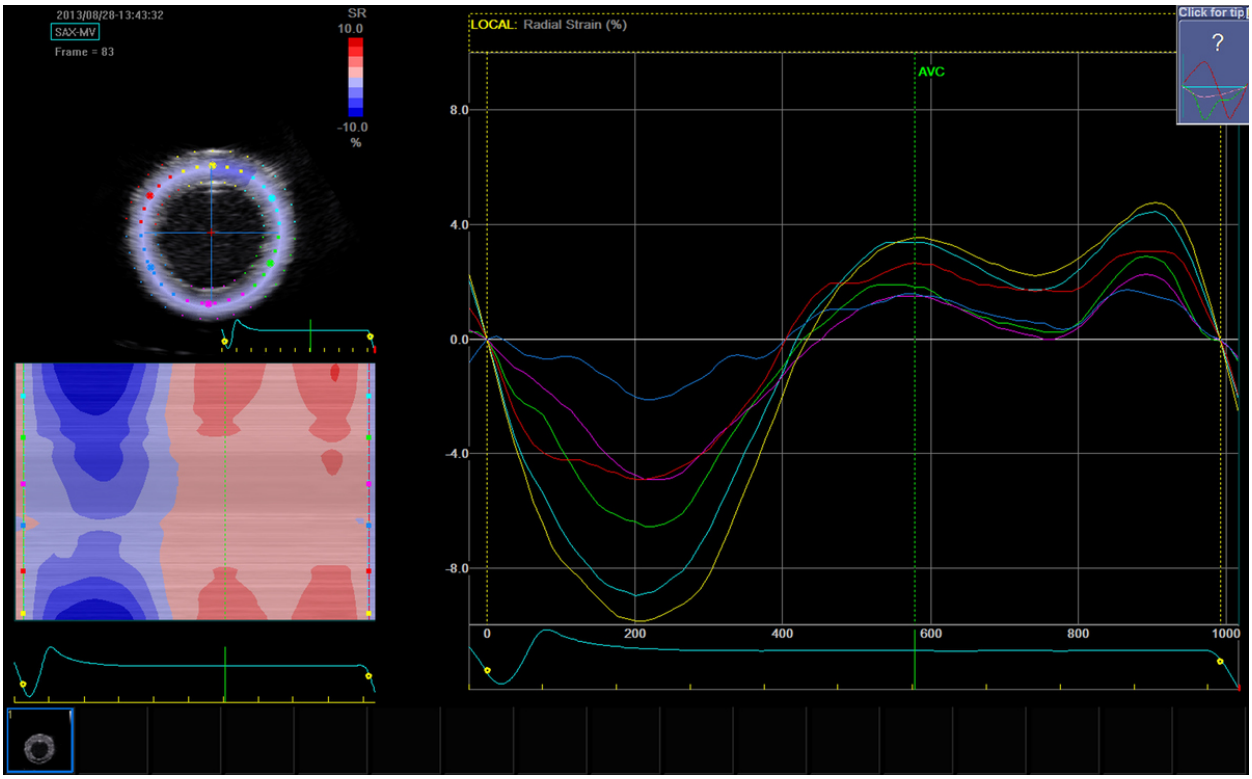
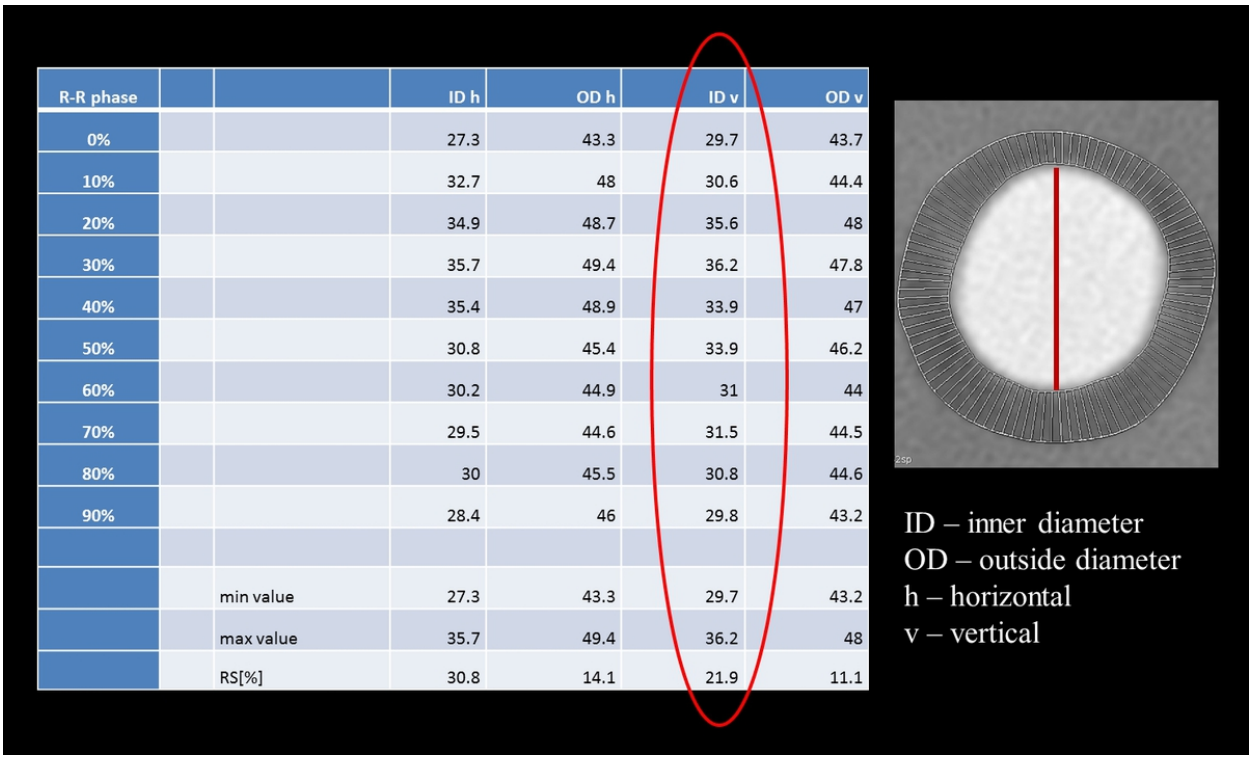


**Fig. 3:** Radial strain analysis using EchoPac PC GE software. LV model plane was automatically segmented into six segments. Radial strain in vertical axis was 22,27%.

# Results

The value of radial strain in vertical plane was 22,27% using ultrasonographic speckle tracking technique and 21,9% using multislice CT scanning. Radial strain was lower in the dried part of LV model that was mimicking pathologic changes.

**Images for this section:**



| R-R phase | | | ID h | OD h | ID v | OD v |
|---|---|---|---|---|---|---|
| 0% | | | 27.3 | 43.3 | 29.7 | 43.7 |
| 10% | | | 32.7 | 48 | 30.6 | 44.4 |
| 20% | | | 34.9 | 48.7 | 35.6 | 48 |
| 30% | | | 35.7 | 49.4 | 36.2 | 47.8 |
| 40% | | | 35.4 | 48.9 | 33.9 | 47 |
| 50% | | | 30.8 | 45.4 | 33.9 | 46.2 |
| 60% | | | 30.2 | 44.9 | 31 | 44 |
| 70% | | | 29.5 | 44.6 | 31.5 | 44.5 |
| 80% | | | 30 | 45.5 | 30.8 | 44.6 |
| 90% | | | 28.4 | 46 | 29.8 | 43.2 |
| | | | | | | |
| | | min value | 27.3 | 43.3 | 29.7 | 43.2 |
| | | max value | 35.7 | 49.4 | 36.2 | 48 |
| | | RS[%] | 30.8 | 14.1 | 21.9 | 11.1 |



**Fig. 4:** CT radial strain measurements (left) and short axis view of the LV phantom on reconstructed CT scan (right). The value of radial strain in vertical axis was 21.9%.

# Conclusion

The study indicates the usefulness of ultrasonographic LV model, Despite the fact that the density of the phantom material was approximately 20 HU lower than that of heart muscle, CT measurements were possible using manual reconstructions.

The results showed very good agreement in radial strain assessment between speckle tracking technique and multislice CT examination. High accuracy of speckle tracking measurements was confirmed.

CT has the potential to serve as reference method in conducting comparative studies using ultrasound scanners of different manufactures.

**Images for this section:**

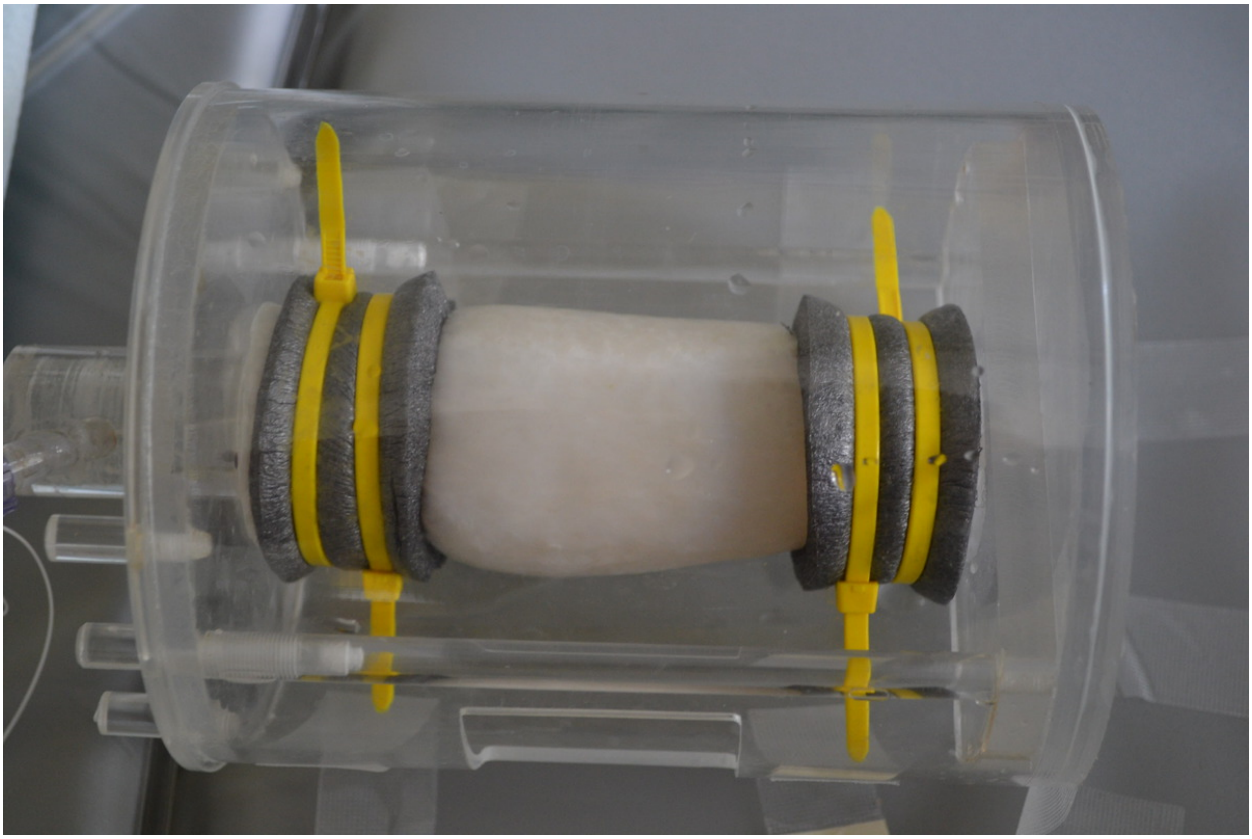


**Fig. 5:** LV model. The phantom material had similar acoustic properties and approximately 20HU lower tomographic density compared with real heart muscle.

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