Variability of LV volume and EF measurements using contrast Echocardiography: The influence of the LV length measurements in a large cohort of patients during monitoring cardiotoxic effects of chemotherapy

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Background

Good reproducibility of LV ejection Fraction measurements is essential for reliable monitoring of LV function in patients treated with cardiotoxic drugs. In clinical practice good endocardial definition is crucial but foreshortening of 4-chamber and 2-chamber views may still affect the measurements of LV volumes and ejection fraction. Foreshortening is suspected when there are major differences in the length of the long axis of the 4- and 2-chamber views. In order to assess the impact of different LV length measurements we studied the interobserver variability of LV volumes and EF measurements in a large cohort of consecutive clinical patients.

Objective

To investigate the influence of length difference in LV long axis between 4- and 2-chamber views on EF, EDV and ESV measurements.

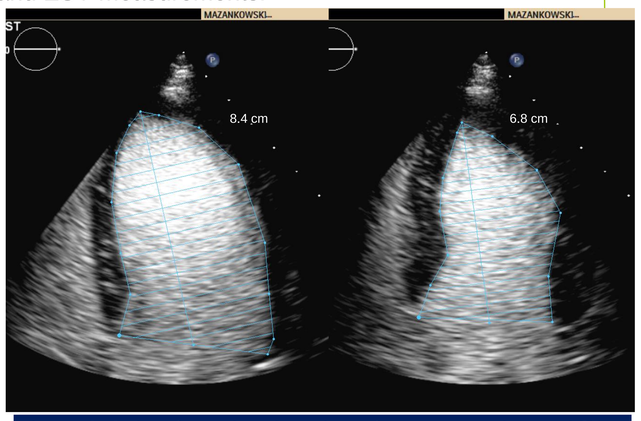

Figure 1. Apical four chamber view of contrast enhanced 2D Echocardiography in the end diastole and systole

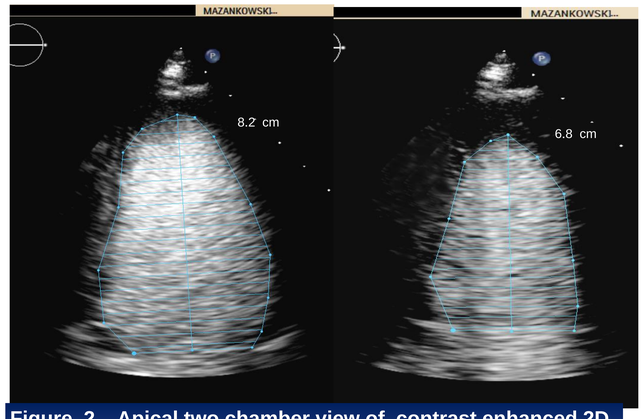

Figure 2. Apical two chamber view of contrast enhanced 2D Echocardiography in the end diastole and systole

Methods

700 consecutive patients with breast cancer underwent contrast echocardiography (CE) before and after chemotherapy. Digital echo recordings of apical views were analyzed offline by a sonographer and then by a cardiologist.

The end-diastolic and end-systolic LV volumes (EDV, ESV) and LV lengths as well as the EF were measured on the beats with best endocardial definition and visually the largest areas using biplane Simpson's method.

Inter-observer variability was assessed using relative mean error (RME) and Bland-Altman analysis. Statistical analysis was done by using ANOVA.

Results

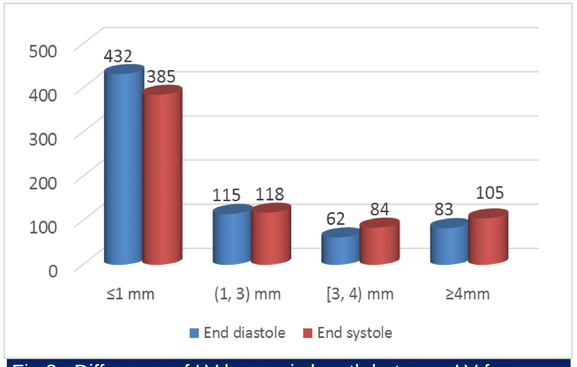

Fig 3 . Difference of LV long axis length between LV four chamber and two chamber views in 692 patients

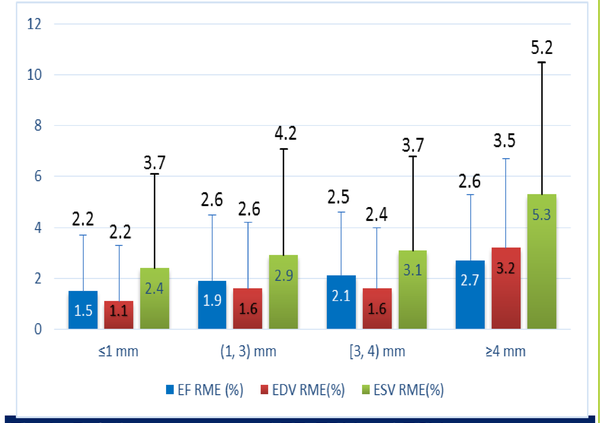

Fig 4. Relative mean error of EF, EDV and ESV measurements: The influence of length difference in LV long axis between four and two chamber views

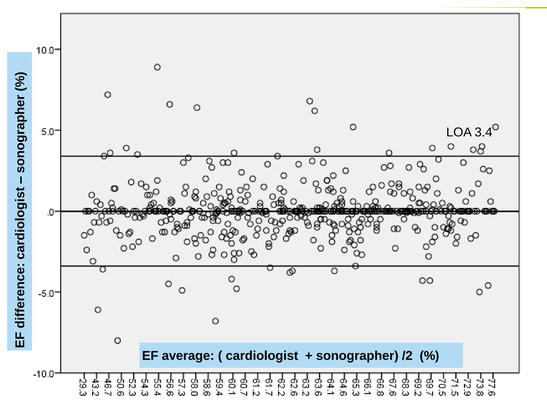

Fig 5 . Bland-Altman plot for EF measurements with ≤3 mm difference of LV long axis between four and two chamber views (n=533)

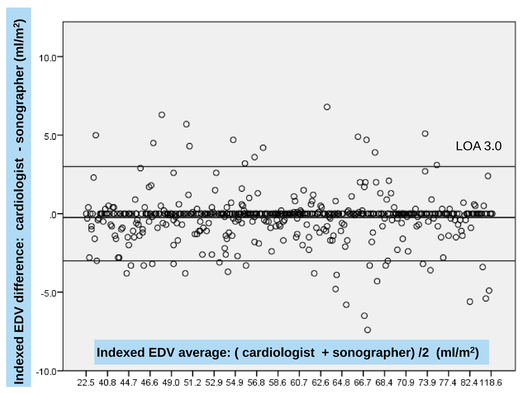

Fig 7 . Bland-Altman plot for indexed EDV measurements with ≤3 mm difference of LV long axis between four and two chamber views (n=533)

- In 692 out of 700 studies diagnostic CE recordings with complete endocardial definition in both 4- and 2-chamber views were obtained.
- The LV length difference (LD) of the long axis measured by the cardiologist was ≤ 1 mm in 284 studies, (1-3) mm in 146 studies, [3-4) mm in 103 studies and ≥4 mm in 159 studies.
- In 62.1 % of cases the end diastolic LV length was longer in the 2 chamber than in 4 chamber view.
- The limits of agreement (LOA) by Bland-Altman method and RME increase with the increasing LD). Compared to the groups with LD < 4 mm, the RMEs in the measurements of EDV, ESV and EF were significantly greater in the group with LD≥4mm (p<0.05).

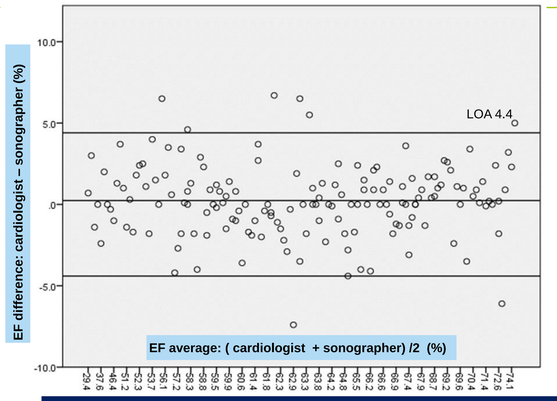

Fig 6 . Bland-Altman plot for EF measurements with >3 mm difference of LV long axis between four and two chamber views (n=159)

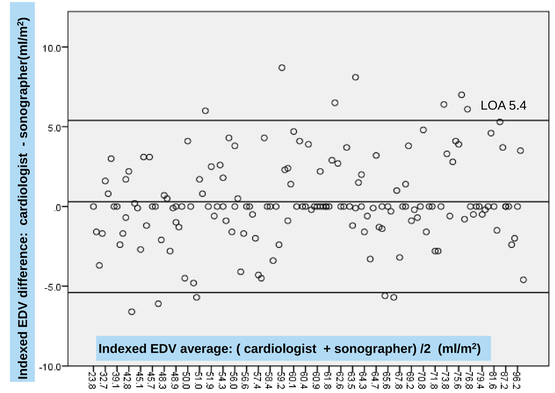

Fig 8 . Bland-Altman plot for indexed EDV measurements with >3 mm difference of LV long axis between four and two chamber views (n=159)

Conclusion

- These results highlight the need for reviewing the LV long axis length measurements in order to provide reproducible LV volume and EF measurements and may be used as benchmarks for quality control.
- A difference of ≤3 mm can be achieved in the majority of patients undergoing contrast echocardiography and is associated with an excellent inter-observer agreement.

References

1.Plana JC, Galderisi M, Barac et al. Expert consensus for multimodality imaging evaluation of adult patients during and after cancer therapy: a report from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr 2014;27:911-39.
2.Larssen MK, Silva CD, Gunyeli E et al. The potential clinical value of contrast-enhanced echocardiography beyond current recommendations. Cardiovascular Ulstrasound2016;14:2-9.