Determination of LV volume and ejection fraction with a novel 3D knowledge based reconstruction technique in comparison with contrast echocardiography measurements

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Introduction

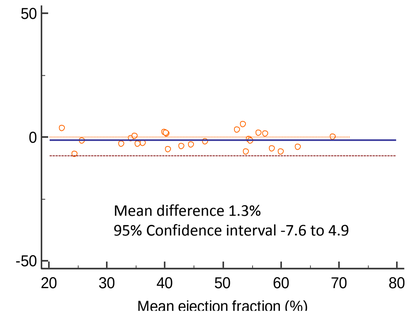
Three dimensional contrast imaging remains the gold standard of left ventricular (LV) volume and ejection fraction (EF) assessment by echocardiography. It is reproducible and has be shown to correlate well with cardiac magnetic resonance imaging data. Use of ultrasonographic enhancing agents presents a small risk of anaphylactic reaction to patients as well as necessitates prolonged image acquisition as compared to non-contrast studies adding to overall healthcare costs. Knowledge based reconstruction (KBR) software, Ventripoint system, is a new technique that allows for three dimensional assessment of LV volumes and EF without the need for an intravenous or ultrasonographic enhancing agents thereby reducing risk to the patient and echo lab spending. Our aim was to assess reliability of the Ventripoint system KBR software in assessing LV measurements in comparison to contrast echocardiography.

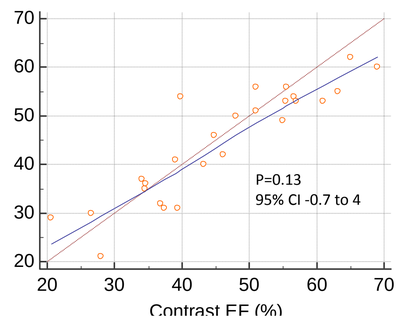
Methods

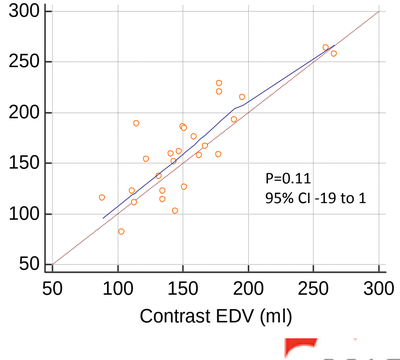
Patients (n=26) undergoing contrast enhanced transthoracic echocardiography (TTE) following admission to the Mazankowski Heart Institute were prospectively recruited. Repeat parasternal and apical TTE windows were obtained using a Philips EPIQ ultrasound machine with a standard Philips S5-1 probe. A magnetic field generator with the addition of a magnetic field localizer system attached to the ultrasound probe was used to collect data on the position and orientation of the receiver. Left ventricular endocardial/apical/mitral valve annulus and aortic annulus were identified at end systolic and end diastolic frames by two separate investigators. Spatial orientation data was then analyzed using the Ventripoint KBR software to develop a three dimensional framework of the left ventricle from which LV volumes and ejection fraction were obtained. These measurements were then compared to LV volumes and EF obtained by contrast echocardiography, which were measured by biplane method of disks, using bolus Definity contrast to optimize the endocardial definition. Correlation and mean differences between LV end-diastolic volume (LVEDV), LV end-systolic volume (LVESV) and EF measured by the Ventripoint system were compared to contrast echocardiography using Wilcoxon's test. Intraclass correlation was performed to compare inter and intraobserver measurements.

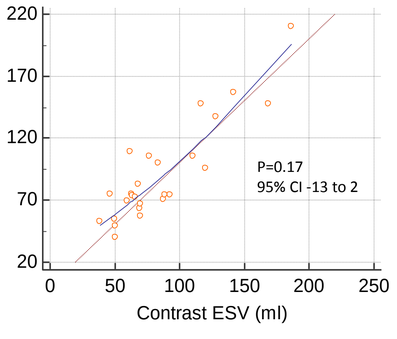
Results

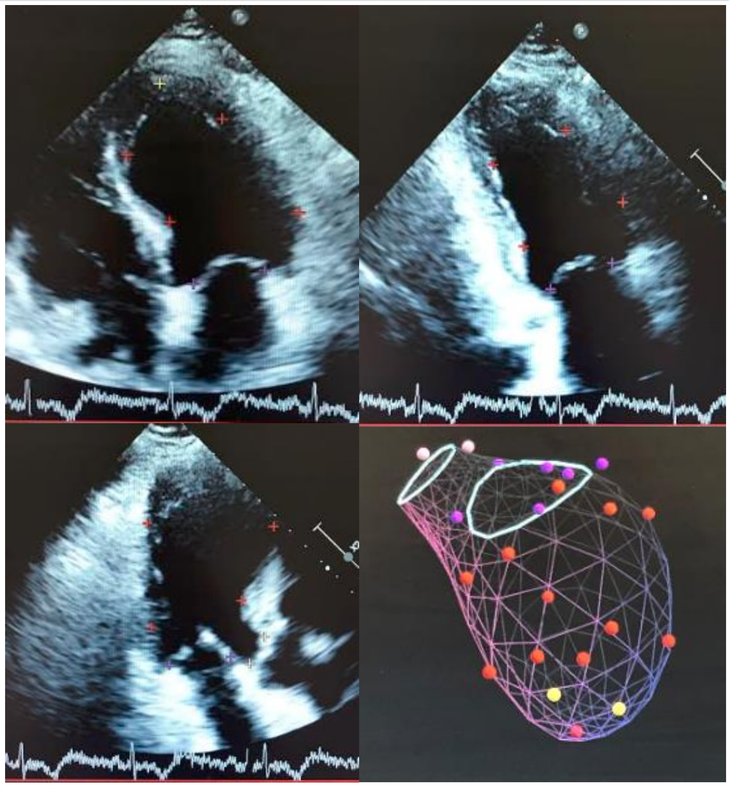
There was no significant difference in the mean LVEF between the Ventripoint assessment (46 +/- 11 %) and contrast echocardiography (46 +/ 13%). There was correlation of EF between the two methods (P=0.13, 95% CI -0.7-4). In addition no significant difference was noted in either the LVEDV (164 +/- 47 ml and 154 +/ 42 ml) or the LVESV (91 +/- 40 ml and 85 +/- 38 ml) between Ventripoint and contrast measurements. Intraclass correlation of intraobserver measurements using the Ventripoint system were 0.98 (0.96-0.99) for LVEF, 0.95 (0.89-0.98) for LVEDV and 0.98 (0.96-0.99) for LVESV, whereas interobserver measurements were 0.92 (0.83-0.96), 0.93 (0.85-0.97) and 0.94 (0.88-0.97) respectively.











Conclusion

The use of the Ventripoint knowledge based reconstruction technique revealed no significant differences in the measurement of ventricular volumes or EF in comparison to contrast echocardiography measurements.

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