2D Speckle Tracking to Assess Left Ventricular Function in a Model of Ex Vivo Heart Perfusion

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Introduction: 2D speckle tracking echocardiography (STE) is an emerging technology to evaluate left ventricular (LV) function and assesses myocardial fibers deformation [1]. Longitudinal shortening of LV fibers in apical views defines global longitudinal strain (GLS) and circumferential shortening in LV short axis views global circumferential strain (GCS). Ex Vivo Heart Perfusion (EVHP) perfuses the heart and allows functional assessment before transplant [2]. We applied STE to evaluate LV performance during EVHP.
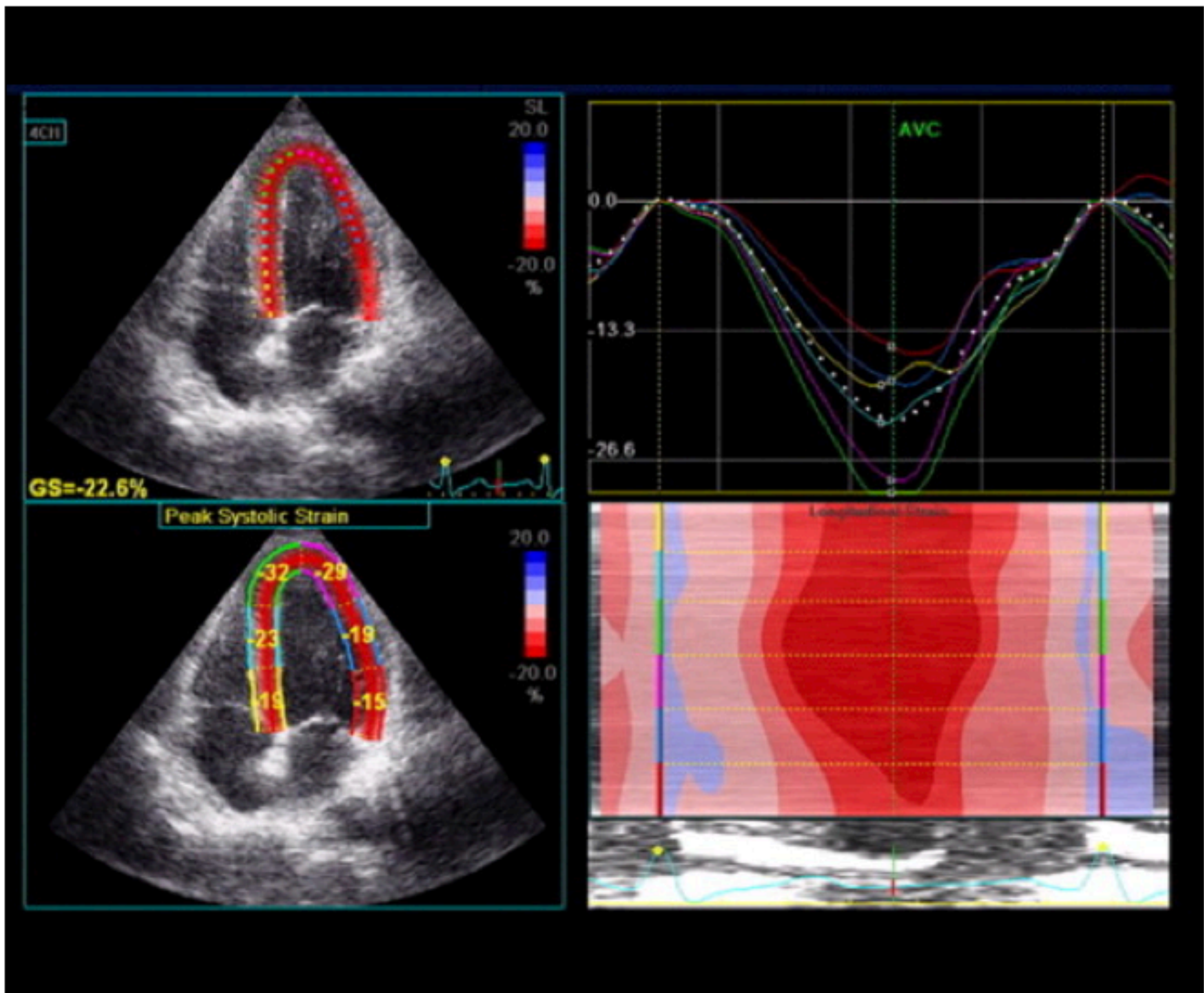

Figure 1. Global Longtudinal Strain of the left ventricle assessd through 2D speackle tracking.

Methods: After Ethics Board Approval, 9 Yorkshire pigs hearts were harvested under general anesthesia and perfused on a custom-made EVHP system. Ejection fraction (EF), left ventricular output tract velocity time integration (LVOT VTI), fraction area change (FAC), GLS and GCS were measured using epicardic echocardiography in vivo and at first and forth hour of ex-vivo perfusion with the LV loaded.

	In Vivo	1h	4h	P
EF BiPlane, %	41±8	35±5*	30±10*	0.007
LVOT VTI, cm	10±4	6±1*	5±2*	0.004
FAC, %	29±5	24±5*	17±5*	<0.001
GLS, %	-11±3	-7±1*	-6±1*	<0.001
GCS, %	-14±3	-12±3*	-7±2*	<0.001

Table 1. Echocardiographic LV parameters during EVHP. One Way RM Anova, P<0.05 as significant *vs In Vivo.

Results: After an initial decrease in LV function compared to in vivo, all the echocardiographic parameters studied remained stable throughout the EVHP (Table 1). GLS correlated significantly with EF by the gold standard biplane methods of the disks (r=0.694 p<0.001 Figure 2 B) and with LVOT VTI (r=0.929 p<0.001 Figure 2 A). The best correlation for GCS was with FAC (r=0.938 p<0.001).
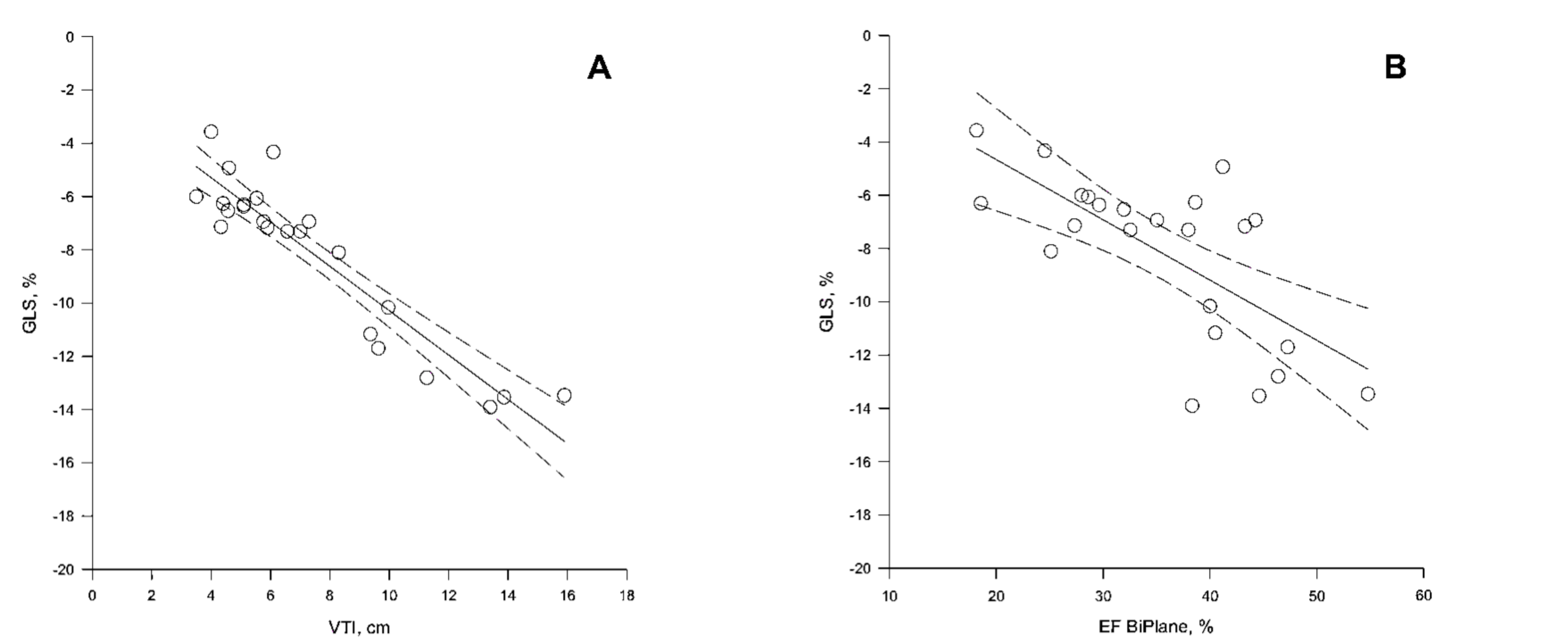

Figure 2. Panel A: Linear regression between GLS and LVOT VTI (r=0.929, r2=0.863, p<0.001). Panel B: Linear regression between GLS and EF (r=0.694, r2=0.482, p<0.001)

Conclusion: LV assessment using traditional echo parameters was feasible in all subjects with comparable trends. GLS had a high level of agreement with VTI and EF. Lack of a more pronounced decrease in GLS during EVHP may be representative of a preserved LV function overtime up to four hours. Correlation with outcome data is necessary to confirm this finding.

1 Voigit JU, European Heart Journal – Cardiovascular Imaging 2015;16:1–11
2 Colah S, Perfusion 2012;27:408-413