Early myocardial strain changes during potentially cardiotoxic chemotherapy may occur due to reductions in LV end diastolic volume in addition to systolic dysfunction: The need to interpret LV strain with volumes

Jennifer H Jordan, PhD, MS,* Giselle C Meléndez, MD,* Ralph B D'Agostino, Jr, PhD,† and W. Gregory Hundley, MD*

From the Departments of Internal Medicine, Section on Cardiovascular Medicine* and Biostatistical Sciences† within the Wake Forest School of Medicine, Winston-Salem, North Carolina

Introduction

Cancer related survival can depend on the amount of chemotherapy received which may be withheld if left ventricular ejection fraction (LVEF) or strain declines during cancer treatment. Importantly however, LVEF and strain may decline with LV end diastolic volume (EDV) declines due to poor PO intake without LV systolic dysfunction. We sought to determine the frequency by which LVEF declined after chemotherapy, its association with changes in Eulerian circumferential strain (ECC), and whether changes in strain were due to a decrease in EDV as opposed to an increase in LV end systolic volume (ESV), reflective of LV systolic dysfunction.

Methods

Using cardiovascular magnetic resonance imaging, we assessed 80 cancer patients before and 3-months after receipt of potentially cardiotoxic chemotherapy. Cine white blood steady state free precession LV short axis (SAX) stacks and mid-SAX tagged imaging were performed for determination of EDV, ESV, and ECC. A priori groups were set as LVEF decline of any amount and changes in EDV (decline of ≥10 ml) and ESV (increase of ≥5 ml).

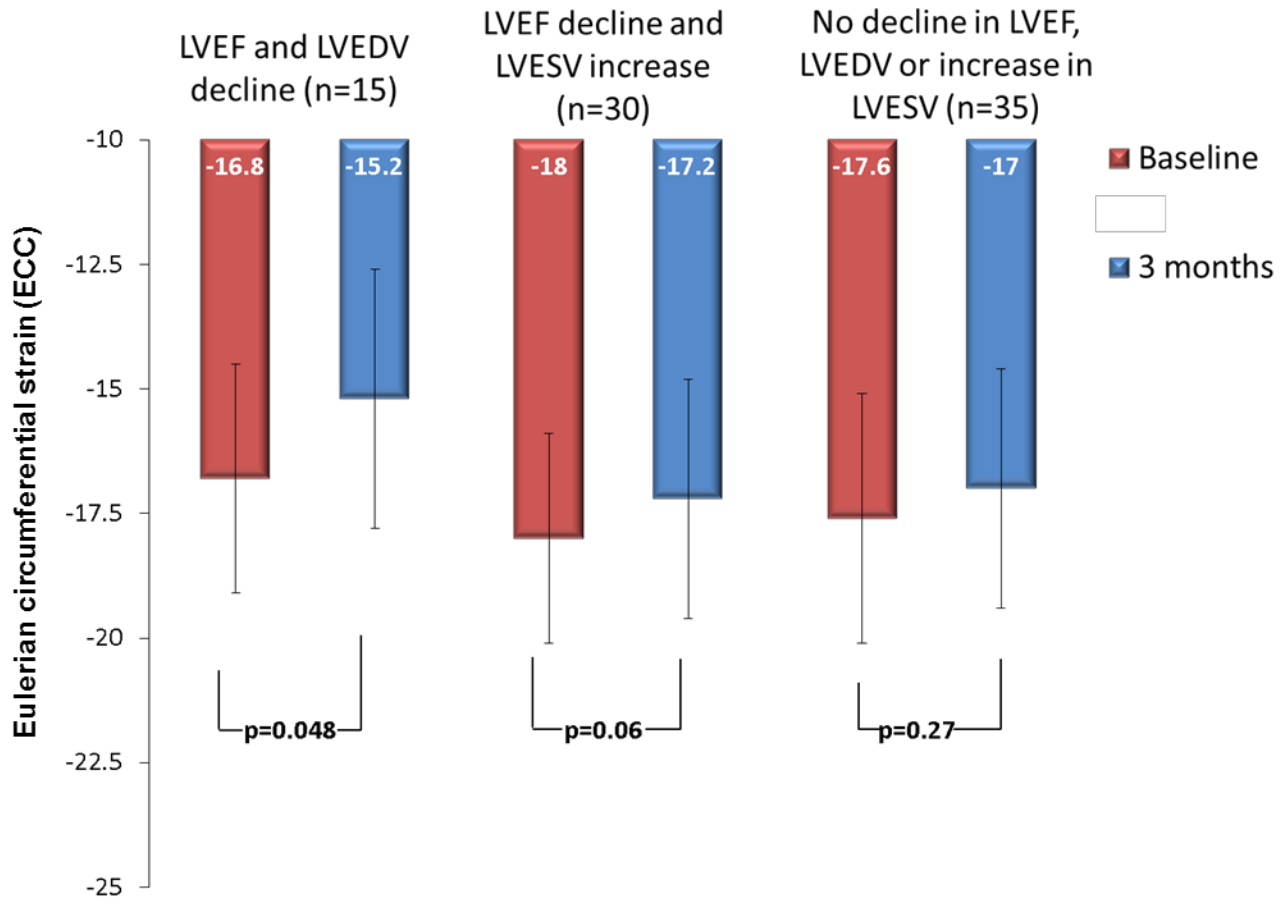
Results

Participants (50±15 years, 71% women) received chemotherapy (73% anthracycline-based) for treatment of breast cancer (49%), hematologic malignancy (45%), or other soft tissue sarcoma (6%). Forty-five participants had a decline in LVEF (56%) of which, 15 were due to a drop in EDV and 30 were due to an increase in ESV. In each condition, there were significant or strong trends toward associations between declines in LV strain due to either EDV decline- or ESV increase-mediated changes in LVEF (Figure).

Conclusions

These data indicate that LV strain behaved similar to LVEF whether a result of EDV declines (similar to strain changes related to dialysis or blood donations) or increases in ESV related to LV systolic dysfunction. To avoid potentially interrupting chemotherapy for intravascular volume depletion, these data would suggest that LV volumes should be measured concomitantly with strain assessments when seeking to optimize therapeutics during potentially cardiotoxic chemotherapy.

Figure:


LVEF and LVEDV decline (n=15)
LVEF decline and LVESV increase (n=30)
No decline in LVEF, LVEDV or increase in LVESV (n=35)
Eulerian circumferential strain (ECC)
-10
-12.5
-15
-17.5
-20
-22.5
-25
-16.8
-15.2
-18
-17.2
-17.6
-17
p=0.048
p=0.06
p=0.27
Baseline
3 months