Impaired left atrial dynamics and its improvement by guided physical activity reveal left atrial strain as a novel early indicator of reversible cardiac dysfunction in rheumatoid arthritis

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Rheumatoid arthritis (RA), is associated with an elevated cardiovascular risk1 and increased arterial stiffness.2 Importantly, RA is also associated with clinical heart failure independently of ischaemic heart disease,3 supporting the notion of direct inflammatory effects on cardiac function. In the prospective PARA (Physical Activity in RA) 2010 trial, we recently demonstrated that guided physical activity in patients with RA without known cardiovascular disease enhanced the ventricular–arterial coupling.4

The aim of the present study was to establish left atrial (LA) and left ventricular (LV) dynamics in RA, their relation to arterial stiffness and the prospective effects of guided physical activity with the hypothesis that subclinical cardiovascular changes in chronic systemic inflammation may forestall the development of heart failure and potentially be reversible by physical activity.

Twenty-nine subjects with RA and free of cardiovascular disease were enrolled,4 of which seven subjects were excluded due to either inadequate image quality or incomplete datasets. The study protocol was approved by the regional ethics committee (2012/769-32) and all subjects provided informed consent. All participants followed a two-year supported programme with circuit training twice weekly and 30 min daily of moderate-intensity physical activity.4 Adherence was defined as total number of exercise occasions monitored by short text messages. LV global longitudinal strain (LV-GS) and LA global strain (LA-GS) were obtained by 2D speckle tracking echocardiography in the apical long axis and expressed as the mean of the peak systolic strain across all segments. Pulse wave velocity (PWV) and augmentation index (Aix) were measured by Arteriograph (TensioMed). All examinations performed at baseline and during follow-up are described in detail in our previous report.4 Statistically significant differences were determined by either analysis of variance on ranks or Friedman test followed up by Wilcoxon signed-rank post hoc test.

A majority (18 of the 22 subjects) demonstrated normal LV strain, defined as >18% as per current guidelines. In contrast, we discovered that LA strain was markedly reduced, with 16 of 22 subjects (72%) demonstrating an LA-GS <38%, which is the lower limit of the normal reference.5 This observation suggests decreased LA strain may preceed decreased LV performance, and help to identify RA patients at risk for future cardiac dysfunction. Recent studies suggest that reduced LA deformation in the absence of overt cardiac disease6,7 may support the early identification of cardiovascular risk.8

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In addition to being the first study to detect an impaired LA deformation in the setting of RA, the present study also established a significant inverse correlation between LA strain and measures of arterial stiffness; Aix ($r = -0.39, p = 0.01$) and PWV ($r = -0.31, p = 0.04$). This raises the notion that the inherent inflammatory nature of RA may be linked to an increased fibrosis of both the vascular and atrial wall, resulting in concomitant increased arterial stiffness and reduced LA deformation.

We recently demonstrated improved physical capacity during the two-year physical activity programme in this cohort, in keeping with a ventricular arterial mechanistic optimisation. Exercise training has earlier been reported to impact cardiac deformation. Here we report that LA-GS, but not LV-GS, was significantly improved at year 1 and year 2 (Figure 1) in the present study. Physical activity adherence was an independent predictor of enhanced LA-GS in a multivariable analysis adjusting for age, sex, mean arterial blood pressure, heart rate and weight, revealing that a more frequent physical activity adherence was significantly associated with improvement in LA-GS at year 2 ($p = 0.032$).

While the prospective design and the strict monitoring of participant adherence to the physical activity programme are major strengths of the current study, the fairly low number of participants should be acknowledged as a limitation and the findings need confirmation in larger cohorts.

Heart failure is believed to be driven by comorbidity-related chronic inflammation and a major goal is to intervene early. Since RA can lead to heart failure in the long term, early detection and intervention is crucial in this patient population. In conclusion, our findings suggest that reduced LA strain may be a novel and early sign of potential future heart failure.

Importantly, early intervention with guided exercise can prevent and even reverse these early changes and thereby potentially prevent the development of heart failure.

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