CARDIAC PUMP PHYSIOLOGY IN THE REMODELED HEART

BACKGROUND
Cardiac remodeling is induced by pressure and volume overload, resulting in morphological and functional adaptations of the heart. Depending on setting, remodeling can be either pathological due to cardiac disease, or physiological resulting from regular exercise. Besides known volumetric adaptations, cardiac pumping physiology and the limiting factors of exercise are not fully elucidated.

AIM
The aim of this thesis is to increase the understanding of cardiac pumping physiology in disease and health.

METHODS
I. 70 patients with heart failure indicated for cardiac resynchronization therapy (CRT) and 20 controls. Cardiac MR (CMR) at baseline and echocardiography at 6 months follow-up. Regional contributions to stroke volume were analyzed as predictor of response to CRT.

II. 13 athletes and 10 sedentary controls. Non-invasive pressure-volume loops using CMR were analyzed to determine contractility, ventricular efficiency, and ventricular-arterial coupling at rest and during exercise.

III. 20 athletes and 13 sedentary controls. CMR at rest and during exercise, maximal cardiopulmonary exercise test. Left and right ventricular and atrial volumes, and longitudinal function will be analyzed to investigate the pump physiological interplay between the atria and ventricles during exercise.

IV. 200 subjects (athletes, patients with left ventricular pathology, and healthy controls). CMR at rest. Atrial and ventricular strain, and atroventricular plane displacement will be analyzed to investigate the association between atrial and ventricular function in different cardiac disorders.

PRELIMINARY RESULTS
I. Patients indicated for CRT had impaired longitudinal function, septal contribution to stroke volume, and increased lateral contribution compared to controls. However, regional contributions to stroke volume did not predict CRT outcome.

II. Athletes had larger left ventricular mass, stroke volume, and end-diastolic volume compared to controls. Contractility and ventricular efficiency increased, and ventricular-arterial coupling decreased from rest to exercise in both groups. Athletes and controls did not differ in response in hemodynamics during exercise.

SIGNIFICANCE
Pathological ventricular remodeling may progress into heart failure, while physiological remodeling is a benign sign of physical fitness and health. By increasing the knowledge of cardiac pumping in heart failure and athletes, we will improve distinguishing between pathological and physiological adaptations.
I. Regional contributions to left ventricular stroke volume determined by cardiac magnetic resonance imaging in cardiac resynchronization therapy. Östenson B, Ostenfeld E, Werther-Evaldsson A, Roijer A, Bakos Z, Kanski M, Heiberg E, Arheden H, Borgquist R, Carlsson M. BMC Cardiovascular Disorders 2021 (In press).

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II. Endurance athletes and sedentary controls increase in exercise-induced cardiac contractility and ventricular efficiency; assessed by non-invasive pressure-volume loops. Östenson B, Edlund J, Heiberg E, Ostenfeld E, Arheden H, Steding-Ehrenborg K.

EXTENDED ABSTRACTS

III. Left and right ventricular physiology assessed by cardiac magnetic resonance imaging at moderate and vigorous intensity supine exercise in elite athletes compared to matched controls. Östenson B, Ostenfeld E, Arheden H, Steding-Ehrenborg K.

IV. Association between atrial-ventricular coupling and ventricular function in athletes and patients with ventricular dysfunction. Östenson B, Steding-Ehrenborg K, Arheden H, Ostenfeld E.