UMEÅ UNIVERSITET

Umeå University Medical Dissertations New Series

Heart Strain During Different Loading Conditions

in Health and Cardiac Illness

Peter Gottfridsson

Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av medicine doktorsexamen framläggs till offentligt försvar i 1D T9 Hörsal B, NUS, fredag den 24 april 2026 kl. 13:00.
Länk för att delta via Zoom: https://umu.zoom.us/j/61924578475?pwd=S3YDclaAopusFtD30DucUthtIiYjFY.1, lösenord: 181590.

Avhandlingen kommer att försvaras på svenska.

Fakultetsopponent:
Docent Jonatan Oras, Institutionen för kliniska vetenskaper, Göteborgs universitet

Department of Diagnostics and Intervention

Organisation
Umeå universitet
Department of Diagnostics and Intervention

Dokumenttyp
Doktorsavhandling

Publiceringsdatum
2 april 2026

Författare
Peter Gottfridsson

Titel
Heart Strain During Different Loading Conditions: in Health and Cardiac Illness

Sammanfattning

Circulatory dysfunction and shock in critical illness has a high mortality. Hypovolemia can contribute to inadequate cardiac output in critical illness. One clinical challenge is that hypovolemia can be difficult to identify. Many hypotensive critically ill patients are hypovolemic, thus need fluid resuscitation, though not all hypotensive patients are hypovolemic. Fluid management is thought to influence patient outcome in critical illness. There is a very common clinical diagnostic dilemma: does the critically ill patient in question need additional fluid administration or have enough or too much already been given. Cardiac 2-dimensional strain offers new parameters for assessment of chamber mechanical function and possibly of left ventricular filling. These novel measurements could be used in the assessment of hypovolemia and cardiac function.

Objectives
The aim of this thesis is assessment of load dependence of left heart chamber wall strain and the interrelation between left atrial and left ventricular strain, with a particular focus on left atrial contraction strain, in healthy individuals and in patients with cardiac illness (cardiac amyloidosis).

Methods
Papers 1 and 2 were conducted in a cohort of healthy volunteers to evaluate the effects of varying loading conditions and sympathetic activation on left atrial contraction strain. Changes in preload were induced through controlled alterations of airway pressure using a CPAP manoeuvre to decrease preload, a passive leg raise to increase preload, and by a Valsalva manoeuvre to decrease preload with a simultaneous increase in sympathetic tone. Paper 3 comprised a retrospective analysis of a study-cohort with cardiac amyloidosis, in which a passive leg raise was used to assess load-dependent changes with a particular focus on left atrial contraction strain. Paper 4 examined the relationship between left atrial and ventricular strain in relation to preload. Atrial and ventricular strain were measured within the same cardiac cycle, and linear regression analysis was used to assess a left atrial/left ventricular strain curve, describing their interdependence under varying loading conditions.

Results
Across the four papers included in this thesis, acute alterations in preload did not result in measurable changes in left atrial contraction strain. This finding was consistent across different preload-modifying interventions, including passive leg raise, CPAP, the Valsalva manoeuvre; and this was observed in both healthy individuals and patients with cardiac amyloidosis. Furthermore, the relationship between left atrial and left ventricular strain during the atrial contraction phase was not affected by changes in preload.

Conclusion
In this thesis, left atrial contraction strain demonstrated stability in response to acute preload alterations in both healthy individuals of different ages and patients with cardiac amyloidosis. These findings support the concept that left atrial contraction strain is largely preload independent within clinically relevant loading ranges and therefore may serve as a robust marker of intrinsic left atrial contractile function.

Nyckelord: Left atrium, Contractile function, Preload, Echocardiography, Speckle tracking, Amyloidosis

Språk
Svenska

ISBN
978-91-8070-982-8 (print)
978-91-8070-983-5 (pdf)

ISSN
0346-6612

Antal sidor
47 + 4 papers