

Using anatomical intelligence to assess LV function

Philips EPIQ ultrasound system

Analysis and case studies provided by Professor Alex Lee,
Division of Cardiology, The Chinese University of Hong Kong

EPIQ is the most intelligent Philips premium ultrasound ever, offering a complete set of easy-to-use quantitative tools to turn reproducible data into information to help guide treatment. Leading-edge Anatomical Intelligence Ultrasound (AIUS) is the heart of EPIQ and is designed to elevate the ultrasound system from a passive to an actively adaptive device. Speckle strain echocardiography is a novel technique designed to allow clinicians to quickly and easily assess myocardial deformation (strain) in day-to-day practice, going beyond ejection fraction in the assessment of left ventricular (LV) function. The ZeroClick technology of the Automated Cardiac Motion Quantification^{AI} (aCMQ^{AI}) tool drives automation to provide reproducible 2D Global Longitudinal Strain (GLS) speckle measurements.

Challenge

In today's cardiology practice, assessment of LV function is no longer limited to evaluation of ejection fraction. Speckle strain echocardiography is a novel technique for use in imaging myocardial deformation (strain). Strain imaging has proven to provide important incremental information in various clinical settings. Areas that hold great promise include the detection of subclinical heart disease (when other systolic functional parameters are normal), the evaluation of myocardial ischemia and viability, and serial assessment of different cardiomyopathies.

For cardiologists to incorporate strain results into their clinical decision-making, it is vital that they can have confidence that various echocardiographic systems generate the same values for a given patient. They also want to be sure that results are not operator-dependent, but rather reproducible by different operators and at different times. In addition, for strain analysis to be practical, it cannot be too time-consuming. Currently, the most important practical limitations of routine clinical incorporation of strain imaging include its impact on workflow efficiency, observer variability, and inter-vendor inconsistency, driven by the fact that different manufacturers may use different tracking algorithms.

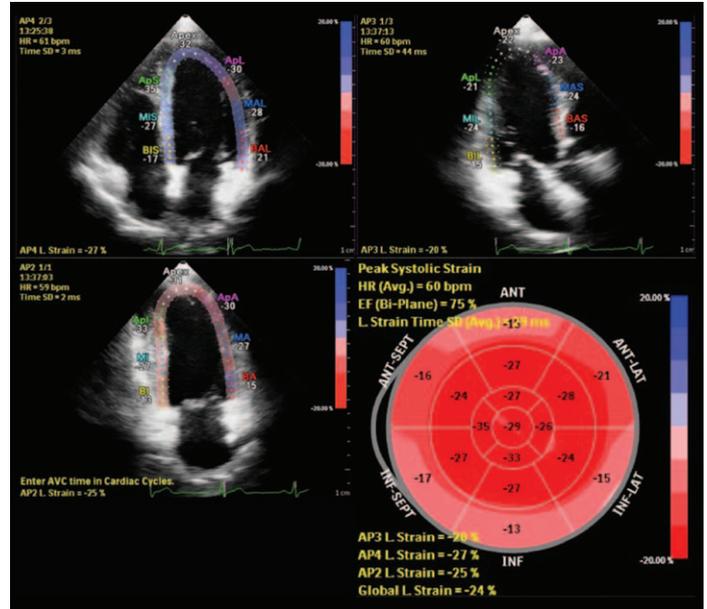
The Philips logo, consisting of the word "PHILIPS" in a bold, blue, sans-serif font.

Solution

As with many other technologies, automation is the key to achieving workflow efficiency and measurement reproducibility of strain echocardiography in a busy clinical practice. Conventional ways to initiate GLS measurement require manual tracing of the endocardial border or at least manual location of anatomic landmarks such as the mitral annulus and LV apex. This inevitably slows workflow and introduces human error and observer variability, hence limiting practical use of strain imaging. With the aCMQ^{AI} tool of Philips EPIQ, GLS can be obtained with ZeroClick technology within a few seconds after acquisition of 2D images from the three routine apical views (4-chamber, 2-chamber, and long-axis).

Impact

Enhancement of workflow efficiency, improvement in reproducibility, and resolution of inter-vendor algorithm discrepancy as a result of full automation are expected to help promote widespread adoption of this novel technique in daily practice.



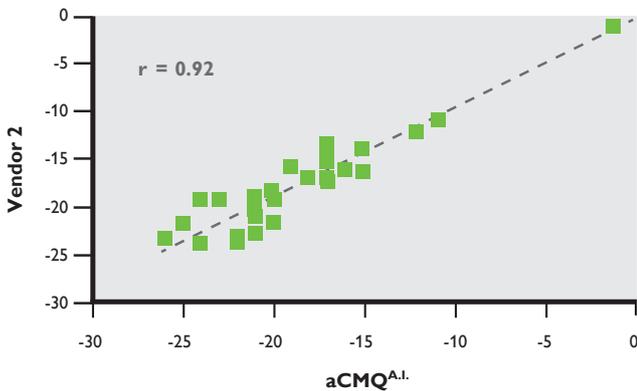
aCMQ^{AI} automatically generates GLS measurements from these 2D images obtained from apical 4-, 3-, and 2-chamber views of a normal heart, with no manual marking of anatomic landmarks required to initiate analysis.

Data comparison

We studied the inter-vendor agreement of GLS measurement in 35 patients. Patients had transthoracic echocardiography performed on EPIQ and on an ultrasound system of a different vendor within the same day, and the images were analyzed for GLS using aCMQ^{AI}.

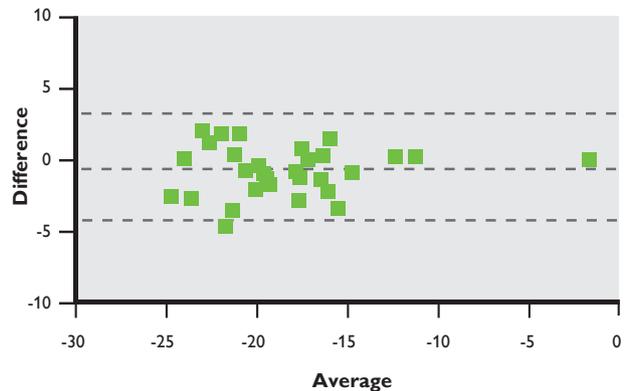
and the strain analysis software of the other vendor. We observed excellent inter-vendor agreement (bias = -0.47%, 95% limits of agreement = -4.06% to 3.12%, coefficient of variation = 2.5%; $r = 0.92$, $P < 0.0001$).

Correlation



Bland-Altman plot:

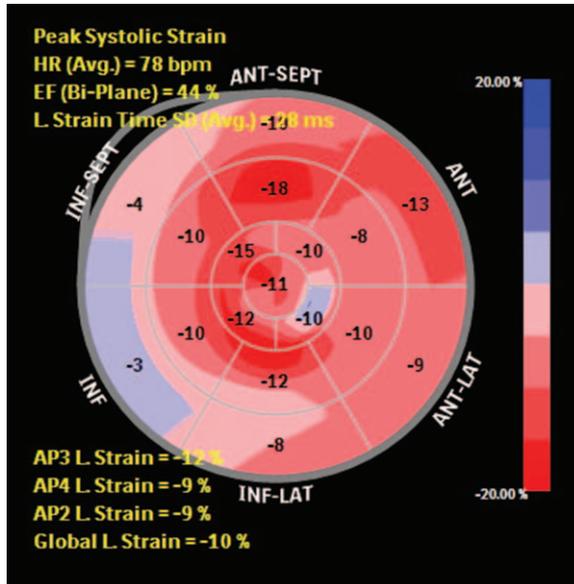
Inter-vendor agreement for GLS measurement



Case study one
Inferior myocardial
infarction

A 59-year-old male was admitted to the coronary care unit for acute chest pain occurring over the preceding 14 hours. ECG showed ST segment elevation over the inferior leads. Echocardiography showed severe hypokinesia over the inferior and inferoseptal segments from basal to mid levels, without obvious regional wall motion abnormality in the rest of the LV segments. Strain analysis with aCMQ^{AI} showed not only markedly reduced longitudinal strains in the inferior, inferoseptal, and inferolateral segments, but also mildly impaired longitudinal strains in the anterior, anteroseptal, and anterolateral segments and the apical cap. Coronary

angiogram revealed sequential severely stenotic culprit obstructions (70-90%) in the dominant right coronary artery (RCA) and multiple significant stenoses (50-70%) in the proximal and distal left anterior descending artery (LAD), with a non-dominant normal circumflex. This case illustrates how strain echocardiography can help identify infarction (indicated by positive strain, i.e., paradoxical systolic lengthening, in the basal inferior segment), peri-infarct schema in the RCA territory, and remote ischemia in the LAD territory. Percutaneous coronary intervention (PCI) was performed to the RCA and staged PCI was performed to the LAD.

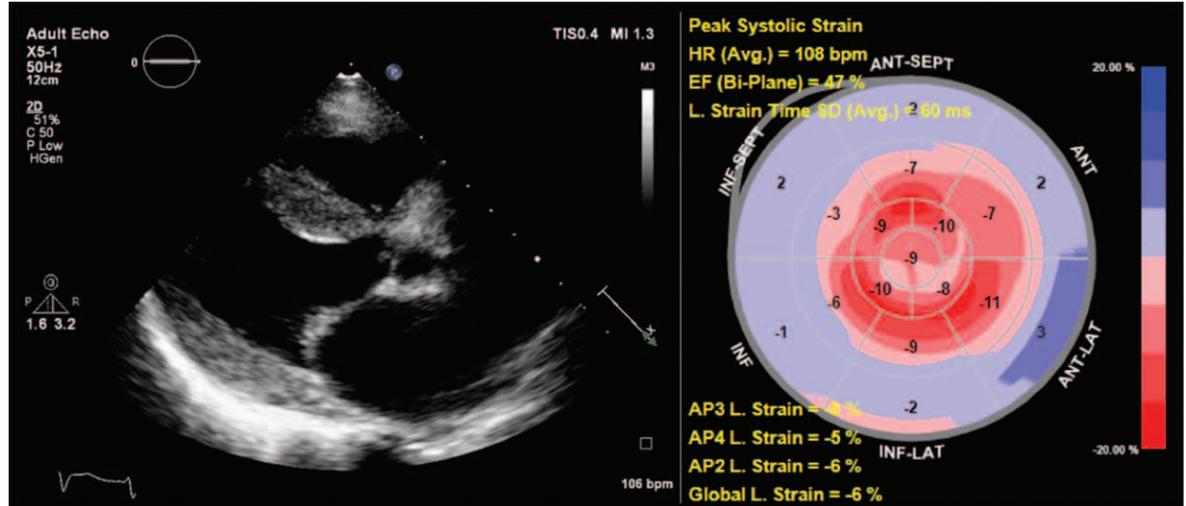


Case study one illustrates how strain echocardiography can help identify infarction (coded blue), peri-infarct schema in the RCA territory, and remote ischemia in the LAD territory (salmon pink).

Case study two Amyloidosis

A 60-year-old female with history of well-controlled hypertension presented with recurrent episodes of syncope. Holter study revealed episodes of non-sustained ventricular tachycardia. ECG showed low QRS voltage and poor R wave progression in the precordial leads. Echocardiography showed concentric increase in LV wall thickness, ejection fraction = 47%, dilated left atrium, restrictive filling of mitral inflow, and thickened mitral and aortic valves. Bone marrow biopsy showed plasma cell dysplasia and rectal biopsy

revealed amyloid infiltration with positive Congo red stain, confirming the diagnosis of AL amyloidosis. Echocardiographic strain analysis showed markedly reduced GLS (-6%) despite only mildly impaired ejection fraction. This case illustrates that GLS is more sensitive than ejection fraction to reveal LV systolic dysfunction and a relative “apical sparing” pattern of GLS is an easily recognizable, accurate, and reproducible method of differentiating cardiac amyloidosis from other causes of LV hypertrophy.



Case study two shows GLS to be more sensitive than ejection fraction in revealing LV systolic dysfunction and that the relative “apical sparing” pattern of GLS is easily recognizable.

Conclusions

Strain imaging holds great promise in providing incremental information on cardiac function in many clinical settings. With the advent of AIUS through a computerized automation technique to enhance efficiency and reproducibility, as well as validation of inter-manufacturer agreement in strain measurement algorithms, it is foreseeable that strain echocardiography can become a standard echocardiographic technique to evaluate cardiac function in today’s cardiology practices.

Please visit www.philips.com/epiq



© 2014 Koninklijke Philips N.V.
All rights are reserved.

Philips Healthcare reserves the right to make changes in specifications and/or to discontinue any product at any time without notice or obligation and will not be liable for any consequences resulting from the use of this publication.

Philips Healthcare is part of Royal Philips

www.philips.com/healthcare
healthcare@philips.com

Printed in The Netherlands
4522 991 00941 * FEB 2014