Early ischemia identified by the wasted energy using speckle tracking analysis

Julien Nahum, Laurens Mitchell-Heggs, Pierre Francois Lesault, Gauthier Mouillet, Alexandre Bensaid, Caroline Dussault, Laurent Macron, Pascal Gueret, Pascal Lim
Hospital Mondor, Cardiologie, Creteil, France

**Purpose**: Post systolic shortening (PSS) and stretching motion occur early during ischemia. Delayed contraction in PSS and stretching motion does not fully contribute to left ventricular end systolic (ES) function and contribute to the left ventricular dysfunction. The wasted energy can be quantified as the difference between peak strain and end systolic strain and used to identify ischemic segments.

**Methods**: Acute myocardial ischemia was induced in 9 anesthetized pigs by balloon coronary occlusion (left coronary descending artery, n=6). Circumferential strain by speckle tracking was computed from short axis view during ischemia at 30' and 60'. PSS was defined as peak strain occurring after ES and stretching motion as positive systolic peak strain.

**Results**: Before induced ischemia, PSS was observed in 38% segments and stretching motion was low (±10%), then the wasted energy was limited (±2%). During acute (5') and prolonged (60') coronary occlusion, stretching motion increased (±2% at 3', and ±2% at 60') and PSS became more prevalent (±4% and ±4%, respectively) and delayed in ischemic segment (3% and 12% of RR interval, respectively). This result the wasted energy was greater in ischemic than non ischemic segment (5±1% vs. 1±1% at 5', p<0.001, 9±1% vs. ±1% at 60' p<0.001). Importantly, using ROC curves, a wasted energy of 25% identify ischemic segment with 70% of sensitivity and 74% of specificity.

**Conclusions**: The wasted energy related to PSS and stretching motion appears accurate to identify early ischemic segments.

How to Use Dose Modulation Protocols to Reduce Radiation Doses of Cardiac CT Scan?

Patrick Dupouy (1), Día El Hakim (1), Ramon Labbe (1), Valérie Huart (1), Jean Claude Gaux (1), Gérard Haquin (1), Mario Auguste (1), Eduardo Apetcar (2), Jean Marc Pernes (1)
(1) PCVI Hôpital privé d'Antony, Antony, France – (2) PCVI Clinique les Fontaines, Melun, France

**Background**: Multislices Cardiac CT scan (MSCT) is a current non invasive coronary arteries imaging modality which is increasingly used. Radiation dose to which the patient is exposed remains a major problematic issue. Prospective Dose modulation protocol (DMP) allows marked dose reduction when correctly used.

**Aim and Methods**: in order to figure out how DMP impacts Dose radiation to patient in daily life practice we prospectively studied 187 consecutive patients referred to our center for a 64 slices MSCT over a 2 months period. DMP was variably used according to the operator’s discretion whether to modulate (1 to 3 EKG phases) or not based on patient’s heart rate. Radiation measured by Dose length product (DLP), percent of modulation whether to modulate (1 to 3 EKG phases) or not based on patient’s heart rate.

**Results**: MSCTs were divided in modulated vs non modulated acquisition and the modulated group was divided in 4 groups according to the dose modulation protocol used : no DMP (n=24), DMP 1 phase (n=97), DMP 2 phases (n=51), DMP 3 phases (n=15) phases. All groups were comparable considering age, sex ratio and body mass index. Kilovolt and intensity were comparable between groups. DLP was significantly lower in the modulated group compared to non modulated (734±311 mGy.cm vs 1100±371 mGy.cm, p<0.0001). Percent of dose reduction was only significantly higher for DMP 1 phase compared to other groups (–40±7% DMP 1 vs –15±5 DMP 2, -10±3 DMP 3, 0 DMP 0, p<0.0001). Global image quality was significantly better in the modulated vs non modulated group (p=0.0016) and there was no quality difference between DMP 1 vs others. S/N ratio was not affected by the use of or not of DMP.

**Conclusion**: DMP has a very positive impact in MSCT dose reduction with no deterioration of image quality. DMP allows the best dose reduction when modulation is conducted over 1 phase and should be used in that way.

Dobutamine stress echocardiography and coronary artery spasm: a missed link

Falah Abouhoudrir (1), Sofiene Rekik (2), Stephane Andrieu (1), Saida Cheggour (1), Michel Pansieri (1), Pierre Barnay (1), Marc Metge (1), Jean Paul Faugier (1), Clement Unal (1), Sylvie Schouvey (1), Stephanie Gonzalez (1), Jean Louis Hichri (1)
(1) centre hospitalier d’avignon, Avignon, France – (2) hopital universitaire HEDI CHAKER, service de cardiologie, Sfax, Tunisie

**Aims**: To assess whether abnormal dobutamine stress echocardiography (DSE) can be a consequence of dobutamine-induced coronary spasm in patients with angiographically documented vasospastic coronary arteries.

**Methods**: Between January 2004 and April 2008, we prospectively evaluated all patients with known or suspected coronary artery disease (CAD) referred to the echocardiography laboratory for dobutamine stress tests (6061 examinations). Those with abnormal DSE underwent coronary angiogram with a systematic methylergometrine intracoronary injection in the case of absence of significant coronary stenosis or spontaneous occlusive coronary spasm. Patients who had spontaneous occlusive coronary spasm or positive methylergometrine test, but no significant stenoses, were ultimately included in this study.

**Results**: About 581 patients had abnormal DSE, among them only 20 (3.4%) fulfilled the inclusion criteria. There were 15 males and 5 females, and mean age was 64.35 years (range 52-85); 8 patients had a known history of CAD and all of them had at least two established cardiovascular risk factors. The culprit vessel was the left anterior descending artery in 10 cases (50%), right coronary artery in 8 cases (40%), and left circumflex in 2 cases (10%). There was a systematic correspondence between the culprit arteries and dobutamine-induced wall motion abnormality territories. No complications occurred during examination or during the provocation test. All the patients were discharged with a calcium channel blocker and were doing well after 13 months of mean follow-up.

**Conclusion**: Coronary artery spasm can be induced at DSE, but is a rare finding; it could, though, be clinically relevant as it may partly explain some erroneously labelled ‘false-positive’ examinations. Methylergometrine provocation test is a safe and advisable approach in such situations.

Interest of tricuspid annular displacement “TAD” in evaluation of right ventricular ejection fraction

Thomas Hugues (1), Dorothée Durecux (2), David Bertora (2), Franck Lemoigne (2), Frederic Berthier (1), Pierre Gebelin (2)
(1) CH Princesse Grace, Cardiologie, Monaco, Monaco – (2) CHU Pasteur, 06000, France

The ultrasound assessment of right ventricular (RV) function is often suboptimal. The range of excursions of the mitral or tricuspid annulus measured in m-mode, 2D or TM mode echocardiography has been shown to reflect the systolic function of both ventricles.
Methods: We studied a new technique based on a tissue tracking algorithm that is ultrasound beam angle independent for automated detection of tricuspid annular displacement (TAD) (QLAB, Philips Medical Imaging). Twenty six patients (pts) with pulmonary arterial hypertension (mean 13), heart failure (mean 9), valvulopathy (mean 5) or myocarditis (mean 1) were referred for magnetic resonance imaging (MRI) and underwent a complete transthoracic echocardiography (TTE). MRI was performed on a 1.5 T MR scanner. MRI RV ejection fraction (RVEF) was correlated by linear regression with TAD, peak systolic tricuspid annular velocity (Sa) and RV fractional area change (FAC). Sixteen pts (61.5%) exhibited right ventricular systolic dysfunction (RVEF < 40%). TTE was performed in 44 healthy subjects in order to assess normal TAD value.

Results: In the pts group, MRI RVEF was positively correlated with TAD (R²= 0.65; p< 0.0001), Sa (R²= 0.56; p<0.001) and FAC (R²= 0.39; p= 0.0025). The strongest relation was observed with TAD. A value of TAD< 14 mm predicted right ventricular dysfunction with a sensitivity of 87.5 % and a specificity of 90%. Most of (90%) healthy subjects exhibited TAD values exceeding this cut-off point (mean 16.9 +/- 1.64 mm, range 13.3 to 24.8 mm). Negative correlation was found between TAD and age (R²=0.36 ; p<0.0001).

Limitations: The echocardiographic and MRI parameters were not obtained simultaneously but at an interval of 24 hours.

Our study is the first to correlate TAD with MRI RVEF.

We conclude that TAD provides a simple, rapid, and non-invasive tool for assessing right ventricular systolic function.

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Preload, contractility and afterload during the course of normal pregnancy – an echocardiographic study

Oana Savu (1), Ruxandra Jurcut (1), Sorin Giusca (2), Ilincu Gussi (2), Roxana Enache (1), Bogdan Alexandru Popescu (1), Jan D’Hooge (3), Jan Deprest (4), Jens-Uwe Voigt (3), Carmen Ginghina (1)

(1) Institute of Cardiovascular Diseases, Cardiology, Bucharest, Romania – (2) Cantacuzino Institute of Obstetrics and Gynecology, Bucharest, Romania – (3) KU Leuven, Department of Medical Imaging, Leuven, Belgium – (4) KU Leuven, Department of Obstetrics and Gynecology, Leuven, Belgium

Purpose: Pregnancy is a physiologic condition associated with increased intravascular volume and decreased systemic vascular resistance. The aim of the study was to provide a longitudinally evaluation of the normal maternal cardiac function through echocardiography.

Methods: Twenty-seven pregnant women (mean age 30.7±2.9y) and 14 age and sex-matched non-pregnant controls (30.2±4.4y) were included. Echocardiography with conventional and speckle tracking based myocardial deformation imaging were performed longitudinally at 11-14, 22-24 and 32 weeks during pregnancy, and at inclusion for the control group. Total vascular resistance (TVR), aortic distensibility (ADs) and arterial elastance (Ea) were calculated for characterization of vascular adaptation. Beside conventional echocardiographic parameters, LV end-systolic wall stress (ESWS) and end-systolic elastance (Ees) were calculated, and ventriculo-arterial coupling index was derived.

Results: During pregnancy we found a progressive increase in LVEDV (93.8 ± 7.0 vs 88.8 ± 6.0 ml in 36° vs 1° trimester, p<0.01) and stroke volume (78.7 ± 14.8 vs 68.7 ± 12.5 ml, p<0.05), associated to decreased TVR (982.7±284 vs 1189.1±158 dyne.s/cm5, p<0.05), which was significantly lower than in controls (1372.9 ± 212 dyne.s/cm5, p<0.01). End-systolic wall stress decreased longitudinally during pregnancy (29.4 ± 5.6 vs 41.9 ± 9.6 g/cm², p<0.01) with a peak during the 3rd trimester and lower values than in control during the whole pregnancy, while ADs progressively increased reaching the peak during the 3rd trimester (7.55 ± 2.5 vs 6.25 ± 2.1 mmHg-1, p<0.05). The ventriculo-arterial coupling index was stable throughout pregnancy (0.79 ± 0.11 vs 0.75 ± 0.11, NS).

Conclusions: Pregnancy is associated with increased preload and decreased afterload, with progressively decreased total vascular resistance and increased aortic compliance, decreased end-systolic wall stress, increased cardiac output and preserved ventriculo-arterial coupling.

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Assessment of Microvascular Obstruction after Acute Myocardial Infarction using Cardiac Magnetic Renoncence (CMR) imaging

Marc Sirol (1), Philippe Malzy (2), Patrick Henry (1), Roland Rymer (3), Philippe Soyer (2)

(1) AP HP – Hôpital Lariboisière, Cardiologie, Paris, France – (2) AP-HP-Lariboisiere, Radiologie, Paris, France – (3) AP HP – Hôpital Lariboisière, Radiologie, Paris, France

Background: Infarct size (IS) and presence of microvascular obstruction (MO) detected by cardiac magnetic resonance imaging (CMR) are of prognostic relevance in ST-elevation myocardial infarction (STEMI) patients. We sought to evaluate different cardiovascular magnetic resonance techniques for detection of MO to predict LV remodeling, in patients with first AMI who were treated within 12 hours with primary stenting.

Methods: Forty-three patients with first STEMI underwent cine CMR at 4 days and 6 months after AMI to calculate LV volumes and ejection fraction (LVEF). Presence of MO was qualitatively evaluated at baseline 1) using a classic first pass perfusion sequence (FP-MO); single shot SR GE at 1’09±0’07 min, 2) using a 2D segmented IR GE pulse sequence (DHE-MO) at 8±1’30 min after contrast administration. CNR’s were calculated from the SNR of contrasted myocardium and the MO region.

Results: MO was detected by both methods in 24% of patients (n= 11). DHE-MO was the strongest predictor of change in LV end-diastolic and end-systolic volumes over time (p<0.01), whereas FP-MO and DHE-MO had a comparable predicted value of change in LVEF (β=3.1, p=0.03 and β=2.8, p=0.04). CNR corrected for spatial resolution was significantly higher for detection of DHE-MO, compared to first pass defect (104±51 vs 8±4, p<0.001).

Conclusions: DHE-MO is the best prognostic marker of LV remodeling, as determined by CMR within the first week of acute STEMI patients.

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Monitoring of the treatment by betablocker in cardiac failure: interest of mitral flow and these variations after modification of the conditions of loads

Hasna Faresse, Anass Assaidi, Fatima Ezzahra Labbi, Kawtar Bennis, Maria Zahraoui, Leila Azzouzi, Ahmed Bennis

CHU Ibn Rochd Casablanca, Cardiologie, Casablanca, Maroc

Background: Post-systolic shortening (PSS) is considered as a marker of viability in ischemic left ventricular dysfunction. However, experimental data suggest that PSS can be observed in viable and non viable segments. The aim of the present study was to differentiate PSS segments with and without contractile reserve (CR) using longitudinal strain derived from speckle tracking analysis.

Methods: Twenty seven patients (22 males, 5 females; mean age 59 ± 13 yrs.) with ischemic LV dysfunction (mean LVEF 44 ± 12 %) underwent low-dose dobutamine echocardiography for viability assessment. Longitudinal strain (ε) and strain rate (SR) were assessed at rest and under dobutamine in the 16 segments using speckle tracking analysis. PSS was defined as peak strain occurring after the end-systole. We sought to determine: 1) PSS prevalence according to CR 2) the best indice to predict CR in PSS segments.