Improved spatial resolution and post-processing for myocardial blood flow quantification in humans using steady-pulsed arterial spin labeling

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Introduction: Arterial spin labeling (ASL) is a powerful tool for the non-invasive assessment of tissue perfusion. In the human heart, however, measuring myocardial perfusion (MBF) is challenging due to strong physiological noise. Steady-pulsed ASL (spASL) under free-breathing had been proposed to improve sensitivity. To improve robustness against respiratory motion, efficiency and spatial resolution, we present an optimization of the post-processing algorithm by way of a dedicated motion correction (Moco).

Methods: The spASL sequence was implemented on a Siemens 3T Verio system, based on an ECG-triggered bSSFP acquisition combined with a slice-selective labeling module. ASL was performed at each cardiac cycle to drive tissue magnetization into a perfusion-dependent steady-state. The spASL acquisition was repeated 128 times to accumulate data and a customized 2-step Moco was carried out. First, global correction in a large ROI was performed by spatially shifting every image and minimizing signal difference with a reference. Then, a more precise regional correction based on contour correlation was used.

Results: When performing global correction, MBF mapping was possible. Fig.1 shows a comparison between two maps in a volunteer without and with Moco. Better homogeneity and delineation of the myocardium can be seen. Using the 2nd described step before carrying out the quantification in myocardial regions led to improved signal stability. Without Moco, signal was found stable when including up to 30% of all images. With Moco, the signal reached a plateau around 50% and remained stable until 80% of included images.

Conclusion: With this new approach, a greater portion (80% versus 30%) of the acquired data can be used for regional perfusion assessment. This work is also a step towards calculation of myocardial perfusion maps with high spatial resolution using ASL.

Abstract 0411 – Figure: MBF maps obtained with spASL MRI

Enhancing the contour of stent: a new tool in the optimization of outcome of coronary angioplasty

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Background: The deployment of coronary stents reduces the rate of TLR (Target Lesion Revascularization), subacute stent thrombosis and restenosis. The enhancement contour of stent recently developed by GE Healthcare on Innova 2100 (StentViz) improves the analysis of the structure of the stent and evaluates its positioning and deployment.

Objectives: The purpose of our study was to clarify the feasibility of StentViz, its advantages and limitations, and the predictors of good image quality.

Patients and methods: We conducted a prospective study between January and April 2011 from a series of 50 stented lesions in patients revascularized on the native vessels in the cardiology department of the Val-de-Grâce Military Hospital. For each procedure, the protocol consisted to successively perform an angiogram after placement of the stent, and a stentViz. Then we compared in single blind, angiogram and StentViz results, using a quality scale (1: stent invisible; 2: stent edge guessed; 3: edge stent visible; 4: edge stent visible and visible stitches).

Results: In 49 cases, analysis of the angiogram was done (98%). It showed a defect of deployment in 27 lesions (54%). The quality score was 26% of cases equal to 2, 38% equal to 3 and 36% equal to 4. In 42 cases, analysis of 1 stentViz was usable (84%). It showed a lack of deployment in 34 lesions (68%). The quality score was 14% equals to 1, 8% equals to 2, 18% equals to 3 and 60% of cases equal to 4. The failure of stentViz, defined as nonvisible stent and/or impossible analysis of deployment was observed in 8 cases. The poor results are obtained on the lesions of the LAD and Circumflex with a failure rate of 20% and 14.2%, while that rate is 12.5% on the right coronary. Statistical analysis showed that the stentViz detects more default deployment than angiography in 14% of procedure (p=0.039). The post expansion was retained in 54% of cases.

Conclusion: The edge enhancement stent represents a new tool in optimizing the outcome of coronary angioplasty. The StentViz developed by GE™ provides 8 out of 10 interpretable image quality. It finds his place in the analysis of stent deployment without increased risk and no additional cost.

Cardiac calcification in hemodialysis

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Introduction: Cardiovascular disease is the first leading cause of death in hemodialysis patients. In this population, cardiovascular calcifications occur at an earlier age and progress faster than in general population.

Patients and methods: In order to determine the prevalence and risk factors of cardiac calcifications, 49 patients on chronic hemodialysis were screened in the coronary arteries and cardiac valves by the 64 multislice ultrafast CT and the transthoracic echocardiography. Different clinical and biological parameters were studied by the SPSS 10.0 statistical software to determine risk factors.

Result: Cardiac calcifications were identified in 81.6% of cases in at least one of the two studied sites. The coronary artery involvement was more common than valvular and concerned 69.4% of cases. The mean Agatston coronary artery calcium score (ACACS) was 331.1 and 522.2 in coronary patients and was correlated to alteration of systolic function of LV (r=0.287, p=0.045). The severity of CACS was positively correlated with age (r=0.332, p=0.02). Coronary calcifications were associated with cardiovascular risk common to those of the general population (age, male sex, systolic blood pressure, diabetes, history of ischemic heart disease), but also to a lesser quality of dialysis. Valvular calcifications were present in 49% of cases and were correlated with left ventricular hypertrophy (p=0.006). The exclusive involvement
of the aortic valve was the most common valvular abnormality. Phosphocalcic and lipid parameters, levels of hemoglobin, CRP and uric acid did not predispose to cardiac calcifications in our patients.

Discussion: In hemodialysis patients, the pathogenesis of cardiovascular calcification is complex and cannot be attributed to a passive process. This process involves several factors that can promote or inhibit calcification. The new multi-slice ultrafast scanner is a very sensitive method for topographic and quantitative assessment of coronary calcification and is a better alternative to invasive techniques.

Conclusion: Our study confirms the high prevalence of cardiac calcification in hemodialysis, and highlights the importance of early screening, and treatment of predisposing factors.

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Topography of the coronary tree calcification in hemodialysis
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Introduction: Cardiovascular disease is the first leading cause of death in hemodialysis. On these patients, cardiovascular calcifications occur at an earlier age and are developing faster than in the general population.

Materials and methods: Forty-nine patients on chronic hemodialysis, 26 men and 23 women, mean age 56.4 years, with a mean duration of 85 months on hemodialysis underwent screening for coronary calcification (CC) by a 64 slide cardioscanner with ECG synchronization and without contrast injection. CC were studied at the anterior inter ventricular artery (AIV) , the right coronary artery ( RCA) , the left coronary artery (LCA) , the circumflex artery (Cx), the diagonal artery (Dia), and the posterior inter ventricular artery (PIA). Agatston coronary artery score (ACCS) was calculated by a pre supplied software.

Results: Coronary calcification concerned 69.4 % of cases and were distributed as follows: 69.4% AIV, RCA 36.7%, 32.7% Cx, Diaq 29.6% 20.4% LCA, PIA 8.2%. CC sat in one artery in 22.4% of cases, in 2, 3 or 5 arteries in 10.2% of cases, respectively, in 4 arteries in 14.3 % of cases and at 6 divisions in one patient. The mean ACCS was 331.1, and 522.2 in the patients treated for ischemic heart disease (p = 0.09). The mean ACCS by coronary division was: AIV 88.5, 69.8 CX, RCA 46.6, 15.8 Diaq, LCA 6, PIA 2.8. Coronary calcification were significantly associated with conventional cardiovascular risk factors (age, male sex, systolic blood pressure, diabetes, history of ischemic heart disease).

Discussion: In this study, the topography of CC is superimposable to coronary atherosclerosis with which CC share several risk factors. Autopsy studies confirm that CC in patients with renal failure are more intense and are associated with more complex histological alterations in comparison with general population. Other studies confirm that total and individual coronary artery calcification scores are independent predictors of mortality in hemodialysis patients

Conclusion: Our results confirm the high prevalence of CC in hemodialysis and encourage early and regular screening.

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Early predictive factors of LV remodeling after STEMI; assessment by coronary angiogram and cardiovascular magnetic resonance
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Background/aim of the study: Several months after acute ST elevation myocardial infarction (STEMI), many patients will develop left ventricular (LV) remodeling and heart failure. The aim of this study was to identify early predictive factors for LV remodeling (LVR) assessed by coronary angiogram and cardiovascular magnetic resonance (CMR) and after STEMI.

Methods: We prospectively included 52 patients with a first STEMI. All patients were successfully revascularized within 12 hours of chest pain onset using percutaneous coronary intervention (PCI). Angiographic parameters such as TIMI flow and blush grade were recorded. Index of microvascular resistance (IMR) was measured immediately after successful reperfusion. CMR was performed at days 4±2 days and at 6 months after STEMI. Comprehensive CMR included cine, T2-weighted, and late gadolinium enhancement (LGE) imaging allowing assessment of ventricular function, infarct size (IS), microvascular obstruction (MVO) and myocardial haemorrhage. LVR was defined as >20% increase of LV volume at 6 months.

Results: LVR was observed in 34.8% of the patients (18/52). TIMI flow and blush grade after PCI was not different between patients with and without LVR (3 and 2 for TIMI flow and 2 and 2 for Blush grade respectively, p=0.95). However the IMR level markedly differed between patients with and without LVR (73,95 vs. 27,23 p=0,0293). In a multivariate analysis IMR>40 was the strongest angiographic factor to predict LVR (OR 15 (1.030- 218.4), p=0,03). Regarding CMR, patients with LVR had lower LVEF (43% vs. 48%; p=0.01), larger IS (51 mg vs 32 mg; p=0.002) and greater MVO extent (4.5seg vs. 2seg; p=0.03) when compared to patients with no LVR.

Conclusion: IMR assessed by coronary angiogram, as well as IS and MVO extent assessed by CMR, are strong predictive factors of LV remodeling 6 months after STEMI.

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Predictive factors of left ventricular remodeling after myocardial infarction. Angiographic and MRI point of view
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Background/aim: several months after myocardial infarction, many patients will develop left ventricular remodeling and heart failure. The aim of this study was to bring out predictive factors of left ventricular remodeling especially angiographic and MRI ones.

Methods: prospective cohort study.

Results: 16 patients of the 46 included had left ventricular remodeling 6 months after myocardial infarction. Angiographic datas : there was statistical association between index of microvascular resistance (IMR) >40 and left ventricular remodeling (OR 15 (1.030-218.4), p=0.0308), IMR level was statistically significant higher in left ventricular remodeling group (73,95 versus 27,23 p=0,0293). MRI datas : there was a statistically significant relationship between transmurality (late gadolinium enhancement) and remodeling (OR 25,46 (1.397-463.8), p=0,0019), the number of akinetic segments was statistically significant higher in left ventricular remodeling group (6,26 versus 4, p=0,0012), and the number of segments with microvascular obstruction too (4,43 versus 2,26, p=0,0392).

Conclusion: High level of IMR, number of segments with microvascular obstruction and transmural late gadolinium enhancement can be considered as predictive factors of left ventricular remodeling 6 months after a myocardial infarction.

Keywords: angiography; MRI; IMR; microvascular obstruction; left ventricular remodeling

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Dynamics of the perfusion reserve during adenosine-induced stress in rats
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Introduction: In clinical routine, myocardial perfusion MRI is generally performed with a stress/rest protocol using adenosine as a short living (10s half-life)