The Coronary Computed Tomography Angiography assessment of the functional significance of the coronary stenosis based on the attenuation transluminal gradient.

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Introduction: Atherosclerosis represents the XXIst century disease with the highest rates of morbidity and mortality worldwide. The assesement of atherosclerosis is one of the main achievements of human pathology.

The aim: The main purpose of this paper was to evaluate a new imagistic parameter, the contrast attenuation gradient in CT examination for the complex characterization of the coronary atherosclerotic plaque. In this paper, the parameter was studied: (1)both in stable plaques, as well as the unstable ones, (2)both from the atherosclerotic plaques from the native atheromatous plaques, as well as from the neoatheromatous tissue developed inside stents, (3) in correlation with several other parameters which quantify the functional significance of the atherosclerotic plaques-fractional flow reserve(FFR), (4) in correlation with the anatomical evaluation.

Material and method: The study lot consists from 86 patients evaluated for angina symptoms, such as unstable pectoral angina, nonSTEMI myocardial infarction or effort angina in Cardiomed Advanced Imagistic CenterTargu Mures from 2014 to 2017.The classic cardiovascular risk factors were assessed for each patient: smoking, diabetes, arterial hypertension, dyslipidemia. Computerized angiography was performed in the first two studies using Somatom Sensation 64-multislice CT (Siemens, Germany), the third and fourth studies used a 128 MultisliceCT, which permits the fast evaluation of the coronary arteries and more. The CT performs the coronary arteries reconstruction automatically, but it is recommended for the reconstruction to be supervised and corrected in certain cases.

After the determination of the mean contrast gradient and TAG, in selected cases, classic angiography was performed and FFR was evaluated, according to which revascularization of the lesion was decided.

Conclusion: Computer tomography represents a coronary arteries evaluation method that is recommended by the European and American Society of Cardiology and it is used increasingly for the screening of patients with angina symptoms. The utility of computed tomography coronary angiography (CTCA) is undisputable in the stented patients' follow-up,for the stent evaluation, as well as that of stent restenosis and associated lessions.

However, there is a small number of patients which can not be evaluated using CT examination because of calcification or artefacts and for these cases additional examinations are required in order to complete the diagnosis. The contrast gradient correctly evaluates the significance of the native coronary lesions, diagnosing the lesions with indication for revascularization.

The contrast attenuation gradient determination evaluates the hemodynamic characteristics of the coronary lesions, contributing In the choosing of treatment for atherosclerotic lesions.

CTCA is useful in the evaluation of coronary stents.Furthermore,the determination of TAG in association with CTCA improves the level of diagnosis and allows the decrease in unnecessary angiographies, with the identification of the risk lesions. TAG associated with CTCA is a sensitive tool which helps the clinician to identify the moment of reintervention in stented lesions.

In the cases of unstable angina patients, TAG helps identifying the unstable coronary plaque involved in the acute coronary syndrome.

Fraction flow reserve is decreased in vulnerable plaques (with higher fibrofatty tissue and necrotic core). In this study we proved that TAG can be considered a new imagistic parameter capable of estimating the functional significance of coronary lesions. It is significantly higher in lesions with an FFR below 0.8,considered hemodynamically significant ,which are to be revascularized.

In coronary disease patients, TAG at the level of stenosis determined using angioCt, correlates with the already known vulnerability markers obtained with angioCT. Vulnerable coronary plaques present a higher functional significance compared to the stable plaques with similar anatomical profile, indicating the fact that coronary plaque vulnerabilization can lead to an increase in functional significance of the lesion.

TAG determination is strongly associated with instability factors and it is considered itself a vulnerability factor. The association of several instability markers increases the risk of plaque complications.

Computer tomography associated with specialized softs permits the identification of vulnerable plaques and helps the clinician in choosing the personalized therapy of the patient and the atherosclerotic plaque. CTCA along with imagistic softwares by evaluatind the paque vulnerability can prevent an acute coronary syndrome.At the same time,Tag correlates with the CT vulnerability markers of the atherosclerotic plaque,indicating that the presence of vulnerability markers inside a atheromatous plaque increases the functional significance of the coronary lesion.

Thesis originality: The present paper evaluates the functional siginificance of the coronary stenosis using a noninvasive method by determining the translesional attenuation gradient both for native stenosis as well as for revasculated lesions.

Although there are many publications that study the role of CTCA in the evaluation of instability factors,to our knowledge there are no published studies that evaluate the correlation between the plaque vulnerability factors determined using CTCA and the functional significance of coronary stenosis.

Published studies calculate the contrast gradient along the coronary artery,whie our study is the first to evaluate the contrast attenuation gradient just at the level of the lesion,which allows a fast and comlete evaluation f the coronary lesion functionality.

The present study is the only one to the author knowledge that evaluates the functional significance of the lesions involved in acute coronary syndromes using TAG and CT.

The study demonstrates the relation between TAG and the degree of instability in coronary lesions,as well as the relation between the invasive and noninvasive determinations of functional signification of coronary lesions.

To the author knowledge, this is the first study that proves the hypothesis that atherosclerotic plaque vulnerabilization can lead to an increase in functional signification of the lesion,decreasing the coronary perfusion distally to the vulnerable lesion and causing a more severe ischemia.

Thereby, the present paper is the first who:

1) evaluates the role of TAG in patients with unstable angina in the identification of unstable coronary plaques involved in acute coronary syndrome

2) studies the correlation between invasive FFR and the anatomical aspect evaluated using CTCA

3) statistically proves the correlation between FFR and the length of the atherosclerotic plaque as well as the degree of luminal narrowing

4) evaluates the correlation between invasive FFR and the vulnerability characteristics of coronary plaques using CTCA

5) demonstrates the statistically siginificant relation between FFR and the degree of instability of the atherosclerotic plaque evaluated using CTCA.