Flow mediated dilation in patients with atherosclerosis risk factors

Poster No.: C-1157
Congress: ECR 2014
Type: Scientific Exhibit
Authors: F. Rajabzadeh; Mashhad/IR
Keywords: Vascular, Ultrasound-Colour Doppler, Physiological studies, Arteriosclerosis
DOI: 10.1594/ecr2014/C-1157

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Aims and objectives

Definition:
Atherosclerosis is a diffuse process beginning in infancy, by which fat is deposited in the intima leading to an increase in the thickness of the intima-media layer in the vessel wall(1). This causes abnormal endothelial function in regulating the vascular tone and the vascular inflammatory process. There are risk factors which accelerate this process such as diabetes, hypertension, hyperlipidemia and smoking (1). Endothelial vascular tone control is normally mediated through the smooth muscles in the vessel wall. Flow mediated dilation (FMD) is characterized by the dilation of a vessel induced by the release of vasodilators such as nitric oxide following the shear stress caused by the release of the inflated cuff around the arm (2-5). This function is abnormal in patients with atherosclerosis (1-5, 6-10).

Normal functions of the endothelium include maintenance of vascular tone and balancing blood fluidity and thrombosis, production and balancing vaso-active substances (nitric oxide, prostaglandins, endothelin-1, angiotesin-2, C-type natriuretic peptide, tissue plasminogen activator, heparin, thrombomodulin, plasminogen activator inhibitor, tissue factor, von Willebrand factor) and control of the vascular inflammatory process (2).

Endothelium Function serves as a barometer for cardiovascular health that can be used for patient care and evaluation of new therapeutic strategies (6).

Pathophysiology of Endothelial dysfunction:
Traditional and novel coronary artery disease risk factors (e.g. hypertension, smoking, dyslipidemia, aging, diabetes, family history of premature CVD, obesity, increased CRP, chronic systemic infections) initiate a chronic inflammatory process including loss of vasodilator and anti-thrombotic factors and an increase in vasoconstrictor and pro-thrombotic product. Endothelial cells acquire a pro-thrombotic phenotype with leukocyte chemotactic factors, adhesion molecules and inflammatory cytokines. These Inflammatory factors promote monocyte and T-cell adhesion, foam cell formation, extra cellular matrix digestion, vascular smooth muscle migration and proliferation leading to atherosclerotic plaque formation. Endothelial dysfunction participates in a "positive feedback loop" with atherosclerosis (11).

Methods of evaluating Endothelial Dysfunction:
Atherosclerosis is associated with a major change in phenotype of endothelial cells. One of them is endothelium-dependent vasodilation which can be assessed by several methods including: quantitative coronary angiography, brachial artery catheterization with venous occlusive plethysmography, vascular tonometry by measurements of vascular stiffness and the brachial artery ultrasound with FMD (6, 12-15).
The advantages of the brachial artery ultrasound with FMD are noninvasiveness, faster and safer than either invasive method, reactivity correlates with the endothelial dysfunction in coronary artery, flow is a physiological stimulus for vasodilation unlike agonist such as acetylcholine and repeatability. The disadvantages include poor resolution relative to vessel size, variability in measurements (%20) and highly operator dependence (6,8).

The advantages and disadvantages of other methods in quantifying endothelial dysfunction are shown in table 1.

We compared the FMD in normal subjects, patients with atherosclerosis risk factors but without coronary artery disease (CAD) and patients with CAD.
Table 1: The advantages and disadvantages of methods other than the brachial flow mediated dilation in quantifying endothelial dysfunction

Methods and materials

One hundred and two subjects including (68 males and 34 females) were randomly selected from patients who had coronary angiography. Twenty two patients had risk factors (dyslipidemia, Smoking, diabetes ...) without coronary artery disease and 57 had coronary artery disease. The control group consisted of 23 healthy individuals.

Technique:

Patients were required to have at least 8-12 hours of fasting and were banned from ingestion of substances which may affect test results of FMD such as caffeine, high fat foods and vitamin C. Tobacco use was also prohibited during the 4-6 hours leading to the test. Furthermore, the subjects were not allowed to exercise or have any extraordinary physical activity during this time. All vasoactive medications, if feasible, were withheld for at least 4 half-lives. The examination was performed in a quiet, temperature-controlled environment.

The diameter of the artery was measured using a 7.5 MHz linear array transducer and a Hitachi EUB525 Doppler ultrasound system. The probe angle (#) was 60 degrees, with the gate of 1.5mm. The diameter of the artery was measured on the gray scale scan (Figure 1). Endothelium dependent vasodilation was performed after resting for 10 minute, the diameter, velocity and flow volume were recorded. The test was repeated after 5 minutes after applying the cuff on the arm. Image acquisition was also performed 5 minutes after taking nitroglycerine pearl (0.4 mg) for endothelial independent vasodilation. Nitroglycerine (NTG) was not given to patients with clinically significant bradycardia or hypotension.
Fig. 1: Measuring the diameter of the brachial artery

© Radiology, Arya - Mashhad/IR
Results

The results are shown in table 2. There was a statistically significant difference in the rate of arterial dilation between the group with coronary artery disease (CAD) risk factors and the control group (p=0.048). This difference was also seen regarding the change in arterial diameter between the two groups (p=0.003). However, the velocity of blood flow at rest did not differ between three groups (p=0.54). The velocity after cuff inflation was higher in healthy persons than in the CAD group (p=0.045), but no difference was observed compared to the risk factor group. Following the administration of nitroglycerine to the subjects, dilatation of the artery was observed in all 3 groups, without significant difference between the healthy subjects and the subjects with risk factor (p=0.77) or and healthy subjects with the CAD patients (p=0.96).
Table 2: The results

© Radiology, Arya - Mashhad/IR
Conclusion

Endothelial dysfunction can be detected by the non-invasive ultrasound study of FMD in peripheral vessels. Endothelial dysfunction detected by this method is a significant indicator of the impaired endothelial functions in high risk patients. This may have clinical implications in identifying asymptomatic subjects at risk of CAD and sparing them the more invasive procedures.
Personal information

Farnood Rajabzadeh, M.D., Radiologist
Radiology department, Mashhad branch, Islamic Azad University, Mashhad, Iran
e-mail: farnood@yahoo.com
References


