SHORT COMMUNICATION

# Endothelial dysfunction and the clinical application

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**Abstract**

**The vascular endothelium is a large organ that secretes numerous factors regulating vascular tone, cell growth, platelet and leukocyte interactions and thrombogenesis. Endothelial dysfunction is an early event in atherogenesis and is also important in establish coronary artery disease. Over the past decade a noninvasive technique has evolved to evaluate flow-mediated vasodilation, an endothelium-dependent function. Procedure is realised on the brachial artery. The stimulus provokes the endothelium to release nitric oxide with subsequent vasodilation that can be imaged and quantitated as the index of vasomotor function. (Fig. 1, Ref. 2.)**
**Key words: vascular endothelium, endothelial dysfunction, atherogenesis, nitric oxide, vasodilation.**

The vascular endothelium is a large organ that secretes numerous factors regulating the vascular tone, cell growth, platelet and leukocyte interactions and thrombogenesis. Endothelial dysfunction is an early event in atherogenesis being important in also the establishment of coronary artery disease (CAD). Over the past decade a noninvasive technique has been developed to evaluate flow-mediated vasodilation (FMD), an endothelium-dependent function. The procedure is carried out on the brachial artery. The stimulus provokes the endothelium to release nitric oxide (NO) with subsequent vasodilation that can be imaged and quantified as the index of vasomotor function (1).

The aim of the presented study was to use the non-invasive method to test the endothelial function in patients (pts) with CAD and to correlate it with the control group of healthy volunteers (C).

## Subjects and methods

35 patients at the average age of 63.3 years (48–78 yrs) were studied by external ultrasound imaging of the brachial artery, using 7.5 MHz linear array transducer. All patients suffered from CAD. History of acute myocardial infarction was present in 15 patients. By use of echocardiography, a reduced left ventricular ejection fraction under 40 % was diagnosed in 11 patients. 18 patients underwent coronary angiography, one vessel obstruction was found in 8 patients, two and more vessel obstructions were detected in 10 of them. Vasoactive medication was withheld for at least 12 hours. The control group (C) was constituted of 20 healthy volunteers at the average age of 45.9 years (28–76 yrs).

*Endothelium-dependent FMD.* To create a flow stimulus in the brachial artery, a sphygmomanometric cuff was placed on the forearm. The cuff was inflated up to 200 mmHg. The cuff was released after 5 minutes (min), and the brachial artery was scanned continuously for 90 seconds (s). FMD was measured at 60 s and 90 s after the release of the cuff occlusion (1).

*Endothelium-independent vasodilatation.* Ten minutes later, the second rest scan was recorded. Isosorbit dinitrate was administered sublingually in a dose of 1.25 mg, and the artery was scanned 4 minutes later. Vessel diameter was measured from super VHS recordings. Measurements were made at end-diastole, determined according to R wave of ECG continuosly recorded. Four cardiac cycles were analyzed and the measurements were averaged. Blood flow was calculated using Doppler flow velocity measurements (2).

## Statistical analysis

An unpaired t test was used for statistical analysis.

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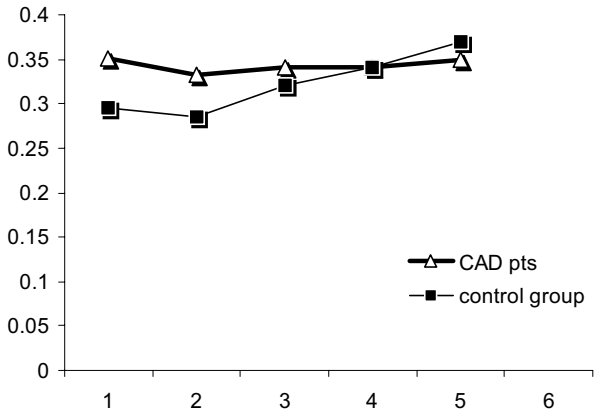


**Fig. 1. Endothelium-dependent vasodilation (brachial artery). Legend: on the axis x: 1 — rest, 2 — to 5 seconds after cuff release, 3 — 60 seconds after cuff release, 4 — 90 seconds after cuff release, 5 — 10 minutes after the second rest; on the axis y: diameter of the brachial artery (cm).**

## Results

At rest the mean arterial size (MAS) in CAD group was 3.51±0.58 mm and in group C 2.95±0.73 mm. At 60 s during reactive hyperemia the MAS in CAD group was 3.41±0.54 mm (FMD -2.9 %, $p<0.02$) and in group C 3.21±0.71 mm (FMD 8.8 %, n.s.). At 90 s MAS in CAD group was 3.41±0.53 mm (percentual change -2.9 %, $p<0.015$), in group C MAS was 3.18±0.71 mm (percentual change 7.7 %, n.s). 10 minutes after the second rest the MAS in CAD group was 3.49±0.57 mm and in group C 3.21±1.1 mm. After isosorbit dinitrate administration in CAD group, the lumen size dilated to 3.86±0.53 mm (9.9 %, p<2.9—7), and in group C 3.70±1.3 mm (25.4 %, n.s.). The rest arterial flows in both groups were similar (CAD group: 0.053±0.02 ml/min, group C: 0.052±0.03 ml/min). 90 s after the beginning of reactive hyperemia, the flow in CAD group increased to 0.071±0.02 ml/min (33.9 %, $p<0.003$), and in group C to 0.081±0.03 ml/min (55.7 %, $p<0.01$). The flow differences after isosorbit dinitrate administration were statistically insignificant.

## Discussion

Many risk factors known to predispose atherosclerosis and its complications are present at early age. A lot of significant risk factors attack the endothelial function. Endothelial dysfunction is present in early stages of atherosclerosis, but there is an important link known between the impaired endothelial function and the later advanced atherosclerotic disease. It is known, that the correlation between peripheral and coronary endothelial dysfunctions exists (2). The ultrasound assessment of brachial artery FMD is a non-invasive method. It gives us an important information about the vascular function. In our group of patients with CAD, no significantly greater baseline diameter of brachial artery was found against group C at rest. 60 and 90 s after the beginning of reactive hyperemia in CAD group the arterial diameter was significantly reduced compared with the group C, and did not reach the pre-treatment value. These results show us the impaired endothelium-dependent vasodilation response in CAD patients (Fig. 1). Preserved endothel-independent vasodilation responses after isosorbit dinitrate administration in both groups were found. The blood flow at rest was found to be similar. At 90 s during reactive hyperemia no significant reduced blood flow in CAD patients compared to the group C was present.

## References

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