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Can normal findings in non-invasive examinations (duplex carotid sonography and ankle brachial pressure index) predict a normal result of coronarography?

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ABSTRACT

Introduction: Ankle-brachial pressure index (ABI) and duplex carotid sonography (DCS) are simple non-invasive investigations that can be used for detection of atherosclerosis and, consequently, for prediction of risk of cardiovascular diseases in patients. Numerous studies proved a positive correlation between pathological findings in ABI or DCS and the presence of ischemic heart disease (IHD). We are however not aware of any study dealing with a question whether and how reliably can physiological findings in DCS and/or ABI predict a physiological coronarography result.

Methods: 219 patients admitted to our cardiology department for elective coronarography with no prior IHD diagnosis were investigated using ABI and DCS prior to performing coronarography. ABI results between 0.9 and 1.4 were considered physiological as well as DCS result showing no atherosclerotic plaque and thickness of intima-media complex under 1.0 mm. Absence of stenosis over 50% in coronary arteries was considered normal coronarography finding.

Results: A physiological ABI was revealed in 112 patients with a normal and 49 patients with a pathological coronarography result while an abnormal ABI was associated with 29 patients with and 29 patients without IHD confirmed by coronarography. A normal DCS result was obtained in 38 patients with normal coronarography result and 10 patients with IHD, while a pathological DCS finding was associated with 103 patients with a normal coronarography result and 68 patients with IHD. Physiological values in a combination of both ABI and DCS correctly predicted a normal coronarography result in 32 patients but provided false negative results in 9 patients.

The negative predictive value of ABI was 69.6%, the negative predictive value of DCS was 79.2% and the negative predictive value of the combination of both examinations was 78.0%.

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Conclusions: A physiological finding of ABI and particularly DCS investigations can predict a normal coronarography finding. Both methods are cheap and non-invasive and as such, they can help in decision making whether or not to refer patients with intermediate risk of IHD for invasive coronarography investigation.

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Introduction

Ischemic heart disease (IHD) is the second most common cardiovascular disease (CVD) and the leading cause of mortality in European population [1], its share of total mortality is 21% in males and 23% in women [2]. Over the last 30 years, a gradual decrease of mortality related to cardiovascular diseases in total as well as to IHD itself can be observed in USA and Western Europe, as well as in Czech Republic [3]. This decline is caused by multiple factors, such as improvements in addressing IHD risk factors, earlier and more accurate recognition of the disease, or improvement in treatment of patients who have already been diagnosed with IHD. All of the above contributes toward reduced IHD incidence in population and reduced mortality in patients who developed IHD.

Patients admitted for coronarography (CG) due to suspected IHD represent a substantial share of admissions to cardiology units in the Czech Republic. Although coronarography itself is an easily accessible and routine examination in the Czech Republic, it is still an invasive procedure bearing a certain risk of complications associated with a radiation burden for the patient as well as for the staff and, besides, burdening the healthcare system with significant financial costs [4]. Reducing the number of CG examinations in patients bearing only low or medium risk of IHD is therefore much desirable.

The likelihood of the patient being diagnosed with IHD can be estimated in the particular patient on the basis of his medical history (the nature of patient's problems, the presence of risk factors, etc.) together with non-invasive examinations such as ergometry, dobutamine stress echocardiogram or single photon emission computed tomography myocardial imaging (SPECT) [5].

Other simple non-invasive methods such as duplex carotid sonography (DCS) measuring intima media-thickness (IMT) or ankle-brachial pressure index (ABI) can also detect the presence of arterial atherosclerotic plaque and predict a high cardiovascular risk. European Guidelines on Cardiovascular Disease Prevention in Clinical Practice (version 2012) strongly recommend IMT and ABI as methods for preventive screening for assessment of cardiovascular risk in asymptomatic adults who are at moderate risk of cardiovascular disease [6].

Large epidemiologic studies such as Kuopio Ischemic Heart Disease Study (KIHD), The Rotterdam Study, Cardiovascular Heart Study, or Atherosclerosis Risk in Communities study (ARIC) proved that thickness of the common carotid artery wall very well reflects a generalized atherosclerosis [7–12]. Patients with atherosclerotic disease of the carotid arteries are more

likely to die from complications that are associated with coronary atherosclerosis than from complications arising as a result of condition of carotid vessels [13,14]. Risk factors for atherosclerosis development in coronary and carotid arteries are identical [15].

The intima-media thickness (IMT) in particular correlates with age, blood lipids level, blood pressure, smoking [16] and diabetes [17].

The Rotterdam study confirmed a linear correlation between the IMT and the extent of angiographically detected coronary atherosclerosis [18]. The KIHD study demonstrated 0.1 mm increase of IMT to predict increase in the likelihood of myocardial infarction by 5.6% and brain stroke probability by 4.4%, which was also consistent with results from ARIC studies [7,16].

There are multiple examination protocols for evaluation of the state of carotid vessels. The most suitable site for IMT complex measurement where the clearest sonography results can be obtained is the distant wall of the communal carotid artery in the longitudinal plane. The *intima* and *media* are showing as hyperechoic and hypoechoic bands (double-line pattern). Measurements are usually taken 1–2 cm proximal to the bulb (where the near and far carotid walls cease to run parallel). The normal IMT value is below 1.0 mm. Where the thickness is 1.5 mm and more or the arterial wall is 50% more prominent than the surrounding wall, the result is classified as atherosclerotic plaque [19].

The main drawback of sonographic IMT measurement is a questionable reproducibility, which is affected by the method of measurement as well as by the experience of the examiner and the result evaluation. On the other hand, it is, unlike other imaging techniques, non-invasive, relatively inexpensive, quick, and does not need any special equipment. For these reasons, it is suitable as a warning parameter of early, still clinically silent, atherosclerosis as well as an indicator of generalized atherosclerosis [20].

Wofford et al. proved in their study on 434 patients aged 40+ who underwent elective coronarography that the extent of atherosclerosis in the carotid arteries correlates strongly and independently with the presence or absence of coronary atherosclerosis in both sexes, the correlation is however stronger in males. The patients were classified according to B-mode score (IMT in millimeters) into quartiles. Men in the lowest B-mode quartile were over six times more likely to have normal CG findings than three- to four-vessel coronary arteries while men in the highest quartile developed three- to four-vessel coronary arteries 10 times more often than normal coronary arteries [21]. Similar findings in a group of 343 patients with IHD and 167 strong control group were presented

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