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Pulse pressure measured at the level of the femoral artery, but not at the level of the aorta, carotid and brachial arteries, is associated with the incidence of coronary heart disease events in a population with a high prevalence of type 2 diabetes and impaired glucose metabolism – The Hoorn study

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KEYWORDS
Central blood pressure;

Abstract *Introduction:* Central (aortic or carotid) pulse pressure (PP) is more strongly associated with local organ damage and possibly mortality than brachial PP.
Aim: To investigate for the first time the association of femoral (f) PP with all-cause mortality, and incident cardiovascular disease (CVD), coronary heart disease (CHD) and cerebrovascular

Abbreviations: aPP, aortic pulse pressure; BP, blood pressure; bPP, brachial pulse pressure; cPP, carotid pulse pressure; CerVD, cerebrovascular disease; CHD, coronary heart disease; CIs, confidence intervals; CVD, cardiovascular disease; eGFR, estimated glomerular filtration rate; fPP, femoral pulse pressure; HR, hazard ratio; ICD-9, international classification of disease, 9th edition; IGM, impaired glucose metabolism; MBP, mean blood pressure; OR, odds ratio; PP, pulse pressure.

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Femoral artery;
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disease (CerVD) events, as well as with markers of renal function (estimated glomerular filtration rate, eGFR, and microalbuminuria).
Methods: We used data from a population-based study, by design including 50% type 2 diabetes and impaired glucose metabolism (IGM). The baseline examination included non-invasive PP assessment at the brachial, aorta (Sphygmocor device), carotid and femoral (ultrasound distention waves calibrated by brachial mean and diastolic pressure) arteries.
Results: After 7.8 years of follow-up (n = 449, age: 68.9 ± 6.0 males: 52%), 66 participants had died, 102 had a CVD event, 45 a CHD event, and 31 a CerVD event. PP at all sites was associated with incident all-cause mortality and CVD events. Only fPP was, however, associated with incident CHD events, even after adjustment for CVD risk factors (HRs 1.31 [1.07−1.61 95% CIs]). No association between PP and incident CerVD events was found − possibly due to the small number of events. fPP was associated with renal function but this was similar to other PP indices. No interaction between each any local PP index and glucose metabolism status or renal function was present.
Conclusion: Beyond anatomical topography, local fPP provide important information related to CVD events. This possibility and the underlying mechanisms should be further investigated.

Introduction

Due to the phenomenon of pulse pressure (PP) amplification, brachial PP is an inaccurate marker of the actual pressure load imposed upon the heart.[1] There is evidence that central PP (i.e., PP in the aorta or carotid artery) is more strongly associated with left ventricular dysfunction or, for instance, carotid intima-media thickness than brachial PP.[2,3] Local PP may therefore be more strongly associated with local organ damage. A meta-analysis on the association between local PP and cardiovascular morbidity and mortality showed that central PP performed only marginally better than brachial PP when it came to the prediction of incident cardiovascular morbidity or mortality.[4] Taking the above into account, the investigation of local PP along the arterial tree in relation to both local organ damage and morbidity and mortality is of particular interest.

The association of PP at the femoral artery (fPP) with the incidence of all-cause mortality and CVD events has never been investigated. The femoral artery is the closest, non-invasively accesible, arterial site to the renal arteries and thus the fPP might intergrate information about renal function, a well established determinant of CVD,[5] that the aPP and cPP cannot. Moreover, the relative impact of type 2 diabetes and impaired glucose metabolism (IGM) on arterial stiffenning is greater in the femoral artery than the aorta and the carotid artery.[6] Per se this has impact on local fPP. For these reasons fPP may have a strong potential to associate with incident all-cause mortality and CVD events, especially in individuals with type 2 diabetes and IGM.

In order to address these hypotheses, we analysed data from the Hoorn Study,[6] a population-based study of elderly individuals by design including around 50% individuals with type 2 diabetes and IGM, which assessed local PP at 4 arterial sites (brachial, aortic, common carotid and common femoral). We investigated the association of, on the one hand, local PP indices at all 4 arterial sites, with on the other hand, all-cause mortality, incident CVD, coronary heart disease (CHD) events and cerebrovascular disease (CerVD) events. In addition, we investigated whether for each index of local PP the potential associations were independent of glucose metabolism status, mean blood pressure (MBP), and CVD risk factors, including renal function. Finally, we investigated (i) the association between each local PP index and renal function and (ii) the potential presence of interaction between each local PP estimate and glucose metabolism status or renal function and renal microcirculation with regard to the incidence of all outcomes.

Methods

Study design

For the present study, we used data from the 2000 Hoorn Study examination. The Hoorn study is a population-based cohort study of glucose metabolism and CVD risk among the inhabitants of the municipality of Hoorn in the Netherlands. The study started in 1989, and in 2000 a follow-up examination (n = 648) was done among surviving participants who gave permission to be re-contacted. Details of the study have been described elsewhere.[7,8]

Blood pressure assessment at the brachial, aortic, carotid and femoral artery

In all participants blood pressure (BP) was measured in a laboratory setting after at least 15 min of rest. PP was calculated as systolic BP- diastolic BP. The local PP indices are summarized in Table 1 and presented in further detail below. The brachial pulse pressure (bPP) was recorded in the left upper arm with an oscillometric device (Collin Press-Mate, BP-8800) [7] just before the recording of the