Role of ankle-brachial pressure index as a predictor of coronary artery disease severity in patients with diabetes mellitus

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BACKGROUND: Previous studies have reported a close correlation between low ankle-brachial pressure index (ABPI) and various cardiovascular risk factors. However, despite the well-established potential hazards of consequent coronary artery disease (CAD), no data exist on the relationship between ABPI and the severity of CAD, particularly in patients with diabetes mellitus (DM).

METHODS: A total of 840 patients ranging from 35 to 87 years of age (mean $\pm$ SD) 63.9 ± 10.2 years) with suspected CAD in a clinical practice were enrolled. All patients underwent ABPI measurements and coronary angiography. Patients were divided into four groups according to the results of ABPI measurements and the presence or absence of DM: group A had an ABPI value of at least 0.9 but no DM (A⁻/D⁻); group B had an ABPI value of at least 0.9 and DM (A⁺/D⁺); group C had an ABPI of less than 0.9 but no DM (A⁺/D⁻); and group D had an ABPI value of less than 0.9 and DM (A⁺/D⁺).

RESULTS: Age was significantly higher in the A⁺ (groups C and D) than the A⁻ patients (groups A and B). Moreover, men predominated in all four groups. Comparisons of sex distribution among the four groups revealed that group D had the highest percentage of women, while group A had the lowest. Total cholesterol level did not differ among the four groups, although group D tended to have the highest result. Patients in group D had the highest percentages of hypertension, hypercholesterolemia, hypertriglyceridemia, low high-density lipoprotein cholesterol and high low-density lipoprotein cholesterol among the four groups. Group D exhibited the highest triglyceride and uric acid levels, the lowest high-density lipoprotein cholesterol level, and the highest metabolic syndrome criteria number and percentage of metabolic syndrome. Furthermore, group D had the highest mean lesion numbers, mean numbers of target vessel involvement, stenoses with type C classification and complex morphology lesions (chronic total occlusion, diffuse or calcified lesions) among the four groups. There were still significant differences in lesion numbers ($P < 0.001$) and numbers of target vessel involvement ($P < 0.001$) for ABPI predicting CAD severity after controlling for the effects of DM and age. The sensitivity, specificity, positive predictive value and negative predictive value of using an ABPI of less than 0.9 to predict CAD differed significantly between patients with and without DM.

CONCLUSIONS: ABPI is a useful noninvasive tool for predicting CAD severity, even in patients with DM.

Key Words: Ankle-brachial pressure index; Coronary artery disease; Peripheral artery disease

Rôle de l'indice de pression cheville-bras comme prédicteur de la gravité de la coronaropathie chez les patients atteints de diabète de type II

HISTORIQUE : Des études antérieures ont fait état d'une étroite corrélation entre un indice de pression cheville-bras (IPCB) faible et divers facteurs de risque cardiovasculaires. Toutefois, malgré les risques potentiels bien établis d'une coronaropathie importante, on ne dispose d'aucune donnée sur le rapport entre l'IPCB et la gravité de la coronaropathie, particulièrement chez les patients atteints de diabète de type II (DT2).

MÉTHODES : En tout, les chercheurs ont recruté 840 patients âgés de 35 à 87 ans (moyenne $\pm$ É.T.) $63,9 \pm 10,2$ ans) atteints de coronaropathie présumée, en milieu clinique. On a soumis tous les patients à une mesure de leur IPCB et à une coronarographie. On les a ensuite répartis entre quatre groupes selon leurs valeurs d'IPCB et la présence ou l'absence de DT2. Le groupe A présentait des valeurs d'IPCB d'au moins 0,9 sans DT2 (A⁻/D⁻). Le groupe B présentait des valeurs d'IPCB d'au moins 0,9 et un DT2 (A⁺/B⁺). Le groupe C présentait des valeurs d'IPCB inférieures à 0,9 sans DT2 (A⁺/D⁻). Et le groupe D présentait des valeurs d'IPCB inférieures à 0,9 et un DT2 (A⁺/D⁺).

RÉSULTATS : L'âge était significativement plus élevé dans le groupe A⁺ (groupes C et D) que dans les groupes A⁻ (groupes A et B). De plus, les hommes étaient en plus grand nombre dans les quatre groupes. Les comparaisons de distribution selon le sexe parmi les quatre groupes ont révélé que le groupe D présentait le pourcentage le plus élevé de femmes, et le groupe A, le plus faible. Le taux de cholestérol total était semblable dans les quatre groupes bien que le groupe D ait eu tendance à présenter des taux plus élevés. Les patients du groupe D présentaient les pourcentages les plus élevés d'hypertension, d'hypercholestérolémie, d'hypertriglycéridémie, de taux élevés de LDL-cholestérol et de taux faibles de HDL-cholestérol parmi les quatre groupes. Le groupe D présentait les taux les plus élevés de triglycérides et d'acide urique, les taux les plus faibles de HDL-cholestérol et le nombre le plus élevé de critères du syndrome métabolique et le pourcentage le plus fort de syndrome métabolique. En outre, le groupe D se démarquait par les nombres moyens les plus élevés de lésions, d'atteintes des vaisseaux cibles, de sténoses de type C et de lésions morphologiques complexes (occlusions totales chroniques, lésions diffuses ou calcifiées) parmi les quatre groupes. On a noté d'autres différences significatives quant au nombre de lésions ($P < 0,001$) et quant au nombre d'atteintes des vaisseaux cibles ($P < 0,001$) pour ce qui est de la valeur prédictive de l'IPCB à l'égard de la gravité de la coronaropathie après un contrôle pour tenir compte des effets du DT2 et de l'âge. La sensibilité, la spécificité et les valeurs prédictives positive et négative d'un IPCB inférieur à 0,9 en ce qui a trait à la coronaropathie ont été significativement différentes selon que les patients souffraient ou non de DT2.

CONCLUSIONS : L'IPCB est un outil non effractiv utile pour prédire la gravité de la coronaropathie, même chez les patients atteints de DT2.

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Atherosclerotic cardiovascular disease is a major health problem and is the leading cause of morbidity and mortality in developed countries. Asymptomatic atherosclerosis is widespread in the population, and while considerable attention has been paid to 'silent coronary' and electrocardiogram ischemia, little is known about occult disease of the lower limbs (1). Previous investigations have shown that the ankle-brachial pressure index (ABPI), a quick and useful tool for assessing and evaluating the presence of peripheral arterial disease (PAD) of the lower extremities, is a powerful predictor of mortality (2,3). Many population studies have shown that subclinical cardiovascular disease in a single vascular bed is associated with clinical disease in another bed, and with subsequent cardiovascular and total mortality (4-6). Several studies have demonstrated that patients with PAD are at increased risk for adverse cardiovascular events compared with individuals without PAD (7-9). Consequently, there is increasing interest in ABPI as a noninvasive tool capable of identifying subclinical atherosclerosis, including coronary artery disease (CAD).

The role of diabetes mellitus (DM) in relation to CAD was believed to be as important as CAD itself. The Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (10) announced that dyslipidemia patients with DM should be treated based on the guideline for patients with CAD. Additionally, owing to their similar vasculopathy characteristics, patients with DM were frequently combined with PAD. However, for outpatients clinically suspected of having CAD, the relationship and interaction between DM and PAD remains unknown. The role of ABPI in predicting the diagnosis of CAD in patients with DM is also being investigated. Furthermore, although there are some observations indicating a relationship between ABPI and CAD severity, the influence of ABPI on CAD severity, lesion morphology and the risk classification for coronary angioplasty for DM patients is still unclear. The association between the metabolic syndrome (MS) and ABPI is also explored.

METHODS

A total of 858 consecutive patients with angina pectoris and suspected CAD seen in the cardiology outpatient department of Chiayi Chang Gung Memorial Hospital (Chiayi, Taiwan) between June 2004 and October 2006 were enrolled in the present study. The sample contained no emergency cardiac angiograms performed in cases of myocardial infarction or unstable angina, or in patients suffering severe cardiac insufficiency. All angiograms performed were for angina pectoris. All patients provided informed consent. Patients were excluded if they had previously undergone a vascular surgical procedure of the aortoiliac vessels because of ischemic legs (8) (regardless of having an ABPI value of less than 0.9 before surgery), or had an ABPI of 1.5 or greater (10) in both legs at the baseline because previous analyses demonstrated that this is a falsely high level resulting from calcified noncompressible vessels in the legs. Thus, a total of 840 patients were enrolled in the study.

All patients underwent coronary angiography examinations. Digital coronary angiograms were analyzed offline with an automated edge detection system (DCI or Integrus BH3000; Philips, The Netherlands) by using the dye-filled guiding catheter as a reference. Quantitative angiographic analysis was performed during the end-diastolic phase, which displayed the most severe stenosis. Lesions were qualitatively classified using the modified American Heart Association/American College of Cardiology grading system. Type A lesions have characteristics that allow for an anticipated success rate of at least 85% and have a low risk of abrupt vessel closure. Type B lesions have characteristics that result in a success rate ranging from 60% to 85% or have a moderate risk of abrupt vessel closure. Type C have characteristics that result in a low success rate of less than 60% or have a high risk of abrupt closure, or both. Based on the classification system, type B2 and C lesions were considered to be complex. The diameter of the reference vessel was measured at the proximal part of the vessel adjacent to the target lesion. Moreover, the stenotic

lesion was defined as a greater than 50% stenosis positioned in a native coronary artery.

The arterial assessment was conducted by well-trained cardiologists following a standard protocol as previously described. The assessment was performed before the coronary angiography procedure on the same day. Patients were examined in the supine position following at least 5 min of rest. Systolic blood pressure was measured in both arms, and in the right and left posterior tibial and dorsalis pedis arteries of each leg. A Doppler stethoscope (8 MHz) and a standard blood pressure cuff connected to a random zero manometer were used to measure the arterial flow. The resting ABPI was defined as the ratio of ankle systolic blood pressure (the average pressure recorded in the posterior and dorsalis pedis arteries) divided by the higher of the left or right brachial pressures. The lower of the two ABPI values obtained served as a gauge of disease in the data analysis.

The ABPI assessment was performed on the same day as the coronary angiography procedure. A second cardiologist, who was not involved with conducting the angiogram, performed an ABPI assessment on each patient. Angiogram and ABPI results from the two different cardiologists were merged into the dataset.

Patients were divided into four groups based on the results of ABPI measurements and the presence or absence of DM: group A (A^-/D^-) had an ABPI of at least 0.9 but no DM ($n=439$ [345 men]; 35 to 87 years of age); group B (A^-/D^+) had an ABPI of at least 0.9 and DM ($n=210$ [144 men]; 35 to 82 years of age); group C (A^+/D^-) had an ABPI of less than 0.9 but no DM ($n=110$ [73 men]; 42 to 85 years of age); and group D (A^+/D^+) had an ABPI of less than 0.9 and DM ($n=81$ [47 men]; 44 to 82 years of age).

The Student's *t* test was used to compare age, lesion number, number of target vessel involvements and clinical laboratory data among groups. The results were expressed as mean $\pm$ SD and the statistics were tested by one-way and two-way AVOVA for testing the effects of DM on ABPI. Moreover, the χ^2 test was applied to compare data regarding sex, history of cerebrovascular accident, presence of DM or hypertension, current smoking status, target vessel location and lesion characteristics. Logistic regression was performed. Multivariate analysis and OR were derived from the logistic model, and 95% CIs were calculated for the main results. $P<0.05$ was considered to be significant. The statistical package SPSS version 14.0 (SPSS Inc, USA) was used to analyze the above data.

RESULTS

All patients underwent coronary angiography examination and ABPI measurement. Age was significantly higher in the A^+ (groups C and D) than in the A^- patients (groups A and B) ($P<0.001$). Men were predominant in all four groups (78.6%, 68.6%, 66.4% and 58%, respectively). However, in comparisons of sex distribution among the four groups, group D had the highest proportion of women (42.0%) while group A had the lowest (21.4%) ($P<0.001$) (Table 1). Significant differences existed in the presence of hypertension ($P<0.001$), triglyceride level ($P<0.001$), hypertriglyceride percentage ($P=0.001$), high-density lipoprotein (HDL) cholesterol level ($P=0.001$), low HDL cholesterol percentage ($P=0.004$), waist circumference ($P=0.024$) and high waist girth percentage ($P=0.043$) between the diabetic (groups B and D) and nondiabetic patients (groups A and C).

Regarding the baseline characteristics of the present study, group D had the highest cholesterol level and hypercholesterol percentage but did not differ significantly from the other groups. Patients in group D had the highest rates of hypertension, hypercholesterol, hypertriglyceride, low HDL cholesterol and high low-density lipoprotein (LDL) cholesterol among the four groups. Group D had the highest triglyceride level and the lowest HDL cholesterol level.

There was a significant difference between the A^+ and A^- groups with respect to LDL cholesterol level ($P<0.001$) and high LDL cholesterol percentage ($P=0.048$). Group D had the highest uric acid level (428.3 ± 107.0 $\mu\text{mol/L}$), and there was a significant difference in uric

TABLE 1
Clinical and biochemical characteristics of patients

	Group A (n=439) A ⁻ /D ⁻	Group B (n=210) A ⁻ /D ⁺	Group C (n=110) A ⁺ /D ⁻	Group D (n=81) A ⁺ /D ⁺	P
Age, years	62.7±10.0	62.0±10.0	70.2±9.3	66.7±8.5	<0.001*
Female sex, n (%)	94 (21.4)	66 (31.4)	37 (33.6)	34 (42.0)	<0.001†
Hypertension, n (%)	182 (41.5)	133 (63.3)	60 (54.5)	53 (65.4)	<0.001†
Smoking, n (%)	179 (40.8)	59 (28.1)	50 (45.5)	36 (44.4)	0.003‡
Cholesterol, mmol/L	4.8±1.0	4.6±1.1	4.8±1.4	4.9±1.0	0.194*
Triglyceride, mmol/L	1.7±1.3	2.2±1.7	1.3±0.7	2.2±2.0	<0.001*
HDL cholesterol, mmol/L	1.1±0.3	1.0±0.3	1.1±0.3	1.0±0.3	0.001*
LDL cholesterol, mmol/L	2.9±0.8	2.7±0.8	3.1±1.2	3.0±0.8	<0.001*
Uric acid, µmol/L	416.4±107.1	380.7±113.0	422.3±113.0	428.3±107.0	<0.001*
hs-CRP, mg/L	2.3±5.6	2.2±2.9	4.8±7.3	4.5±7.7	<0.001*
History of CVA, n (%)	19 (4.3)	11 (5.2)	9 (8.2)	7 (8.6)	0.234†
Hypercholesterolemia, n (%)	137 (31.2)	54 (25.7)	34 (30.9)	32 (39.5)	0.141†
Hypertriglyceridemia, n (%)	161 (36.7)	102 (48.6)	33 (30)	40 (49.4)	0.001†
Low HDL cholesterol, n (%)	247 (56.3)	138 (65.7)	54 (49.1)	56 (69.1)	0.004†
High LDL cholesterol, n (%)	115 (26.2)	43 (20.5)	32 (29.1)	29 (35.8)	0.048†
High waist girth, n (%)	104 (23.7)	70 (33.3)	30 (27.3)	27 (33.3)	0.043†
Waist circumference, cm	92.0±9.4	93.9±10.0	90.9±10.4	93.5±9.3	0.024*
Criteria of the metabolic syndrome	1.6±1.1	3.1±1.1	1.6±1.1	3.3±1.0	<0.001*
Metabolic syndrome ratio, n (%)	92 (21.0)	143 (68.1)	26 (23.6)	61 (75.3)	<0.001†

Data presented as mean ± SD unless specified otherwise. *One-way ANOVA; †Two-way ANOVA. A⁻ Ankle-brachial pressure index <0.9; A⁺ Ankle-brachial pressure index ≥0.9; CVA Cerebral vascular accident characteristics of patients; D⁻ Without diabetes mellitus; D⁺ With diabetes mellitus; HDL High-density lipoprotein; hs-CRP High-sensitivity C-reactive protein; LDL Low-density lipoprotein

TABLE 2
Target vessel and lesion characteristics

	Group A (n=439) A ⁻ /D ⁻	Group B (n=210) A ⁻ /D ⁺	Group C (n=110) A ⁺ /D ⁻	Group D (n=81) A ⁺ /D ⁺	P
Total lesions, n	621	356	259	211	
Lesions, n, mean ± SD	1.4±1.2	1.7±1.2	2.3±1.2	2.6±1.2	<0.001*, <0.001†
Target vessel involvement, n, mean ± SD	1.2±1.0	1.5±1.0	1.9±1.0	2.1±0.9	<0.001*, 0.002†
Target vessel location, n (%)‡					
Left main coronary artery	26 (4.2)	16 (4.5)	9 (3.5)	9 (4.3)	0.774§
Left anterior descending coronary artery	278 (44.8)	144 (40.5)	101 (39.0)	82 (38.9)	
Left circumflex coronary artery	143 (23.0)	91 (25.6)	62 (23.9)	54 (25.6)	
Right coronary artery	174 (28.0)	105 (29.5)	87 (33.6)	66 (31.3)	
Lesion site, n (%)‡					
Ostial	75 (12.1)	46 (12.9)	48 (18.5)	28 (13.3)	0.09§
Proximal	171 (27.5)	85 (23.9)	68 (26.3)	60 (28.4)	
Middle	290 (46.7)	155 (43.5)	101 (39.0)	91 (43.1)	
Distal	85 (13.7)	70 (19.7)	42 (16.2)	32 (15.2)	
Lesion type, n (%)‡					
A	105 (16.9)	67 (18.8)	21 (8.1)	26 (12.3)	<0.001§
B1	189 (30.4)	113 (31.8)	58 (22.4)	48 (22.8)	
B2	156 (25.1)	82 (23.0)	81 (31.3)	46 (21.8)	
C	171 (27.6)	94 (26.4)	99 (38.2)	91 (43.1)	
A + B1	294 (47.3)	180 (50.6)	79 (30.5)	74 (35.1)	<0.001§
B2 + C	327 (52.7)	176 (49.4)	180 (69.5)	137 (64.9)	
Lesion morphology, n (%)					
Complex morphology (CTO + diffuse + calcification)	234 (46.1)	171 (56.2)	159 (52.5)	151 (59.5)	0.002§
Noncomplex morphology	274 (53.9)	133 (43.8)	144 (47.5)	103 (40.5)	

*One-way ANOVA; †Two-way ANOVA; ‡% calculated based on the total number of lesions; §χ² test. A⁻ Ankle-brachial pressure index <0.9; A⁺ Ankle-brachial pressure index ≥0.9; CTO Chronic total occlusion; D⁻ Without diabetes mellitus; D⁺ With diabetes mellitus

acid level between the A⁺ and A⁻ groups (P<0.001). Furthermore, there was a significant difference in high-sensitivity C-reactive protein (hs-CRP) level between the A⁺ and A⁻ groups (P<0.001). Finally, group D had the highest MS criteria number and prevalence of the MS (P<0.001).

Regarding target vessel and lesion characteristics, there were noticeable differences in mean lesion numbers (1.4±1.2, 1.7±1.2, 2.3±1.2 and 2.6±1.2, respectively [P<0.001]) and mean numbers of target vessel involvement (1.2±1.0, 1.5±1.0, 1.9±1.0 and 2.1±0.9, respectively [P<0.001]) among the four groups (Table 2). Group D contained the

most lesions and the highest numbers of target vessel involvement, while group A had the lowest. No significant differences in lesion location of target vessels and lesion sites existed among the four groups ($P=0.774$ and $P=0.09$, respectively). There were still significant differences in lesion numbers ($P<0.001$) and numbers of target vessel involvement ($P=0.002$) when controlling for the effect of DM on ABPI. According to the classification of the American Heart Association/American College of Cardiology, group D had the highest percentage of stenoses with a type C classification ($P<0.001$). Moreover, groups C and D contained a higher percentage of complex stenoses with either type B2 or C classification than in groups A and B (69.5% and 64.9% versus 52.7 and 49.4, respectively; $P<0.001$). Lesion morphology comparisons revealed that group D had the highest percentage of complex morphology lesions (chronic total occlusion, diffuse or calcified lesions) (59.5%) among the four groups ($P=0.002$). There were still significant differences in lesion numbers ($P<0.001$) and numbers of target vessel involvement ($P<0.001$) for ABPI predicting CAD severity after controlling for the effects of DM and age.

The sensitivity, specificity, positive predictive value (PPV) and negative predictive value for predicting CAD given an ABPI of less than 0.9 in patients without and with DM were significantly different (23.9%, 92.8%, 92.7% and 23.5% [OR 3.91]; and 31.4%, 94.9%, 97.5% and 17.6% [OR 8.45], respectively) ($P<0.001$). The ORs for the presence of CAD compared with group A (reference) were 1.43 (group B), 3.91 (group C) and 12.11 (group D) ($P<0.001$).

DISCUSSION

The ABPI measurement is now used worldwide as an easy, practical method for PAD evaluation, and can be used to clinically assess the risk of future cardiovascular events. Although PAD risk factors showed sex differences, previous studies have recognized that patients with arterial disease of the lower extremities are at higher risk for adverse cardiovascular events, stroke, transient ischemic accident and preclinical carotid plaque (11-13). The natural history of patients with PAD is also influenced by coexistent CAD and cerebral vascular disease (4,8,14,15). An increased incidence of new coronary events was observed in patients with PAD (16). An ABPI of less than 0.9 has been consistently linked to a three- to eightfold increase in cardiovascular death and a two- to fivefold increase in overall mortality compared with an ABPI of 0.9 or greater (2,17,18).

The main finding of the present study was that an ABPI test result of less than 0.9 is a strong predictor of patients being diagnosed with CAD in clinical settings. Coexisting PAD is correlated with the prevalence of multivessel CAD, obstructive CAD and coronary revascularization, and has been reported by Sukhija et al (19). Low ABPI was also independently associated with a high risk of all-cause and cardiovascular disease mortality (20). The present study found that patients with a low ABPI value had more CAD target vessel involvement and higher mean lesion numbers than those with a normal ABPI value. These results were compatible with the findings of our previous study (21).

Furthermore, the present study showed that the presence of DM in patients with ABPI values of less than 0.9 may be an additional and powerful factor in CAD prediction. In patients with an ABPI of less than 0.9, for both target vessel involvement or mean lesion numbers, the presence of DM differed significantly compared with individuals without DM. Group D exhibited the most CAD target vessel involvement and mean lesion numbers among the four groups. The sensitivity, specificity, PPV and negative predictive value in predicting CAD using an ABPI value of less than 0.9 differed significantly between patients with and without DM. The OR in predicting CAD with ABPI values of less than 0.9 in patients without DM was 3.91, compared with 8.45 for patients with DM. The OR was 12.11 for the presence of CAD in the comparison between group A (reference) and group D. Because it was shown that a low ABPI value predicts a diagnosis of CAD, physicians

should pay attention to DM patients with low ABPI values because they are at considerable risk for CAD.

Our previous study found an association between ABPI and CAD severity in patients with ischemic heart disease. More complex stenotic lesions (B2 or C) were found in the group with an ABPI value of less than 0.9 than in the group with an ABPI of 0.9 or greater (21). The results of the present study supported similar conclusions regarding the distribution of these complex stenotic lesions. However, to our knowledge, no studies have demonstrated any association between ABPI and CAD severity in patients with or without DM. In the present study, although most stenoses (69.5%) were complex stenoses classified as either type B2 or type C in group C patients, the highest prevalence of type C classification stenoses (43.1%) occurred in group D patients ($P<0.001$). Regarding lesion morphology distribution, group D patients had the highest percentage of complex stenotic lesions with lesion morphology of chronic total occlusion, diffuse and calcification (59.5%) ($P=0.002$). The above data indicate the importance of DM in predicting CAD and CAD severity for patients with ABPI values of less than 0.9. The results of the present study confirm and extend the findings of other researchers, implying that the measurement of ABPI in DM patients with suspected CAD is valuable for identifying those at risk for high-grade CAD severity.

Given the correlation demonstrated between PAD and atherosclerotic ischemic heart disease, predictably, PAD has also been closely associated with several classical risk factors for CAD, particularly dyslipidemia, cigarette smoking and hypertension (18,22-25). Not surprisingly, the baseline characteristics of patients in the present study are compatible with these findings, except that there were no differences in the total cholesterol level among the four groups, although group D tended to have the highest cholesterol level. In the present study, patients in group D were associated with the greatest prevalence of hypertension, hypercholesterol, hypertriglyceride, low HDL cholesterol and high LDL cholesterol among the four groups. Group D displayed the highest triglyceride level and the lowest HDL cholesterol level. These results illustrate that more atherosclerotic risk factors existed in DM patients with ABPI values of less than 0.9 compared with other groups of patients.

Whether hyperuricemia is an independent risk factor of atherosclerosis remains controversial. Considerable evidence suggests that serum uric acid is a significant independent risk factor for cardiovascular and renal diseases, particularly in patients with hypertension, heart failure or DM (26,27). Patients with hypertension and hyperuricemia have a three- to fivefold increased risk of developing CAD or cerebrovascular disease compared with patients with normal uric acid levels (27-29). The First National Health and Nutrition Examination Study (NHANES I) (28) identified a correlation between raised uric acid levels and increased risk of ischemic heart disease and cardiovascular mortality. However, the Framingham Heart Study (30) and the Meharry-Hopkins Study (31) did not identify uric acid levels as an independent risk factor for cardiovascular disease or death from cardiovascular disease. However, most studies evaluating uric acid as a risk factor for atherosclerosis have focused on its association with heart disease. The present study found that group D had the highest uric acid level among the four groups. Our study also identified considerably higher raised uric acid levels in patients clinically suspected of having CAD with PAD and DM compared with other patients.

Recently, hs-CRP was identified as a powerful independent risk factor for atherosclerosis and atherosclerosis-related complications in healthy individuals and patients with cardiovascular disease, with a predictive power exceeding that of LDL cholesterol (32). A recent study demonstrated that the serum hs-CRP level is independently associated with PAD in type 2 DM patients (33). The present study found that hs-CRP levels were significantly and positively correlated with patients suspected of having CAD associated with PAD.

Although a given ABPI value of less than 0.9 had a poor sensitivity in predicting CAD in the present study, a high specificity and PPV in predicting a diagnosis of CAD were evident, illustrating that it is

important for physicians to pay attention to patients with low ABPI values who are at substantial risk for CAD.

CONCLUSION

The ABPI, a simple, inexpensive and well-established method for diagnosing patients with PAD, can be used to predict potential hazards in patients suspected of having CAD in a clinical setting. The present study confirmed that the ABPI could predict individuals with complex lesion subtypes that have been demonstrated to influence procedural and in-hospital outcomes following subsequent intervention. Low ABPI values indicated high uric acid and hs-CRP levels, which are potential risk factors for atherosclerosis and atherosclerosis-related complications such as cardiovascular morbidities and mortalities, stroke evidence, and increased rate of MS occurrence. These conclusions can be extended to patients with DM.

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