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Coronary calcium score for the prediction of asymptomatic coronary artery disease in patients with non-embolic ischemic stroke

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ABSTRACT

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Background and Aims: Many patients with ischemic stroke have concomitant coronary artery disease (CAD). AHA/ASA has recommended that patients with atherosclerotic stroke or significant carotid artery disease should undergo noninvasive evaluation for CAD. In the present study, we investigated whether the addition of coronary artery calcium (CAC) scores can improve the prediction of asymptomatic CAD based on the presence of risk factors and cervicocephalic artery atherosclerosis in patients with acute ischemic stroke.

Methods: Acute stroke patients who had undergone multi-detector computed tomography coronary angiography and cerebral angiography were enrolled. We compared the ability of risk factors, cerebral atherosclerosis, and CAC score to predict CAD via area under curve (AUC) analysis.

Results: Among the 1,143 included patients, significant (≥50%) coronary artery stenosis in at least one coronary artery was detected in 398 patients (34.8%). Significant stenosis (≥ 50%) of cervicocephalic arteries was detected in 362 patients (31.7%). CAC score was significantly correlated with significant CAD (Odds ratio of log [CAC+1]: 1.673, 95% confidence interval: 1.568-1.786, $p<0.0001$). The AUC value for the prediction of significant CAD was 0.6 for the number of classic risk factors, 0.6 for the number of cervicocephalic arteries with significant stenosis, and 0.788 for CAC score ($p<0.0001$ for all). For the combination of all three variables, the AUC value was 0.812.

Conclusions: CAC scanning may aid in screening for CAD in patients considered high risk based on classic risk factors and the presence of cervicocephalic artery atherosclerosis.

Key words: stroke, coronary artery disease, coronary calcium score, risk factors, cerebral atherosclerosis

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I. INTRODUCTION

Ischemic heart disease is among the leading causes of long-term mortality in patients with stroke. A recent meta-analysis reported that the annual risk of myocardial infarction in patients with ischemic stroke is approximately 2.2%[1,2]. Research has further indicated that the presence and extent of asymptomatic stenosis on coronary angiography is strongly predictive of major cardiovascular events, suggesting that many patients with ischemic stroke experience concomitant coronary artery disease (CAD)[3]. In fact, previous studies have identified significant (≥50%) stenosis of the coronary artery in 20-41% of patients with stroke via autopsy, coronary angiography, or multi-detector computed tomography (MDCT)[3-7].

These findings suggest that coronary screening is necessary in patients with stroke at high risk for CAD. The American Heart Association (AHA) and American Stroke Association (ASA) have recommended that patients with atherosclerotic stroke be considered at high risk (≥20% over 10 years) for further atherosclerotic coronary events[8]. However, it remains uncertain which group of patients with stroke should undergo evaluation for asymptomatic CAD, and which assessment tools are most appropriate for coronary screening in such patients.

Cardiac computerized tomography (CT) is useful for the diagnosis and screening of CAD. Although coronary CT angiography (CTA) using MDCT can be utilized for the diagnosis of asymptomatic CAD, the procedure requires the administration of contrast agents, which limits its use in patients with chronic kidney disease and has been associated with idiosyncratic side effects. Beta-blockers are also often required for heart rate control. Coronary artery calcium (CAC) scores obtained via non-contrast cardiac CT have been widely utilized for the prediction of ischemic heart disease. Although coronary CTA is superior to CAC for the prediction of major cardiovascular events[9], measurement of CAC is noninvasive, does not require the use of contrast agents, and can be performed very rapidly and easily.

The aim of the present study was to investigate the role of CAC score as an additional screening tool for the diagnosis of asymptomatic CAD in patients with stroke. We hypothesized that the prediction of CAD in patients with stroke can be improved by the addition of CAC scores to predictions based on the presence of cerebral artery atherosclerosis and vascular risk factors. Thus, we examined whether CAC scores could predict significant CAD in patients with acute stroke, and which patients would benefit from additional screening for significant CAD.

II. PATIENTS AND METHODS

1. Study population

For the present study, we considered consecutive patients with acute ischemic stroke or transient ischemic attack who had been admitted to the hospital within 7 days after the onset of symptoms. All admitted patients were evaluated using a standard protocol, which included brain CT and magnetic resonance imaging (MRI), cerebral angiographic studies (CT angiography, MR angiography, or digital subtraction angiography), standard blood tests, 12-lead electrocardiography, continuous electrocardiography monitoring during hospitalization in the stroke unit or 24-hour Holter monitoring, echocardiography, and MDCT [10,11]. All patient data were entered into the prospective registry. Patients who had been admitted between September 2011 and August 2013 and had undergone both MDCT and cerebral angiographic studies were included in the present study. MDCT was indicated when at least one of the following criteria was observed: (1) presence of atherosclerosis in the intracranial or extracranial cerebral arteries; (2) presence of ≥ 2 risk factors for CAD such as hypertension, diabetes mellitus, dyslipidemia, cigarette smoking, or central obesity; and (3) age associated with increased risk of CAD (men > 45 years, women > 55 years). Exclusion criteria were as follows: (1) known CAD (i.e., angiographically confirmed CAD, unstable angina, coronary artery stent or angioplasty/ coronary artery bypass graft); (2) high pulse rate (> 65/min) that were not controlled using beta blockers at the time of MDCT; (3) poor cooperation; (4) impaired renal function (estimated glomerular filtration rate <60 mL/min/1.73 m2 or history of chronic kidney disease), and (5) failure to obtain informed consent[7,12]. Patients with high-risk potential cardiac sources of embolism were excluded from analysis. The present study was approved by the Institutional Review Board of Severance Hospital, Yonsei University Health System (Seoul, Korea). Written informed consent for the cohort and MDCT was obtained from all patients. Informed consent for this specific study protocol was waived due to the retrospective nature of the analysis.

2. Assessment of cerebral atherosclerosis

Any abnormalities on angiographic studies were discussed and identified at a weekly stroke conference, based on a neuroradiologist’s report and the consensus of stroke specialists. The degree of stenosis in extracranial and intracranial arteries was evaluated using the North American Symptomatic Carotid Endarterectomy Trial and Warfarin vs. Aspirin for Symptomatic Intracranial Disease method, respectively.[13,14] When multiple stenotic lesions were present in one artery, data from the most severe lesion were used. Significant stenosis of cerebral artery atherosclerosis was defined as atherosclerotic stenosis ≥ 50% or obstruction.

3. Assessment of coronary atherosclerosis and CAC score

Patients underwent MDCT within 2 weeks after admission, using a second-generation dual-source CT scanner (Somatom Definition Flash; Siemens Medical Solutions, Erlangen, Germany) with prospective electrocardiographic gating, 330-ms gantry rotation time, and a 120-kV tube. A beta blocker (40 mg propranolol hydrochloride) was administered 1–2 h before examination for patients with a resting pulse rate > 65/min. Volume-rendered images, curved multiplanar images, and routine cardiac axis views were obtained using a dedicated workstation (Wizard; Siemens Medical Solutions) and interpreted by independent cardiac radiologists. The presence of stenosis was determined at four main coronary branches: left main, left anterior descending, left circumflex, and right coronary arteries. Significant stenosis was defined as atherosclerotic stenosis ≥ 50% or obstruction. The severity of obstructive CAD was categorized as follows: no CAD, mild CAD, one-vessel disease, two-vessel disease, and three-vessel disease.

CAC was identified as a high-attenuation area (exceeding the threshold of 130 Hounsfield units in a minimum of three contiguous pixels) in the coronary artery. CAC scores were calculated according to the Agatston method.[15] Patients were categorized into the following four subgroups based on the CAC score: 0, 0.1–99.9, 100–399.9, and ≥ 400.

4. Data analysis and statistics

All continuous data are expressed as means ± standard deviations, and all categorical data are presented as numbers (percentage). Independent Samples t-tests and Pearson $\chi 2$ tests were used to compare risk factors as well as the severity and location of cerebral artery atherosclerosis among the five CAD subgroups. Univariate and multivariate logistic regression analyses were performed to identify potential predictors of CAD. Odd ratios (ORs) with 95% confidence intervals (CIs) were calculated to estimate the risk associated with a particular variable, based on binomial distributions.

To determine which patients were at high risk due to probable, preclinical CAD, we simplified variables into two categories based on methods utilized in previous studies [6,7]. Following univariate analyses, risk was determined for each patient based on (a) the number of classic risk factors identified and (b) the presence of significant stenosis in the internal carotid artery (ICA), vertebrobasilar artery (VBA), or both. Hypertension, diabetes mellitus, dyslipidemia, and cigarette smoking were regarded as classic risk factors. Receiver operating characteristic (ROC) curves were generated to predict significant stenosis in at least one coronary artery. CAC score group, simplified cerebral stenosis group, and the number of classic risk factors were used as independent variables for the ROC curve analysis. Separate ROC curves were generated using a single independent variable, two independent variables (i.e., risk factors and simplified cerebral stenosis group), and all three independent variables. Areas under the ROC curve (AUCs) were calculated to assess the ability of each model to predict CAD, and were compared among the three models. ORs associated with CAC score group were calculated for patients with potential CAD as determined via ROC analysis and compared to those of patients at low risk. Logarithmic values of (CAC+1) were used for regression analysis. Statistical significance was set at $p<0.05$. SPSS for Windows (version 17.0, SPSS Inc., Chicago, IL, USA) was used for statistical analysis. AUC analysis and comparisons of ROC curves were performed using MedCalc Statistical Software version 17.6 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2017).

III. Results

1. Baseline characteristics of study population

Among the 2,306 patients admitted during the study period, 1,762 patients (76.4%) underwent MDCT coronary angiography. Following the exclusion of patients with high-risk potential cardiac sources of embolism (397 patients), those without available CAC scores (212 patients), and those without cerebral angiographic data (10 patients), a final total of 1,143 patients (49.6%) were included in the analysis.

Among these 1,143 patients (717 men; 62.7%), the mean age was 63 ± 12 years (range: 17 to 96). The mean CAC score was 221.5 ± 498 (range: 0 to 5893). Cerebral atherosclerosis was detected in 810 patients (70.9%). Cerebral atherosclerosis with significant (≥50%) stenosis in any location was detected in 591 patients (51.7%). Among these 591 patients, isolated extracranial atherosclerosis was identified in 150 patients (25.3%), isolated intracranial atherosclerosis was identified in 335 patients (56.7%), and combined extracranial and intracranial atherosclerosis was identified in 106 patients (17.9%).

Significant stenosis of the ICA was detected in 164 patients (14.3%), while significant stenosis of the VBA was detected in 279 patients (24.4%). Significant stenosis of both the ICA and VBA was detected in 81 patients (7.1%). Significant coronary artery stenosis (≥50% stenosis) in at least one coronary artery was detected in 398 patients (34.8%: one-vessel disease in 205 patients [17.9%], two-vessel disease in 114 patients [10.0%], and three-vessel disease in 79 patients [6.9%]).

Patients were categorized into five subgroups based on the extent of CAD (Table

1). Patients with severe CAD were older and more frequently male ($p<0.001$). Hypertension, diabetes mellitus, dyslipidemia, metabolic syndrome, and peripheral artery disease were more frequent in patients with severe CAD (Table 1). Initial blood glucose, fasting blood glucose, fibrinogen, and triglyceride levels were also higher in patients with severe CAD. However, high-density lipoprotein (HDL) cholesterol levels were lower in patients with severe CAD (Table 1). The extent of CAD increased as the CAC score increased ($p<0.001$) (Table 2).

Table 1. Baseline characteristics of study population based on the extent of coronary artery atherosclerosis

	Normal (N=305)	Mild (N=440)	1-vessel disease (N=205)	2-vessel disease (N=114)	3-vessel disease (N=79)	P
Age, years	57.8 ± 12.7	63.7 ± 11.3	66.0 ± 11.2	68.6 ± 10.0	70.3 ± 10.6	<0.0001
Sex, male	160 (52.5)	283 (64.3)	135 (65.9)	78 (68.4)	61 (77.2)	<0.0001
Risk factors						
Hypertension	169 (55.4)	301 (68.4)	150 (73.2)	90 (78.9)	55 (69.6)	<0.0001
Diabetes mellitus	58 (19.0)	104 (23.6)	82 (40.0)	43 (37.7)	35 (44.3)	<0.0001
Dyslipidemia	75 (24.6)	100 (22.7)	49 (23.9)	43 (37.7)	21 (26.6)	0.024
Smoking	85 (27.9)	124 (28.2)	63 (30.7)	33 (28.9)	22 (27.8)	0.963
Metabolic syndrome	89 (29.2)	154 (35.0)	89 (43.4)	46 (40.4)	27 (34.2)	0.016
Peripheral artery disease	5 (2.0)	8 (2.2)	9 (5.4)	5 (6.0)	14 (23.0)	<0.0001
Previous stroke	36 (11.8)	79 (18.0)	32 (15.6)	17 (14.9)	19 (24.1)	0.057
Laboratory findings						
HbA1C	155.5 ± 229.6	145.3 ± 119.4	153.0 ± 88.1	149.1 ± 41.4	159.8 ± 47.8	0.908
Initial glucose	127.7 ± 43.8	134.3 ± 52.4	148.7 ± 68.0	147.7 ± 68.1	164.4 ± 68.5	<0.0001
Fasting glucose	106.8 ± 33.2	108.0 ± 33.2	116.8 ± 39.0	121.2 ± 55.7	126.3 ± 46.0	<0.0001
C-reactive protein	22.8 ± 56.9	16.7 ± 28.0	19.4 ± 23.8	34.1 ± 69.0	21.3 ± 28.0	0.503
hs-CRP	5.9 ± 21.8	10.2 ± 116.1	6.5 ± 19.0	7.2 ± 15.2	11.0 ± 30.2	0.809
Total cholesterol	189.7 ± 41.2	184.4 ± 44.5	191.7 ± 89.5	210.3 ± 145.7	186.7 ± 43.9	0.121
Triglyceride	124.4 ± 95.6	124.9 ± 80.0	131.7 ± 70.4	137.8 ± 91.4	148.7 ± 133.1	0.018
HDL cholesterol	43.6 ± 11.2	42.7 ± 10.9	40.9 ± 9.9	41.6 ± 10.0	39.0 ± 7.3	<0.0001
LDL cholesterol	112.5 ± 64.5	106.6 ± 34.1	108.1 ± 32.7	114.1 ± 38.3	112.4 ± 31.7	0.805
Initial systolic BP	153.9 ± 26.5	157.6 ± 28.2	161.0 ± 27.7	154.4 ± 26.6	154.4 ± 25.6	0.547
Initial diastolic BP	87.1 ± 15.6	89.0 ± 15.8	86.0 ± 14.9	82.9 ± 12.2	82.5 ± 13.2	<0.0001

Values are presented as the mean ± standard deviation or number (%).
hs-CRP, high-sensitivity C-reactive protein; HDL, high-density lipoprotein; LDL, low-density lipoprotein; BP, blood pressure

Table 2. Association between coronary artery calcium (CAC) scores and coronary artery disease

CAC score	Coronary atherosclerosis					P
	Normal (N=305)	Mild (N=440)	1-vessel disease (N=205)	2-vessel disease (N=114)	3-vessel disease (N=79)	
CAC score (mean ± SD)	32.2 ± 158.9	105.1 ± 210.7	268.4 ± 476.5	483.8 ± 499.9	1100.9 ± 1104.9	<0.0001
CAC score group						<0.0001
CAC score 0	217 (71.1)	81 (18.4)	28 (13.7)	3 (2.6)	2 (2.5)	
0 < CAC score <100	71 (23.3)	233 (53.0)	74 (36.1)	23 (20.2)	5 (6.3)	
100 ≤ CAC score <400	9 (3.0)	96 (21.8)	63 (30.7)	38 (33.3)	11 (13.9)	
CAC score ≥400	8 (2.6)	30 (6.8)	40 (19.5)	50 (43.9)	61 (77.2)	

Numbers in parentheses represent percentages.

SD, standard deviation

2. Factors associated with significant coronary artery disease

Univariate analysis revealed that older age, male sex, hypertension, diabetes mellitus, metabolic syndrome, peripheral artery disease, high triglyceride levels, high initial glucose levels, high fasting glucose levels, low HDL levels, and low initial diastolic blood pressure were associated with significant CAD (Table 3). CAC score was significantly correlated with significant CAD (ORs of log [CAC+1]: 1.673, 95% CI: 1.568-1.786, p<0.0001), and the strength of the association increased as CAC score increased (Table 3). CAD was also associated with cerebral atherosclerosis. The association between cerebral atherosclerosis and CAD was marked for the ICA (OR: 2.2237, 95% CI: 1.5918-3.1065, p<0.0001) and VBA (OR: 2.3657, 95% CI: 1.7947-3.1184, p<0.0001) but marginal for the intracranial arteries (anterior, middle, and posterior cerebral arteries) (OR: 1.316, 95% CI: 1.011-1.713, p=0.041).

Table 3. Factors associated with significant coronary artery disease

	Odds ratio (95% confidence interval)	P
Mean age ± SD, years	1.048 (1.037–1.061)	<0.0001
Sex (male)	1.506 (1.164–1.949)	<0.0001
Risk factors		
Hypertension	1.676 (1.28–2.193)	<0.0001
Diabetes Mellitus	2.419 (1.855–3.155)	<0.0001
Dyslipidemia	1.291 (0.98–1.702)	0.69
Smoking	1.081 (0.827–1.413)	0.57
Metabolic syndrome	1.418 (1.102–1.824)	0.007
Peripheral artery disease	4.521 (2.307–8.860)	<0.0001
Previous stroke	1.129 (0.813–1.567)	0.469
Laboratory findings		
HbA1C	1 (0.999–1.001)	0.704
Initial glucose	1.006 (1.004–1.008)	<0.0001
Fasting glucose	1.008 (1.005–1.011)	<0.0001
C-reactive protein	1.002 (0.996–1.009)	0.422
hs-CRP	1 (0.998–1.002)	0.841
Total cholesterol	1 (002,1.000–1.004)	0.064
Triglyceride	1.001 (1.001–1.003)	0.038
HDL cholesterol	0.979 (0.967–0.991)	0.001

LDL cholesterol	1.001 (0.998–1.004)	0.578
Initial systolic blood pressure	1.002 (0.998–1.007)	0.324
Initial diastolic blood pressure	0.983 (0.974–0.991)	<0.0001
CAC group		
CAC score 0	Reference	
0 < CAC score <100	3.03 (1.98 3–4.629)	<0.0001
100≤ CAC score <400	9.632 (6.158–15.068)	<0.0001
CAC score ≥400	35.884 (21.639–59.506)	<0.0001

hs-CRP, high-sensitivity C-reactive protein; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SD, standard deviation

3. Prediction of significant CAD

We investigated the ability of risk factors, cerebral atherosclerosis, and CAC score to predict significant CAD via AUC analysis. The AUC value was 0.6 for the number of classic risk factors (hypertension, diabetes mellitus, dyslipidemia, and smoking), 0.6 for the number of cerebral arteries with significant (≥50%) atherosclerosis (ICA and VBA), and 0.788 for CAC score (p<0.0001 for all). The AUC value was 0.642 for the combination of risk factors and cerebral atherosclerosis (p<0.0001). For the combination of all three variables, the AUC value was 0.812, which was significantly higher than other AUC values (p<0.0001) (Figure 1).

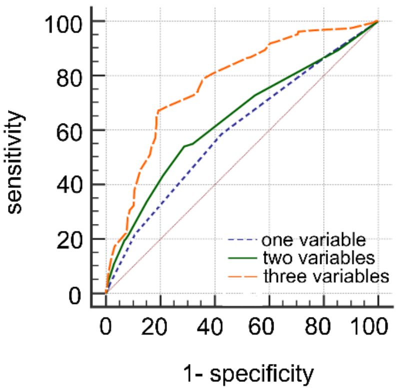

Figure 1. Prediction of significant coronary artery disease. Comparison of receiver

operating characteristic curves obtained using one variable (number of risk factors), two variables (number of risk factors and number of arteries with significant stenosis [ICA and/or VBA], and three variables (number of risk factors, number of arteries with significant stenosis [ICA and/or VBA], and coronary artery calcium score). ICA: internal carotid artery; VBA: vertebrobasilar artery.

Comparison of receiver operating characteristic curves obtained using one variable (number of risk factors), two variables (number of risk factors and number of arteries with significant stenosis [ICA and/or VBA], and three variables (number of risk factors, number of arteries with significant stenosis [ICA and/or VBA], and coronary artery calcium score). ICA: internal carotid artery; VBA: vertebrobasilar artery.

IV. Discussion

In the present study, the presence of vascular risk factors or cervicocephalic artery atherosclerosis was associated with asymptomatic CAD in patients with cerebral infarction. Atherosclerosis is a systemic disease, and CAD shares several risk factors with cerebral atherosclerosis[1]. In accordance with our findings, previous studies have demonstrated a significant association between CAD and atherosclerosis of the VBA or carotid arteries[2-5]. Indeed, the AHA/ASA recommended that routine noninvasive evaluation for CAD be considered in the presence of significant carotid disease[1]. However, the AUC estimates in our study population indicated the predictive ability of vascular risk factors or cervicocephalic artery atherosclerosis was poor, even when both vascular risk factors and cervicocephalic artery atherosclerosis were considered.

The Framingham risk score is commonly used to predict CAD. The Framingham risk score is a multivariable statistical model that uses a risk factor-based paradigm, which includes variables such as age, sex, smoking, and total cholesterol, LDL cholesterol, systolic blood pressure, and pharmacological treatment for high blood pressure. The Predicting Asymptomatic Coronary Artery Disease in Patients with Ischemic Stroke and Transient Ischemic Attack (PRECORIS) score, which considers the presence and severity of cervicocephalic artery stenosis in addition to Framingham risk score, has proven useful for the identification of a population of patients with stroke exhibit high rates of CAD[2,6.] However, the use of PRECORIS scores for coronary screening of patients with stroke in clinical practice remains limited.

Previous research has indicated that CAC is superior to risk factor-based prediction of CAD and coronary events[7-10.] In the present study, predictions of CAD based on CAC scores were more accurate than those based on risk factors and cervicocephalic artery atherosclerosis. Additional studies have reported that CAC scores are associated the severity of CAD: Scores of 0-10 are associated with a low probability of significant CAD, scores of 11-100 indicate that mild CAD is likely, and scores of 101-400 are associated with a high likelihood of non-obstructive CAD [11]. In a large prospective population cohort registry of 6,814 individuals, the risk of coronary events increased as the CAC score increased [10]. Further research has demonstrated that CAC scores >400 are indicative of CAD, with 10-year event rates exceeding 20% in asymptomatic patients [12]. In accordance with these previous findings, CAC scores greater than 400 were associated with a 35-fold increase in the risk of significant CAD in the present study.

Asymptomatic CAD has been associated with poor long-term outcomes in patients with stroke. Among patients without known CAD, major vascular events are more frequent in patients who are diagnosed with CAD via coronary angiography [13]. In a recent study involving 1,893 patients with acute ischemic stroke, asymptomatic CAD detected via MDCT was associated with an increased risk of vascular events or death during long-term follow-up [14.] Propensity score matching analyses have revealed that, among patients with acute ischemic stroke, vascular events and death were less frequent in patients who had undergone MDCT during follow-up than in those who had not [15.] These findings highlight the need to screen for asymptomatic CAD in patients with acute cerebral infarction.

In the present study, the addition of CAC scores to predictions based on the presence of risk factors and cervicocephalic artery atherosclerosis remarkably improved the AUC estimates of asymptomatic CAD risk in patients with stroke. Previous studies have demonstrated that the addition of CAC scores to predictions based on vascular risk factors or Framingham risk score improves the prediction of coronary events in patients without known CAD [9,16]. Taken together, these findings indicate that the combination of CAC score, risk factors, and cervicocephalic artery atherosclerosis may be useful for noninvasive screening for asymptomatic CAD in patients with stroke.

The present study possesses some limitations of note. First, CAC scores in our study population may have been higher than those in the general population, as all enrolled patients had experienced a stroke or transient ischemic attack. Second, this study was based on data obtained from a single hospital-based registry, in which all patients were of the same ethnicity. Since the prevalence and risk of CAD and cerebral atherosclerosis may differ among countries and ethnicity [17], caution should be applied when generalizing our results to other population, and further studies are required to validate our findings in additional populations. Third, 29% of our study population exhibited a CAC score of 0. As small calcifications were detected on thin-slice CT images obtained from patients with CAC scores of 0 in a recent study [18], CAC scores may differ based on the thickness of CT slices.

Although the AHA/ASA have highlighted the importance of noninvasive screening for CAD in patients with stroke at high risk for significant carotid artery disease or atherosclerotic stroke[1], the application of such screening measures in clinical practice remains quite low. This discrepancy is due in part to the lack of evidence or consensus regarding the most appropriate diagnostic tool for such assessment. As CAC scores can be obtained easily and noninvasively, our findings suggest that CAC scanning can be used to screen for CAD in patients considered high risk based on classic risk

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ABSTRACT (IN KOREAN)

비색전성 뇌경색 환자에서 관상동맥칼슘 점수를 통한 무증상의 관상동맥질환의 예측

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배경: 뇌경색 환자의 상당수에서 관상동맥질환을 함께 앓고 있는 경우가 많다. 미국심장협회와 미국뇌졸중학회에서는 죽상동맥경화증에 의한 뇌경색 또는 심각한 경동맥 질환을 갖고 있는 환자의 경우 비침습적인 방법으로 관상동맥질환의 동반여부를 검사하도록 권고하고 있다. 본 연구에서는 관상동맥 칼슘점수가 급성 뇌경색 환자에서 무증상의 관상동맥질환을 예측하는데 있어 기존의 위험인자 및 대뇌죽상동맥경화증 외에 추가적으로 어떠한 도움을 주는지를 알아보고자 하였다.

방법: 급성 뇌경색으로 입원한 환자 중 관상동맥 전산화 단층촬영과 두부 혈관촬영을 시행한 환자를 후향적으로 선발하였으며 이들 환자에서 위험인자, 대뇌죽상동맥경화증, 관상동맥칼슘점수를 곡선하면적 분석을 통해 무증상의 관상동맥질환에 대한 예측력을 알아보고자 하였다.

결과: 1143명의 환자 중 최소 하나 이상의 심각한 (≥50%)

관상동맥질환을 갖고 있는 환자는 398명이었고 (34.8%), 심각한 (≥50%) 대뇌죽상동맥경화증 (내경동맥 또는 척추뇌기저동맥) 환자는 362명이었다 (31.7%). 관상동맥칼슘점수는 관상동맥질환의 중증도와 높은 연관성을 보였으며 (Odds ratio of log [CAC+1]: 1.673, 95% 신뢰구간: 1.568-1.786, $p<0.0001$) 심각한 관상동맥질환을 예측하기 위한 곡선하면적 값은 위험인자는 0.6, 대뇌 죽상동맥경화증은 0.6, 관상동맥칼슘점수는 0.788 ($p<0.0001$) 이었다. 3가지 값을 모두 고려하였을 때 곡선하면적 값은 0.812로 가장 높았다.

결론: 관상동맥칼슘점수는 관상동맥질환을 예측하는데 있어 위험인자 및 대뇌죽상동맥경화증과 함께 중요한 요소가 될 수 있다.

핵심되는 말: 뇌경색, 관상동맥질환, 관상동맥칼슘점수, 위험인자, 대뇌죽상동맥경화증