Study of the involved vascular territories in patients with ischemic stroke in Kerman, Iran

Hossein Ali Ebrahimi[(1)], Mohammad Saba[(2)], Behnaz Sedighi[(3)], Hoda Kamali[(4)]

Short Communication

Abstract

BACKGROUND: The races show different cerebrovascular involvements, for example, the involvement of intracranial arteries are higher among Asians than Caucasians. The aim of this study was to investigate the cerebrovascular stenosis pattern by computed tomography angiography (CTA), which is unprecedented in Iran.

METHODS: In this study, patients with brain stroke (thrombosis), confirmed by CT scanning and cardiac assessments, who referred to Shafa Hospital in Kerman, Iran, underwent brain and cervical arteries CT angiography to assess involved cerebrovascular territories and also its risk factors from June 2012 to June 2013.

RESULTS: We did CTA for 100 patients. Eighty-four cases had cerebral artery stenosis. Intracranial vessel involvement alone was observed in 47.6% of patients, simultaneous intracranial and extracranial artery stenosis in 26.2%, and extracranial artery stenosis in 26.2%. Posterior cerebral artery territory showed the highest degree of vascular stenosis. Posterior cerebral artery stenosis alone was observed in 51.3% of the cases; 27.4% of the cases suffered from anterior artery stenosis, and 21.6% had simultaneous anterior and posterior cerebral artery stenosis. Smokers showed higher extracranial artery involvement compared to non-smokers; 44% of smokers and 14% of non-smokers had extracranial vertebral involvement.

CONCLUSION: Our findings showed that intracranial artery involvement was the most prevalent finding in patients with thrombotic stroke in Kerman. Also posterior cerebral artery stenosis was more prevalent than anterior artery stenosis. Hypertension was the most common risk factor. Furthermore, smoking was considered as an important risk factor for extracranial artery stenosis, especially in the posterior cerebral artery.

Keywords: Thrombosis, Stroke, Computed Tomography, Angiography, Risk Factors

Date of submission: 26 Nov 2014, ***Date of acceptance:*** 07 May 2016

Introduction

Stroke is a sudden neurological deficit, due to the disturbance of blood and oxygen supply.[1] Stroke is one of the main causes of morbidity and is the third leading cause of mortality after heart disease and cancer, and the second most common cause of mortality in developing countries.[2]

One of the most important causes of ischemic stroke is intracranial atherosclerosis,[3] which is defined as the skull base large-artery atherosclerosis with a poor prognosis.[4] The prevalence of intracranial atherosclerosis is different in different countries.[5] In the past two decades, many studies have pointed to different intracranial arteries stenosis and related risk factors in different races.[5-9]

Numerous methods can be done for cerebrovascular assessment. Brain and cervical computed tomography angiography (CTA) have high sensitivity and specificity (98%) for detecting intracranial stenosis, providing reliable and fast-produced information regarding the location of obstruction, the segment involved, and the presence or absence of collateral arteries,[10] with a high negative predictive value, unlike Doppler ultrasound and magnetic resonance angiography (MRA).[11]

Because CTA highlights intracranial artery thrombosis in patients with mild symptoms of acute stroke, and that this thrombosis increases recurrent strokes and worsens the patient's clinical symptoms,[7] application of CTA is rising. CTA is a

1- Professor, Neurology Research Center, Kerman University of Medical Sciences, Kerman, Iran
2- Assistant Professor, Neurology Research Center, Kerman University of Medical Sciences, Kerman, Iran
3- Associate Professor, Neurology Research Center AND Department of Neurology, Kerman University of Medical Sciences, Kerman, Iran
4- Resident, Neurology Research Center, Kerman University of Medical Sciences, Kerman, Iran
Correspondence to: Hossein Ali Ebrahimi, Email: hebrahimi@kmu.ac.ir

rapidly developing technology with great potentials. This is particularly true for evaluating neurovascular diseases.[12] CTA has been advanced by the development of improved multi-detector CT (MDCT) and workstations that post-process the data.[13,14]

Materials and Methods

Sampling: In this cross-sectional study, we evaluated 100 patients with thrombotic stroke. The patients with suspected stroke, who referred to the Neurological Emergency Department of Shafa Hospital in Kerman, Iran, underwent physical examination by a neurologist from June 2012 to June 2013. After that, brain CT scan or Magnetic resonance imaging (MRI) was conducted for the suspected patients to confirm thrombotic stroke diagnosis.

Exclusion criteria were hemorrhagic stroke, embolic stroke, unstable hemodynamic status, impaired renal function or sensitivity to the radio-contrast agent and those who did not consent.

Based on a population-based study, risk factors for atherosclerosis were defined as hypertension, diabetes mellitus and hypercholesterolemia.[15] Patients with daily dependence on cigarettes and opium were considered smoker and opium-addict, respectively.

Performing CTA: As a part of the diagnosis program, brain and cervical CTA (with contrast medium 370 mg/ml) were conducted for patients with confirmed thrombotic stroke, and without the mentioned exclusion criteria (non-invasive method).[16-18] Findings such as 3-dimention images, were assessed by a radiology faculty member to determine the involved vascular territories. We used descriptive and Student's t-test for data analysis.

Results

Prevalence of the involved vascular territory: Eighty-four patients (male = 45, female = 39) had visible cerebral artery stenosis. As for the 16 cases with no evidence of cerebral and cervical artery stenosis in the CTA, the pertaining clinical and radiographic symptoms indicated the involvement of intracranial small artery. Concerning risk factors analysis (sex, mean age of patients, rate of smoking, opium addiction, hypertension, diabetes and hyperlipidemia), no significant relationship was observed between the two groups, with small and large artery stenosis. The involvement of middle cerebral artery was more than twice of anterior cerebral artery.

Investigation of risk factors: Seventy-three percent of the cases were hypertensive. Extracranial artery involvement was significantly higher in men than in women (40 vs. 10%) (P = 0.003), while, women showed higher simultaneous intra- and extracranial artery stenosis (P = 0.003).

Intracranial vertebral artery involvement was significantly higher in women (38.5%) than in men (13.3%) (P = 0.008). Whereas, extracranial vertebral artery involvement was higher in men (P = 0.030).

About 44% of smokers and 14% of non-smokers had extracranial vertebral involvement, which was statistically significant (P = 0.030).

There was no significant relationship between age, hyperlipidemia, diabetes mellitus, opium-dependence, and intra- and extracranial artery involvement.

As for risk factor analysis in the two groups, concerning the involvement of posterior and anterior cerebral circulation, hypertension was observed in 62% and smoking in 53% of ischemic stroke patients, within the territory of posterior cerebral circulation. Involvement of posterior cerebral circulation was significantly higher in smokers, than in non-smokers (P = 0.040). However, no significant relationship was observed between gender, age, high blood cholesterol, diabetes, opium-dependence, and anterior/posterior cerebral circulation involvement.

Discussion

Intracranial atherosclerosis is a major cause of ischemic stroke. Frequency of atherosclerosis is different in different races. Intracranial artery involvement is more common in Asian races. Information on ischemic stroke patients in Iran, according to the findings of Doppler ultrasound, indicated that extracranial artery involvement was higher than that of intracranial artery.[19-21] Of the studied cases, 16% had no involvement, which might be due to small artery disorders. In general, CTA may slightly underestimate stenosis.[13]

The present study reported an intracranial artery involvement of 47.6%, which confirms the results of the majority of studies conducted in Asia. In a study in South Korea, the intracranial artery involvement was reported in 26.4% of the cases, simultaneous intra- and extracranial artery involvement in 39%, and extracranial artery involvement in 12.2% of the cases.[22] Another study in China reported 29% intracranial artery involvement, 9% extracranial, 43% simultaneous and no stenosis in 19% of cases.[23]

A study in Netherlands showed an exceeding 30% intracranial artery stenosis in 36% of the cases, mostly present in posterior cerebral circulation

(67%), which matches our findings in terms of the territory of the involved arteries, but against with some studies in Europe, as well as a study in Iran.[19,21] Paciaroni et al.[24] studied the correlation between the potential causes of stroke (TOAST etiological groups) and the involvement of different vascular territories seen on CT scans in patients with ischemic stroke. Large artery disease was the main cause of entire middle cerebral artery (MCA) territory infarcts (40.9%), superficial MCA territory infarcts (35.7%), and watershed infarcts (68.2%).[24] Chung et al.[25] studied a consecutive series of 2702 acute ischemic stroke patients whose stroke lesions were confirmed by diffusion weighted imaging and who underwent a thorough etiological investigation. Large artery atherosclerosis (37.3%) was the most common stroke subtype, and MCA (49.6%) was the most frequently involved territory. Large-artery atherosclerosis was the most common subtype for anterior cerebral, middle cerebral, vertebral, and anterior and posterior inferior cerebellar artery territory infarctions.[25] Maybe different conclusions are due to different methodologies; for example studies done in Iran used Doppler ultrasound, which has a lower sensitivity in finding intracranial stenosis, especially those of posterior cerebral circulation.[10,11]

Our finding of higher prevalence of stenosis in the territory of posterior cerebral circulation is against reported results by other studies in Asia, which similarly employed CTA.[11] These studies reported the middle and carotid cerebral arteries as the most common involved arteries,[22,23,26] which may be a result of racial differences. Smokers, in our study, suffered from a higher extracranial artery involvement, which is supported by a study in China.[27]

The most common risk factors for patients with posterior cerebral artery stroke were hypertension (62%), followed by smoking (53%). The study by Mousavi and Hoseini showed similar risk factors, where smoking was reported more common in patients with posterior, rather than anterior cerebral artery involvement.[28] Against our findings, Lee et al. reviewed consecutive patients with acute posterior cerebral artery territory infarction who underwent diffusion-weighted MRI (DWI) and MRA within 7 days after onset. In this study, hypertension (n = 144, 70.2%) was the most prevalent risk factor, followed by diabetes (n = 74, 36.1%), smoking (n = 60, 29.3%), hyperlipidemia (n = 46, 36.1%), previous stroke (n = 35, 17.1%), heavy alcohol drinking (n = 29, 14.1%), and other potential risk factors (n = 21, 10.2%).[29]

Our study has limitations. First, vascular evaluation was performed by CTA, but not conventional angiography. Second, transesophageal echocardiography and longtime Holter monitoring were performed in a limited number of patients. As discussed earlier, this might have underestimated the frequency of cardiac emboli. However, we attempted to document the source of embolism whenever an embolism was suspected.

Conclusion

Our findings showed that intracranial artery involvement was the most prevalent finding in patients with thrombotic stroke in Kerman. Also, posterior cerebral artery stenosis was more prevalent than anterior artery stenosis and hypertension was the most common risk factor. Furthermore, smoking was considered as an important risk factor for extracranial artery stenosis, especially in the posterior cerebral artery.

Acknowledgments

This study was approved by the Neurology Research Center of Kerman University of Medical Sciences, and is a part of residency thesis of Hoda Kamali.

Conflict of Interests

Authors have no conflict of interests.

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How to cite this article: Ebrahimi HA, Saba M, Sedighi B, Kamali H**. Study of the involved vascular territories in patients with ischemic stroke in Kerman, Iran.** ARYA Atheroscler 2016; 12(5): 250-3.