Identification of Suspected Ruptured Atherosclerotic Plaque in Acute Ischemic Stroke on ^{18}F -Sodium Fluoride Positron Emission Tomography-Computed Tomography

Guang-Uei Hung, MD; Chao-Hsien Hung, MD; Tai-Yi Chen, MD; Woon-Man Kung, MD; Cheng-Yu Wei, MD; Chia-Hung Kao, MD; Shinichiro Uchiyama, MD, PhD

Figure 1. Diffusion-weighted magnetic resonance imaging showing (A) hyperintensity in the territory of the left middle cerebral artery. (B,C) Carotid sonography showing calcified atherosclerotic plaque (arrows) in the bilateral internal carotid arteries near the bifurcation area. Luminal stenosis was estimated as (B) 36% of the diameter for the plaque in the left internal carotid artery and (C) 15% for the plaque in the right internal carotid artery.

An 81-year-old woman, with a past history of type 2 diabetes and hypertension, was brought to the emergency room with acute-onset decreased responsiveness accompanying right-sided weakness. Neurological examination indicated motor aphasia, right central facial palsy, and right hemiparesis. Computed tomography (CT) showed no evidence

of intracranial hemorrhage, while laboratory data were unremarkable. Magnetic resonance imaging showed acute ischemic stroke in the left middle cerebral artery territory (Figure 1A). Carotid sonography showed non-obstructive atherosclerotic plaque in the bilateral internal carotid arteries near the bifurcation, with only 36% luminal stenosis for the left side (Figure 1B)

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Department of Nuclear Medicine (G.-U.H.), Department of Neurology (C.-H.H., C.-Y.W.), Department of Radiology (T.-Y.C.), Chang Bing Show Chwan Memorial Hospital, Changhua; Department of Biomedical Imaging and Radiological Science, Central Taiwan University of Science and Technology, Taichung (G.-U.H.); Department of Exercise and Health Promotion, College of Education, Chinese Culture University, Taipei (W.-M.K., C.-Y.W.); Department of Neurosurgery, Lo-Hsu Foundation, Lotung Poh-Ai Hospital, Yilan (W.-M.K.); Department of Neurology, Show Chwan Memorial Hospital, Changhua (C.-Y.W.); Department of Nuclear Medicine, School of Medicine, China Medical University, Taichung (C.-H.K.), Taiwan; Clinical Research Center for Medicine, International University of Health and Welfare, Tokyo (S.U.); and Center for Brain and Cerebral Vessels, Sanno Hospital and Sanno Medical Center, Tokyo (S.U.), Japan

The first two authors contributed equally to this work (G.-U.H., C.-H.H.).

Mailing address: Cheng-Yu Wei, MD, MS, Department of Neurology, Chang Bing Show Chwan Memorial Hospital, No. 6, Lugong Road, Lugang Town, Changhua County, Taiwan 505. E-mail: yuyu@seed.net.tw and Chia-Hung Kao, MD, Department of Nuclear Medicine, School of Medicine, China Medical University, No. 91, Hsueh-Shih Road, Taichung, Taiwan, 404. E-mail: d10040@mail.cmuh.org.tw

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Rupture of an atherosclerotic plaque is the major cause of acute myocardial infarction and ischemic stroke.^{1,2} Most of the high-risk (also called vulnerable) plaques are non-obstructive and are not identified on routine stress testing or other non-invasive imaging, thus, ruptured plaque is difficult to predict.³ According to the literature, ¹⁸F-NaF PET-CT was found to be the first non-invasive imaging method to identify ruptured or vulnerable coronary plaque.⁴ This is a major clinical advance for the prevention and treatment of acute coronary syndrome. Although some studies have shown the usefulness of ¹⁸F-fluorodeoxyglucose as a surrogate for vascular inflammation and macrophage burden,^{5,6} ¹⁸F-NaF activity seems to distinguish culprit plaque and non-culprit plaques better.⁴ ¹⁸F-NaF PET-CT is a clinical, routine imaging modality used for the evaluation of primary and metastatic bone tumors, because it detects area of active calcification and region of remodeling in the skeleton. In addition, ¹⁸F-NaF PET-CT can detect vascular microcalcification, a major feature of vulnerable atherosclerotic plaques unable to be detected on standard CT.⁷ The accuracy of localization on ¹⁸F-NaF PET-CT may be better than multi-slice CT

to predict unstable plaque in acute coronary syndrome.⁸ Here, we report the first case of ruptured carotid plaque successfully identified on ¹⁸F-NaF PET-CT in an acute ischemic stroke patient. Further studies are warranted to establish its clinical value in the prevention of ischemic stroke.

Disclosures

None.

References

1. Falk E, Nakano M, Bentzon JF, Finn AV, Virmani R. Update on acute coronary syndromes: The pathologists' view. *Eur Heart J* 2013; **34**: 719–728.
2. Nighoghossian N, Derex L, Douek P. The vulnerable carotid artery plaque: Current imaging methods and new perspectives. *Stroke* 2005; **36**: 2764–2772.
3. Naghavi M, Libby P, Falk E, Casscells SW, Litovsky S, Rumberger J, et al. From vulnerable plaque to vulnerable patient: A call for new definitions and risk assessment strategies: Part I. *Circulation* 2003; **108**: 1664–1672.
4. Joshi NV, Vesey AT, Williams MC, Shah AS, Calvert PA, Craighead FH, et al. ¹⁸F-Fluoride positron emission tomography for identification of ruptured and high-risk coronary atherosclerotic plaques: A prospective clinical trial. *Lancet* 2014; **383**: 705–713.
5. Miyagawa M, Yokoyama R, Nishiyama Y, Ogimoto A, Higaki J, Mochizuki T. Positron emission tomography-computed tomography for imaging of inflammatory cardiovascular diseases. *Circ J* 2014; **78**: 1302–1310.
6. Yamashita A, Zhao Y, Zhao S, Matsuura Y, Sugita C, Iwakiri T, et al. Arterial ¹⁸F-fluorodeoxyglucose uptake reflects balloon catheter-induced thrombus formation and tissue factor expression via nuclear factor-κB in rabbit atherosclerotic lesions. *Circ J* 2013; **77**: 2626–2635.
7. Chen W, Dilsizian V. Targeted PET/CT imaging of vulnerable atherosclerotic plaques: Microcalcification with sodium fluoride and inflammation with fluorodeoxyglucose. *Curr Cardiol Rep* 2013; **15**: 364.
8. Kawasaki T, Koga N, Node K. Prediction of acute coronary syndrome by using multislice computed tomography: Can we predict the onset of acute coronary syndrome? (Pro). *Circ J* 2011; **75**: 2013–2018.