Clinical Observation

Imaging Features of Symptomatic Radiation-induced Cervical Artery Stenosis

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Recently, the survival rate of head and neck cancer patients has increased with the improvement of radiotherapy (RT) technology and comprehensive treatment. Cancer survivors after RT are at increased risk for cerebrovascular events.[1] Radiation-induced cervical artery stenosis (RICAS) has its own characteristics compared with those lesions without a history of RT.

Seventeen patients (15 men and two women), with a mean age of 61.5 ± 10.6 years, who had completed head and neck RT over 2 years were studied. All patients were classified into large artery atherosclerosis stroke according to the Trial of ORG 10172 in Acute Stroke Treatment classification system. The National Institutes of Health Stroke Scale (NIHSS) score at admission was collected. $ABCD^2$ score was used to assess the risk of stroke for transient ischemic attack (TIA) patients. Patients were excluded if they had any of the following: a history of head and neck trauma or operations, atrial fibrillation, valvular heart disease, autoimmune vasculitis, contraindication to antiplatelet therapy, gastrointestinal bleeding or major surgery within the previous 3 months, or severe noncardiovascular coexisting condition. Patients were also excluded if they had any cerebrovascular events before the diagnosis of cancer.

All patients received ultrasound examination and digital subtraction angiography (DSA), and the results including carotid intimal-medial thickness (CIMT) were collected. Afterward, the length and severity of stenosis were measured according to the results of DSA. Arteries with stenosis or ulcer plaques were considered as pathological vessels.

RT was performed several years (mean: 12.1 years; range: 2–24 years) before the onset of stroke or TIA. The indications for RT were as follows: nasopharyngeal carcinoma, 11 cases; laryngeal squamous cell carcinoma, two cases; vocal cord carcinoma, two cases; gingival carcinoma, one case; and tonsil cancer, one case. Two of these patients, with the $ABCD^2$ score of both six points were diagnosed as TIA.

The mean CIMT was 1.06 ± 0.11 mm. The mean NIHSS score at admission was 3.76 ± 3.27. With regard to the Oxfordshire Community Stroke Project classification of the 15 patients diagnosed with cerebral infarction, the proportion of lacunar infarcts (lacunar stroke or lacunar infarct, seven) was highest, followed by partial anterior circulation infarcts (five), total anterior circulation infarct (two), and posterior circulation infarcts (one).

Hypertension was the most commonly risk factor and 76.5% of the patients had the medical history of hypertension. Two patients were diagnosed with diabetes mellitus (DM), and the mean fasting blood glucose was 5.40 ± 1.10 mmol/L. Five patients had a history of smoking and two patients with drinking alcohol. Three patients were diagnosed with hyperhomocysteinemia (>15 mmol/L), and the mean homocysteine was 17.53 mmol/L at admission. The mean low-density lipoprotein-cholesterol was 2.75 ± 0.84 mmol/L.

There were 41 pathological arteries in these patients. Internal carotid artery (ICA, 36.6%) and common carotid artery (CCA, 19.5%) were most commonly involved, followed by external carotid artery (ECA, 17.1%), vertebral artery (VA, 17.1%), and subclavian artery (SA, 9.8%) [Figure 1]. There was no cerebral or basilar

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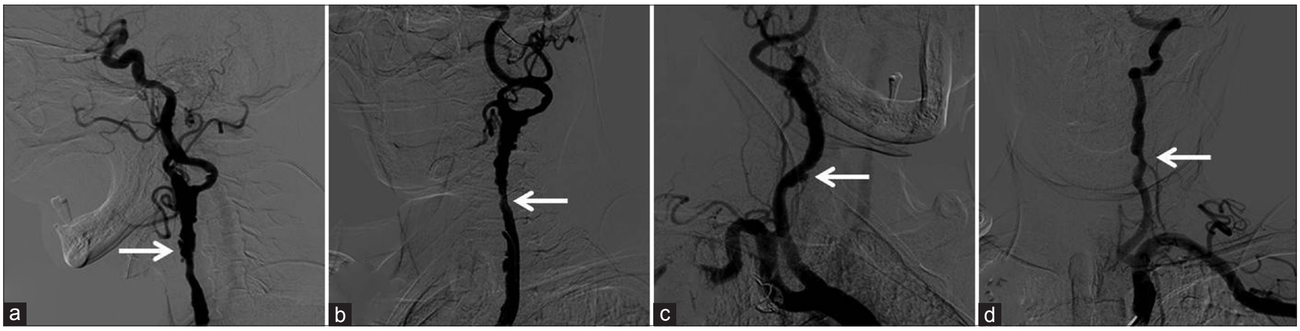

Figure 1: Imaging features of a 77-year-old male patient who had performed RT for 18 years because left laryngocarcinoma was demonstrated by DSA. (a and b) DSA showed the long segment stenosis and multiple ulcer plaques in left CCA (arrow). (c) Mild atherosclerotic plaques of the right CCA was revealed by DSA (arrow). (d) The left VA with obvious circuitry and mild stenosis was demonstrated (arrow). RT: Radiotherapy; DSA: Digital subtraction angiography; CCA: Common carotid artery; VA: Vertebral artery.

artery stenosis. Intracranial stenosis was present in only three arteries (7.3%).

Unilateral stenosis was common in this group. The proportion of unilateral stenosis of CCA, ICA, ECA, and VA was 50.0%, 75.0%, 88.3%, and 60.0%, respectively. All SA stenoses were unilateral. Ulcer plaques were also common. The proportion of ulcer plaques was 75.0%, 80.0%, and 71.4% in CCA, ICA, and ECA, respectively. Moreover, the proportion of ulcer plaques of SA and VA was 75.0% and 100%, respectively.

The mean length of CCA stenosis was 59.82 ± 34.12 mm. The mean length of ICA and ECA stenosis was 15.99 ± 12.68 mm and 11.67 ± 9.87 mm, respectively. Moreover, the mean length of SA and VA stenosis was 27.09 ± 28.11 mm and 10.02 ± 3.23 mm, respectively.

RT is the mainstay of treatment for head and neck cancer patients. However, the consequences of RT, such as cerebral artery stenosis and increased incidence of stroke, have gained increasing attention.[2]

RICAS has its own clinical and imaging features. Most of the stenotic lesions located in the anterior circulation system. This was associated with the irradiated region during RT, which mostly covers the front neck region.[3] Similarly, the results showed that extracranial lesions were more common. Nevertheless, RICAS might not only focus on the radiation-exposed area but also extends beyond the margins of the radiation field, especially to the proximal CCA and distal ICA.[4]

Ulcer plaques were also common in the RT group. Plaques in radiation-exposed patients are more diffuse with less shadowing and are more hypoechoic. These are related to intraplaque hemorrhage or lipid deposits within the plaque. In addition, ulcer or hypoechoic plaques are more likely to rupture, resulting in the subsequent occurrence of ischemic events.[5]

Symptomatic RICAS mainly presents in patients with prior RT for head and neck malignancies, with an interval of over 10 years. Symptomatic RICAS mainly involves ICA and CCA from the anterior circulation; VA and SA from the posterior circulation might also be affected. It mainly affects extracranial and unilateral arteries, which is consistent with the radiation field.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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