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Case Report

A case of radiation-induced subclavian artery stenosis treated with percutaneous transluminal angioplasty

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ABSTRACT

We report on a female patient who underwent a standard radical mastectomy and radiation therapy for right breast cancer at the age of 50 years without recurrence. At the age of 76 years, she started to experience fatigue in the right upper limb. The symptom gradually worsened and she was admitted to our hospital for further investigation. With computed tomography scan and angiography, we observed a high degree of subclavian artery (SCA) stenosis and asymptomatic right common carotid artery (CCA) stenosis. After undergoing carotid artery stenting to the right CCA stenosis at another hospital, we performed percutaneous transluminal angioplasty to SCA. Although we chose to treat the highly calcified lesion only with a balloon and slightly decreased the degree of stenosis, her symptoms clearly improved. Since arterial severely stenotic lesions were limited in the area of radiation exposure while other part of the arteries looked smooth and relatively free of sclerosis, it was highly suspected that arterial injury was induced by radiation. There are few reports of radiation-induced injury of upper limbs. However, this case suggests that we need to consider the possibility of radiation-induced arterial injury in patients with a history of radiation therapy.

<**Learning objective:** There are few reports regarding upper limb arterial stenosis and occlusion due to radiation-induced arterial injury. However, the underlying mechanism might be overlooked because the symptoms such as fatigue and numbness of the upper limb caused by arterial stenosis and occlusion resembled those of lymphedema and nerve disorders that frequently occur after mastectomy. This case suggests that we need to consider the possibility of radiation-induced arterial injury in the patients with a history of radiation therapy.>

Introduction

Large vessel damage caused by radiation therapy is considered relatively rare, and there have been not many case reports. It is also pointed out that arterial injury in the limbs after mastectomy can be overlooked because symptoms resemble postoperative lymphedema and nerve disorders.

We report on a case in which symptoms of high-degree subclavian artery (SCA) stenosis appeared 26 years after radiation therapy, and in which percutaneous transluminal angioplasty (PTA) was performed to treat the condition.

Case report

A 76-year-old female, who had undergone standard radical mastectomy and radiation therapy (50 Gy) to treat right breast cancer at 50-year old, started to experience fatigue and a sense of coldness in the right upper arm about 1 month before the admission.

Physical examination revealed that right upper arm was cold and that pulsation in the radial, ulnar or brachial artery of the right arm was not palpable. The noninvasive blood pressure (NIBP) in the right arm was 70/40 mmHg while it was 125/65 mmHg in the left arm and pattern of pulse wave in ankle brachial index (ABI) was dull in the right arm (Fig. 1A). A high-grade calcified plaque and stenosis of the right SCA was observed with computed tomography (CT) scan (Fig. 1B) and also with angiography (Fig. 1C and D). The symptoms in the right arm were thought to be caused by this lesion. In addition, a high degree of right common carotid artery (CCA) stenosis (peak systolic velocity: 511 m/s and 93% stenosis) without cerebral infarction was observed with carotid echocardiography, CT, and angiography.

These findings suggested that the patient was eligible for intervention to treat the right CCA and right SCA. At first, the patient underwent carotid artery stenting at another hospital. About

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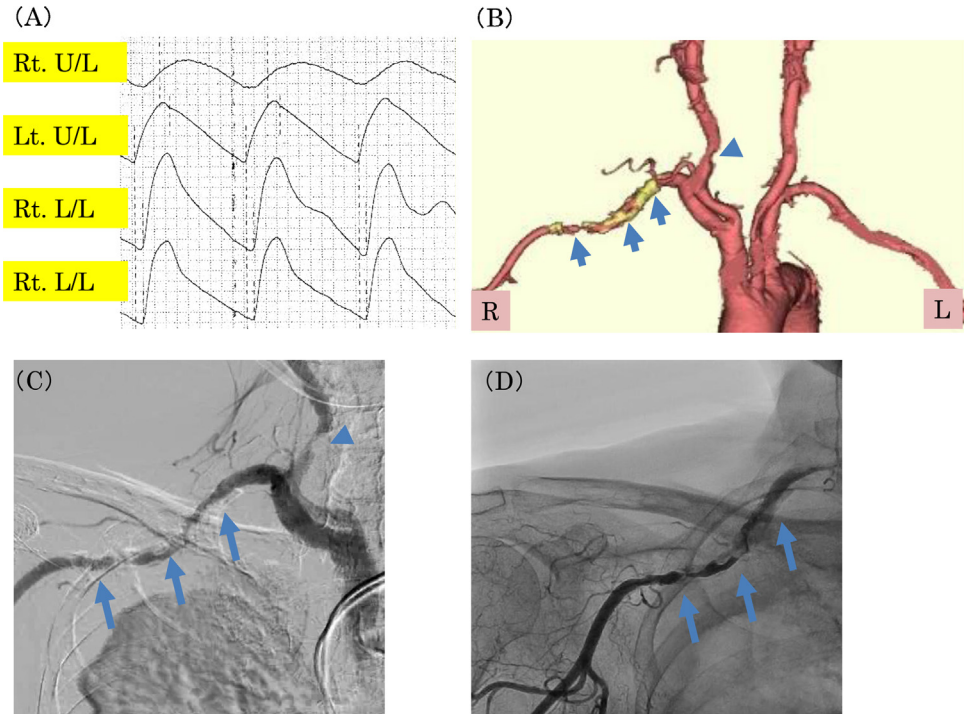

Fig. 1. Pattern of pulse wave was dull in Rt. U/L (A). Computed tomography (CT) angiography (B), digital subtraction angiography (C) and angiography (D) showing high-degree stenosis with severe calcified plaque in the right subclavian artery (SCA) (arrow) and stenosis of the right common carotid artery (arrow head). On the other hand, CT angiography showing no lesion in the left SCA. Rt, right; Lt, left; U/L, upper limb; L/L, lower limb.

1 month after the treatment, the patient was again admitted to our hospital for the treatment of the right SCA.

Initially we wanted to approach from the radial artery, but Allen test was clearly negative. Therefore, we chose the trans-brachial artery approach. There was no palpable pulse on the right brachial artery, and puncture was conducted using ultrasound guidance. We placed a 6 Fr Radifocus® Introducer II H (Terumo, Tokyo, Japan). For the imaging on the contralateral side, a 5 Fr Brite Tip™ sheath (Cordis Corporation, Fremont, USA) was placed in the right femoral artery, through which a 5 Fr JR 4.0 catheter was introduced and placed in the right brachiocephalic artery. After carefully crossing the lesion using a Neo's Cruise wire (0.014 inch, ASAHI INTECC, Aichi, Japan) via the sheath in the right brachial artery, a Coyote™ (1.5 mm × 20 mm; Boston Scientific, Natick, MA, USA) was used to perform dilatation using 18 atm of pressure for 30 s. Then, we switched to a Coyote™ (2.5 mm × 30 mm) and dilated the entire lesion at 18 atm for 30 s. In spite of the several further attempts of plain old balloon angioplasty (POBA) with 2.5 mm balloon, recoil was observed and only mild dilatation was achieved.

Intravascular ultrasound (IVUS; Eagle Eye®, VOLCANO, San Diego, CA, USA) after these dilatations showed that the internal lumen diameter of normal vessel was approximately 4 mm and the lesion had a roughly circumferential, high-degree calcified plaque and narrowest lumen diameter was less than 2 mm (Fig. 2). Therefore, we attempted to gradually enlarge the size of the balloon from 2.5 mm. However, we chose to terminate the procedure because numbness of the right arm which appeared after performing IVUS, progressed into movement and sensory disturbances in spite of the fact that the imaging findings showed mild improvement of the stenosis (Fig. 3A). Postoperatively, when the sheath placed in the right brachial artery was removed, the resting numbness and motor and sensory disturbances that were observed during the procedure immediately disappeared. No other obvious complications were observed. NIBP measured after the procedure was 84 mmHg, and showed only slight improvement from preoperative 70 mmHg. The pattern of pulse waves also showed a slight increase in pulse pressure (Fig. 3B), that was associated with an obvious improvement in her symptoms including arm tiredness and coldness.

Discussion

In this case, because the atherosclerotic and stenotic lesions corresponded exactly to the region exposed to the previous radiation therapy, we presume these findings are related to the injury caused by radiation therapy. The pathological condition "radiation-induced arterial injury" was first reported in 1978 by Silverberg et al. [1] who defined it as a radiation therapy-induced condition that resulted in stenosis or occlusion of the major vessels.

Clinical characteristics include the following facts: (1) the site of radiation matches the site of the lesion, (2) the lesions are caused by relatively low doses of radiation such as 40–80 Gy, (3) a number of years or decades may elapse between radiation and the appearance of symptoms, and (4) the lesions pathologically resemble those of atherosclerosis [2,3]. The reports indicate a mean period of 14.7 years, with a range from 3 to 24 years, between radiation and the onset of symptoms [4].

Our patient also received radiation therapy after breast cancer surgery. Lesions were observed only in the CCA and SCA in the area exposed to radiation, and not in the vessels outside the area. Risk factors for atherosclerosis such as hypertension and dyslipidemia had been well controlled, and no other lifestyle-related risk factors were present. Based on these facts, we highly suspected that the etiology of the stenosis in the right CCA and the right SCA in this case was radiation-induced arterial injury caused by previous radiation therapy.

Fewer cases of radiation-induced arterial injury which affect the upper limb circulation have been reported [4–9]. Bypass