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INVITED REVIEW

Doppler Ultrasonography of Axillary and Subclavian Artery in Giant Cell Arteritis

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Giant cell arteritis (GCA) is a systemic vasculitis characterized by immune-mediated inflammation of the large arteries [1]. GCA usually affects the aorta and/or its major branches and often involves the temporal artery [2]. The gold standard for the diagnosis of GCA is temporal artery biopsy which is an invasive procedure with limited sensitivity [3,4]. Ultrasound (US) with color Doppler US is the preferred first-step imaging modality in patients with suspected GCA because of its low cost, accessibility, and safety. The main US and color Doppler US findings in patients with GCA are thicker vessel walls with decreased lumen caliper and velocity changes in the affected vessel [5]. Schmidt et al. also defined a concentric "halo" sign in all patients with suspected GCA, which disappears two weeks after glucocorticoid therapy [5].

A normal intima-media complex (IMC) should have a hypo-anechoic homogeneous appearance limited by two linear parallel echogenicities on US examination called "double line pattern." A typical vessel should be compressible with pressure (Figure 1). The inflammation in GCA generally starts in media and progresses to intima and adventitia, which causes US findings that are defined for GCA [6]. The early finding; the "halo" sign is the concentric hypoechoic thickening in the vessel wall. The suggested upper limit for IMC thickness for the axillary artery is 0.6 mm with 1.5-2 mm in GCA [7]. The inflammation in the vessel wall also causes non-compressible arteries [6]. Stenosis and occlusions generally occur in the setting of critical vessel wall inflammation that can be diagnosed as increased peak systolic velocities and absence of color-coding with color Doppler US, respectively [6]. Halo sign is generally seen in the acute phase. Loss of double line pattern with concentric wall thickening and findings such as stenosis, occlusion, and collateral vessels are usually seen in the chronic phase [10].

It is shown that the axillary artery should also be included in the US evaluation as the temporal artery may not be involved in some GCA cases [8,9]. Both arteries should be evaluated in routine GCA examination, and other large arteries should also be assessed in the setting of insufficient findings [6]. Supra-aortic vessels such as subclavian arteries, carotid arteries, and vertebral arteries may be evaluated with US and color Doppler US. The term large-vessel GCA (LV-GCA) is used in extra-cranial involvement [11] (Figure 2). The aortic arch and proximal third of the left subclavian arteries can be evaluated with low-frequency probes due to the deep location that causes lower resolution. However, the right subclavian artery, middle and distal part of the left subclavian artery can be examined with high-frequency probes, as well as the axillary artery, carotid artery, and vertebral arteries.

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Note:
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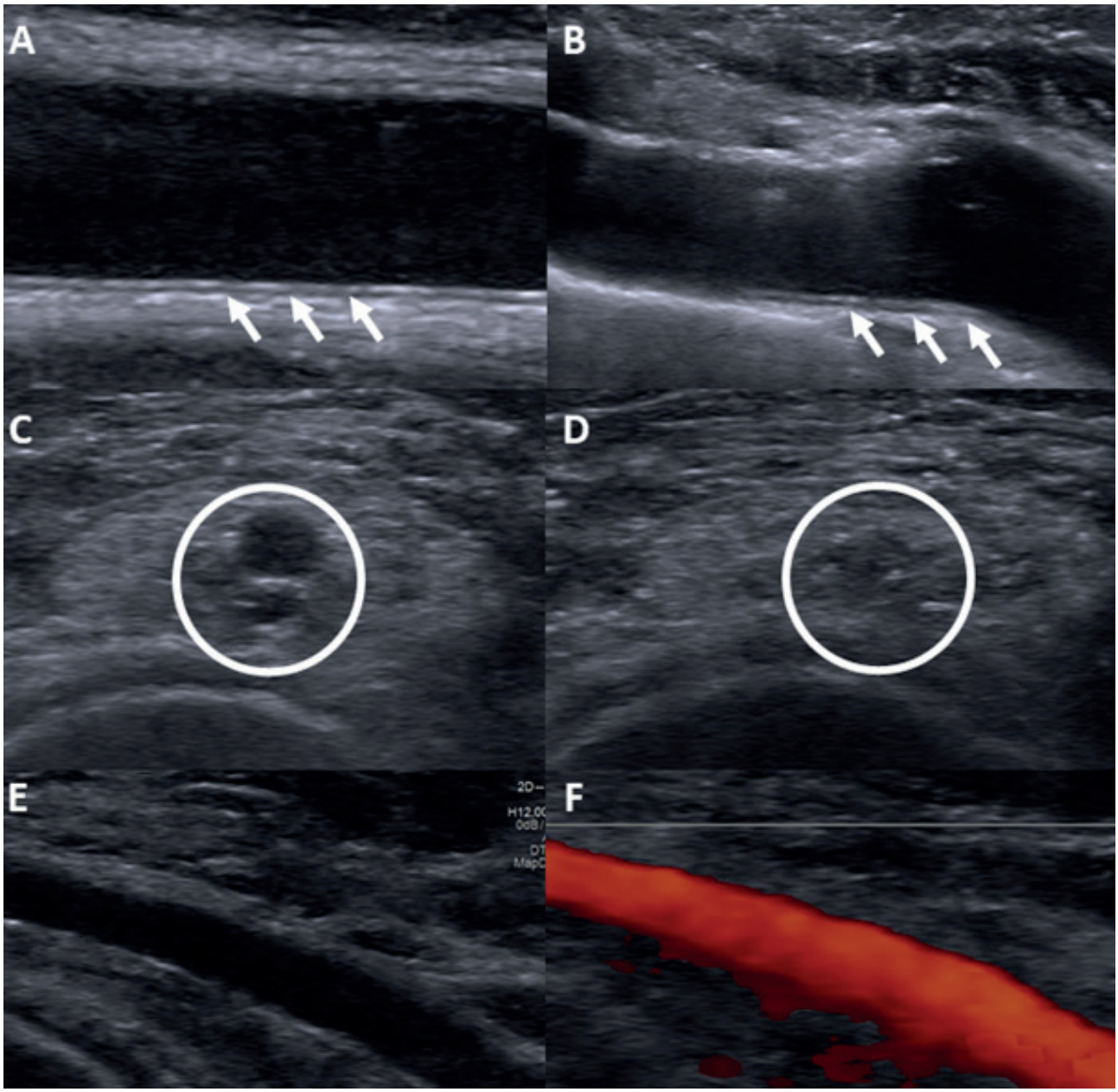

Figure 1. US and color Doppler US images of a 47-year-old female patient with normal findings. US images demonstrate normal intima-media thickness of the right carotid artery (A) and the right subclavian artery (B) with a "double line pattern" (arrows). Normal compressibility of the right axillary artery is demonstrated in the axial US images; before (C) and after compression (D). US (E) and color Doppler US (F) of the right axillary artery are demonstrated in the longitudinal US images.

In the follow-up evaluation, regression of the halo sign is defined mainly for temporal arteries after glucocorticoid therapy [12,13]. Aschwanden et al. evaluated LV-GCA and observed that regression of wall thickening is less common than in the temporal artery in LV, irrespective of clinical remission [14]. Sebastian et al. also demonstrated a stable axillary artery halo score after tocilizumab therapy in contrast with a significant decrease in median temporal artery halo score [15]. Seitz et al. evaluated IMT in temporal arteries, axillar arteries, and subclavian arteries and observed that glucocorticoid pulse therapy resulted in a transient decrease in all arteries IMT [16]. However, tocilizumab monotherapy resulted in a slower and steady decrease in just temporal arteries IMT [16].

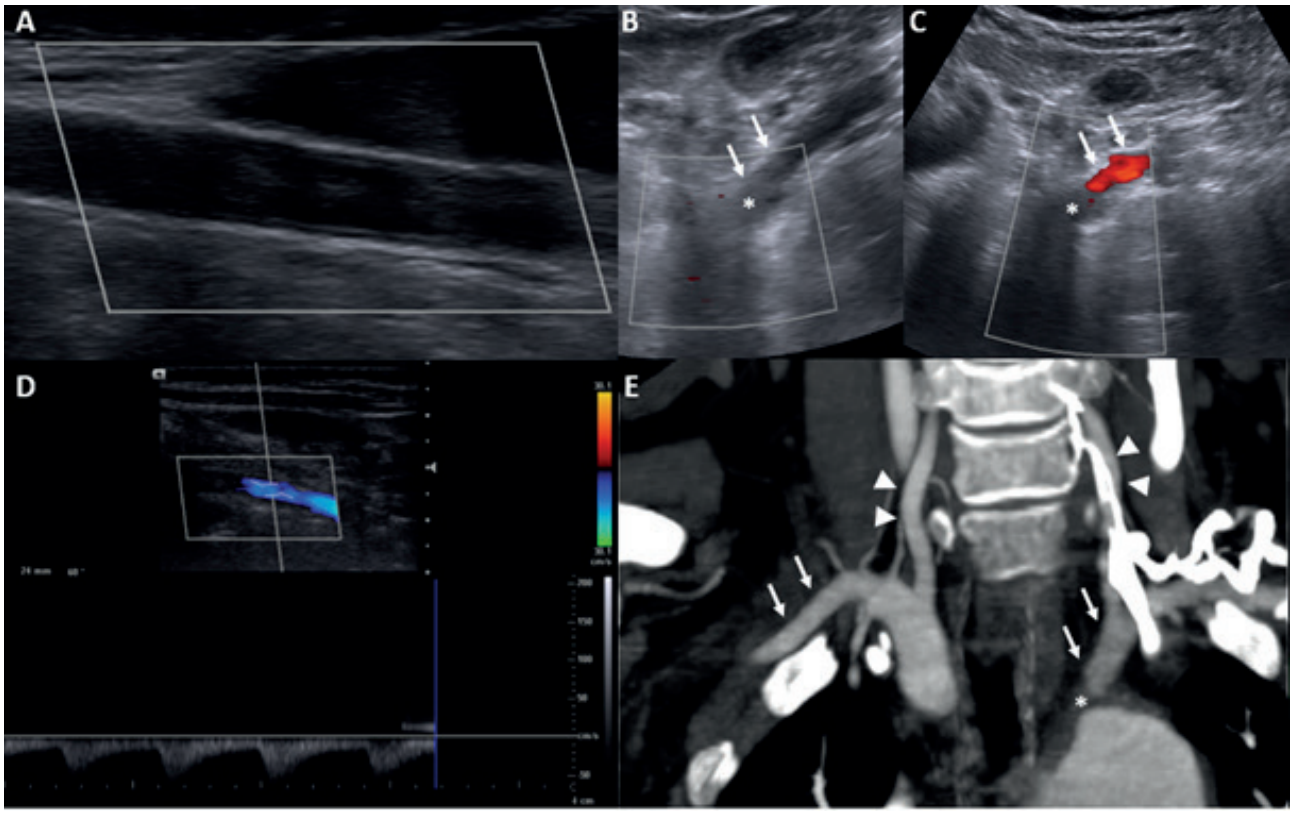

Figure 2. US and color Doppler US images of a 48-year-old female patient with known large vessel vasculitis. Color Doppler US demonstrates left main carotid artery occlusion (A) with left subclavian artery origin occlusion (B). In the proximal part of the left subclavian artery (arrows), the color Doppler US demonstrates the blood flow. Completely retrograde flow is observed in the left vertebral artery on color Doppler US (D), confirming subclavian steal syndrome. Please also note lower iodine concentration in the left subclavian artery (arrows) and vertebral artery (arrowheads) in contrast with the right ones in the coronal MPR computed tomography image (E). The left subclavian artery origin occlusion is also evident (*)

In conclusion, US and color Doppler US should be used as a first-step imaging modality in patients with GCA. The findings in GCA are halo sign, non-compressibility, stenosis, and occlusion in the involved vessel. The axillary artery should also be included in the routine US evaluation, as well as temporal arteries. The physician should be aware of US and follow-up imaging characteristics in specific vessels in GCA.

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