Doppler ultrasonography in the diagnosis of giant cell arteritis

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ABSTRACT

Ultrasonography of the temporal arteries detects characteristic signs of vasculitis with a high sensitivity and specificity: a hypoechoic halo due to an oedema of the artery wall and stenoses. The use of modern scanners with high resolution is essential. A halo has to be displayed in two planes. It is always circumferential. The colour intensity must not be too strong, otherwise the colour may cover the halo. A hypoechoic halo is also seen in large vessel giant cell arteritis at the axillary and brachial arteries and at the temporal arteries in polyarteritis nodosa.

Introduction

Conventional Doppler ultrasonography permits the assessment of the flow characteristics of a vessel. Colour duplex ultrasonography reveals additional details of the anatomical structures, especially of the vessel wall.

Conventional Doppler ultrasonography

Conventional Doppler ultrasonography has been used to localize the temporal arteries before biopsy (1). More patients with active giant cell arteritis (GCA) have stenoses and obliteration of the temporal arteries than other individuals of the same age (2, 3). Conventional Doppler ultrasonography is also used to investigate the supratrochlear arteries. This test can exclude collateral flow from the external to the internal carotid artery via the temporal artery due to the severe stenosis or occlusion of the internal carotid artery. In cases of collateral flow, temporal artery biopsy should be avoided (4).

Colour Doppler ultrasonography

Colour Doppler ultrasonography of the vasculature of the eye permits the assessment of orbital vessels which may be involved in the inflammatory process (5). Colour Doppler ultrasonography may be

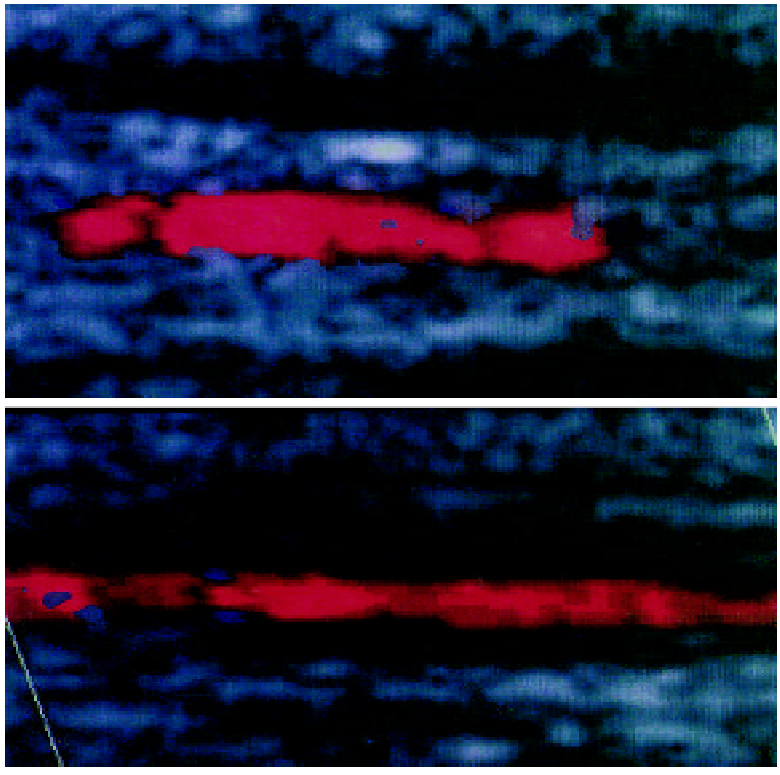

Fig. 1. Colour Doppler image of a normal (**a**) and an inflamed temporal artery (**b**).The black region surrounding the red zone in image (**b**) shows the characteristic thickening of the oedematous wall.

also performed on the temporal arteries (6). With modern scanners these small, superficial vessels can be investigated. We start at the common superficial temporal artery and continue as far as possible to the distal area of the frontal and parietal ramus. Both sides are examined. The diameter of the lumen of the parietal and frontal ramus is about 0.7 mm. The diameter of the vessel wall including the temporal fascia is also about 0.7 mm. Flow velocities may be measured, but except in stenosis they provide no additional information for the diagnosis of temporal arteritis.

In normal temporal arteries the perfused lumen and the bright vessel wall can be clearly defined. In temporal arteritis a hypoechoic, dark area may be found around the perfused lumen of the temporal arteries (Fig. 1). We believe that this phenomenon is due to an oedema of the vessel wall. It disappears within two to three weeks after the start of treatment with corticosteroids. Skip lesions are found by ultrasonography. Additionally stenoses may be suspected by colour Doppler ultrasonography and confirmed by Doppler ultrasonography (duplex ultrasonography). In patients with temporal arteritis often more than one stenosis is found in the temporal arteries. The stenoses detected by ultrasonography are usually short. Ultrasonography may also detect occluded vessels. In these vessels the artery may be found by grey scale ultrasonography with no colour signals in the obliterated lumen.

Since 1993 we have performed 517 investigations of the temporal arteries in 420 patients. Active temporal arteritis was diagnosed in 56 patients, and active polymyalgia rheumatica (PMR) was found in 77 other patients. One hundred and twelve of these subjects were investigated in a prospective study from 1994 to 1996 (7). The others were seen during the routine diagnostic process of suspected temporal arteritis. Figure 2 shows the sensitivity and Figure 3 the specificity of the test. The hypoechoic area is not found in all patients.

Sensitivity is improved if the temporal arteries are investigated additionally for stenoses. It again increases in patients with a positive histology. In some patients histology is negative despite a clinically clear diagnosis of temporal arteritis due to biopsied skin lesions whereas ultrasonography may be positive. In 3% of the patients without temporal arteritis there are stenoses, mostly in those with arteriosclerotic disease. In addition, 3% of investigated patients without temporal arteritis have either a missing frontal or parietal ramus as an anatomical variant. A hypoechoic halo around the perfused lumen of a temporal artery is a very specific sign. We have only seen this phenomenon in 2 patients with the clinical diagnosis of PMR and negative histology. It remains open whether the histology was false negative or the ultrasonography was false positive in these two cases.

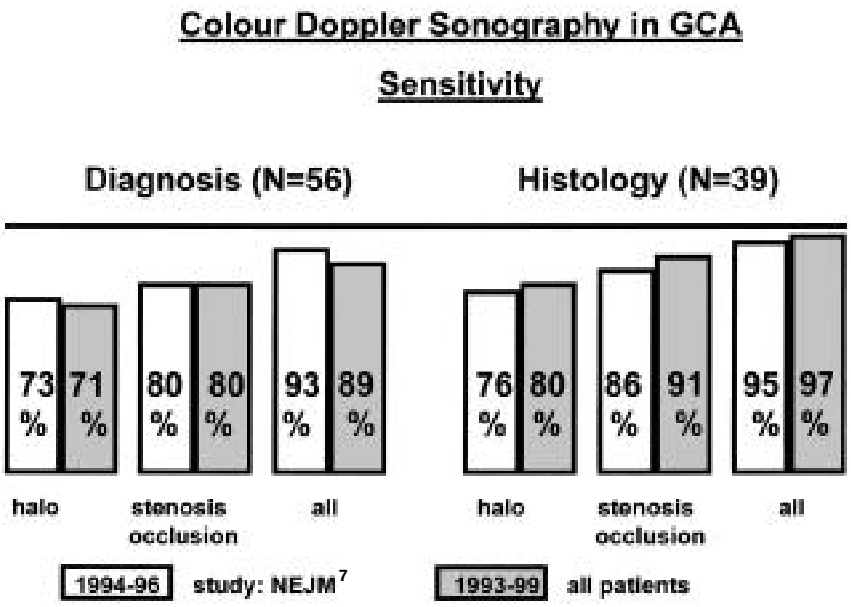

Fig. 2. Sensitivity of duplex ultrasonography in the detection of temporal arteritis.

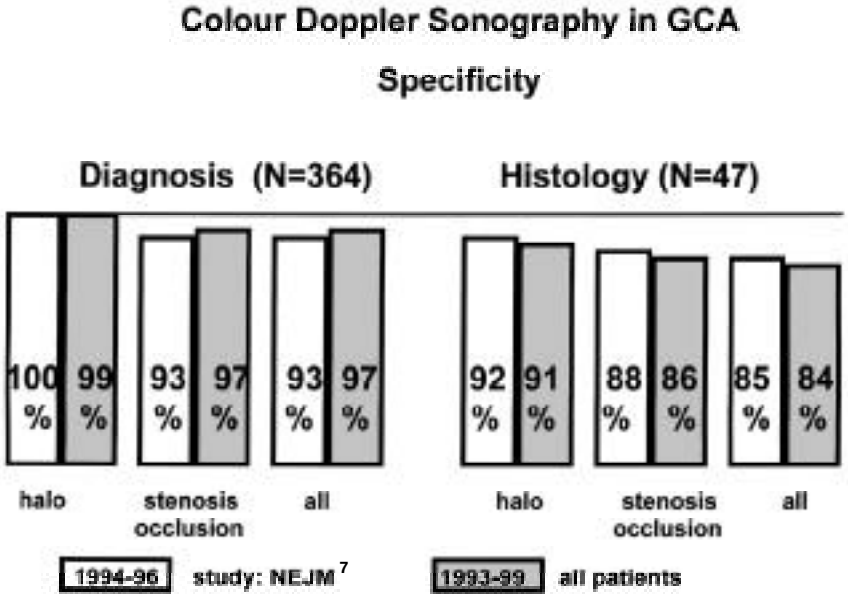

Fig. 3. Specificity of duplex ultrasonography in the detection of temporal arteritis.

Practical aspects of colour Doppler ultrasonography

Ultrasonography is an investigator-dependent test. There are two main pitfalls. A halo may be misdiagnosed, especially in the common superficial temporal artery that has an accompanying vein. If

Table I. Ultrasound scanners with adequate resolution to be used for investigation of the temporal arteries.

Company	Type	Scanners (MHz)
Acuson	Sequoia	15-8; 11-7
	Aspen	15-8; 11-7
Aloka	SSD-5000	12-4
	SSD-5500	12-4
ATL	UM 9 HDI	10-5
	UM 3000	12-5; 10-5
	UM 3500	12-5; 10-5
	UM 5000	12-5; 10-5
Esaote	Technos	14-5
GE	500 MR 3	13-6
	700 MR	13-6
Kretz	Voluson 530 D	12-4
Siemens	Elegra	9-5
Toshiba	6000	15-6; 14-6

no flow is detected in this vein a black area is found next to the artery which is, of course, not a sign of inflammation. The halo always has to be circumferential, and it must be detected in two planes. The other pitfall concerns colour intensity. It is easier to detect small vessels using strong colour intensity. This can lead to the phenomenon that the coloured area is bigger than the perfused lumen so that it covers the inflamed wall. Thus the halo may be missed.

Another very important aspect is the equipment used for the test. Table I shows the scanners that may be used according to our experience. Many other scanners do not have an adequate resolution to investigate the small temporal arteries which are located very close to the skin surface.

Meanwhile there have been more studies investigating the temporal arteries by colour Doppler ultrasonography (8-10). Lauwerys (8) found only one patient with a halo out of 4 patients with active biopsy-proven GCA. However, he used inadequate equipment. The Acuson 128 series may not be used for this indication because of insufficient resolution in the region of interest. Wenkel (9) applied a 50 MHz grey scale ultrasound scanner that is normally used for ophthalmologic investigations. He found characteristic changes such as middle-reflective shadowing of the arterial (obliterated) lumen, as well as condensation and enlargement of the muscularis media in all 4 of his patients with biopsy-proven GCA. Wenz (10) used modern colour Doppler ultrasound equipment with a good resolution (Siemens Elegra). He found a halo in all 10 patients with positive temporal artery histology and no halo in 18 of 20 patients with negative histology.

Use of ultrasonography in subsets of GCA

PMR may be associated with temporal arteritis. Most PMR patients have no clinical signs of temporal arteritis. Nevertheless, we investigate all PMR patients with colour Doppler ultrasonography. Of the patients with symptoms only of PMR, 11% had pathologic findings on ultrasonography, in some of whom histology also revealed GCA.

Large-vessel GCA is characterised by upper extremity vasculitis involving in particular the axillary and proximal brachial arteries (11). Ultrasonography shows hypoechoic wall thickening which becomes more echogenic with treatment (12). This is different from Takayasu's arteritis, where the wall thickening is echogenic (13).

In few cases temporal arteritis is due to another vasculitis than GCA. One case with a temporal artery halo and the histological diagnosis of polyarteritis nodosa has been described recently (14). Ultrasonography can detect vasculitis of the temporal artery but fails to lead to an exact histological diagnosis.

In summary, ultrasonography of the temporal arteries is a quick, easy, and non-invasive method to obtain information about inflammation of the temporal arteries.

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