



The eL18-4 PureWave linear Array with Micro Flow Imaging and Contrast Enhanced Ultrasound (CEUS) Imaging in the Assessment of Asymptomatic Carotid Stenosis

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Overview

Diagnostic ultrasound is commonly used to assess supra aortic arteriosclerotic disease and is especially valuable in the evaluation of carotid stenosis in respect of further invasive therapy.



Figure 1 The Philips eL18-4 PureWave linear array transducer is our first high-performance transducer featuring ultra-broadband PureWave crystal technology with multi-row array configuration, allowing for fine-elevation focusing capability.

Patient history

A 74-year-old female patient with stable peripheral arterial disease with claudication due to occlusions of the superficial femoral artery on both sides underwent Duplex ultrasound of the carotid arteries based on a carotid murmur. She was asymptomatic regarding cerebrovascular events (no TIA or ischemic stroke). The patient had several cardiovascular risk factors including a controlled arterial hypertension and dyslipidemia. She was a current smoker (12 cigarettes per day) and had a familial history of cerebrovascular events.

Protocol

Carotid standard ultrasound was performed using a Philips EPIQ 7 ultrasound system equipped with the eL18-4 PureWave linear array transducer. The examination was performed by a trained vascular specialist using a standard imaging protocol. Left and right carotid arteries were examined in a supine position with the head turned to the contralateral side at a 45° angle. The examination included B-mode ultrasound imaging, color Doppler ultrasound, and pulsed wave Doppler spectral analysis of the common carotid artery (CCA), the extracranial segments of the internal carotid artery (ICA), and the external carotid artery.

Findings

B-mode ultrasound imaging revealed an atherosclerotic lesion at the origin of the internal carotid artery on both sides. Color Doppler ultrasound showed aliasing in the proximal left internal carotid artery but no aliasing at the right internal carotid artery. Pulsed wave Doppler spectral analysis revealed increased peak systolic velocity (PSV) at the origin of the left internal carotid artery of 270 cm/sec and end-diastolic velocity (EDV) of 100 cm/sec. Normal PSV of 90 cm/sec and EDV of 30 cm/sec were measured at the origin of the right internal carotid artery.

Based on these hemodynamic measurements, the diagnosis of an asymptomatic (almost 70%) stenosis of the internal carotid artery of the left side and a carotid plaque without relevant stenosis at the right side is made.

Furthermore, CEUS imaging with SonoVue® using the eL18-4 transducer reveals considerable microbubble perfusion within the stenotic lesion, corresponding to an

extensively vascularized atherosclerotic carotid stenosis [1].
For better risk stratification of the high grade carotid

stenosis on the left side, more information about the lesion characteristics on ultrasound imaging was required.

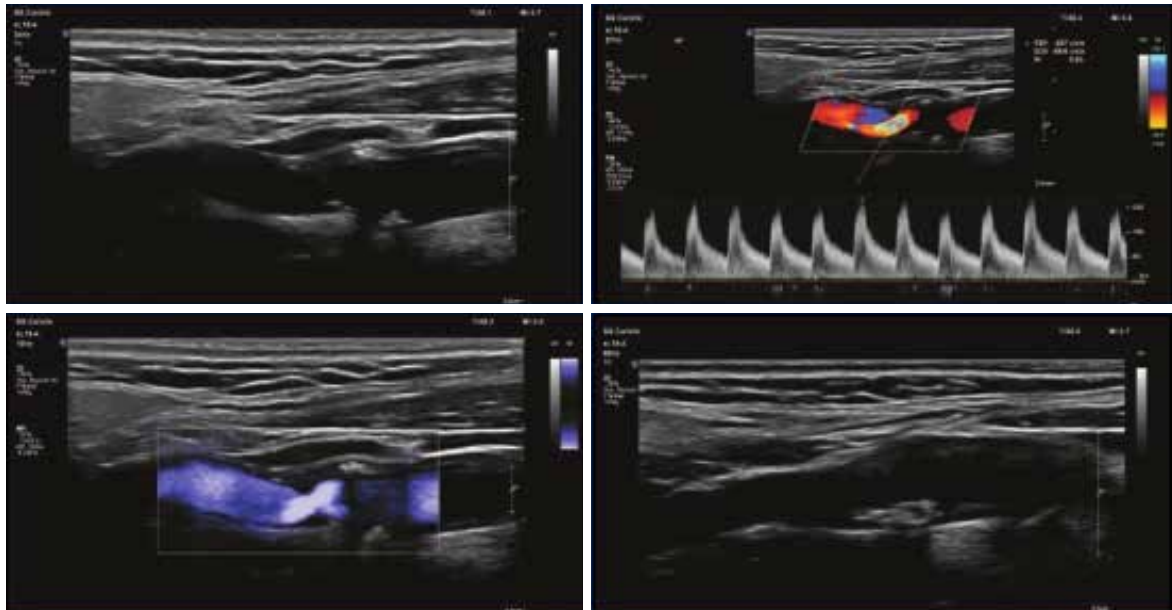


Figure 2 B-mode ultrasound of the origin of the left (above) and right (below) internal carotid artery with atherosclerotic plaques. Heterogenic echotexture with hypo- and hyperechogenic parts. Color Doppler ultrasound and pulsed wave Doppler of the left (above) and right (below) internal carotid artery.

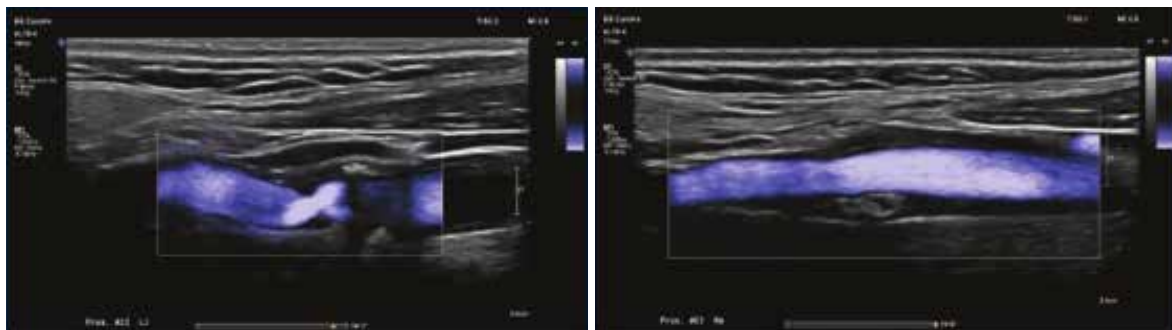


Figure 3 MFI demonstrating obvious surface irregularities of the left carotid atherosclerotic lesion (left) and no irregularities of the right atherosclerotic lesion (right).

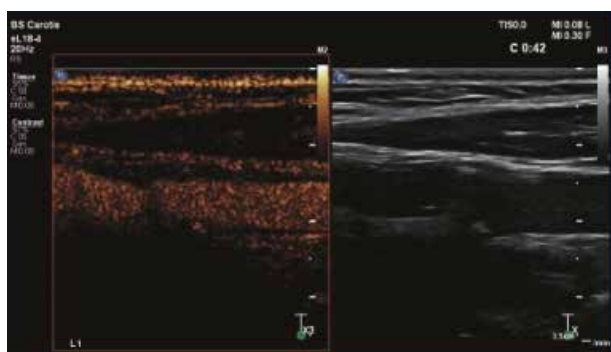


Figure 4 CEUS imaging of left internal carotid artery, demonstrating intraplaque neovascularization.

High resolution ultrasound of the eL18-4 transducer showed nicely the heterogenic texture of the plaque with hypo- and hyperechoic areas and some calcifications

with ultrasound shadowing. Particularly in hypoechoic atherosclerotic structures, the delineation of the plaque border and its irregularities is challenging. However, the use of color Doppler ultrasound is limited for this purpose. The additional use of MicroFlow Imaging (MFI) revealed an excellent delineation of the luminal border and showed plaque irregularities of the carotid plaque at the left side but no irregularities on the right side.

Conclusion

In conclusion, ultrasound imaging revealed an asymptomatic 70% carotid stenosis at the origin of the left internal carotid artery. Extended ultrasound characterisation using the eL18-4 transducer provided signs of higher vulnerability, including heterogeneous echotexture with hypoechoic portions, surface irregularity

on MFI, and intraplaque neovascularization on CEUS imaging, supporting the evaluation of invasive therapy as prophylactic carotid endarterectomy or carotid stenting based on a higher risk of cerebrovascular events [2].

Declaration

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

Reference

[1] Staub D, Partovi S, Schinkel AF, Coll B, Uthoff H, Aschwanden M,

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- [2] Aboyans V, Ricco JB, Bartelink MEL, Björck M, Brodmann M, Cohnert T, et al. 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS): Document covering atherosclerotic disease of extracranial carotid and vertebral, mesenteric, renal, upper and lower extremity arteries Endorsed by: the European Stroke Organization (ESO) The Task Force for the Diagnosis and Treatment of Peripheral Arterial Diseases of the European Society of Cardiology (ESC) and of the European Society for Vascular Surgery (ESVS). *Eur Heart J* 2018; 39: 763-816.

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