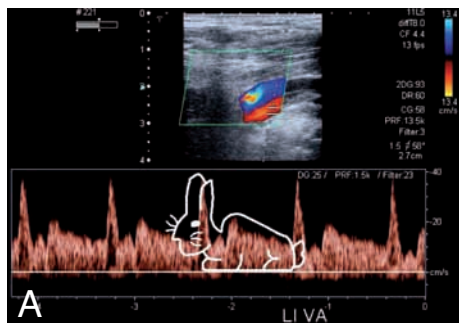


IMAGES IN CLINICAL RADIOLOGY



The vertebral bunny waveform: an early manifestation of the subclavian steal syndrome

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A 69-year-old man was referred to the radiology department for pre-operative duplex evaluation of the carotid and vertebral arteries. The patient was scheduled for coronary artery bypass graft surgery. Duplex examination showed diffuse intimal thickening and bilateral non-stenotic, small heterogeneous plaque formation at the level of the carotid bifurcation. The flow pattern at the left vertebral artery showed a sharp decline during midsystole and a subsequent rounded second systolic peak, resembling a rabbit in profile (Fig. A). We performed a CT angiography which showed the presence of a stenosis of 50% at the ostium of the left subclavian artery (Fig. B and C arrows).

Comment

The vertebral artery (VA) supplies the low resistance intracranial vascular system together with the internal carotid artery (ICA). In normal conditions the vertebrobasilar system is responsible for 20 to 30% of intracranial blood flow. The spectral Doppler velocity waveform in the normal vertebral artery therefore resembles a weakened ICA pattern.

A complete subclavian steal (SCS) is a well-documented entity with a typical spectral Doppler pattern on vertebral examination in which there is a total reversal of flow throughout the cardiac cycle. This pattern indicates a high-grade stenosis or occlusion of the ipsilateral subclavian artery (SCA). In 90%, SCA stenosis and resulting SCS occurs on the left side. Usually this condition remains asymptomatic and represents an appropriate physiological response to a hemodynamically significant stenosis or occlusion of the ipsilateral SCA. Less frequently SCA stenosis can result in arterial insufficiency of the upper extremity and reduced brachial blood pressure as well as vertebrobasilar insufficiency, especially when the arm is exercised. A subclavian steal in association with one of these symptoms, is referred to as SCS syndrome. Less known is the fact that it is possible to detect lesser degrees of SCA stenosis prior to the establishment of a complete SCS syndrome by more subtle changes in the vertebral waveform pattern. Different intermediate waveforms (or pre-steal waveforms), maintaining a substantial antegrade flow, may be seen before a complete reversal of flow.

The earliest manifestation of the subclavian steal physiology is a sharp deceleration of blood flow after the first systolic peak. During peak systole, a significant pressure drop occurs at the level of the SCA stenosis in combination with a high-velocity flow jet (Bernoulli's principle). As a result, blood flows in the vertebral artery from distal to proximal on the side of the subclavian stenosis. This produces a decelerating systolic notch, dividing a first sharp systolic peak and a second more rounded and

lower peak, referred to as the vertebral bunny waveform (Fig. 1).

Kliwer et al. found that the depth of the decelerating notch correlated to the degree of SCA stenosis. The decelerating notch may be seen at its earliest with a 45% stenosis of the subclavian artery; at 55% a deeper cleft is seen producing the vertebral bunny waveform; above 72% of stenosis the midsystolic cleft falls below the baseline. At high grade stenosis or occlusion a complete subclavian steal, characterized by a complete reversal of flow, is seen.

Reference

1. Kliwer M.A., Hertzberg B.S., Kim D.H., Bowie J.D., Courneya D.L., Carroll B.A.: Vertebral artery Doppler waveform changes indicating subclavian steal physiology. *AJR*, 2000, 174: 815-819.

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