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Detection of Microembolism Signs using Transcranial Doppler in Infective Endocarditis

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ABSTRACT

Introduction: Transcranial Doppler (TCD) is a rapid, noninvasive, reproducible, and dynamic examination of the intracranial circulation. A unique advantage of TCD is the ability to detect microembolic signals (MES) during monitoring.

Case presentation: We present the case of a 24-year-old man with no significant history or previously identified risk factors.

With a probable diagnosis of infectious endocarditis based on clinical findings. The echocardiogram revealed a bicuspid aortic valve, with a doubtful diagnosis of cardiac vegetation. A diagnosis of endocarditis was made thanks to the support of microembolic signal detection by transcranial Doppler.

Conclusion: The relevance and importance of transcranial Doppler support in infective endocarditis is evaluated. This is a tool that could be considered to be part of the DUKE criteria.

KEYWORDS: Infective endocarditis, transcranial Doppler, Embolic microsignals, DUKE Criteria, Bicuspid aortic valve.

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INTRODUCTION

Transcranial Doppler (TCD) is a rapid, noninvasive, reproducible, and dynamic examination of the intracranial circulation. A unique advantage of TCD is the ability to detect microembolic signals (MES) during monitoring. (6)

Although the vast majority of microembolic signals (MES) are asymptomatic, there is substantial evidence that MES are relevant in certain clinical conditions, and their association with cardiac embolism has already been demonstrated. (6)

Some patients may not meet echocardiographic criteria for definitive infective endocarditis due to the lack of visualized vegetations or the absence of a new regurgitant murmur. (4) Hence the importance of TCD in helping to establish the origin of the source of embolism.

Detecting MES is not only a tool to help us in the diagnosis, but also useful for establishing the risk of stroke and monitoring therapeutic response. The aim of this article is to demonstrate the usefulness of TCD for the detection of MES of cardiac origin in a patient with suspected infective endocarditis with neurological manifestations and discrepancy between the results of transthoracic and transesophageal echocardiogram.

CASE PRESENTATION

24-year-old man with neurological deterioration and bilateral amaurosis. He presented Janeway lesions, Osler nodes, splinter hemorrhages in the nail bed and a changing murmur in the pulmonary and mitral foci. Simple head CT scan with parenchymal hemorrhagic lesions, as well as other hypodense lesions in both occipital lobes, left temporal and right thalamic lobes. (Figure 1)

Two blood cultures with development of Staphylococcus hominis.

Transthoracic echocardiogram with a mobile mass of 11x9 mm in the aortic valve and transesophageal echocardiogram with a non-mobile lesion of 9 x 4 mm in the bicuspid aortic valve, suggestive of critical angle artifact. Bilateral fundus with 10 Roth spots.

Transcranial Doppler with an EZ Dop DWL device, 2 mHz transducer, recording through the right transtemporal window at 60 mm depth in the middle cerebral artery for 25 minutes, finding microembolic signals every 5 minutes (Figure 2). The diagnosis of infective endocarditis was confirmed.

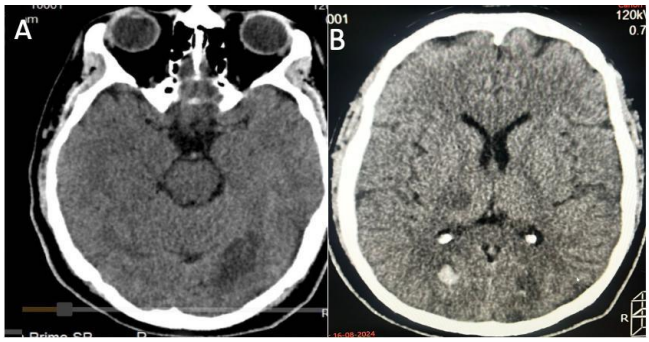

Figure 1. A) Simple head CT scan with ischemic lesion in left occipital lobe. B) Simple head CT scan with multiple hemorrhagic and ischemic lesions in both occipital lobes.

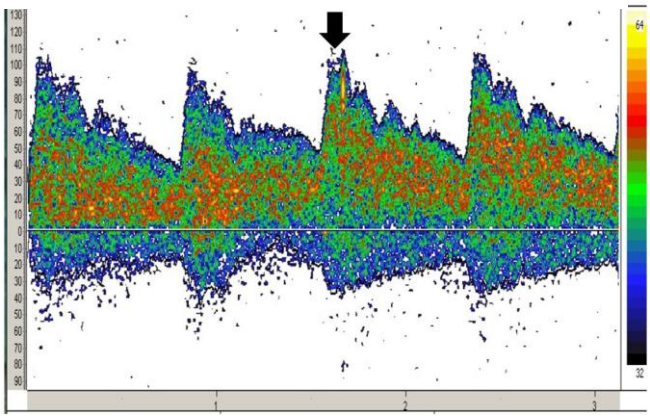

Figure 2. Transcranial Doppler with microembolic

DISCUSSION

In developed countries, the incidence of infective endocarditis ranges from 2.6 to 7 cases per 100,000 inhabitants per year. [1] However, this incidence increases to 48.13 cases per 10,000 patients annually in bicuspid aortic valve carriers, as they face a 12-fold higher risk. [2]. Regarding etiology, coagulase-negative staphylococci represent approximately 5% of cases of native valve endocarditis. For non-typical microorganisms, the Duke criteria establish that a minimum of three positive blood cultures are required. In the present case, the isolation of staphylococcus hominis, although it was only in two blood cultures, the clinical and imaging findings suggest a real infection and not contamination, with the capacity to cause embolic phenomena. [3]

In patients with infective endocarditis, between 40% and 56% will develop a clinically evident ischemic stroke, and up to 82% of these may have asymptomatic brain lesions on neuroimaging studies. An increasing number of studies have proposed adding cerebral microbleeds to the spectrum of septic embolization. [4].

The presence of hemorrhagic and ischemic lesions in the right and left occipital lobe on plain cranial tomography evidences the effect of embolic phenomena secondary to valvular vegetation. This finding is consistent with that reported in the literature, which indicates that vegetations larger than 10 mm, such as those observed in this patient (11x9 mm in the aortic valve on transthoracic echocardiogram), significantly increase the risk of embolization. [5]

In order to clarify the diagnostic uncertainty generated by the presence of a critical angle artifact during transoesophageal echocardiography, it was decided to use transcranial Doppler (TCD) as a complementary tool.

TCD is a rapid and noninvasive diagnostic tool that can provide real-time measurements of relative changes in cerebral blood velocity. Emboli monitoring using TCD detects microembolic signals (MES), which are defined as short-duration signals (<0.01-0.03 s), unidirectional, with an increase in intensity >3 dB within the Doppler frequency spectrum; they appear randomly within the cardiac cycle and produce a "click" sound when passing through the sample volume. [6]

The optimal monitoring time depends on the clinical entity. In patients with cardiac involvement, the frequency of emboli is usually low, typically 1 to 2 emboli signals in 60 min. Embolic activity is highest in the first hours after stroke; however, emboli can be detected days and weeks after cerebrovascular events, indicating an increased risk of stroke. [5]

In the present case, TCD was performed on the tenth day in a transtemporal window for 25 min, where microembolic signals were found in the right middle cerebral artery, with signals recorded up to 5 minutes apart between each signal. In addition, monitoring was extended to the rest of the vessels without finding other signals.

It should be noted that patients who do not have emboli signals recorded (even in repetitive monitoring) cannot be declared as "negative for emboli." However, patients who have detectable emboli, especially in large numbers, should be considered high-risk patients for stroke. [5]

Detection of microemboli in both middle cerebral arteries (MCA) suggests a cardiac origin, whereas microemboli detected on only one side indicate an ipsilateral embolic source, such as in the case of carotid stenosis. [5]

In patients who experience recurrent emboli or enlarging valvular vegetations, despite appropriate antimicrobial therapy, DTC monitoring for MES could theoretically serve as a clinical tool to identify those cases at increased risk for stroke recurrence due to the substantial burden of MES, helping to shift their risk-benefit ratio in favor of surgical interventions. [4]

Despite positive blood cultures, some patients may not meet echocardiographic criteria for definitive infective

endocarditis due to lack of visualized vegetations or absence of a new regurgitant murmur; Emboli monitoring in DTC by MES detection can provide the evidence of emboli to meet the criteria for embolization in the modified Duke criteria, as was the case in our patient.

CONCLUSIONS

The DTC is a tool that helps us detect microembolism at the cerebral level. In possible infectious endocarditis, when we have neurological manifestations without a source of cardiac embolism, the detection of MES is a great tool, since it documents in real time whether there is microembolism, to what degree and the source of it.

Although there are discrepant results on the prevalence of MES in some past studies, this was due to the fact that the criteria for MES were not the same. The current universal criteria for MES are practical and punctual, so it is expected that this prevalence will increase in the future. In addition, it is considered that the use of the DTC for the detection of MES may become a criterion in infectious endocarditis, which helps us when there is diagnostic doubt. It can also help to establish the cerebrovascular risk in relation to the MES load of the patient, and regulate therapeutic conduct, allowing us to be more aggressive when the MES load is high and persistent.

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