Diagnosis of Right-to-Left Shunts by Transcranial Doppler in Patients With Insufficient Temporal Bone Window

To the Editor:

I read with great interest the article entitled “Diagnosis of right-to-left shunt with transcranial Doppler and vertebrobasilar recording,” which appeared in Stroke. The authors studied use of vertebrobasilar circulation (VBC) monitoring for detection of right-to-left shunts (RLS) by contrast transcranial Doppler, so-called as “the bubble test.” In comparison with right middle cerebral artery (MCA) recordings, contrast transcranial Doppler with VBC monitoring missed 12 of 28 patients when the test was performed at rest, and 7 of 43 patients when Valsalva’s maneuver was performed during the bubble test. The authors were satisfied with these numbers because contrast transcranial Doppler with VBC recording caught all of the 22 patients with nonlow-grade RLS, which was defined as presence of at least 11 microbubbles (MBs). Based on these data, they suggest a possible use for VBC monitoring in subjects with insufficient sonic bone windows, in whom transesophageal echocardiography, according to the statement by the authors in the introduction section of the article, remains the only way to diagnose patent foramen ovale in these patients. I have some comments on the problems concerning use of VBC for the bubble test and the other TCD methodologies for patent foramen ovale detection in the subjects with inadequate temporal sonic bone windows.

Indeed, inadequate temporal acoustic bone window is a prevalent barrier for the bubble test. Temporal sonic window is absent in about 10% of the population undergoing TCD examination, and was detected in 4% (8/195) of the subjects in this study. In addition to total absence of window, at least in a similar percentage of the subjects, bone window quality is low, and leads to frustrating time expenditures in locating of the suitable windows and fixation of transducers. In the presence of this problem, the bubbles test can be performed by insonation of extracerebral arteries directly, the carotid siphon transorbitally, and the vertebral or basilar arteries transarminally.

We have previously shown that submandibular (high cervical) internal carotid artery (ICA) recording is at least as sensitive and specific as the MCA monitoring. In this prospective study, more (77% higher at average) MBs were detected in the submandibular ICA compared to the ipsilateral MCA in 40 of 49 bubble tests. The reasons for this difference are MB decay before their arrival into intracranial arteries and entry into the anterior cerebral artery. Accordingly, the detection rate of small RLS was increased with submandibular ICA recording. We have observed that some of the small RLS would have been missed if the MCAs had only been monitored, because all MBs visualized in the submandibular ICA passed into the anterior cerebral artery or were detected only in this vessel. In other words, the submandibular ICA methods not only offer an alternative route for insonation in the subjects with inadequate acoustic windows, but also increases the sensitivity of the bubble test. In contrast, the VBC way recommended by Del Sette et al is hampered by loss of detection rate of small RLSs and correspondent sensitivity. In their study, visualized MB numbers are low in VBC compared to the MCA at rest (10.75±7.9 and 8.25±8.2 in MCA and VBC, respectively) and during Valsalva’s maneuver (18.44±15.03 and 6.77±2.5 in MCA and VBC, respectively). The lower number of MB in the VBC is a reflection of anatomic distribution of microemboli. Several studies had previously demonstrated a lower entry rate (between 21.4% to 75%) of microemboli into the basilar artery in comparison with the anterior circulation.

The probe fixation is troublesome in the VBC method described by Del Sette et al.1 Manual positioning can be attempted, but loss of the vessels would not be rare during the Valsalva’s maneuver, which is the most critical part of the test. Reflecting this reality, Del Sette et al found a decrease, instead of increase, of MB number during Valsalva’s maneuver (from 8.25±8.2 to 6.77±2.5) in VBC recording. In my opinion, performance of bubble test at prone position is not optimal for injection of agitated saline and performance of Valsalva’s maneuver. Furthermore, this method is prone to the artifacts originating from tracheal air passage and neck muscle contraction occurring Valsalva’s maneuver.

When compared to the alternative vessels in the subjects with insufficient temporal windows, the submandibular ICA method seems to be advantageous. I have already mentioned its superiority over the suboccipital monitoring of the basilar or vertebral arteries. Albeit not systematically tested, its tolerability seems to be better than transorbital monitoring of the carotid siphon. In conclusion, I recommend using submandibular ICA recording instead of vertebral/basilar ones for identification and quantification of patent foramen ovale in patients with inadequate bone windows.

Of note, bubble test cannot be performed by using standard duplex (4 to 7 MHz) transducers in imaging the common carotid artery because the detectability of microemboli is inversely dependent on the transducer frequency. As transducer frequency increases, backscatter from blood decreases more slowly than that from microemboli. Accordingly, monitoring with 2 to 2.5 MHz probes resulted in 10 to 17 times more MBs in comparison with 5 to 5.33 MHz probes in the patients with artificial heart valves. However, this problem can be overcome by harmonic imaging.

Disclosures

None.

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