Journal of Medical Ultrasound (2015) 23, 129–132

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.jmu-online.com

ORIGINAL ARTICLE

Factors Associated with No or Insufficient Temporal Bone Window Using Transcranial Color-coded Sonography

Yi-Pin Lin [1,2†], Mu-Hui Fu [1], Teng-Yeow Tan [1*†]

[1] *Division of Cerebrovascular Disease, Department of Neurology, Chang Gung Memorial Hospital, Kaohsiung, Taiwan, and* [2] *Department of Neurology, Tainan Municipal An-Nan Hospital-China Medical University, Tainan, Taiwan*

Received 7 April 2015; accepted 14 July 2015
Available online 28 August 2015

KEYWORDS
factors,
temporal bone window failure,
transcranial color-coded sonography

Abstract *Purpose:* Transcranial color-coded sonography (TCCS) noninvasively assesses physiologic and pathologic intracranial blood flow especially in non-Caucasians who have high prevalence of intracranial steno-occlusive arterial disease. However, a higher temporal bone window failure (WF) rate is found in non-Caucasians and thus limits the utilization of TCCS. This study was performed to explore the associated factors of temporal bone WF in Taiwanese patients.
Methods: Between January 2014 and June 2014, 355 consecutive patients who received TCCS examination during their hospitalization at neurological ward were enrolled in this study, including 218 men and 137 women. Patients were classified into two groups, one with no or insufficient temporal bone window and the other with good temporal bone window for identification of middle, anterior, and posterior cerebral arteries via transtemporal approach. Age, sex, and conventional vascular risk factors in each group were compared.
Results: It was found that 28.8% of the patients had no or insufficient temporal bone window. Among them, 20.3% had complete bilateral temporal bone WF. For all factors studied, older age and female sex were significantly associated with no or insufficient temporal bone window.
Conclusion: The failure rate of temporal bone window was considered high as compared to Western countries but, not surprisingly, age and sex remained the significant factors. Introducing echo contrast agents during the TCCS examination might help to increase the success rate of TCCS examination and provide useful information to clinicians.

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

* Correspondence to: Dr Teng-Yeow Tan, Division of Cerebrovascular Disease, Department of Neurology, Chang Gung Memorial Hospital, 123 Dabi Road, NiaoSung District, Kaohsiung 833, Taiwan.
E-mail address: tengyeow@pchome.com.tw (T.-Y. Tan).
† These authors contributed equally to this work.

http://dx.doi.org/10.1016/j.jmu.2015.07.002

Introduction

Transcranial color-coded sonography (TCCS) is widely used to assess noninvasively physiologic and pathologic intracranial blood flow. It is routinely applied to ischemic stroke patients in clinical practice to screen for intracranial arteries stenosis. It provides important diagnostic and prognostic information in ischemic stroke patients [1—3] especially in non-Caucasians who have high prevalence of intracranial steno-occlusive arterial disease. Approximately 40—50% of strokes and transient ischemic attacks [4—7] are caused by intracranial steno-occlusive arterial disease in Asian populations.

CLOTBUST had shown that ultrasound enhances the effect of thrombolytic agents on reperfusion in patients with an acute cerebral infarction in the middle cerebral artery (MCA) territory and whether it improves outcome in patients with acute ischemic stroke is currently being investigated [8]. However, a higher temporal bone window failure (WF) rate was found in non-Caucasians [9,10] and thus limits the clinical application of TCCS and also decreases the chance for these patients to receive ultrasound-enhanced thrombolytic therapy for ischemic stroke.

Duplex ultrasound can be hampered by insufficient acoustic penetration, an unfavorable insonation angle, or by conditions of low or no flow. Previous studies have shown that about 5—37% of the patients had inadequate Doppler signal because of an insufficient acoustic temporal window or WF during transcranial Doppler examination [9,11—14]. The temporal bone window is the thinnest area of the lateral skull, located above the zygomatic arch and anterior to the ear. It allows ultrasound beam to invade and be reflected. Although numerous studies have reported that an inadequate temporal bone window is more common in older women [15—18] and in non-Caucasians, we have less knowledge about the prevalence of temporal bone WF and the associated factors of WF in Taiwanese patients [10].

The aim of the present study is to demonstrate the prevalence of temporal bone WF and explore the factors associated with temporal bone WF using TCCS.

Patients and methods

From January 2014 to June 2014, 355 consecutive patients with admission impression of cerebrovascular disease who received TCCS examination during their hospital stay at neurological ward were enrolled. Patients were classified into two groups, one with no or insufficient temporal bone window and the other with good temporal bone window for identification of MCA, anterior (ACA), and posterior cerebral arteries (PCA) via transtemporal approach. The clinical records of the patients were reviewed for demographic data, underlying medical diseases, and conventional vascular risk factors.

TCCS

TCCS (Philips HDI 5000 System ATL; Philips, Bothell, WA, USA) equipped with a 2-MHz sector transducer were used to carry out the examination. Patients were examined by an experienced ultrasound technologist. We used the transtemporal approach to identify the MCA, ACA, and PCA. While being examined, the patient is supine on the examination bed. The probe is placed above the zygomatic arch and anterior to the ear where the thinnest section of the squamous portion of the temporal bone is. For those with a small temporal bone window, the entire region between the ear and the frontal process of the zygomatic bone is carefully searched for an available window. The examiner first searches for hypoechogenic butterfly-shaped mesencephalic brain stem surrounded by the hyperechogenic basal cistern in axial scanning plane using B-mode ultrasonography. The color mode is then switched on to find the arteries. The arteries of the circle of Willis can be identified by their anatomic location with respect to the brain stem structure and by determination of the flow direction. The MCA, along with the P1 and P2 segments of PCA are usually coded red due to their flow direction toward the transducer. By contrast, the A1 and A2 segments of the ipsilateral ACA and the distal P2 segment of the PCA are coded blue due to their flow direction away the transducer. To record the Doppler spectrum, the sample volume is placed under visual control in the vessel segment of interest.

We defined temporal bone window failure as inability to visualize the midbrain structures of the interrogated sides on the B-mode image. Good temporal bone window was defined as clear visualization of midbrain structures and all three ipsilateral vessels (MCA, ACA, and PCA) were identified with adequate color and Doppler signals. For those with fewer than three vessels identified were classified as having insufficient temporal bone window. We did not attempt to insonate the MCA, ACA, or PCA ipsilateral to the poor window from the contralateral side. In case of no or insufficient temporal bone window, the power output of the transducer unit was increased to 100% with an appropriate color gain, then the probe was moved slowly ensuring good contact between the transducer and the skin. The depth was set at 45—70 mm and the angle of the probe was adjusted for MCA, ACA, PCA, and siphon internal carotid artery detection.

Statistical analysis

Data are expressed in terms of mean and standard deviation. To test for group differences, the Chi-square test was used for discrete variables and the independent-sample Student *t* test for variables measured on a continuous scale. A p value < 0.05 was considered statistically significant.

Results

Table 1 presents the baseline characteristics of the 355 patients. These included 218 men and 137 women (age 64.5 $\pm$ 13.2 years); 28.8% of the patients had no or insufficient temporal bone window. Among them, 20.3% had complete bilateral temporal bone WF. Hypertension, old cerebrovascular disease, and hyperlipidemia were the most common underlying medical problems followed by diabetes mellitus and left ventricular hypertrophy. Patients with WF were older and more often female. Univariate analysis revealed that age and female sex were the only significant