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Research Article

The Value of c-TCD in the Diagnosis of Migraine and Cryptogenic Stroke Caused by PFO

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Abstract: ***Objective:*** To investigate the value of contrast-enhanced transcranial doppler (c-TCD) in the diagnosis of patent foramen ovale (PFO) of patients with migraine and cryptogenic stroke. Methods: A retrospective analysis of 160 patients undergoing c-TCD monitoring in our hospital from June 2014 to June 2019 was performed. Among them, there were 80 cases of patients with migraine (38 cases with aura and 42 cases without aura) in group A, and 80 cases of patients with cryptogenic stroke in group B. The positive detectable rate of PFO in the two groups were calculated and analyzed. ***Results:*** The detectable rate was 50.00% in group A, and 40.00% in group B. There was no statistical significance between the two groups (P>0.05). Among them, the detectable rate of PFO in migraine with aura in group A (62.50%) was higher than that in group B(37.50%). The difference was statistically significant (P<0.05); In the two groups of PFO-positive patients, the difference didn't have statistical significance, comparing the proportion of the inherent type to that of potential type (P>0.05); There was no statistical significance of the difference between the RLS incidence of grade I and that of grade II among two groups of PFO-positive patients (P>0.05); the incidence of RLS in grade III in group B (50.00%) was higher than that in group A (25.00%), and the difference was statistically significant (P<0.05). ***Conclusion:*** c-TCD can accurately screen migraine and cryptogenic stroke caused by PFO, and grade and classify it as a clinical diagnosis of migraine and cryptogenic caused by PFO. It can also act as a objective reference of estimating the effect of treatment in different diseases and preventing cryptogenic stroke.

Keywords: Patent foramen ovale; Contrast-enhanced transcranial doppler; Migraine; Cryptogenic stroke

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1 Introduction

Patent foramen ovale (PFO) is the most common congenital heart abnormality in adults. It has no effect on the hemodynamics of the heart and is often ignored. In cryptogenic stroke, the incidence of PFO is about 40%-50%, while in migraine, the incidence of PFO is as high as 50% and above[1]. With the development of imaging technology, the contrast-enhanced transcranial doppler (c-TCD) is gradually applied to the screening and diagnosis of PFO, and its value has been affirmed[2]. Based on this, the purpose of this study was to explore the value of c-TCD in the diagnosis of PFO in patients with migraine and cryptogenic stroke. It is reported as follows.

2 Materials and methods

2.1 General materials

An retrospective analysis was undertaken of 160 patients monitored by c-TCD in our hospital from June 2014 to June 2019. Among them, there were 80 patients with migraine (38 patients with aura and 42 patients without aura) in group A, and 80 patients with cryptogenic stroke were in group B. In group A, there were 37 males and 43 females; aged 25-72 years, with

an average age of (47.78 ± 5.38) years. Patients in group B included 42 males and 38 females; aged 30-72 years, with an average age of (49.43 ± 5.27) years. There was no statistically significant difference in the general data of gender and age between the two groups of patients (P> 0.05), and the study was comparable.

2.2 Inclusion criteria

Inclusion criteria: patients with migraine or cryptogenic stroke confirmed was confirmed by clinical materials and other accessory examinations; exclusion criteria: they are those who cannot cooperate with Valsalva.

2.3 Methods

A German color transcranial doppler ultrasound diagnostic instrument of DWL Doppler BOX-type was used to collect data by using software of foaming test. The method was as follows: the subject took the supine position and was monitored the MCA on one side (chose to monitor VA4 on one side when the temporal window was closed). An indwelling needle was inserted into one elbow vein and a three ways pipe was connected. One syringe draws 8ml of physiological saline + 1ml of venous blood, and one draws 1ml of clean air, both of which are connected to the path of 18G cannula needle through a three ways pipe. By quickly aspirate in the middle of the two syringes, it took at least 10 times to make activated physiological saline. And then bolus injection was immediately undertaken to observe whether there was MES within 11-25 seconds; if it was negative, the patient would lie flat for 2 minutes and repeat the above operation for 5 second and do Valsalva action to observe whether there was MES 11-25 seconds after bolus injection. If it was negative, the operation can be repeated once.

2.4 Diagnostic Criteria

PFO was graded according to the number of MES monitored by c-TCD: I: 1-10 MES were monitored; II: MES were monitored> 10 but no rain curtain was formed; III: MES that was monitored formed a rain curtain. In the resting state, MES was an inherent type; in the resting state, there was no shunt. And Valsalva induces MES to be a latent type.

2.5 Evaluating index

The comparison of the detectable rate of PFO between the two groups; the incidence of PFO in migraine with aura and migraine without aura in group A. Analysis of the characteristics of the classification and grading of patients who was detected to have PFO in two groups.

2.6 Statistical methods

The SPSS 25.0 software was used for data processing. Enumeration data were expressed as percentages, and tested by χ^2. If P<0.05, it meant that the difference was statistically significant.

3 Results

3.1 The comparison of detectable rate of PFO between two groups

The detectable rate of PFO in group A was 50.00%, and the detectable rate in group B was 40.00%. There was no statistically significant difference between group A and group B (P>0.05); in group A, the detectable rate of PFO in migraine with aura was 62.50%, while migraine without aura was 37.50%. And the difference was statistically significant (P<0.05). See Table 1.

Table 1. The comparison of detectable rate of PFO between observation group and comparison group n(%)

Group	Detectable rate	Group A	Detectable rate
Group A(n=80)	40(50.00)	Migraine with aura	25(62.50)
		Migraine without aura	15(37.50)
Group B(n=80)	32(40.00)	-	-
χ^2	1.616	-	5.000
P	0.204	-	0.025

3.2 The comparison of grading and classification of PFO-positive patients in the two groups

There was no statistically significant difference in the comparison of the incidence of RLS in grade I and grade II in the two groups (P>0.05). The grade III shunt (50.00%) in group B was higher than that in group A. (25.00%), and the difference was statistically significant (P<0.05); there was no statistically significant difference between the inherent and latent RLS in the two groups (P>0.05). See Table 2.

Table 2. The comparison of the incidence of RLS between group A and group B n(%)

Group	Grade I	Grade II	Grade III	The inherent type	The latent type
Group A(n=40)	11(27.50)	19(47.50)	10(25.00)	24(60.00)	16(40.00)
Group B(n=32)	4(12.50)	12(37.50)	16(50.00)	19(59.38)	13(40.63)
χ^2	2.425	0.725	4.816	0.003	
P	0.119	0.394	0.028	0.957	

4 Discussion

In the past, the gold standard for clinical detection of PFO was transesophageal ultrasound. However, this method of diagnosis is sort of traumatic, which increases the patient's physical and psychological burden, so there are certain limitations in the scope of application[3]. In recent years, with the continuous development of medical technology, c-TCD is also gradually applied to the detection of PFO. This method of detection activates physical saline by intravenous injection of the elbow, and simultaneously monitors the presence or absence of signals of microemboli in the intracranial arteries within a certain time window, which can effectively identify the presence of right-to-left shunts and has a positive value for the detection of PFO.

Migraine is a common clinical syndrome of headache, and studies have shown that the positive detectable rate of PFO migraine with aura is higher, while the positive detectable rate in migraine without aura has comparatively smaller difference from that of normal patients. The results of this study show that the detectable rate of PFO in patients with migraine is 50.00%, and the detection rate of PFO in aura with migraine (62.50%) is evidently higher than that in migraine without aura (37.50%). Studies have confirmed that c-TCD has a high sensitivity to PFO in cryptogenic stroke, and its positive detectable rate of PFO is about the same as that of transesophageal ultrasound. Therefore, It is objective to use c-TCD to screen for cryptogenic stroke[4]. This study shows that the detectable rate of PFO in cryptogenic stroke is 40.00%, which is in good agreement with the results of related results of studies. The morphology of PFO of patients with migraine mostly enters in the form of dots which varies less, so only some fine microemboli pass through[5]. The mechanism of cryptogenic stroke induced by PFO may be that local hemodynamic parameter changes and causes the forming of in situ thrombosis. Once it is detached, it will induce paradoxical cerebral embolism and then cause cryptogenic stroke[6]. It can be concluded from the above studies that the size of PFO and the number of microemboli are related to migraine and cryptogenic stroke. In this study, the proportion of grade III shunts (50%) in patients with positive PFO of cryptogenic stroke was higher than that(25%) of patients with migraine. It greatly confirms the above opinions.

In summary, c-TCD can accurately screen for migraine and cryptogenic stroke caused by PFO, providing a basis for clinical treatment. And it is objective in the diagnosis of different grades of PFO in two syndromes. Apart from that, it has the advantages of simple operation, non-traumatic, and low price. It can be widely used in clinical practice as an objective reference for diagnosing and evaluating the efficacy of the disease and preventing cryptogenic stroke.

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