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Assessment of Percheron infarction in images and clinical findings

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ABSTRACT

Objective: To assess the imaging and clinical features of patients with an artery of Percheron infarction comprehensively.
Methods: Of 6539 patients with a first-ever stroke, 18 patients with a Percheron infarction were enrolled, and their images and clinical data were retrospectively investigated.
Results: All patients underwent neurological intensive care unit (NICU) management. The initial symptom of a Percheron infarction included dizziness, transient blurred vision, double vision, barylalia, cerebellar ataxia, drowsiness, and a coma. Subsequent symptoms differed for the three subtypes of Percheron infarction, and the three subtypes are bilateral paramedian thalamic infarction with midbrain involvement, bilateral paramedian thalamic infarction without midbrain involvement, and bilateral paramedian and anterior thalamic infarction without midbrain involvement. Between favorable and unfavorable outcomes, there was no significant difference in the following patient characteristics including current smoking, hypertension, diabetes, hyperlipidemia, hyperhomocysteinemia, heart disease, time from stroke onset to medical care, and Glasgow Coma Scale score at admission ($P > 0.05$), but there were significant differences in both the National Institute of Health stroke scale (NIHSS) and Acute Physiology and Chronic Health Evaluation II (APACHE II) score at admission ($P < 0.05$). If the midbrain or larger infarct volume was involved or hemorrhagic transformation occurred, outcomes of a Percheron infarction were frequently unfavorable.
Conclusion: The clinical presentation of patients with a Percheron infarction is variable; early recognition, image performance, NICU management, NIHSS, and APACHE II score would help in diagnosis, evaluation, and treatment.

1. Introduction

The artery of Percheron (AOP), a rare anatomic variant arising from segment one of the posterior cerebral artery (P1) with a single common branch that provides bilateral arterial supply to the paramedian thalamus and the rostral midbrain, was first described by Percheron in 1973 [1]. Occlusion of the AOP gives rise to a Percheron infarction, which is characterized as a specific bilateral paramedian thalamic distribution with or without a mesencephalic distribution [2].

With a relatively small ischemic lesion in the bilateral paramedian thalami, patients with Percheron infarction would present with an apparent life-threatening event such as a massive ischemic infarction unless they had timely treatment [3,4]. Thus, it is necessary to consider Percheron infarction in clinical practice and imaging for its management. For decades, a few isolated cases have been reported in clinical practice [5–8]. N.A. Lazzaro et al. [9] and Antonio Arauz et al. [10] successively demonstrated the clinical and imaging spectrums with 37 and 15 cases, respectively. Although the relationships between clinical and imaging patterns have been described, little is known about the relationship among imaging, clinical presentation, and prognostic characteristics.

In this study, we not only described the clinical and imaging spectrums but also investigated the prognostics of patients with Percheron infarction.

Abbreviations: MRI, Magnetic resonance imaging; CT, computer tomography; DWI, diffusion weighted imaging; MRA, magnetic resonance angiography; posterior communicating artery, PCoA; GCS, Glasgow Coma Scale; NIHSS, National Institute of Health stroke scale; APACHE II, Acute Physiology and Chronic Health Evaluation II scale; HT, hemorrhagic transformation; mRS, modified Rankin Scale; NICU, neurological intensive care unit

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2. Materials and methods

2.1. Patients

The protocol for this study was approved by the institutional review board of our hospital. Of 6539 patients with a first-ever stroke, 18 patients with Percheron infarction were identified in our stroke registry from Jan 2012 to Jun 2016. The inclusion criteria were as follows: (1) presence on imaging of an abnormal and restricted diffusion with or without hyperintense T2 or FLAIR and hypointense T1 signal intensity on magnetic resonance imaging(MRI), and/or hypodense on computer tomography(CT) within a specific bilateral paramedian thalamic distribution or without rostral midbrain involvement; (2)first-ever stroke; and (3)exclusion of pathology-proved neoplasm, infection, inflammation, basilar artery syndrome, or Wernicke-Korsakoff syndrome.

2.2. Clinical data

The Glasgow Coma Scale (GCS), National Institute of Health stroke scale (NIHSS), and Acute Physiology Chronic Health Evaluation II scale (APACHE II) and time from stroke onset to medical care were recorded at admission for all patients, as well as their initial symptoms. At the same time, risk factors were noted, including current smoking, hypertension, diabetes, hyperlipidemia, hyperhomocysteinemia, and heart disease (such as atrial fibrillation, recent myocardial infarction, and valvular heart disease). Moreover, the potential etiology was classified into four subtypes [11] based on clinical features and data collected from tests such as brain imaging (CT/MRI), cardiac imaging (echocardiography, etc.), duplex imaging of the extracranial arteries, and arteriography (for large-artery diseases, small vessel disease, cardiac source, and other causes).

All patients had therapy based on guidelines for the early management of patients with acute ischemic stroke from the American Heart Association/American Stroke Association [12]. Meanwhile, any changes in symptoms, especially mental status, were monitored. Lastly, the patients' prognosis was assessed at 3 months, based on a modified Rankin Scale (mRS) as follows: favorable outcome (mRS $\leq$ 2) and unfavorable outcome (mRS $>$ 2).

2.3. Image analysis

All patients obtained CT and MRI scans one or more times according to changes in the patients' conditions. These images were blindly reviewed by two neuroradiologists. Disagreements were resolved by consensus. For each case, the infarction territories were recorded using the following categories: the bilateral paramedian thalami (symmetric or asymmetric), anterior thalamus, and midbrain (Fig. 1 A–C). The visualizations of the posterior communicating artery (PCoA) on magnetic resonance angiography (MRA) and lesions of infarct volume on DWI were reviewed on the workstation (ADW4.6 GE). Furthermore, increased consideration was given to areas that had hemorrhagic transformation (HT) and infarct extension during imaging follow-ups.

2.4. Statistical analysis

The data were analyzed using Statistical Package for Social Sciences software for Windows (Version 20, IBM). Mann–Whitney *U* test or Fisher's exact test was used to compare the GCS, NIHSS, APACHE II score, HT, midbrain involvement, time from stroke onset to medical care and infarct volume between the favorable and unfavorable groups. Statistical significance was defined as a P of < 0.05.

3. Results

Of 6539 patients who had an acute stroke, there were 18(0.27%) patients (14 males and 4 females; mean age ± SD: 63.22 ± 8.18 years old) with Percheron infarction in our stroke register. The risk factors, potential etiology, and clinical findings are shown in online Table 1. Hypertension was present in 14 patients (77.8%), along with hyperhomocysteinemia in 11 (61.1%), current smoking in 10 (55.6%), diabetes mellitus in 5 (27.8%), and hyperlipidemiain 4(22.2%). The most frequent cause of Percheron infarction was small vessel disease in 7 patients (38.9%), followed by cardioembolism in 4 patients (22.2%), large-artery diseases in 4 patients (22.2%), and others in 3 patients (16.7%).

3.1. Imaging findings

All patients obtained CT and MRI scans one or more times according to changes in their condition. The MRIs including conventional MR, DWI, and MRA sequences were of sufficient quality to meet diagnostic standards.

Nine (50%) patients who had an abnormal signal on brain MRI did not have abnormal imaging finding on their admission brain CT. Based on the involved infarction territories, 9 (50%) patients had a bilateral paramedian thalamic infarction with midbrain involvement, 6 (33.3%) patients had a bilateral paramedian thalamic infarction without midbrain involvement, and 3 (16.7%) had a bilateral paramedian and anterior thalamic infarction without midbrain involvement. None of the cases had a bilateral paramedian or an anterior thalamic infarction with midbrain involvement. The absence of PCoA was found in 17 patients with Percheron infarction (Fig. 1D).

3.2. Clinical findings

All patients underwent neurological intensive care unit management, and 4 patients were administered thrombolytic therapy. Upon admission, the patients had the following: median GCS, 8 (range from 4 to 15); median NIHSS, 15 (range from 1 to 40); and median APACHE II, 15 (range from 8 to 18). The initial symptom varied, including dizziness (6 cases), transient blurred vision (1 case), double vision (5 cases), barylalia (2 cases), cerebellar ataxia (1 case), drowsiness (1 case), and a coma (9 cases). Subsequently, the clinical presentations included mental status disturbance (17 cases), behavioral amnesic impairment (3 cases), aphasia or dysarthria (10 cases), ocular movement disorders (15 cases), motor deficits (6 cases), and cerebellar signs (4 cases).

All cases presented with altered mental status except 4 cases whose mental impairment did not improve within 3 to 7 days. HT was confirmed in 4 cases on both sides of the thalamus according to a follow-up brain CT (Fig. 1E). Furthermore, two cardioembolic cases experienced sudden worsening with respiratory failure because of recurrent embolism to the brainstem (Fig. 1F).

3.3. Prognosis

There were 61% patients with a favorable outcome who experienced a good functional recovery and could perform their activities of daily living. Current smoking, hypertension, diabetes, hyperlipidemia, hyperhomocysteinemia, heart disease, and time from stroke onset to medical care were not associated with the clinical outcomes for patients with Percheron infarction in this study ($P > 0.05$). Between favorable and unfavorable outcomes, there was no significant difference in GCS score at admission ($P > 0.05$), but there were significant differences in both the NIHSS and APACHE II score at admission ($P < 0.05$). If the midbrain or larger infarct volume was involved or if an HT occurred, the outcome of a Percheron infarction was frequently unfavorable (Fig. 2).

4. Discussion

Percheron infarction is a catastrophic cerebral vascular event because of a rare anatomic variant involving the paramedian thalamus