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Classification of posterior circulation stroke: a narrative review of terminology and history

Abstract. Background. Little is known about the history of classification of posterior circulation stroke. However, it helps in developing secondary prevention and treatment strategies. We purposed to provide a narrative review of terminology and history of classification of posterior circulation stroke. **Materials and methods.** A comprehensive electronic literature search was performed on Scopus, Web of Science, MEDLINE, ScieLo, PubMed, the Cochrane Library, EMBASE, Global Health, CyberLeninka, RINC databases, and databases of government scientific libraries of Ukraine, European Union, United Kingdom, and the USA for 1900–2021 to identify the articles and books that discussed the classification of posterior circulation stroke and its history. **Results.** A narrative review of terminology and two approaches to the classification of posterior circulation stroke are presented and discussed. **Conclusions.** We provided a comprehensive narrative review of terminology and history of classification of posterior circulation stroke.

Keywords: posterior circulation stroke; classification; history; review

Introduction

Posterior circulation stroke (PCS) was first studied in the 19th century. However, this branch of clinical vascular neurology remains poorly understood compared to anterior stroke. Moreover, there is not enough data about the classification of posterior circulation stroke, especially its history.

The purpose of this work is to provide a comprehensive narrative review of terminology and history of classification of posterior circulation stroke.

Materials and methods

A comprehensive electronic literature search was performed in Scopus, Web of Science, MEDLINE, ScieLo, PubMed, the Cochrane Library, EMBASE, Global Health, CyberLeninka, RINC databases, and databases of government scientific libraries of Ukraine, European Union, United Kingdom, and the USA for 1900–2021 to identify articles and books that discussed the classification of posterior circulation stroke and its history. The applicable articles are cited and referenced. No limit is placed on publication

time or the language of the article. All relevant articles were identified and screened by both authors, and disagreements were resolved by consensus. The results are summarized descriptively.

Results and discussion

Globally, stroke is a leading cause of mortality and disability with substantial economic costs for post-stroke care [1–9]. Stroke mortality is reported to be 3 to 4.5 times higher in Central and Eastern Europe compared to Northern, Southern, and Western Europe with the highest age-standardized stroke death rates in Ukraine [10–23].

Posterior circulation strokes account for approximately 20–25 % of ischemic strokes [24–26]. These strokes are less represented in the scientific literature, they are more difficult to diagnose, have a more severe clinical course, and higher mortality compared to anterior circulation stroke [18, 27–34]. Terminological definitions and classification of posterior circulation strokes have been discussed and changed

over the years. That is why we consider it necessary to focus the attention of medical doctors on the modern definition of posterior circulation stroke, conducting a historical analysis of its classification.

Definition of posterior circulation stroke

PCS, also referred to as posterior circulation infarction, corresponds to any infarction (ischemic or hemorrhagic) occurring within the vertebrobasilar vascular territory, which includes the brain stem, cerebellum, midbrain, thalami, and areas of temporal and occipital lobes [25].

Previously, physicians used the general term “vertebrobasilar insufficiency” to describe the cause of hemodynamic disorders in all cases of posterior circulation ischemia [35]. This concept was first proposed by American neurologists at the Mayo Clinic [36]. Around this time (the 1950s), D. Danny-Brown used the term “cerebrovascular insufficiency” to explain the mechanism of transient ischemia in patients with anterior and posterior circulation transient ischemic attacks [37]. These definitions only partially reveal the nature and origin of PCS, and the mechanism of its occurrence but do not reflect the duration and reversibility of neurological symptoms. The knowledge accumulated at that time on this problem and the existing views became the basis for the formulation of two approaches to the classification of PCS.

Classification of posterior circulation stroke

The first approach to the classification of PCS substantiated the definition of a brain stem infarction by the name of the artery in the area of which there was a lesion. This approach is typical for anterior stroke classification and is more often associated with thrombotic or embolic occlusion of the large and medium-sized arteries of the anterior circulation [21, 24, 25]. It is based on the peculiarities of the topographic structure of the carotid arteries and the functional insufficiency of the anastomosis system.

However, the patterns of blood supply in the brain stem are completely different. Such considerations have induced some authors to identify certain neurological syndromes that are typical for the impairment of various arteries of the posterior circulation, in particular, the syndromes of the posterior inferior cerebellar artery [38], superior cerebellar artery [39], anterior inferior cerebellar artery [40], the main artery in the area of branching [41], etc.

First of all, it should be noted that the approach to determining the diagnosis of PCS, taking into account the area of blood supply to a particular artery, has significant methodological shortcomings. In this case, the diagnosis of PCS of a certain part of the brain stem is replaced by a diagnosis of thrombosis or embolism of the corresponding posterior artery.

The accuracy and reliability of the diagnosis of cerebral stem infarction, which affects a certain area of arterial blood supply, is questionable. Adjacent areas of brain stem vascularization overlap and form a closely related vascular association [36, 42]. There are also differences in the topography of the arteries, anastomotic potential, and the possibility of collateral circulation in the brain stem [43].

It is also difficult to identify the area of arterial lesions in case of multiple brain stem infarctions that occur simultaneously in the area of blood supply to several arteries and are characterized by combined neurological symptoms [44, 45]. Crucial evidence for the impossibility of identifying cerebral stem infarction with occlusion of a specific artery was obtained in the late 20th century after the introduction of methods for visualization of brain tissue and vascular system [35, 45, 46].

The second approach to the classification of PCS was based on the syndromic principle, i.e. on determining the localization of the brain lesion depending on the existing alternative syndrome, with the name of the author who described it (eponymous classification).

It is known that alternative syndromes were considered pathognomonic for half of the lesions of the brain stem structures. The lesion of certain anatomical structures is accompanied by different syndromes depending on the involved vascular area: medulla, pons, and midbrain [47]. At the same time, the authors rightly point out that the isolated syndromes and their variants may be incomplete, and sometimes pontine infarctions can mask combined infarctions in other areas supplied by the posterior circulation arteries [25].

More specific information on this problem is given in the work published in 2009 by J.J. Marx and F. Thomke “Classical crossed brain stem syndromes: myth or reality?” [48]. Over three years, the authors examined 308 patients with signs or symptoms of acute brain stem infarction. Analysis of the results of the study, using clinical and neurological methods, cerebral, and vascular imaging, showed that only the alternating Wallenberg syndrome had clinical significance. At the same time, other clinical alternating syndromes were not significant in clinical practice. Weber, Claude, Raymond-Cestan, and Babinski-Nageotte syndromes were seldom found in ischemic stroke. Other syndromes (Foville, Millard-Gubler) are sometimes identified with each other in the literature [49, 50].

The presented literature data limit the clinical value of alternative syndromes in neurology for the topical diagnosis of lesions of the anatomical structures of the brain stem. Alternative syndromes isolated in different periods, except for Wallenberg syndrome, have no topical and diagnostic significance. Thus, topical alternating syndromes do not allow the medical doctor to correctly assess the clinical situation, neurological status, determine stroke nosology, which can lead to diagnostic errors.

Negative attitude towards the eponymous classification of PCS and its identification with occlusion of the infarction-dependent posterior circulation artery was expressed in previously published reviews of medulla oblongata syndrome [51], pons Varolii [52], midbrain [53] and substantiates the classification of PCS depending on the brain stem area. This classification is based on the results of a study of brain stem vascularization, according to which there is a very strict constancy of distribution of the median (paramedian), lateral, and dorsal parts of the brain stem and a clear correspondence among these areas in the localization of brain stem infarction [54–56].

The data obtained demonstrated that vascular trunk syndromes are classified by the condition of the internal arteries, not the superficial ones. According to the proposed classification, infarctions of the medulla oblongata, pons Varolii, and midbrain are divided into medial, lateral, and dorsal ones.

However, this classification reflects the distribution of PCS only in the brain stem. At the same time, vertebrobasilar system provides vascularization not only of the medulla oblongata, pons Varolii, and midbrain, but also to other intracranial anatomical areas of the brain: cerebellum, thalamus, occipital lobes, and the posterior temporal lobes of the cerebral hemispheres. Therefore, the classification of PCS according to the posterior circulation must be supplemented.

Conclusions

It is well known that each patient with posterior circulation stroke has his characteristics of the neurological course, which may differ from the generalized version. Therefore, it is often very difficult, especially for young neurologists, to form a clinical diagnosis. The difficulty lies in defining the modern terminology of posterior circulation stroke. Summarizing the above, we would like to highlight that in the case of PCS in different parts of the brain stem or cerebellum, it is preferable not to use the diagnosis “stroke in the vertebrobasilar territory”, as it only partially reveals the nature of stroke, including the presence of clinical neurological symptoms and mechanism of their occurrence. In case of medullary, pontine, mesencephalic, cerebellar, or thalamic stroke it is advisable to use a terminological formulation of the diagnosis that reflects the vascular area (proximal, medial, distal), clinical variant of infarction, anatomical, and topographic analysis.

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Класифікація вертебробазиллярних інсультів: огляд термінології та історії

Резюме. Актуальність. Про історію класифікації вертебробазиллярного інсульту відомо небагато. Однак і це допомагає в розробці стратегій вторинної профілактики та лікування. Ми прагнули надати огляд термінології та історії класифікації інсульту вертебробазиллярного басейну. **Матеріали та методи.** Було проведено комплексний електронний пошук літератури в базах даних Scopus, Web of Science, MEDLINE, ScieLo, PubMed, the Cochrane Library, EMBASE, Global Health, CyberLeninka, RINC, а також у базах даних державних науко-

вих бібліотек України, Європейського Союзу, Великобританії та США за період 1900–2021 рр. з метою знайти статті та книги, в яких обговорювалася термінологія і історія класифікації вертебробазиллярного інсульту. **Результати.** Подано огляд термінології і два підходи до класифікації інсульту вертебробазиллярного басейну. **Висновки.** Ми надали всебічний огляд термінології та історії класифікації вертебробазиллярного інсульту. **Ключові слова:** вертебробазиллярний інсульт; класифікація; історія; огляд