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VARIANTS FOR THE DEVELOPMENT OF CEREBRAL ARTERIES: POSTERIOR TRIFURCATION OF THE INTERNAL CAROTID ARTERY

Baiguisova D.Z., Kalshabay E.E., Li V.V.
National scientific center of surgery named after A.N. Syzganov, Almaty, Kazakhstan

Abstract

Vascular diseases of the brain are one of the main problems of modern medicine. The quantity and quality of neurosurgical operations is growing. We conducted a search for literature covering various variants of the structure of vascular blood supply to the brain; we were interested in trifurcation of the internal carotid artery, as the most common development option among non-classical ones. We tried to illuminate the frequency of occurrence of posterior ICA trifurcation, its functional significance, and the effect on the development of circulatory disturbances in the brain and vascular anomalies.

ABOUT THE AUTHORS

Baiguisova Dinara Zulkhanaevna *– Doctor of Radiation Diagnostics, Head of the Department of Radiation Methods of Research JSC NSCS named after A.N. Syzganov.*
e-mail: dina_gallyamova@mail.ru

Li Vladimir *– 2nd year Resident of radiology NSCS named after A.N. Syzganov.*

Kalshabay Erkezhan *– 2nd year Resident of radiology NSCS named after A.N. Syzganov.*

Keywords
trifurcation, internal carotid artery, structural features of blood vessels, brain

Ми артериясының даму нұсқалары: ішкі ұйқы артериясының артқы трифурациясы

Байгуисова Д.З., Калшабай Е.Е., Ли В.В.
А.Н.Сызғанов атындағы Ұлттық ғылыми хирургия орталығы, Алматы, Қазақстан

Аңдатпа

Қазіргі медицинаның басты мәселелерінің бірі мидың қан тамырлары аурулары болып табылады. Нейрохирургиялық операциялардың саны мен сапасы өсуде. Біз миды тамырлы қанмен қамтамасыз ету құрылымының әр түрлі нұсқаларын қамтитын әдебиеттерді іздедік, классикалық емес түрлердің ішіндегі ең кең таралған нұсқасы ретінде ішкі каротид артериясының трифурациясы қызықтырды. Біз ИКА-ның артқы трифурациясының пайда болу жилігін, оның функционалды маңыздылығын және церебральды қанмен қамтамасыз етудің бұзылыстары мен тамырлы ауытқулардың дамуына әсер етуді атап көрсетуге тырыстық.

АВТОРЛАР ТУРАЛЫ

Байгуисова Динара Зулхарнаевна *– А.Н. Сызғанов атындағы Ұлттық ғылыми хирургия орталығының сәулелі тәсілдермен зерттеу бөлімінің меңгерушісі, сәулелі зерттеу дәрігері.*
e-mail: dina_gallyamova@mail.ru

Ли Владимир: *А.Н. Сызғанов атындағы ҰҒХО сәулелі тәсілдермен зерттеу бөлімшесінің резиденті.*

Калшабай Еркежан: *А.Н. Сызғанов атындағы ҰҒХО сәулелі тәсілдермен зерттеу бөлімшесінің резиденті.*

Түйін сөздер
трифуркация, ішкі ұйқы артериясы, қан тамырларының құрылымық ерекшеліктері, ми

Варианты развития артерий головного мозга: задняя трифуркация внутренней сонной артерии

Байгуисова Д.З., Калшабай Е.Е., Ли В.В.
Национальный научный центр хирургии им. А.Н. Сызганова, Алматы, Казахстан

Аннотация

Сосудистые заболевания головного мозга являются одной из основных проблем современной медицины. Растет количество и качество нейрохирургических операций. Мы провели поиск литературы, освещающей различные варианты строения сосудистого кровоснабжения головного мозга, нас заинтересовала трифуркация внутренней сонной артерии, как наиболее часто встречающийся вариант развития среди неклассических. Мы постарались осветить частоту встречаемости задней трифуркации ВСА, ее функциональное значение, влияние на развитие нарушений кровоснабжения мозга, сосудистых аномалий.

ОБ АВТОРАХ

Байгуисова Динара Зулхарнаевна *– врач лучевой диагностики, заведующая отделом лучевых методов исследования Национального научного центра хирургии им. А.Н. Сызганова.*
e-mail: dina_gallyamova@mail.ru

Ли Владимир *– резидент отдела лучевых методов исследования Национального научного центра хирургии им. А.Н. Сызганова.*

Калшабай Еркежан *– резидент отдела лучевых методов исследования Национального научного центра хирургии им. А.Н. Сызганова.*

Ключевые слова
трифуркация, внутренняя сонная артерия, особенности строения сосудов, головной мозг

The problem of vascular diseases of the brain remains one of the leading in modern world medicine. There is an increase in neurosurgical operations performed, for which knowledge of morphometry and anatomical variability is important [1]. The influence of the structural variants of the arterial blood supply to the brain affects the state of hemodynamics in the brain. Unequal blood circulation in certain variants of the development of the arterial circle can lead to the formation of vascular aneurysms, with subsequent rupture, and the development of hemorrhagic stroke, or can to a decrease or full cessation of blood flow through the supply vessels with the development of ischemic stroke [2]. The arterial circle of the cerebrum is the most important, constantly acting anastomosis between the systems of the internal carotid arteries and the vertebrobasilar system. However, in the available literature there is no clear conception which variations of the Willis circle are normal variants that do not worsen the compensatory capabilities of collateral blood flow, and which predispose to a disturbance in the blood supply to the brain [3]. Anomalies in this network can lead to serious clinical conditions, such as stroke, leading to poor blood supply to the brain [4]. Congenital vascular abnormalities of the brain: aplasia or hypoplasia of blood vessels, vessels with atypical morphology, etc. are the result of an early defection of their development [5].

The anatomical anastomosis provided by the circle of Wellis is of great importance if one of the main vessels of the brain undergoes occlusion. It was found that in more than 50% of people with a healthy brain and 80% with dysfunctional changes, at least one artery is present in the arterial circle of the brain that is absent or underdeveloped [4,6]. “Non-classical” variants of the structure of the arterial circle of the cerebrum (Willis circle) are found according to various authors from 25 to 75% of cases [7]. F. Toda and D. Gacheshiladze give the following figures: 14-25% of cases, 7-16% [8]. In studies of J. Sidorov and his colleagues, 24% posterior ICA trifurcation was also more often detected, which conform to 13 patients [9]. According to A. Gorbunov as a result of his research of 322 people, the “classic variant” of the Willis circle was found in 51.6% and in 48.4% one of the non-classical variants, of which 5.1% revealed posterior trifurcation [10]. In his work, Gorbunov singled out partial posterior ICA trifurcation – equality in diameter of the posterior connecting artery and posterior cerebral artery on one side and full trifurcation – superiority in diameter of the PcCA over the proximal segment of the PCA on one side [10]. In opinion of scientists, such options show its full-fledged function, which plays a large role in the regulation of blood flow in the brain. Variants of the non-classical structure of the Willis circle can be the cause of aneurysms in both its anterior and posterior departments. [7]. The most dangerous are the anterior and posterior trifurcations of the carotid artery, which affect the spreading of blood in the brain, until the occurrence of occlusive changes requiring good collateral circulation. The internal carotid artery on the side of its posterior trifurcation delivers about 50% of the blood to the brain, the opposite internal carotid artery - 40% of the blood, and the basilar artery - only 10% of the blood [11,12]. In the posterior section, the most common are: posterior trifurcation of the internal carotid artery (the posterior cerebral artery departs from the internal carotid artery), aplasia of one or both posterior connecting arteries [13]. Kotsenko’s studies have shown that patients with ICA pathology, such as complete posterior trifurcation, PCA hypoplasia, s-shaped pathological tortuosity, and loop formation are more often observed cognitive impairment (12.6%), less often moderate (7%) and lungs (8.5%). With a combination of anomalies of the intracerebral arteries and precerebral arteries (complete posterior trifurcation of the left ICA and hypoplasia of the left PCA), moderate violations of intellectual-mnestic functions more often developed (33.3%)[14].

In the posterior trifurcation of the ICA, the anterior, middle, and posterior arteries of the brain depart from it, in this case, the posterior cerebral artery departs by means of the posterior connecting artery. The proximal segment of the posterior cerebral artery adjacent to the basilar artery (P1) is usually hypoplastic, however, in rare cases, the diameter of P1 is equal to the diameter of the enlarged posterior connecting artery. Unilateral posterior trifurcation of the internal carotid artery is detected in 22% of cases, and on the right - 2 times more often than on the left, bilateral - less often (4% of cases). Posterior trifurcation of both internal carotid arteries, in which there are large posterior connective arteries, is found to be normal in the first 4 half of the intrauterine period, which is of great functional importance [7]. Also, the presence of posterior trifurcation is important in the treatment of aneurysms of the mouth of the posterior connective and anterior villous arteries located on the supraclinoid segment. Due to the frequent cases of trifurcation and the importance of the anterior villous artery, determine the need to maintain their patency in the treatment of these aneurysms [15].

Consequence and conclusions:

According to various data, the structure of the arterial circle of the cerebrum (Willis circle) is found in about half of the cases, the other half consists of various non-classical structures [7,11,12]. Also, some authors suggest a dependence of the structure of the arterial circle with the frequency of occurrence of cerebral circulatory disorders [16,4]. In

Trushel's studies, only people with non-classical variants of the structure of the Willis circle were found to have cerebrovascular disorders [3]. Knowing the structural features of the various variants of the Willis circle also allows you to choose the right tactics in making medical procedures, such as the treatment of aneurysms of the intracranial ICA, for example, paraclinoid aneurysms, which make up 20-33% of all cerebral aneurysms [15]. The posterior ICA trifurcations are of particular interest since, according to Trushel's data, they are found more often than others, in Gorbunov's work, trifurcation was also more common than others, and in combination with other phenomena of the structure of cerebral vessels [3,7,10,16]. In studies Kostrov O.Yu. and his colleagues, it was shown that among the patients with arterial aneurysms mainly women prevail. Moreover, they were 4 times more likely to have an open type of structure of the Willis circle. Thus, the features of angioarchitectonics of cerebral vessels, of course, predispose to the development of cerebrovascular disorders [13]. Anomalies and variants of the cerebral arteries are biologically less reliable and lead to the development of diseases. It is no accidentally that they are often associated with aneurysms [5].

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