
THE SIGNIFICANCE OF THE EXTRACRANIAL-INTRACRANIAL ANASTOMOSES OF CAROTID SYSTEM IN OCCLUSION OF INTERNAL CAROTID ARTERY

Amela Kulenović*¹, Faruk Dilberović¹

¹ Department of anatomy, Medical Faculty, University of Sarajevo, Bosnia and Herzegovina

* Corresponding author

ABSTRACT

The existence of collateral circulation in patients with impaired intracranial circulation was studied. We analysed angiograms of 35 patients of the Neurology Clinic of Clinical Centre in Sarajevo with occlusion of internal carotid artery. In majority cases collateral circulation was not established. In patients with occlusion of internal carotid artery, extracranial-intracranial anastomoses were established in some cases, with results of surviving and patients recovery. Collateral circulation based on blood vessels which are formed in the early stages of fetal life. Some embryonal arteries undergo an involution process, while the other part of blood vessels stay unfunctional during life, until cerebrovascular disease appearance, when it comes to their activation. Establishing of the collateral circulation in post-occlusiv status depend on great number of factors: number of anastomoses, their calibre, velocity of occlusion and complete vascular status of patients.

Key words: internal carotid artery, collateral circulation, extracranial- intracranial anastomoses

INTRODUCTION

Collateral brain arteries include the great number of anastomotic channels or plexus connections between brain arteries, as well as between brain arteries and head and neck arteries (8, 2, 7, 3, 1). Collateral circulation of brain has the great functional and clinical significance, and based on blood vessels which are formed in the early stages of fetal life. Common clinicians opinion are that patients have different ability for blood compensation in a case with changes in cerebral blood flow. Carotid artery occlusion in one persons can be followed only with transitive neurological deficit or without symptoms, while in other persons we can find infarction of the great part of one cerebral hemisphere. These differences are undoubtedly in connection with existence or non existence of adequately collateral circulation. Functional effect of collateral circulation in post-occlusive status depend on great number factors: number of anastomoses and their calibre, as well as status of cerebrovascular system, vascular variations and anomalies, velocity of occlusion (trombosis or embolism), on systemic arterial pressure, volume and blood viscosity.

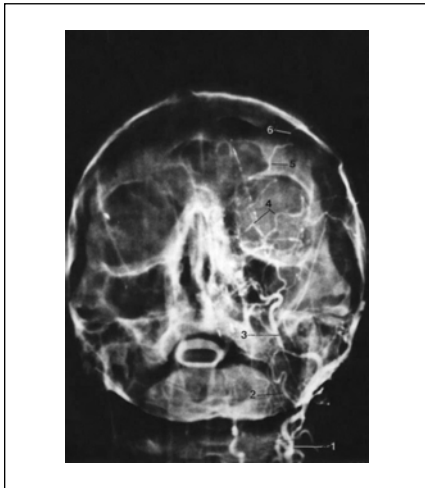
Based on type and position of anastomotic arteries, anastomoses can divide into: cervical, extracranial, extracranial - intracranial, extracerebral anastomoses, extracerebral- cerebral anastomoses and cerebral anastomoses. According to some authors (11, 5), and others extracranial-intracranial anastomoses are connections between branches of the external carotid artery and internal carotid artery. There are in the field of the corresponding craniofacial cavities (orbit, nasal cavity, tympanic cavity). Anastomoses exists in orbit between branches of ophthalmic artery (branch of internal carotid artery) and corresponding branches of external carotid artery, are usually functional after occlusion of the internal carotid artery. In this group of anastomoses include and individual persistent embrional blood vessels. The first idea for detail investigations of collateral circulation date from 1958. Modern radiology technics open possibility to precisely investigations of patients with cerebrovascular diseases, with possibility of visualization of collateral circulation through the existence of arterial anastomoses in the field of central nervous system.

MATERIAL AND METHODS

For this work we used angiograms of 35 patients of the Neurology Clinic of Clinical Centre in Sarajevo, suspected on occlusion of internal carotid artery, using direct carotid angiography. X-ray films were taken serially in two projections, with observation of all phases of circulation. Arteriograms were careful analysed.

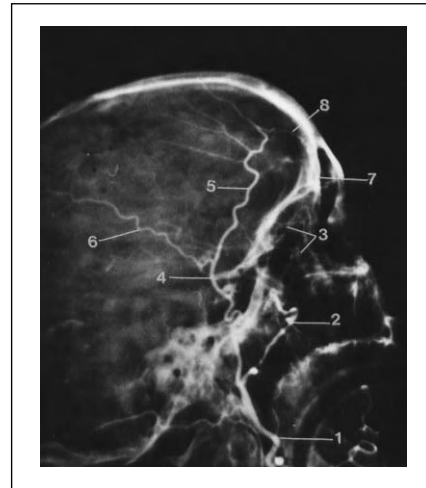
RESULTS

In the pathology of hemodynamic diseases a frequent case is occlusion of internal carotid artery. Patients hospitalized at the Neurology Clinic in coma, who survived thanks to good development of the extracranial-intracranial anastomoses were analysed. Carotid angiography was applied after hospitalization. Carotid angiograms in the anteroposterior and the lateral projection show the external carotid artery and its collateral and terminal branches, facial artery, maxillary artery and superficial temporal artery. Except that we can observe blood vessels, branches of the ophthalmic artery, and anastomosis between good filled supraorbital artery and frontal branch of the superficial temporal artery (Fig.1 and 2). Branches of the ophthalmic artery are filling retro-



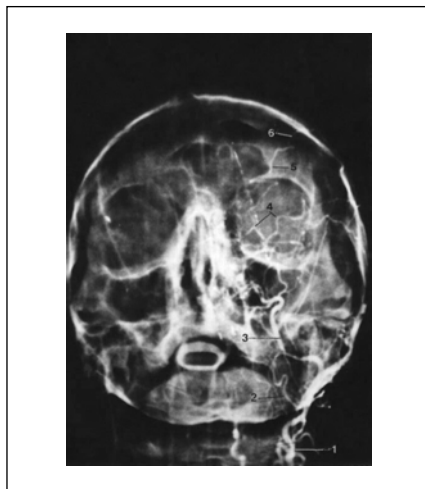
- 1- external carotid artery
- 2- facial artery
- 3- maxillary artery
- 4- ophthalmic artery (orbital branches)
- 5- supraorbital artery
- 6- superficial temporal artery (frontal branch)

Figure 1 Carotid angiogram.
Anteroposterior projection



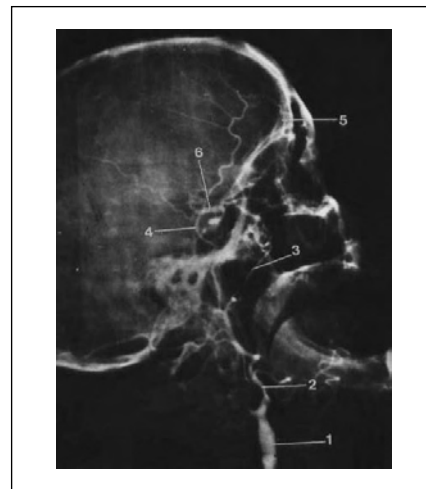
- 1- external carotid artery
- 2- maxillary artery
- 3- ophthalmic artery (branches)
- 4- superficial temporal artery
- 5- superficial temporal artery (frontal branch)
- 6- superficial temporal artery (parietal branch)
- 7- supraorbital artery
- 8- anastomosis between superficialis temporal artery and ophthalmic artery

Figure 2 Carotid angiogram. Lateral projection



- 1- external carotid artery
- 2- maxillary artery
- 3- branches of the ophthalmic artery
- 4- middle cerebral artery

Figure 3 Carotid angiogram. Anteroposterior projection. Establishing of the cerebral circulation with extracranial-intracranial anastomoses, in occlusion of carotid internal artery



- 1- common carotid artery
- 2- external carotid artery
- 3- maxillary artery
- 4- superficialis temporal artery
- 5- supraorbital artery
- 6- middle cerebral artery

Figure 2 Carotid angiogram. Lateral projection. Establishing of the cerebral circulation with extracranial-intracranial anastomoses, in occlusion of carotid internal artery.

grade from the maxillary artery, with extracranial-intracranial anastomoses between sphenopalatine artery and ethmoidal arteries, as well as between deep temporal arteries and lacrimal artery, and in the end through extracranial-intracranial anastomoses between infraorbital branches of the maxillary artery with inferior palpebral arteries of the ophthalmic artery. Supraorbital artery is filling by frontal branch of superficial temporal artery, so we can see many blood vessels in orbit. Although occlusion of internal carotid artery is found, thankful extracranial-intracranial anastomoses, patients started recovery.

Carotid angiography made again fifteen days later. Angiograms showed retrograde circulation through ophthalmic artery to supraclinoidal part of the internal carotid artery, and the beginning of the middle cerebral artery in anteroposterior and lateral projection is visible (Fig.3 and 4).

DISCUSSION

Collateral circulation based on blood vessels which are formed in the early stages of fetal life. Some embryonal arteries undergo an involution process, while the other part of blood vessels stay for vascularization of structures in development. Collateral blood vessels exist in the prenatal development, stay unfunctional during life, until cerebrovascular disease appearance, when it comes to their activation as describe Fields at al (3) in their study about collateral circulation.

Pitts (9) established atherosclerosis as the most frequent causa of stenosis in the big arteries usually on bifurcation of arterial channels. Before total occlusion the lumen of blood vessels is narrowing with subintimal atherosclerotic plaque. In a case with compression on the lumen, the blood flow is slow, and the possibilities of tissue depend on collateral circulation. Although this process is more gradual than hasty, the body mechanisms are usually able for compensation of blood flow. This statement agree with our findings, in elder patients with occlusion of internal carotid artery and sclerotic blood vessels.

Angiograms made when patients arrived in hospital, showed intracranial-extracranial anastomoses between ophthalmic artery and superficial temporal artery, with results of establishing of cerebral flow and the survival of an individual.

Krayenbuhl et Yasargil (6) et all. and Fisher (4) showed that the opening of the existing collaterals is the first body answer on occlusion of the large arteries. According

to many authors this is possible because vasomotor reflex causing vasodilatation of the blood vessels. The differences of the pressure can cause opening unfunctional collaterals and good blood flow through dilatable functional blood vessels.

Compensatory, hemodynamic, metabolic and nervous mechanisms are very important and their effect determine abilities of the ischemic tissue for life. The tissue recovery are not only depend on cells-life abilities, as well as on growth of blood flow, for an increase of metabolic changes.

In his study of collateral circulation Quiring (10) describe some factors

which have influence on dynamic of collateral circulation:

- anatomical status of circulation channel
- time of occlusion
- status of systematic circulation

According to many researches and their published papers, cerebral ischemia is not only in relation with physiological changes.

So, Lazorthes at all. (7), Duvernoy (2) and others consider the anatomical factors often neglected, but the same significant as was noted previously. We also agree that the anatomical variations in human development in the most percents are responsible for the variety of signs and symptoms of occlusion, have an effect on recovery from neurology deficit.

Based on type and position of anastomotic arteries, anastomoses can divide into: cervical, extracranial, extracranial - intracranial, extracerebral anastomoses, extracerebral- cerebral anastomoses and cerebral anastomoses.

CONCLUSION

There is not a general model of the morphological changes of blood vessels in acute and chronic insufficiency, but there are an individual differences for the all man.

We can conclude that the functional activity of collateral circulation in post-occlusive status depend on great number factors : number of anastomoses and their calibre, as well as status of cerebrovascular system, vascular variations and anomalies, velocity of occlusion (thrombosis or embolism), as well on systemic arterial pressure, volume and blood viscosity.

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