FOLIA MEDICA CRACOVIENSIA
Vol. LIII, 1, 2013: 41–46
PL ISSN 0015-5616

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CLINICAL IMPORTANCE OF THE MIDDLE MENINGEAL ARTERY

Abstract: Middle meningeal artery (MMA)is an important branch which supplies among others cranial dura mater. It directly attaches to the cranial bones (is incorporated into periosteal layer of dura mater), favors common injuries in course of head trauma. This review describes available data on the MMA considering its varability, or treats specific diseases or injuries where the course of MMA may have clinical impact.

Key words: Middle meningeal artery (MMA), aneurysm of the middle meningeal artery, epidural hematoma, anatomical variation of MMA.

TOPOGRAPHY OF THE MIDDLE MENINGEAL ARTERY AND ITS BRANCHES

Middle meningeal artery (MMA) [1] is most commonly the strongest branch of maxillary artery (from external carotid artery) [2]. It supplies blood to cranial dura mater, and through the numerous perforating branches it nourishes also periosteum of the inner aspect of cranial bones. It enters the middle cranial fossa through the foramen spinosum, and courses between the dura mater and the inner aspect of the vault of the skull. Next it divides into two terminal branches — frontal (anterior) which supplies blood to bones forming anterior cranial fossa and the anterior part of the middle cranial fossa; parietal branch (posterior), which runs more horizontally toward the back and supplies posterior part of the middle cranial fossa and supratentorial part of the posterior cranial fossa. Branches of MMA traverse the arterial grooves giving rise to abundant lateral tracts which supply dura mater and periosteum. Perforating branches of the anterior and posterior branches reach also the diploe and from time to time they can reach even external coats of the skull. Apart from two strongest branches, MMA gives rise to three other branches: accessory meningeal branch, petrous branch and the superior tympanic artery (STA). It happens that accessory meningeal branch arises directly from the maxillary artery, still within infratemporal fossa [3]. It

supplies pterygoid muscles, auditory tube, levator and tensor veli palatini. It supplies commonly the trigeminal ganglion (ganglion of Gasser). Petrous branch runs through canal of greater petrosal nerve, supplies blood to facial nerve, and anastomoses with the stylomastoid artery.

To facilitate finding MMA, it was decided that Krönlein's method is the simplest way to find the main trunk of MMA, because there is a lack of precise topographic points in its course. To present location of the frontal branch one should localize the position of two imaginary lines — the superior horizontal, guided through the upper margin of orbit and the anterior vertical line, which runs through the middle of the zygomatic arch. To establish position of the parietal branch one should find the point of intersection of two lines: superior horizontal and posterior vertical, which runs immediately next to the back of the mastoid process. One must remember however that the length and the course of the trunk of MMA is the most frequent, although variations more or less popular can be found.

VARIATIONS OF MMA

Among described variants you can find the origin of MMA from the inferior posterior cerebellar artery [4]. Embryological base of this variation is still an object of profound studies, however from neurosurgical point of view knowledge of it may help to avoid occidental severance of blood supply of structures placed in the posterior cranial fossa during MMA embolisation [5].

Equally rare is origin of MMA from basilar artery or from one of its branches. Thorough location of origin is always speculative, however it might have been associated with persistent anastomozes in the vicinity of the trigeminal ganglion, between lateral pontine artery and intracranial components of the stapedian artery [6].

Next, even more frequent variant comparing to the last is the origin of MMA from lateral aspect of the internal carotid artery, which occurs in the vicinity of the foramen lacerum. It traverses the carotid canal together with the internal carotid artery and enters foramen lacerum. It does not go through the middle ear cavity nor pierces the stapes. When it reaches foramen lacerum, passes the cavernous sinus running immediately inferior to the trigeminal ganglion. Subsequently it takes a normal course and divides into anterior and posterior branches [6].

The remaining, described in the literature, variations consist of the case when it enters the middle cranial fossa through the foramen ovale together with the mandibular nerve (while foramen spinosum is absent [7, 8]), its origin from maxillary artery from the third portion (pterygopalatine) [9]. In this case MMA enters the middle cranial fossa through the lateral end of the superior orbital fissure. MMA may originate also from the ascending pharyngeal artery [10], completely or partially from the ophthalmic artery. It goes through the lateral edge of the

superior orbital fissure or through the meningoorbital foramen of the greater wing of sphenoid bone [11, 12]; as a branch of the persistent stapedian artery. Stapedian artery is usually a branch of the petrous fragment of the internal carotid artery [13, 14]. It enters the tympanic cavity and next through the foramen located between the footplate of the stapes and its limbs (crura). It courses through a small bony canal placed above promontory and goes into the facial canal, and next into the middle cranial fossa, giving a rise to a branch (MMA). Finally MMA may arise from the lacrimal artery [15].

INJURIES OF THE MMA

Meningeal vessels closely adhere to the internal aspect of bony vault of the skull and in case of their fracture can be damaged causing epidural hematoma even until 85% of cases [16]. Patients with cranial fractures affecting the meningeal vessels are more commonly subjected to epidural hematomas and recurrent episodes of bleeding because of enlargement of this hematomas. One of the most frequent and typical consequences of the rupture of dural vessles is a sudden development of hematoma, its expansion and immediate deterioration of neurological status of the patient [17]. Early surgical intervention is a standard in patients with epuidural hematomas and allows to elude intussusception, and next decease of the patient as a a result of subsequent neurological complication. However the doubts associated with little hematomas do not let to state if surgical intervention is avoidable. In such case only very careful analysis of patient's condition with permanent monitoring of the intracranial pressure and repeatant CT scans can help to serach the dynamics of the process. We cannot forg et however about the reversion of the bleeding and thus the enlargement of the hematomas' mass. Based on the available literature one can find reports following which even 65% of little hematoma is characterized by a tendency of enlargement during 24 hours from the moment of trauma [18]. Studies performed proved , that patients following the cranial fractures traversing the vicinity of the course of meningeal vessels may suffer from a large risk of delayed bleeding and late hematoma swelling [19]. It may be concluded also that pseudoaneurysms and active extravasation of the contrast can be more frequently seen in patients with small epidural hematomas resulted from cranial fractures associated with skull injury projected to the position of MMA [19]. A knowledge on the variation of MMA lets to reduce the risk of thromboembolism during operative treatment of the lesion [15]. It i salso well recognized that spasm of MMA is one of the main players in etiology of migrenic pains [20, 21].

ANEURYSMS OF MMA

Mentioned above peudoaneurysm of MMA creates high risk of rupturing of the artery, which brings high mortality rate. From another hand however it quite rare complication and lack of typical signs and symptoms, led the researchers to find few features which may fitness the pathology in course. Based on series of CT few characteristic changes were ascertained, which may bring a suspection of the pseudoaneurysm, before it brings a risk of rupture. They consist of the following: cranial rupture or fracture, specialty of temporal region, hypodense aggregation in the field of acute hematoma, hypodense aggregations in the field of organized hematoma. 3-D CT is an effective and non-invasive method of verification of these suspections [22, 23].

Aneurysms of MMA may coexist, although in quite a few percent of cases, with meningiomas, Paget's disease, angiomas, moyamoya syndrome (a rare disease of unknown etiology, existins mostly in young Asians, causing blockage of large intracranial; arteries, especially terminal portion of internal carotid artery and/or middle and anterior cerebral arteries) [24]. They are treated as non-traumatic aneurysms and belong to great rarities. Their natural course is not well recognized because of their rarity, however from the period when preoperative angiography of cerebral vessels became a standard, the aneurysms of this type are more commonly diagnosed. Despite this in the literature there were described only few examples of such aneurysms coexisting with meningiomas [25, 26]. The authors postulate that although aneurysms on the surface of dura mater can be succesively treated by craniotomy, ensovascular procedures are much safer and may be equally effective [27].

SUMMARY

Modern neurosurgery lets quite safe even even broad craniotomy.The ability to localize precisely the course of blood vessels located immediately next to the internal aspect of the skull vault is an essential factor which conditions success in many operative procedures. The knowledge about the course of middle meningeal artery and its branches is prerequisite for medical doctor in a situation of head trauma assessment, or pathology which affect MMA and the regions supplied.

CONFLICT OF INTEREST STATEMENT

None declared.

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