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THALAMUS VASCULARISATION

L. ONISAI[1] I. DUMITRU[2] S. TOMA[1]

Abstract: *Although the vasculature of the thalamus was studied for many years, but with all anatomical references of groups involved are contradictory, describing them marked diversity and complexity of these descriptions perfusion pressure does not help in formulating a sound basis for pathologists.*
In literature there are few works on this theme and are often imprecise. Macroscopic and microscopic anatomy of the trunk and related thalamic arteries isolation in relation to other trunks, even delimit vascular territories appears to be incomplete and therefore inaccurate. In this work, 6 adult human cerebellums (24 hemispheres) were dissected. With care for clarification and standardization, the extra-paren-chymal thalamic arteries were classified in six groups: pre-mamillary artery, perforating thalamic arteries, thalamo-geniculate arteries, perforating branches of the postero-medial, postero-lateral and anterior choroidal arteries.

Key words: *arterial, thalamus, branches, description.*

1. Introduction

Pathology of the thalamic vascularisation that is frequently taken into account by clinicians shows the nature of decision problems induced by random anatomical descriptions.

Primary description thalamic arterial groups as that of Duret and Foix / Hillemand have created controversy. Duret also introduced the theory that the average cerebral artery vascularity participate in the thalamus, describing a branch called lenticulo-optic artery. Latest papers of Percheron's and Lazorthes and more recently thaws of Plates excluded this hypothesis. Because of anatomic variability and inaccuracy of descriptions is not yet possible to define precisely the arterial territories of the thalamus. These observations led us to undertake a study of the extra-parenchymatous disposition of the thalamic arterial groups.

2. Objectives

Objectives of this study are to described the extra-parenchymatous disposition of the thalamic arterial groups. These data regarding the arterial vascularization of the thalamus will be the base for us to the next step in studying micro vascularisation mapping of the thalamus.

[1] Departament of Anatony *Transilvania* University of Braşov.
[2] SUJ Fogolyan Kristof Sfantu Gheorghe.

3. Matherial and Methods

This study was done on 6 adult human brains, removed rapidly after death (12 hemispheres).

The brains were fixed in a 10% formalin solution for a period of 30–45 days.

The dissection was carried out carefully. The 6 brains were dissected according to a reproducible protocol. The constituents of the circle of Willis at the base of the brain were separated. The different arterial trunks participating in thalamic vascularization were thereafter followed from their origin. The posterior cerebral arteries, posterior communicating arteries, anterior choroidal arteries, postero-medial choroidal arteries and postero-lateral choroidal arteries were thereafter progressively dissected in systematic fashion. The temporal horn of the lateral ventricle was finally opened. The region of the geniculate bodies and the pulvinar were then dissected. The dorsal wall of the third ventricle was opened to visualize the entry point of the postero-medial choroidal arteries. Branches of the choroidal arteries were exposed and followed to the superior part of the thalamus.

4. Results

We considered that there are four thalamic vascular territories, each with a predilection for groups of thalamic nuclei. In literature they are described the following territory: tubero-thalamic, infero-lateral, paramedian and posterior choroidal. Thalamic blood supply varies between individuals regarding the origin of each branch vessel, artery position, and nuclei tributary area irrigated by each branch. There are three main sources: first portion of the posterior cerebral artery, terminal portion of the anterior choroidal artery and posterior choroidal artery.

We used the division into four segments of the posterior cerebral artery as follows the P1 segment was between the origin of the posterior cerebral artery and the junction of the posterior communicating artery, the P2 segment corresponded to the course of the artery around the cerebral peduncle as far as the pulvinar the P3 segment ran from the pulvinar to the calcarine groove, the usual point of division of the artery into its two terminal branches and the P4 segment was defined by the expansion of the posterior cerebral artery into its cortical branches.

The premamillary artery has been described as the most voluminous of the perforating branches of the posterior communicating artery [24, 35]. It penetrates the perforated lateral mamillary substance.

The perforating thalamic arteries arising from the P1 segment of the posterior cerebral arteries or from the bifurcation of the basilar artery [8]. They penetrated the posterior rostral perforated substance.

The postero-lateral choroid artery was the arterial trunk arising from the posterior cerebral artery, giving the medial and lateral branches [34]. The lateral branch are anastomosing with the plexiform branches of the anterior choroids artery. The medial branch ran a shorter course, and also provide thalamic branches.

For the postero median choroids artery an arterial trunk arising from the posterior cerebral artery we used the division into two branches proposed by Plets and Van Den Bergh [31]. A medial branch for the choroidal plexus and a lateral branch preferentially gave branches penetrating the perihabenular region. The medial branch anastomosed with the postero lateral choroid artery.

The thalamo-geniculate arteries described the arteries entering the perigeniculate region. They are arising from: posterior cerebral artery, postero lateral choroidal artery or collicular artery [8, 35].

The course of the anterior choroidal artery was divided into a cisternal segment and a plexiform segment [35]. Agreeing with Plets et al. [30, 21] and Schlesinger [34], we consider that the branches of the anterior choroidal artery could also vascularize the lateral part of the thalamus.

There was one premamillary artery per hemisphere. Seven arose from the middle of the posterior communicating artery, three from the anterior of the posterior communicating artery, one from the posterior cerebral artery (P1 or P2), one from the posterior of the posterior communicating artery.

All the perforating thalamic arteries arose from the P1 segment of the posterior cerebral artery. For five brains, the origin of the perforating thalamic arteries was unilateral. There were in total 7 thalamic perforating arteries, dividing into 20 branches penetrating the thalamus giving an average of 3.33 arterial branches per brain (extremes 2–4).

Perforating branches of the postero-medial choroidal artery

There was one postero median choroids artery per hemisphere that mean a total of 12 arteries. Eight postero median choroids artery arose from segment P2 of the posterior cerebral artery, two from segment P3, one from the junction of segments P and P3. The 12 arteries gave 38 perforating branches for the thalamus. 32 went to the medial thalamus, 4 to the pulvinar, 2 to the superior part of the thalamus. The average number of branches per hemisphere was 3.16 (extremes 0–9).

There were 24 posterio lateral choroidal branches, giving an average of 2 arteries per hemisphere. All these branches arose from the posterior cerebral artery. 14 came from the junction of segment P2, five from a cortical branch, five from segment P3. The postero lateral choroidal artery gave 54 branches to the thalamus. There were 46 to the superior aspect and 8 to the pulvinar, leaving an average of 4.5 per hemisphere.

There were 132 thalamo-geniculate arteries, giving an average of 11 per hemisphere (extremes 6–14). 70 arteries arose from the posterior cerebral artery, 35 came from a postero median choroidal artery, 27 from a postero lateral choroidal artery.

There was one anterior choroidal artery per hemisphere except one hemisphere were there were two. These arteries gave 50 potentially thalamic arteries.

5. Discussion

Because of the variability and imprecision of anatomical descriptions, it is still not possible to define precisely the arterial territories of the thalamus.

This study is a preliminary work carried out with the aim of description of the extra-parenchymatous portion of the thalamic arterial groups.

First description the thalamic artherial groups made by Duret and after that by Foix and Hillemand have created controversy. Duret introduced the theory that the middle cerebral artery participate in the thalamus blood supply, describing a branch called lenticulo-optic artery.

This was contested by Beevor [3], and after that by Foix and Hillemand [9]. The most recent works by Lazorthes [18], Percheron and Escourolle [25] and Plets et al. [30] have formally moved away from the participation of the middle cerebral artery. The anterior cerebral artery in thalamic vascularization does not participate to the thalamic vascularisation recent studies have confirmed the hypothesis [27, 30].

In this study, we exclude from the beginning the participation of the anterior and middle cerebral arteries in thalamic vascularization based on literature data.

In literature, the branch named pre-mamillar artery by some authors or thalamo-tuberic artery [9], the tubero-thalamic artery [34], the inferior and anterior arterial group [17] or polar arteries [26] has a high variability.

We noted in our study that the pre-mamillary artery is highly variable. In our study, we noted one premamillary artery per hemisphere arising from the posterior cerebral artery, which is also reported in the literature [11, 24].

Thalamic perforating correspond to the retro-mamillary pedicle described by Foix and Hillemand [9], also called by Schlesinger intra-peduncular arteries, the para-median thalamic arteries by Buttner [5], the paramedian thalamo-subthalamic arteries by Percheron [28] or even the inferior and middle thalamic arteries by Lazorthes and Salmon [17].

In agreement with the data in the literature, we noted that all the perforating thalamic arteries arose from the bifurcation of the basilar artery or from the P1 segment of the PCA [34]. In comparison with the works of Percheron [28] and Pedroza et al. [23], we observed the unilateral origin of the perforated thalamic arteries.

All the arterial branches entering into the peri-geniculate region were potentially the thalamo-geniculate arteries [8, 34, 40] and that all they have their origin in the P2 segment of posterior cerebral artery. Lazorthes and Salamon [17] defined the thalamo-geniculate arteries as the inferior and posterior arterial group of the thalamus. Gillilan [12] named them as the lateral arteries of the thalamus. Percheron [26] did not identify such an arterial group. Foix and Hillemand [9] or Lazorthes [18] described a predominant presence of a thalamo-geniculate artery but Plets et al. [30] does not and so we. In this study is described an average of 5.9 thalamo-geniculate arteries pe hemisphere originally from posterior celebral artery [19, 30].

In our study the posterior medial choroidal artery was single and arose preferentially from segment P2 of the posterior cerebral artery, which has been confirmed by several authors [35, 40].

We counted an average per hemisphere of 3.3 perforating thalamic branches arising from the lateral branch of the PMChA. In the literature, Plets and Van Den Bergh [31] gave an average of three perforating branches per hemisphere and results similar to those in our study.

In our series as in other works in the literature, the postero lateral choroidal artery were most often multiple (2–3 per hemisphere) and arose from segment P2 of the posterior cerebral artery [39, 40].

Postero-lateral choroidal artery anastomosis are different types, of which the most common are: the anastomoses with the anterior choroid arteries in the lateral ventricle called ‘‘the choroidal vessels’’ by Plets et al. [3], the network connecting the medial with lateral branches of the posterior choroidal artery in the choroidal plexus of the lateral ventricle [39]. We noted these two types of anastomoses in our study.

The postero-medial and postero-lateral choroidal arteries are an important element in thalamic vascularization.

Schlesinger [34], Plets et al. [30] and Theron and Newton [37] noted the existence of branches for the thalamus coming from the cisternal segment of the anterior choroid artery. Plets et al. [30] even proposed calling these branches the ‘‘lateral ventral thalamic network’’. The presence of branches coming from the plexiform segment and running towards the pulvinar has been reported by Fujii et al. [10], Lazorthes [18], Schlesinger [34] and Morandi et al. [21].

6. Conclusions

Variations of the pre-mamillary artery are rare.The origin of the perforating thalamic arteries is unilateral in most of cases. The origin of the thalamo-geniculate arteries is split between the posterior cerebral artery and the posterior choroidal arteries. The choroidal arteries are an important arterial supply. The postero-medial choroid artery is most often single and arising from segment P2 of the posterior cerebral artery. The postero-lateral choroids artery is frequently multiple and arises from the junction of segments P2 and P2 of the posterior cerebral artery. The pulvinar network arises most often from the postero-lateral choroid artery. The anterior choroid artery is a source of thalamus vascularization of the thalamus by its cisternal branches.

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