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Supratrochlear artery. Anatomy, variations and neurosurgical applications

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supratrochlear artery, supraorbital artery, angular artery

ABSTRACT

Introduction. The supratrochlear artery (STA) is a small vessel with a relatively tiny and quite constant course. The literature describing the STA fails to provide a collective description of the anatomy and neurosurgical applications of the STA. Therefore, we are here to present an overview of anatomy, anatomical variability, and the clinical application of STA.

Method. We conducted a literature review in Google Scholar and PubMed medical databases to review the existing studies on STA regarding its anatomy and neurosurgical applications.

Results. We identified 18 articles that discuss the anatomical variations and neurosurgical applications of the STA. Certain parameters are used to describe the surgical anatomy of STA, including origin, course, diameter, branches, depth, and distance in relation to the midline and vertical glabellar line. We also discussed certain applications of STA and its importance in neurosurgical reconstruction flaps and the diagnosis of carotid artery disease.

Conclusion. Comparable to the supraorbital artery (SOA), the STA is less variable in its anatomical course, and exhibits a more superficial course. The STA has certain important neurosurgical applications through its involvement in reconstruction flaps for the skull base and plays an important role in the diagnosis of carotid artery disease.

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INTRODUCTION

The supratrochlear artery (STA) is a terminal branch of the ophthalmic artery. It is a small vessel with a relatively tiny and quite constant course (2). Although its anatomical path is predictable, several anatomical variations in its origin and branches have been reported, even within

the two hemi-faces of the same individual (10). Notwithstanding its relatively pitiful size, the STA has an essential role in the blood supply of the glabellar region and the neighboring medial aspect of the forehead (3). Furthermore, a rich anastomotic vascular network was formed that connected the following vessels: STA, Supraorbital artery (SOA) and angular artery (AA) in the nasoglabellar region. It is crucial to mention that STA communication with internal and external carotid arteries is feasible, amplifying the STA's role. (7)

Understanding the anatomy of the forehead and its vascularity plays an important role in skin flap and gives the best chance to of graft survival. The STA has certain important neurosurgical applications through its involvement in reconstruction flaps for the skull base and plays an important role in the diagnosis of carotid artery disease.

The literature describing the STA fails to provide a collective description of the anatomy and neurosurgical applications of the STA. Therefore, we are here presenting an overview of anatomy, anatomical variability, and the clinical application of STA.

Methods

In order to assess the existing research on STA with regard to its anatomy and neurosurgical applications, we did a literature review in the medical databases Google Scholar and PubMed. The following search terms were used: “supratrochlear artery anatomy”, “supratrochlear artery vascular anatomy variations”. We include the studies with the following criteria: i) English language, ii) suitable methodology for targeted data. We exclude the studies which are i) non-English, ii) questionable results. Results were categorized and selected appropriately. The data extraction includes surgical anatomy and neurosurgical application of STA.

Results

While reading the available articles and original works regarding SOA, taking into consideration the inclusion and exclusion criteria, 18 papers that cover the anatomical variants and neurosurgical uses of the STA were found. The origin, course, diameter, branches, depth, and distance from the midline and vertical glabellar line are some of the characteristics used to characterize the surgical anatomy of STA. We also covered other STA uses, including its significance in carotid artery disease diagnostics and neurosurgical repair flaps.

Discussion

1. STA anatomy

STA exhibits a more superficial course than SOA and has less variability in its anatomical path. Moreover, the branching pattern of the STA and the vessel’s relationship to bony and soft tissue landmarks were remarkably consistent. (15)

1.1 STA origin

The STA originated as a terminal branch of the ophthalmic artery, which represents the first branch of the internal carotid artery inside the cranial cavity (2). This was found in 85% of cases, while in the remaining one, the STA and the SOA originated as a single vessel from the ophthalmic artery that bifurcates later on, forming the STA and SOA (2,7). Klenjet reported unusual incidents cases in which STA was absent. In the first case, the paracentral artery, a branch of the AA, contributed to maintaining the blood supply as a lateral branch in the paramedian position of the forehead. While in the second one, a lateral branch from the paracentral artery arises. Later, it connects with the transverse frontal artery, the frontal branch of the superficial temporal artery, following a transverse course (10). There's a rare case when STA originates directly from the AA as described by Cong et al. (5).

1.2 STA course

The STA traverses the trochlea, accompanying the supratrochlear nerve. Subsequently, it crosses the supraorbital margin to penetrate the orbital septum and reach the forehead (16). Later, it passes between the forehead's muscles; corrugator supercilii, orbicularis oculi, and the frontalis muscle just above mid-forehead; it penetrates the frontalis muscle to be subcutaneous (17).

Moreover, STA participates in a rich anastomotic network in the nasoglabellar region with the AA, the SOA, and their contralateral vessels to create vascular arcades, allowing in this way the communication of the internal carotid artery (ICA) with the external carotid artery (ECA) (3). In addition, this network of anastomoses includes, apart from the infraorbital, the lateral nasal, the bilateral dorsal nasal, and tiny periosteal perforating arteries that are responsible for supplying the paranasal region

(4,9). Furthermore, there is another anastomosis formed between the lateral branches of STA, SOA, and the frontal branch of the superficial temporal artery. Last but not least, several horizontal arteries cross the midline to connect the pair of STAs (12).

1.3 STA branches

An overabundance of STA branches exists in the literature. Kleintjes describes Nine side branches of the STA (10). These branches supply the periosteum of the supraorbital rim and glabella, the muscle of the upper eyelid, corrugator supercilii, the frontalis, and the procerus muscle. Furthermore, cutaneous branches supply the skin of the glabella and the medial aspect of the forehead (3). In most cases, STA divides into superficial and deep branches, although in some cases, the deep branch was absent (figure 1) (7).

Figure 1 shows the branches of supratrochlear artery

1.4 STA depth

The average distance between the skin surface and STA at the horizontal mid-eyebrow level was 3.34 mm and it varies with differences in facial expression. Furthermore, no statistically significant difference was reported between genders and sides. Cotofana et al. study on generalized linear models for age, BMI, and forehead width revealed no statistical influence on the depth for the STA (6).

1.5 STA diameter

The mean diameter of the STA was 0.90 ± 0.02 mm (range, 0.5-1.3 mm) when measured at the horizontal mid-eyebrow level (6).

1.6 Distance of STA from the Midline

The mean distance between the STA and the midline at rest was 16.13 mm and 14.80 mm for males and females, respectively. Furthermore, zero percent of STA were located within 5 mm from the midline (6).

1.7 Relationship between STA and Vertical Glabellar Line

In addition, the mean distance between the STA and the ipsilateral vertical glabellar line at rest was in 10.59 mm and 8.21 mm in males and females, respectively (6).

2. Neurosurgical application of STA

In contrast to SOA, STA applications in the field of neurosurgery are quite limited; although both arteries have almost the same course and run parallel and near each other, the usage of SOA is greater than that of STA. The reason behind this is unknown.

2.1 Pericranial flap

Anteriorly based pericranial flaps are one of the pedicled flaps that are widely in anterior cranial base reconstruction because of their simplicity, reliability, and low morbidity. STA has an important contribution to the arterial supply of the pericranial flap through the deep branches that divided from the main trunk at, below, or above the level of the supraorbital rim (18,14,11).

2.2 Diagnosis of carotid artery diseases

STA has been implicated in the diagnosis of disease in the common and internal carotid arteries. The technique involves non-invasive directional continuous wave doppler ultrasound to assess the direction of flow in the STA and waveform analysis of the common carotid and STA signals. This technique provides a safe, atraumatic method of assessing patients with symptoms of extracranial arterial disease (13,8).

Conclusion

STA has less variability in its anatomical structure and limited neurosurgical applications comparable to SOA. However, STA is still a valuable option for certain neurosurgical procedures, such as bypass surgeries. It provides a reliable source of blood flow and can be easily accessed and manipulated during surgery. In order to clarify both the benefits and drawbacks of STA in neurosurgical procedures, more study needs to be conducted.

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