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Anatomical and surgical study of the sphenopalatine artery branches

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Abstract The sphenopalatine artery gives off two main branches: the posterior lateral nasal branch and the posterior septal branch. From 2007 to 2012 17 patients were treated with cauterization and/or ligature of the sphenopalatine artery with endonasal endoscopic approach. 90 nasal dissections were performed in 45 adult cadaveric heads. We evaluated the number of branches emerging from the sphenopalatine foramen and the presence of an accessory foramen. In the surgery group, we observed a single trunk in 76 % of the patients (13/17) and a double trunk in 24 % (4/17). We found an accessory foramen in four cases. We obtained a successful result in bleeding control in 88 % of the cases. In the cadaver dissection group, 55 nasal cavities had a single arterial trunk (61 %), 30 had 2 arterial trunks (33 %) and in only 5 nasal fossae we observed 3 arterial trunks (6 %). We were able to dissect four accessory foramina. We suggest that in most cases only one or two branches are found in the sphenopalatine foramen.

Keywords Sphenopalatine artery · Posterior lateral nasal artery · Posterior septal artery · Sphenopalatine foramen · Endonasal endoscopic surgery · Epistaxis

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Introduction

The sphenopalatine artery is the terminal branch of the maxillary artery that emerges from the superomedial part of the pterygopalatine fossa and enters the nasal cavity through the sphenopalatine foramen. It gives off two main branches: the posterior lateral nasal branch (PLNB), which supplies the region of the lateral nasal wall and then anastomoses with branches of the anterior and posterior ethmoidal arteries, and the posterior septal branch (PSB), which courses the anterior inferior wall of the sphenoid sinus and distributes on the nasal septum. The distal extreme of this septal branch, the nasopalatine artery, ends in the incisive canal where it anastomoses with the greater palatine artery [1, 2].

The orbital and sphenoidal processes of the perpendicular plate of the palatine bone define the sphenopalatine notch, which is converted into foramen by the articulation with the surface of the body of the sphenoid bone. Sometimes, the two processes are completely united and form a real foramen. This foramen is usually located in the superior meatus although it may also be found in the middle meatus or at the transition of both meatuses, according to its location above or below the ethmoidal crest [3–7]. This anatomic landmark is a crest in the

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perpendicular plate of the palatine bone where it is attached to the posterior and inferior end of the middle turbinate, being an optimal bone reference to localize the sphenopalatine artery because it is just anterior to the sphenopalatine foramen [1, 8].

Several authors have studied the number of branches in the sphenopalatine foramen to improve the surgical results in the epistaxis management [3, 4, 9–13]. The idea of this study is based on our surgical experience in the treatment of severe epistaxis. We never gained the impression of finding so many branches when we dissected the sphenopalatine foramen and that led us to study a series of anatomic specimens.

The aim of our study is to describe the number of branches at the level of the sphenopalatine foramen in cadaver specimens but also in a group of patients who had undergone endonasal endoscopic surgery. We also describe the outcomes of the sphenopalatine artery ligation in the surgery group.

Materials and methods

Patients and cadaveric heads

From January 2007 to April 2012, 17 patients who consulted the ENT Department at Santa Creu i Sant Pau Hospital for epistaxis, and with whom the traditional anterior nasal pack failed, were treated with cauterization and/or ligature of the sphenopalatine artery with endonasal endoscopic approach. 90 nasal dissections were performed in 45 adult cadaveric heads provided by the Department of Anatomy of the Faculty of Medicine of the University of Alicante and by the Department of Anatomy of the Faculty of Medicine of the University of Barcelona from September 2007 to September 2012. The quality of specimens used was all fresh-frozen.

We evaluated the number of branches emerging from the sphenopalatine foramen and the presence of an accessory foramen both in the cadaveric group and in the surgical group.

In the surgery group, we examined the main epidemiological characteristics of the patients and the outcomes of the endoscopic sphenopalatine ligation. We did not collect the epidemiological data from the cadavers.

Surgery and cadaveric dissection

Endoscopic endonasal approach was performed under general anaesthesia, using 0° rigid endoscope. We examined the nasal fossa and cauterization possible bleeding points. Then, we began the surgery medially displacing the two anterior thirds of the middle turbinate with the Freer elevator. On most occasions we performed a middle meatal antrostomy until we observed the posterior maxillary sinus wall. Then an incision was made in the mucosa of the perpendicular plate of the palatine bone and we created a subperiosteal dissection until the sphenopalatine foramen was located. Once the artery was identified, it was clamped or cauterized with bipolar forceps. The nasal cavity was packed for 24 h and the patients were discharged home the day after surgery.

The cadaver dissection was performed endoscopically similar to the surgical approach in both nasal fossae.

Results

Endonasal endoscopic surgery group

The mean age at diagnosis was 58 years with a range of 16–90 years. There were 16 males (94 %) and 1 female (6 %). 15 patients did not present surgical antecedents. One patient had been operated previously for septoplasty and another patient had undergone inferior turbinate surgery.

We obtained a successful result in bleeding control in 88 % of the cases (15/17). One patient who was not controlled with sphenopalatine ligature was successfully controlled posteriorly with endoscopic ethmoidal arteries cauterization. The other ligation failure was controlled with angiography and embolization.

While endonasal endoscopic surgery was performed we could observe a single trunk medial to the ethmoidal crest in 76 % of the patients (13/17) and a double trunk in 24 % (4/17). We did not find more than two branches in any endonasal endoscopic approach. We found an accessory foramen in four cases. This foramen was always smaller and inferior to the main foramen and it presented only one branch in all cases.

None of the patients suffered from postoperative complications.

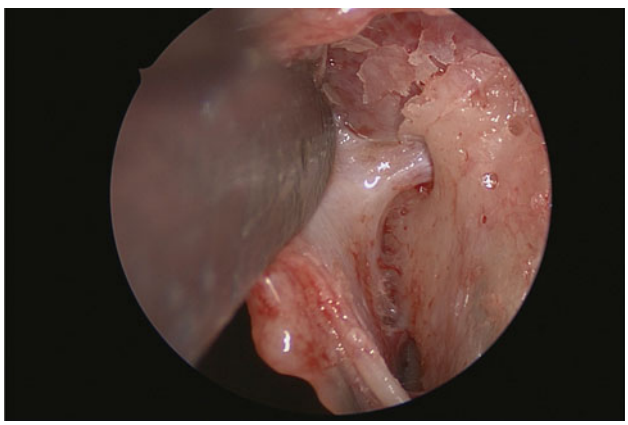

Fig. 1 A single arterial trunk in the left nasal cavity

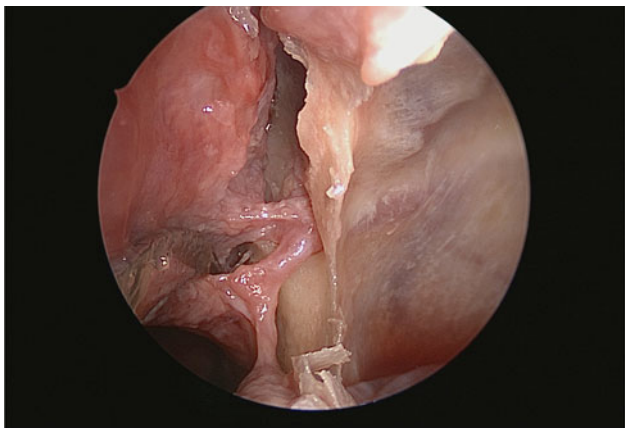

Fig. 2 Two arterial trunks through the sphenopalatine foramen in the left nasal cavity

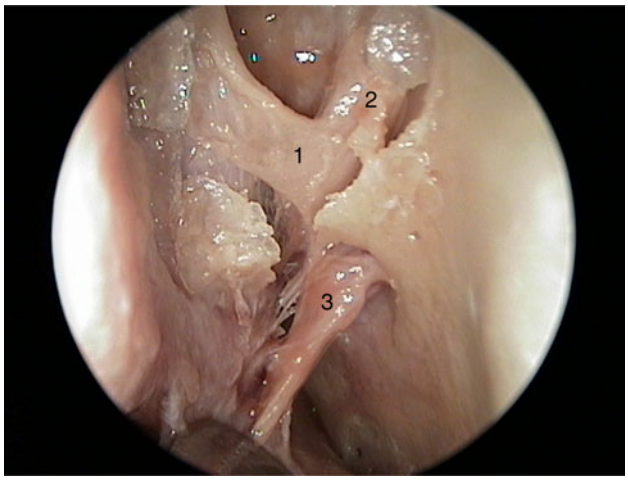

Fig. 3 Three arterial trunks emerging from the sphenopalatine foramen in the left nasal cavity

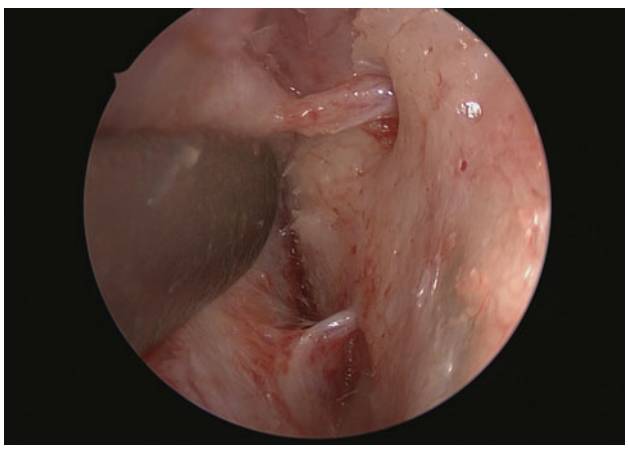

Fig. 4 An accessory foramen, smaller and inferior to the sphenopalatine foramen in the left nasal cavity

Table 1 Number of branches and accessory foramen

	Surgical group $n = 17$	Cadaveric group $n = 90$	Total $n = 107$
One	76 % (13)	61 % (55)	63 % (68)
Two	24 % (4)	33 % (30)	32 % (34)
Three	0 % (0)	6 % (5)	5 % (5)
Accessory foramen	23 % (4)	4 % (4)	7 % (8)

Cadaver dissection group

55 nasal cavities had a single arterial trunk (61 %), 30 had 2 arterial trunks (33 %) and in only 5 nasal fossae we observed 3 arterial trunks (6 %) (Figs. 1, 2, 3). We were able to dissect four accessory foramina with one branch across it (4 %) (Fig. 4).

In sum, we explored 107 nasal cavities where the sphenopalatine artery was a single branch in 68 cases (63 %), was divided into 2 branches in 34 cases (32 %) and was divided into 3 branches in 5 cases (5 %). The presence of an accessory foramen was observed in 7 % of the cases (8/107) (Table 1).

Discussion

The endoscopic sphenopalatine artery ligation or cauterization is nowadays the main treatment for epistaxis unresponsive to medical treatment, and it is an important procedure to reduce the haemorrhage in some nasosinusal or skull base approaches for different tumors. Therefore, good anatomical knowledge of this territory is essential.

Reviewing several reports, there is a certain confusion related to the anatomical nomenclature of the sphenopalatine branches and to the number of branches emerging from the sphenopalatine foramen.

According to the Federative Committee on Anatomical Terminology [2], the sphenopalatine artery gives off two main branches, the PLNB and the PSB, which can be divided before or after crossing the sphenopalatine foramen.

Our surgical results suggest that in most patients this division occurs after this, so a single arterial trunk runs through the sphenopalatine foramen and posteriorly it divides into the two main branches. But in 24 % of them, the artery divides before it enters the nasal fossa and as a result it presents two trunks medial to the ethmoidal crest.

This discovery certifies the fact that once the sphenopalatine artery is located it is advisable to continue the dissection posteriorly to facilitate finding a second trunk. This posterior branch is the PSB which courses the anterior

inferior wall of the sphenoid sinus. Bolger [8] and Wareing [5], although they employed a different anatomical nomenclature, noted that the PSB was situated more superiorly and posteriorly than the PLNB, and Midilli et al. [14] found that the PSB was almost always situated in a superior location in the middle meatus, on the posterosuperior border of the middle turbinate. The PLNB was close to the posterior tip of the middle turbinate and it was situated 1 cm anterior to the end of the middle turbinate [3, 14].

Our results with cadaver heads, in a great number of dissections performed, confirm our surgical findings. We could identify a single vessel in 61 % of nasal cavities, a double artery in 33 % and only in 6 % of the cavities we observed more than two branches.

Our study is concurrent with other authors. Pádua et al. [4] published similar outcomes observing a single trunk in 67 % and two trunks in 21 % of the 122 nasal fossae dissected. Lee et al. [3] found that the sphenopalatine artery divides into two major branches in 76 % of cases, in three branches in 22 % and in four branches in 2 % of the cadaver heads explored. Babin [15] noted that the sphenopalatine artery division was more frequent in the pterygopalatine fossa than in the nasal cavity. Prades [16] and Schwartzbauer [12] reported similar observations. On the other hand, our results disagree with Simmen et al. [9] who in 65 % of specimens found three or more branches, even showing a patient with ten branches.

We cannot account for this disparity in outcomes. The dissection technique employed, microscopic or endoscopic, or the cadaver specimens dissected, complete cadaver heads or sectioned sagittal heads, might explain these differences.

Probably there are the same outcomes but with different anatomical interpretation. The lateral nasal wall and septum vascularisation depend on the different branches originating from the sphenopalatine artery. If these branches are close to the bifurcation, before or after the sphenopalatine foramen, more than two vessels can be found in this area. However, in our opinion these vessels are branches emerging from the two main trunks. Therefore, the more extensive, superiorly and inferiorly, the dissection performed is, the more probable it is to find branches from the PLNB and the PSB (Fig. 5).

In addition, if the sphenopalatine artery presented multiple branches emerging from the sphenopalatine foramen, it would be logical to think that the rate of failure in the endoscopic ligation would be high. In most of reports the success rate in endoscopic ligation the sphenopalatine artery is between 88 and 100 % and the failure rate is very low [17–23]. We obtained a successful result in bleeding control in 88 % of the cases cauterizing or ligaturing the two main trunks. One case that was not controlled was due to the failure of application of the vascular clip and the other because the bleeding point was not a branch of the sphenopalatine artery, but a branch of the anterior ethmoidal artery. Therefore, we suggest that in most cases only one or two branches are found in the sphenopalatine foramen and that the cauterization or ligature of these arteries will be effective in the majority of patients. Nowadays we prefer to cauterize the artery with bipolar forceps than perform a vascular clip, as the clip often contacts the sphenoidal process of the palatine bone and the clip will not sit over the branch properly.

We also recommend extending the subperiosteal flap inferiorly due to the possibility of discovering an accessory foramen. We reported 7 % of accessory foramina in 107 nasal cavities explored. Its presence varies from 5 to 13 % and most authors agree that the foramen is inferior and smaller than the sphenopalatine foramen [4, 5, 24]. Regarding the number of branches emerging from the accessory foramen, we reported only one branch, which is in accordance with most authors [4, 25].

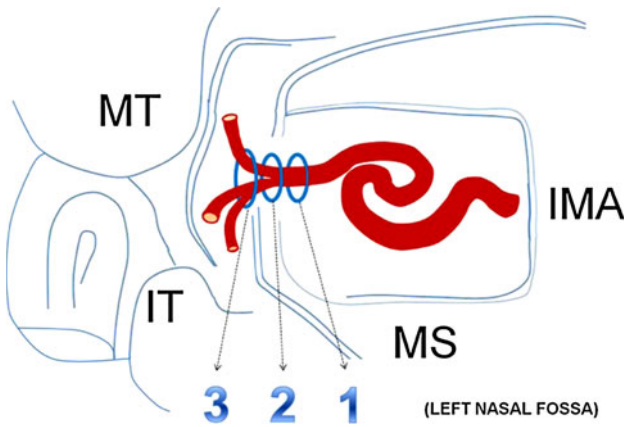

Fig. 5 Number of branches illustration before or after crossing the sphenopalatine foramen

Conclusion

The cauterization of the sphenopalatine artery with endonasal endoscopic approach is an effective procedure when the traditional anterior nasal pack fails. We suggest that in most cases only one or two branches are found in the sphenopalatine foramen.

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