Sphenopalatine Artery Ligation: A Cadaver Anatomic Study

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Abstract

Objective. To clarify endoscopic anatomy of the sphenopalatine artery (SPA) in relation to intranasal endoscopic landmarks using a human cadaver model and to simplify the surgical approach to SPA ligation.

Study Design. Prospective anatomic study from November to December 2009.

Setting. University of Tennessee Health Science Center Gross Anatomy Lab.

Subjects. Fifty human cadaveric sagittally sectioned heads.

Methods. The cadaveric nasal cavities were examined using a 0° endoscope, and the SPA and foramen were identified. The number of nasal cavities in which a transnasal approach successfully revealed the SPA foramen was compared with those that required maxillary antrostomy. The distance from the posterior edge of the maxillary natural ostium to the anterior edge of the SPA foramen was measured.

Results. Successful ligation of the SPA via a lateral nasal wall incision was achieved in 45 of 50 specimens (90%). The mean distance from the posterior edge of the maxillary natural ostium to the anterior edge of the SPA foramen was 23.79 mm (95% confidence interval, 22.03-25.55).

Conclusion. The method of performing SPA ligation via lateral nasal wall incision was achieved in 45 of 50 specimens (90%). The mean distance from the posterior edge of the maxillary natural ostium to the anterior edge of the SPA foramen was more than 2 cm. The routine use of maxillary antrostomy and uncinectomy is not needed to locate the SPA in most nasal cavities.

Keywords
posterior epistaxis, sphenopalatine artery, sphenopalatine artery anatomy, endoscopic treatment epistaxis, cadaver study, minimally invasive epistaxis management

Epistaxis is a common clinical entity and can be difficult to treat, especially in patients with comorbidities such as hypertension and coagulopathy. When the bleeding is posterior in origin, it can be challenging to visualize and control; many methods of treating this problem have been described. It is well established that the sphenopalatine artery (SPA) and its branches supply the posterior nasal cavity, the posterior nasal septum, and much of the paranasal sinuses and thus is the source of most posterior epistaxis. Historically, ligation of vessels proximal to the SPA (transantral internal maxillary artery and transcervical external carotid artery) was carried out for severe bleeding. However, bleeding recurred due to abundant collateral circulation to the nasal cavity. In recent years, endoscopic exposure of the SPA with transnasal ligation has gained popularity because of high success and low complication rates.

Prades described microsurgical transantral ligation of the SPA in the early 1970s using the technique for vidian neurectomy for relief of nasal hypersecretion in patients with allergic rhinitis or severe vasomotor rhinitis. Sulsenti used Prades’ bivalved speculum and the operating microscope to ligate the SPA in the middle meatus under local anesthesia.

After the rigid Hopkins rod telescope was introduced in the 1980s, endoscopic techniques were developed. White described endoscopic ligation of the SPA using canine fossa antrostomy and posterior antral wall osteotomy, passing instruments through a separate endoscopic middle meatal antrostomy.
He found it helpful to perform uncinectomy and middle meatal antrostomy. Soon thereafter in 1999, Bolger et al described a reliable anatomic landmark on the lateral nasal wall for locating the SPA and foramen intranasally: the crista ethmoidalis. Enthusiasm for this approach to epistaxis management has engendered further study to determine reliable location techniques and to identify variations in SPA anatomy. Padua and Voegels in 2008 confirmed Bolger’s observation of the reliability of the crista ethmoidalis by noting its presence in 100% of 61 cadavers. This study also identified a mean distance from the anterior nasal spine to the SPA foramen of 6.6 cm. Several studies have indicated that the artery branches in most cases within the foramen, and thus, there may be from 1 to 10 branches emerging into the submucosa of the lateral nasal wall. The work of Middlili et al in 20 adult cadaver heads revealed that 20% of the SPA foramina were located superior to the horizontal lamella of the middle turbinate and that accessory forameni were present in 10%.

Further endoscopic landmarks were identified by Prades et al, who noted a mean distance of 18.27 mm from the inferior rim of the SPA foramen to the horizontal plate of the palatine bone and 13.04 mm to the horizontal lamina of the inferior turbinate. This study also noted an hourglass shape of the foramen, with the crista ethmoidalis at the narrowest point. Scanavine et al in 2009 noted in 54 cadaver heads that the forameni were often multiple and advocated a transnasal but wide flap anterior to the posterior attachment of the middle turbinate to expose all potential accessory forameni.

Accessing the SPA endoscopically through the middle meatus has been found to be less traumatic and less challenging than previous endoscopic approaches through the superior meatus or via transantral means. However, it remains controversial whether endoscopic identification of the SPA and foramen requires uncinectomy and maxillary antrostomy (“trans-sinus” approach) as some authors advocate, or whether a direct transnasal approach is sufficient and effective. No study to date has addressed defining the endoscopic anatomy to facilitate the least invasive approach or to measure how often a minimally invasive approach is sufficient.

In this study, we sought to determine in the anatomy lab if uncinectomy and maxillary antrostomy are necessary to provide access to the SPA, as we have not found either of these necessary in clinical SPA ligation. Furthermore, we sought to identify a readily visible and consistent endoscopic landmark to facilitate a minimally invasive approach to the SPA foramen.

**Methods**

This study qualified for exempt status by the University of Tennessee Health Science Center Institutional Review Board under Federal Regulations 45 CFR 46.102(f) definition of “Human Subjects.” Data were collected from 50 human cadaveric sagitally sectioned heads (21 female, 29 male) from November to December 2009 in the University of Tennessee gross anatomy lab. Because of the inherent lack of distensibility of cadaveric tissues, a 2.7-mm, 0° nasal endoscope (Stryker, San Jose, California) was used to carry out a C-shaped incision in the lateral nasal wall. The 1-cm vertical limb was placed 1 cm anterior to the posterior-most attachment of the middle turbinate. From the inferior edge of the vertical incision, the horizontal limb was then carried approximately 1 cm in the posterior direction (Figure 1). The mucosa of the lateral nasal wall was elevated with a Cottle elevator in a subperiosteal plane posteriorly until the crista ethmoidalis was palpated and visualized (Figure 2). The SPA and its branches were located just posterior to the crista ethmoidalis and carefully dissected to identify all branches emerging from the foramen. Vascular clips were placed across the arteries just as they exited the foramen (Figure 3).

The heads were then positioned to facilitate visualization of the lateral nasal wall. A linear measurement was taken from the posterior rim of the natural maxillary ostium to the anterior rim of the sphenopalatine foramen in each specimen (Figure 4).
Results

Successful identification and ligation of the SPA via the lateral nasal wall incision was achieved in 45 of 50 specimens (90%). Of the specimens (n = 5) for which the lateral nasal wall approach was unsuccessful, the SPA was located after performing a maxillary antrostomy. In one specimen with a large septal spur, another specimen with signs of previous sinus surgery and a large septal spur and with a narrow middle meatus limiting access in the remaining three-fifths, maxillary antrostomy was necessary to gain visualization of the SPA.

The mean distance from the anterior edge of the maxillary os to the anterior edge of the sphenopalatine foramen was 23.79 mm (95% confidence interval, 22.03-25.55).

Discussion

Treatment options for posterior epistaxis include nasal packing, electrocautery, surgical vessel ligation, and endovascular embolization. Complications of nasal packing such as pain, synchia, periorbital cellulitis, sinusitis, syncope, hypoxia, toxic shock syndrome, angina, myocardial infarction, septal perforation, otitis media, and aspiration of packing with airway obstruction have been reported at a rate of 2% to 68.8%.16 These are particular risks in patients with significant comorbidities, such as hypertension, cardiac disease, diabetes, and chronic lung disease.

No serious complications have been reported from endoscopic SPA ligation, with the most common negative consequence being recurrence of epistaxis. Simmen et al11 found that 97% of specimens had 2 or more branches and 64% of the specimens had between 3 and 10 branches of the SPA medial to the crista ethmoidalis.11 Failure to recognize this branching pattern and ligate at the proximal-most intranasal SPA may contribute to the few patients with recurrent epistaxis, as can failure to identify other sources of bleeding such as the anterior ethmoid artery. Given this high rate of branching, it is surprising that the rates of recurrence of epistaxis after endoscopic ligation of the SPA are not higher than the reported 0% to 8%.10 Branching patterns are unpredictable and may differ from side to side in the same patient. Therefore, it is important to achieve control of the SPA immediately after it emerges from the foramen, either with endoscopic clip placement, bipolar cautery, or suction cautery. Even with an 8% recurrence rate, this is a great improvement over the 26% to 52% failure rate of conventional posterior nasal packing.

While surgical approaches to epistaxis have become progressively less involved and invasive, nonsurgical therapies should still be instituted on first presentation. If these maneuvers (packing, correction of coagulopathy, control of hypertension) are unsuccessful, then endoscopic ligation of the SPA can be considered, as this approach addresses the most distal source of bleeding and thus decreases the risk of persistent bleeding from collateral flow.

There are multiple advantages to performing endoscopic SPA ligation without uncinectomy or maxillary antrostomy. The most significant advantage is minimizing open wounds of the nasal mucosa in a patient already predisposed to bleeding. Using a C-shaped intranasal incision provides access to the occasional accessory foramen and SPA branch that might otherwise be missed.13,15 Reducing mucosal trauma within the middle meatus should reduce the risk of scarring and synchiae, and preserving intranasal landmarks such as the middle turbinate, uncinate process, and natural maxillary os is beneficial for the subsequent sinonasal surgeon. For patients with recurrent epistaxis but without bleeding at the time of surgery, this procedure can be performed as an outpatient.

Furthermore, leaving the maxillary natural ostium intact serves as a fairly consistent landmark to indicate the location of the SPA foramen, given the observed range of 22.03 to 25.55 mm between the 2 structures.

Our study suggests that ligation of the SPA via lateral nasal wall incision without uncinectomy or maxillary antrostomy is successful in 90% of the studied specimens and 100% of…
specimens with the addition of maxillary antrostomy. In the event that SPA ligation is not possible by way of lateral nasal wall incision with mucosal flap, it becomes useful to know the distance between the maxillary os and the emergence of the SPA into the lateral nasal wall. Also, this information is useful in other intranasal procedures, such as sinus surgery, to avoid inadvertent injury to the vessel, resulting in distortion of the operative field from significant bleeding. In patients with large sinusal tumors, upfront ligation of the SPA before tumor resection may be desirable.

Two of the specimens were found to have septal deviations that precluded the ability to ligate the SPA with only lateral nasal wall incision, secondary to poor visualization. Perhaps in these specimens septoplasty would have allowed transnasal access to the SPA. However, maxillary antrostomy resulted in success of ligation of the SPA. Maxillary antrostomy performed by taking down the medial maxillary sinus wall posterior to the natural os has a low risk of complications and is a basic skill among general otolaryngologists. The surgeon should note septal deviation preoperatively and discuss options, including septoplasty, with the patient.

Conclusion

Ligation of the SPA has been accepted as the most efficient surgical method of controlling posterior epistaxis and has the lowest reported rate of complications. The method of approach and identification of the SPA and foramen have varied among authors from fairly extensive trans-sinus exposure to a less invasive nasal incision. As demonstrated in this study, performing SPA ligation via a lateral nasal wall incision (without uncinectomy or maxillary antrostomy) is feasible in 90% of human cadaveric sectioned heads. Maxillary antrostomy allows definition of the posterior wall of the maxillary antrum, serving as an additional landmark in the occasional patient. Uncinectomy should not be necessary in endoscopic SPA ligation. Avoiding maxillary antrostomy and uncinectomy and accessing the SPA via a minimally invasive transnasal approach allows for the least mucosal trauma, especially critical in the hypertensive, coagulopathic patient.

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Author Contributions

Courtney B. Shires, design, data acquisition, analysis of data, creation of first draft, final approval of submitted version; John D. Boughter, design, data analysis, critical revision of early draft, final approval of submitted version; Merry E. Sebelik, corresponding author, conception and design, data acquisition, analysis of data, critical revision of early draft and creation of final draft, final approval submitted version.

Disclosures

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