Endoscopic Vidian Neurectomy

The Value of Preoperative Computed Tomographic Guidance

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Objective: To explore the vidian nerve anatomy by endoscopy and paranasal sinus computed tomography (CT) to elucidate the appropriate surgical approach based on preoperative CT images.

Design: Retrospective analysis.

Setting: Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan, Republic of China.


Main Outcome Measures: Paranasal sinus CT had been performed in all patients 2 weeks before surgery. Preoperative surgical planning was based on CT images, which were compared with intraoperative endoscopic findings. Two endoscopic approaches were used for vidian nerve transection, and the success rates were recorded for each.

Results: The transsphenoidal approach was successful on 42 sides (39.6%), while the transnasal approach was successful on 91 sides (85.8%). Success rates for the transsphenoidal approach were 0.0%, 72.1% (31 of 43 sides), and 84.6% (11 of 13 sides) for canal corpus types 1, 2, and 3, respectively. Success rates for the transsphenoidal approach were 50.0% (28 of 56 sides), 51.9% (14 of 27 sides), 0.0%, and 0.0% for canal floor relationship types 1, 2, 3, and 4, respectively. The transsphenoidal approach was successful only in patients without an embedded canal and with a canal floor relationship type 1 or type 2. Presence of the septum and continuation of the canal bony structure also influenced the choice of surgical approach.

Conclusions: The vidian nerve can be precisely identified and microinvasively transected using endoscopy. Preoperative CT images delineate the vidian canal and enhance preoperative surgical planning.


VASOMOTOR RHINITIS IS THE most common form of chronic nonallergic rhinitis, with clinical presentations that include nasal obstruction, postnasal drip, itching, redness, clear rhinorrhea, and watery eyes. It has been thought to result from an imbalance in the autonomic input to the nasal mucosa, with increased parasympathetic stimulation without adequate sympathetic balance. Attempts to treat the disease can be frustrating, and primarily involve stimulant avoidance and pharmacologic approaches such as topical anticholinergics, antihistamines, or corticosteroids.

Vidian neurectomy is an alternative treatment for intractable vasomotor rhinitis that is unresponsive to other interventions and in patients with significantly impaired quality of life because of their symptoms. In the past, vidian neurectomy was performed by various approaches, including transseptal, transpalatal, transantral, and endoscopic-assisted transnasal methods. However, this surgery did not gain great popularity. One drawback was the difficulty in accurate nerve identification and transection. To overcome this, we developed a unique surgical modality that depends largely on thorough preoperative imaging. Although vidian nerve anatomy has been widely studied in image analyses and cadaver dissections, an ideal surgical approach corresponding to preoperative computed tomography (CT) mapping of the course of the vidian canal has not been adequately explored. Therefore, our objectives were to explore the vidian nerve anatomy by endoscopy and paranasal sinus CT to elucidate the appropriate surgical approach based on preoperative CT images.

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Sixty-seven patients underwent 106 endoscopic vidian neurectomies between January 9, 2006, and June 30, 2009, at Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan, Republic of China. There were 54 men and 13 women, with a mean (SD) age of 28 (9) years. All patients were diagnosed as having vasomotor rhinitis and had poor treatment response to a 3-month trial of corticosteroid nasal sprays. They initially underwent unilateral endoscopic vidian neurectomy of the most symptomatic canal (by subjective patient identification). If at 6 months after surgery they were satisfied with their results but had remaining symptoms on the other side, they were then offered the same procedure at that location. Paranasal sinus CT was performed in all patients 2 weeks before surgery using a 64-section multidetector system (Brilliance; Philips Medical Imaging, Best, the Netherlands) with 1-mm contiguous coronal and axial sections. Coronal CT sections demonstrated the vidian canal and its various positions are shown in Figure 1 and in Figure 2. The relationship between the canal and the sphenoid bone (canal corpus type) was categorized as follows: (1) embedded inside the sphenoid corpus, (2) partially protruding, or (3) connected to the bone with a stalk inside the sinus. The relationship between the canal and the sphenoid sinus floor (canal floor type) was categorized as follows: (1) the floor was flat, and the canal was at the same level as the floor; (2) the floor was upsloping, and the canal was superior to it; (3) the floor was downsloping; or (4) the canal was inferior to it, and the floor was an inverted V shape. Other observed anatomical landmarks included the palatovaginal canal, presence of the septum between the canal and the vomerine crest, continuation of the canal bony structure, and the mean distances from the vidian canal to the vomerine crest, superior wall of the sphenoid sinus, and foramen rotundum. Patients without an embedded canal and with a canal floor relationship type 1 or type 2 were candidates for the transsphenoidal approach.

To understand the prevalence of each canal corpus type and canal floor type, we retrospectively analyzed paranasal sinus CT findings between January 1, 2006, and June 30, 2009, at Tri-Service General Hospital. These images were originally ordered for patients who had a clinical suggestion of chronic sinusitis. Patients who had a history of nasal or paranasal sinus surgery, tumoral disease, or nasal trauma were excluded. Six hundred eighty-two sides among 341 patients with identifiable vidian canals were selected. The study group comprised 241 men and 100 women (age range, 18-73 years; mean age, 40.7 years). For all patients, each side was studied separately. Measurements and positions of the canals are summarized in Table 1 and in Table 2.

Initial surgery in all 67 study patients was performed using the transsphenoidal approach, and anatomy inside the sphenoid sinus was evaluated. The transnasal approach to the vidian canal then followed whether it could be identified inside the sphenoid sinus or not. Endoscopic findings were recorded and were compared with preoperative CT images. Transection of the nerve inside the sphenoid sinus was attempted. The nerve was transected again outside of the sphenoid sinus whether it had already been done inside or not. Surgery was considered successful by direct vision of nerve transection or by pathologic finding of nerve component in the specimen. The success rates of each surgical approach were recorded separately.

**SURGICAL PROCEDURE**

**Transsphenoidal Approach**

After general anesthesia is administered, the patient is placed in the semi-Fowler position. Cottonoids soaked with diluted epinephrine (1:100 000) and cocaine, 10% (benzylmethyl-cegonine), are positioned between the middle turbinate and the nasal septum to enlarge the space between them and to obtain decongestion of the nasal mucosa. The head of the middle turbinate is delicately dislocated laterally to further widen the virtual space between the middle turbinate and the nasal septum. After creation of adequate space between the middle turbinate and the nasal septum, the endoscope is angled upward along the roof of the choana until it reaches the sphenoid ostium, usually located approximately 1.5 cm above the roof of the choana. If the sphenoid ostium is not visible, pressure with a blunt instrument is exerted to create access to the sphenoid cavity between the superior turbinate and the nasal septum.
Once the sphenoid cavity is reached, coagulation of the area around the sphenoid ostium is performed. This serves to avoid arterial bleeding originating from septal branches of the sphenopalatine artery. Ostium enlargement proceeds circumferentially by use of bone punches; care must be taken in the inferolateral direction, where the sphenopalatine artery or its major branches lie. To avoid these vessels, it is sufficient to cut away the nasal mucosa slightly in an inferolateral direction and to coagulate it with bipolar forceps, completely exposing the sphenoid rostrum. The sphenoid rostrum is then removed in fragments (not en bloc). Once the anterior sphenoidotomy is completed, small amounts of bleeding originating from the edges of the sphenoidotomy must always be checked to avoid occluding the lens of the endoscope.

A 70° endoscope is used to identify the vidian canal, usually at the sphenoid sinus floor, lateral to the natural ostium. Transection of the nerve is performed using an angle probe under di-

| Table 1. Distance From the Vidian Canal to 3 Landmarks |
|---------------------------------|-----|-----|-----|
| Distance From the Vidian Canal, mm | Minimum | Maximum | Mean (SD) |
| To the vomerine crest | 4.2 | 16.0 | 11.6 (0.2) |
| To the superior wall of the sphenoid sinus | 3.9 | 31.0 | 14.9 (0.5) |
| To the foramen rotundum | 1.7 | 15.5 | 6.8 (0.3) |

Figure 2. Coronal computed tomography sections showing the vidian canal and its different positions. A, The vidian canal is embedded in the bone (left). Canal floor type 1 (right) and type 2 (left) are shown. B, Complete (right) and partial protrusion (left) into the sinus. Canal floor type 4 with canal wall dehiscence (left) is shown. C, The vidian canal is medially located close to the medial lamina of the pterygoid process (bilateral). Canal floor type 3 (left) is shown. D, Caliper measurement of the distance between the vidian canal and the vomerine crest (left) and between the vidian canal and the foramen rotundum (right; asterisk). Arrows indicate vidian canal; straight lines in A, C, and D and the caret in B indicate the canal-floor relationships. The bifid tail arrow in D indicates the palatovaginal canal.
formed successfully on 42 of 106 sides (39.6%), while the transsphenoidal approach was successful only in patients without an embedded canal and with a canal floor relationship type 1 or type 2. Presence of the septum rendered the transsphenoidal approach more difficult and time-consuming. This anatomical variation resulted in failure of the transsphenoidal approach in 6 patients who had been viewed as candidates for the approach before surgery (Figure 5). In contrast, patients with dehiscence of the canal bony structure are considered good candidates for the transsphenoidal approach. If there is dehiscence of bone above the canal, the mucosa lining the sinus will rest directly against the periosteum lining of the vidian canal. In this situation, the nerve can be easily transected by a probe in the transsphenoidal approach. Fifteen canals with more laterally situated anatomy failed the transnasal approach. Although the anterior opening of the canal could be identified, direct view of nerve transection was not achieved. Further cauternization was used in these 15 canals. One mistaken transection of the palatovaginal canal was corrected by further dissection and discovery of the vidian canal superolateral to it.

No intraoperative complications were encountered. After surgery, symptoms (including rhinorrhea, nasal obstruction, and sneezing) significantly improved. How- ever, improvement of postnasal drip was not significant. The only minor adverse effect was dry eyes, which was experienced after 6 vidian neurectomies. The cases were mild, and only 1 patient with dry eyes required intermittent treatment. No visual acuity changes occurred after vidian neurectomy.

**COMMENT**

Through its autonomic fibers formed by union of the greater and deep petrosal nerves, the vidian nerve is thought to have a role in rhinitis, epiphora, crocodile tears, Sluder neuralgia, cranial and cluster headaches, and corneal ulceration. This nerve exits the lateral part of the anterior end of the carotid canal, passes along the upper part of the anterolateral edge of the foramen lacerum, courses through the vidian canal, and ends in the pterygopalatine ganglion at the posterior part of the pterygopalatine fossa. Clinically, it is an important landmark in endoscopic and microsurgical approaches to the cranial base, especially for the lacerum and petrosal segment of the internal carotid artery. Furthermore, vidian neurectomy has been advocated as an alternative management for patients with intractable vasomotor rhinitis.

Theoretically, neurectomy of postganglionic secretomotor fibers innervating the nasal mucosa is the ideal treatment with the fewest adverse surgical effects. However, the difficulty in nerve identification

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**Table 2. Computed Tomographic Findings of the Vidian Canal Among 341 Patients**

<table>
<thead>
<tr>
<th>Finding</th>
<th>Right Side (n=341)</th>
<th>Left Side (n=341)</th>
<th>Total (n=682)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vidian canal corpus type(^a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>186 (54.5)</td>
<td>178 (52.2)</td>
<td>364 (53.4)</td>
</tr>
<tr>
<td>2</td>
<td>112 (32.8)</td>
<td>121 (35.5)</td>
<td>233 (34.2)</td>
</tr>
<tr>
<td>3</td>
<td>43 (12.6)</td>
<td>42 (12.3)</td>
<td>85 (12.5)</td>
</tr>
<tr>
<td>Dehiscence of the bony roof of the canal</td>
<td>90 (26.4)</td>
<td>117 (34.3)</td>
<td>207 (30.4)</td>
</tr>
<tr>
<td>Relationship with the pterygoid process</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial, including on the same line</td>
<td>335 (98.2)</td>
<td>323 (94.7)</td>
<td>658 (96.5)</td>
</tr>
<tr>
<td>Lateral</td>
<td>6 (1.8)</td>
<td>18 (5.3)</td>
<td>24 (3.5)</td>
</tr>
<tr>
<td>Septum between the canal and the vomerine crest</td>
<td>202 (59.2)</td>
<td>193 (56.6)</td>
<td>395 (57.9)</td>
</tr>
<tr>
<td>Visualization of the palatovaginal canal</td>
<td>173 (50.7)</td>
<td>145 (42.5)</td>
<td>318 (46.6)</td>
</tr>
</tbody>
</table>

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\(^a\) Type 1 is embedded inside the sphenoid corpus, type 2 is partially protruding, and type 3 is connected to the bone with a stalk inside the sinus.

\(^b\) For type 1, the floor is flat, and the canal is at the same level as the floor. For type 2, the floor is upsloping, and the canal is superior to it. For type 3, the floor is downsloping, and the canal is inferior to it. For type 4, the floor is an inverted V shape.
The numerous surgical complications in dissection of this area, including injury of the major vessels and damage to the maxillary nerve, have limited this approach. Vidian neurectomy, a preganglionic nerve transection, has become the alternative. Golding-Wood first described vidian neurectomy in the early 1960s. However, the technique was largely abandoned because of difficulties in surgical technique and in accurate localization of the vidian nerve. The vidian nerve is seated deep at the base of the skull, an area that is anatomically difficult to reach, and is surrounded by numerous important structures. With advances in instruments and endoscopes, transection of the vidian nerve can be microinvasively achieved in selected patients. Robinson and Wormald developed a specific technique using endoscopy. The sphenopalatine artery was cauterized and the sphenopalatine foramen identified first. Transection of the vidian nerve was performed before its entrance into the sphenopalatine fossa. Although practical, this approach was too technically demanding. However, their work inspired us to develop other approaches, including endoscopic transnasal and transsphenoidal methods. The transsphenoidal approach has several advantages, including limited mucosa and bony structure destruction and minimal intraoperative bleeding. However, the risk for orbital complications or unintentional skull base penetration limited its application, especially for novice surgeons. Compared with the transnasal approach, the transsphenoidal approach results in fewer complications of the skull base but requires a larger area of mucosal destruction, with slightly more intraoperative bleeding. Furthermore, dissection is usually in the infralateral direction from the natural ostium, where the sphenopalatine artery or its major branches lie. Care must be taken in this step to avoid injuring vessels. The choice of an ideal approach depends on precise preoperative recognition of the anatomical structures. For this purpose, CT has a central role. Detailed imaging data enable the surgeon to interpret any anatomical variations or pathologic conditions before operating.

Figure 3. Intraoperative endoscopic views of the transsphenoidal approach. A, Coronal computed tomography section shows a vidian canal with canal floor type 1. B, The vidian canal can be visualized at the floor of the sphenoid sinus. C, A probe is used to transect the vidian canal. D, Successful transection of the vidian nerve is performed by direct vision. All arrows indicate the vidian canal.
Using CT images, Yazar et al. delineated the vidian canal in 150 patients. They attempted to establish the position and configuration of the vidian canal visually with 3-mm contiguous coronal and axial sections. The canal corpus relationship was studied, but the canal floor relationship was not. Extrapolation to clinical application was not demonstrated in their study. At our institution, paranasal sinus CT images were obtained using a 64-section multidetector system with 1-mm section thickness. In evaluating the clinical application of preoperative images, our study showed that it is impossible to precisely identify the vidian canal in the sphenoid sinus floor when it is embedded inside the sphenoid corpus. All patients with this anatomy (canal corpus type 1) underwent successful vidian neurectomy using the transnasal approach. In patients with the remaining 2 canal corpus types, protrusion of the canal into the floor of the sphenoid sinus can aid in locating the vidian canal, but not all of these patients are candidates for the transsphenoidal approach. Other important factors need to be considered such as the canal floor relationship and presence of the septum between the canal and the vomerine crest. Presence of the septum between the canal and the natural ostium would block visualization and hinder surgery. Removal of the septum is usually time-consuming and may be associated with greater intraoperative bleeding and unintentional skull base penetration. The canal floor relationship influences the choice of surgical approach. The transsphenoidal approach can be considered only in patients with a canal floor relationship type 1 or type 2. In patients with type 3 or type 4, visualization of the vidian canal and instrument blockage were observed in our study, limiting application of the transsphenoidal approach. In contrast, patients with dehiscence of the bony roof of the canal in the floor of the sphenoid sinus are good candidates for the transsphenoidal approach. This anatomy was observed in 30.4% (207 of 682 canals) of CT images reviewed in our study and in 4.4% to 32% of canals in other radiologic investigations. In this situation, the nerve can be easily transected by a probe using the transsphenoidal approach.

Figure 4. Intraoperative endoscopic views of the transnasal approach. A, Coronal computed tomography section shows a vidian canal with canal floor type 3. B, It is difficult to visualize the vidian canal transsphenoidally. C, The vidian nerve is identified where it leaves the sphenoid bone. D, Successful transection of the vidian nerve is performed by direct vision. All arrows indicate the vidian canal.
The foramen rotundum on the lateral side and the palatovaginal canal on the medial side can be mistaken for the vidian canal. In our review of CT images from 341 patients, the foramen rotundum was located 1.7 to 15.5 mm superolateral to the vidian canal. The palatovaginal canal was recognized bilaterally in 37.0% (126 patients) and unilaterally in 19.4% (66 patients). Similar results were obtained by Rumboldt et al., with bilateral and unilateral incidence rates of 38% and 20.7%, respectively. The palatovaginal canal is located between the upper edge of the sphenoid process of the palatine bone and the vaginal process of the sphenoid bone, which projects medially from the upper end of the medial pterygoid plate. This canal opens anteriorly through the posterior wall of the pterygopalatine fossa and transmits the minute pharyngeal branch that arises from the third part of the maxillary artery and the pharyngeal branch of the pterygopalatine ganglion to the pharyngeal orifice of the eustachian tube. Although mistaken transection of this nerve does not lead to any pronounced complication, nasal discomfort will persist, and the patient may require another procedure. Therefore, surgeons should keep this anatomic structure in mind when performing vidian neurectomy transnasally. Overall, preoperative CT images provide objective data for choosing a surgical approach. With good preoperative planning, bilateral neurectomy takes less than 60 minutes. Hospitalization is shorter, because there is no significant bleeding. Complete hemostasis is achieved without nasal packing. So far, we have encountered no major complication with this procedure. In conclusion, the course of the vidian canal may vary among patients and between sides in an individual patient. Although small and hidden at the base of the cranium, the vidian canal and its relationship with neighboring structures are clearly delineated in CT images. Careful preoperative planning is the first step to successful vidian neurectomy. Therefore, a surgeon addressing disease in this area must be familiar with classic vidian canal anatomy in CT images before operating. Submitted for Publication: August 26, 2009; final revision received October 27, 2009; accepted January 6, 2010.

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Author Contributions: Drs Liu, Wang, and Su had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Wang. Acquisition of data: Liu and Su. Analysis and interpretation of data: Liu and Wang. Drafting of the manuscript: Liu. Critical revision of the manuscript for important intellectual content: Wang and Su. Statistical analysis: Liu. Administrative, technical, and material support: Su. Study supervision: Wang.

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REFERENCES


Announcement

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