Radiographic and Anatomic Characterization of the Nasal Septal Swell Body

Dary J. Costa, MD; Thomas Sanford, MD; Christine Janney, MD; Margaret Cooper, PhD; Raj Sindwani, MD

Objective: To analyze the radiographic, anatomic, and histologic characteristics of the nasal septal swell body.

Design: Computer-aided analysis of magnetic resonance images (MRIs) and histologic examination of cadaveric nasal septa.

Setting: Tertiary medical center.

Patients: Fifty-four head MRI studies were performed on adult live patients; we also used 10 cadaveric nasal septa.

Main Outcome Measures: Radiographic dimensions of the swell body and distances to other nasal landmarks were measured. Nasal septa and swell body histologic characteristics were evaluated using light microscopy. Relative proportions of vascular, connective, and glandular tissues within the swell body and the adjacent septum were compared.

Results: The swell body was fusiform shaped and located anterior to the middle turbinate, with mean (SD) width of 12.4 (1.9) mm; height, 19.6 (3.2) mm; and length, 28.4 (3.5) mm. The epicenter was 24.8 (2.9) mm from the nasal floor, 43.9 (4.1) mm from the nasal tip, and 39.0 (4.6) mm from the sphenoid face. Histologic analyses revealed that, compared with adjacent septal mucosa, the swell body contained significantly more venous sinuses (37% vs 16%, P<.001) and fewer glandular elements (28% vs 41%, P<.001).

Conclusions: The swell body is a conserved region of the septum located anterior to the middle turbinate approximately 2.5 cm above the nasal floor. The high proportion of venous sinuses within the swell body suggests the capacity to alter nasal airflow. Additional study is required before these findings are used in a clinical setting.


The nasal septal swell body (SB) is a widened region of the anterior nasal septum. This mucosal-lined swelling is readily identifiable on anterior rhinoscopy, nasal endoscopy, and on sinonasal imaging studies. Little is known about the structure or function of the SB. Samples of the SB mucosa taken during nasal surgery have offered some insight into the composition of the SB, which contains both glandular and vasoerectile tissues.1 Magnetic resonance imaging (MRI) studies of the nasal cavity have documented a significant decrease in the size of the anterior nasal septum following topical decongestion.2 A better understanding of the SB and its function could prove clinically relevant, given the close proximity of this structure to the region of the internal nasal valve3 and its possible influence airflow through its vasoactive properties. Surgical management of anatomic nasal obstruction due to extreme turbinate hypertrophy or septal deviation has become commonplace and has been shown to improve nasal airflow.1

The goals of the present study were to perform a systematic evaluation of the nasal septal SB and to characterize its radiographic, anatomic, and histologic features. We also explore the functionality and possible clinical significance of this structure.

METHODS

The Saint Louis University institutional review board approved this project. A 3-dimensional computer-aided analysis of the nasal septum and SB was performed on T1-weighted postgadolinium MRI studies of adult heads. The MRI brain studies, ordered for nonsinonasal complaints and reported as normal after being reviewed by a radiologist, were performed using the head coil of a 1.5-T scanner (Philips, Andover, Massachusetts) while the patient was in the supine position. The studies were loaded and analyzed on the StealthStation TREON surgical navigation computer (Medtronic Corp-
The SB was identified in the axial, coronal, and sagittal views, and the epicenter was marked at the level of greatest width for reference. The dimensions of the SB were measured using the software measuring tool. Measurements of the superior-inferior (height), anterior-posterior (length), and lateral (width) dimensions of the SB region were recorded. Measurements were also taken from the SB epicenter to other clinically relevant nasal landmarks, including the nasal floor, the sphenoid sinus face, and the nasal tip.

Ten cadaveric nasal septa were collected and examined grossly. The entire specimens were then sectioned through the most prominent aspect of the SB and through the septum adjacent to the SB. Specimens were stained with hematoxylin-eosin and examined via light microscopy by a pathologist and otolaryngologist unblinded to the location of the section. The image was visualized on a computer monitor, and a transparent grid was overlaid on the screen. We recorded the tissue type (glandular, venous sinusoid, artery, capillary, and connective) at each point of intersecting lines on the grid. The number of points recorded for each tissue type was divided by the total number of points to provide a calculation of the relative area for each tissue within the specimen. The tissue composition of the SB and adjacent septum were compared using the 2-tailed t test, and a P < .05 was considered significant.

RESULTS

A total of 54 MRI studies of the head were analyzed, of which 25 were from male patients and 29 from female patients. Postgadolinium images demonstrated bright signal of the sinonasal mucosa, including the region of the SB. The septal SB was easily identified in all studies and was consistently located superior to the anterior aspect of the inferior turbinate and anterior to the head of the middle turbinate (Figure 1). The SB was determined to be fusiform in shape and tapered gently at its anterior aspect, with the epicenter located near the junction of the septal cartilage and perpendicular plate of the ethmoid (Figure 2). The mean (SD) width of the SB was 12.4 (1.9) mm; length, 28.1 (3.6) mm (Figure 3A). The mean (SD) height was 19.6 (3.0) mm. With respect to anatomic location relative to other nasal structures, the epicenter of the SB was located at a point on the anterior septum a mean distance of 24.8 (2.9) mm from the nasal floor; 39.0 (4.6) mm from the sphenoid face; and 43.9 (4.1) mm from the nasal tip (Figure 3B).

Comment

This study demonstrated that the nasal septal SB is a conserved component of the anterior nasal septum that is easily identified. Although the SB is continuous with and difficult to distinguish from adjacent portions of the nasal septum grossly, this structure has distinct microscopic boundaries and characteristic histologic features.

Previous studies have reported that the SB was composed of mostly glandular elements with only minimal venous sinusoids, providing less support for a role in influencing airflow. Our findings of a significant distribution of sinusoids (37% of the composition) in the SB are contrary to those of Wexler and colleagues, who noted only 10% venous sinusoids and 50% seromucinous glands in 2- to 4-mm biopsy specimens of the SB. In contrast to their methods, we analyzed full-thickness specimens of the entire nasal septum and were able to further demonstrate that seromucinous glands were organized more superficially in the mucosa, whereas the sinusoids tended
to occupy deeper areas. Thus, the discrepancies in venous sinusoid composition between our study and theirs may be owing to the biopsy techniques used. The present study demonstrates that the SB does indeed contain a significant proportion of venous sinusoids and fewer glandular and connective tissue elements than the adjacent septum.

The anatomy and histologic characteristics of the SB may provide clues to the potential function of this poorly understood structure. Nasal airflow is regulated predominantly by the nasal turbinates. However, the observation that the SB contains significant vasoerectile tissue has prompted suggestions that it may also influence nasal airflow. The anatomic location of the SB would appear supportive of this proposal; the SB occupies the space in the anterior nasal chamber anterior to the middle turbinate head and superior to the anterior portion of the inferior turbinate, approaching the region of the internal nasal valve. The SB may also increase turbulence and protect the nasal mucosa from rapidly moving inspiratory flow. This study, however, has limited clinical utility in the absence of additional data. The role of the SB in allergy, immunologic function, olfaction, and temperature regulation is intriguing but presently unclear.

It is important to note that the SB is a normal structure that is not to be confused with a septal deviation. On nasal examination, the SB appears as a swelling of the anterior septum located superiorly in the nasal cavity above the inferior turbinate, bilaterally. Unlike a septal deflection, the SB will shrink down in response to topical decongestion, underscoring the importance of examining the nose in both predecongestion and postdecongestion states.

In addition, this study raises the question of whether the SB should be directly addressed surgically in patients with nasal obstruction. At present, surgical treatment is considered aggressive and controversial. The anterior septum is very important in nasal airflow, and Gupta et al3 suggest that the superior septum should be addressed surgically in patients with obstruction. Generally, however, this approach focuses on modifications or resection of deviated cartilage in this area, with no particular attention paid to the overlying mucosa. Haight and

<table>
<thead>
<tr>
<th>Tissue Type</th>
<th>Swell Body Tissue Area</th>
<th>Nasal Septum Tissue Area</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venous and/or sinusoid</td>
<td>36.9 (15.3)</td>
<td>16.1 (6.7)</td>
<td>&lt;.001b</td>
</tr>
<tr>
<td>Glandular</td>
<td>27.6 (9.2)</td>
<td>41.1 (11.3)</td>
<td>&lt;.001b</td>
</tr>
<tr>
<td>Arterial</td>
<td>3.5 (2.3)</td>
<td>2.3 (3.1)</td>
<td>.19</td>
</tr>
<tr>
<td>Capillary</td>
<td>2.4 (1.2)</td>
<td>2.9 (2.3)</td>
<td>.34</td>
</tr>
<tr>
<td>Connective</td>
<td>29.5 (10.1)</td>
<td>37.7 (10.1)</td>
<td>.01b</td>
</tr>
</tbody>
</table>

Table. Proportion of Tissue Within the Swell Body and Adjacent Nasal Septum

a Unless otherwise indicated, data are reported as mean (SD) percentage of tissue.

b Statistically significant.
Gardiner\textsuperscript{7} actually performed nasal cautery or cryotherapy of the “nasal septal turbinate” (septal SB) and the inferior turbinate and concluded that there was no additional benefit from treating the septal turbinate. However, their study was limited by a very small number of patients and multiple different techniques.

It is also possible that the SB is affected inadvertently during routine septal surgery. Removing cartilage from the area of the SB in the anterior septum improves the cross-sectional area in the region of the nasal valve, but it also might interfere with the microenvironment and innervation to the SB, preventing parasympathetic tone from promoting vasodilation. In light of recent studies describing the complex interplay between the septum and inferior turbinates before and after surgical manipulation,\textsuperscript{8} further study into the effects of treating the SB in patients complaining of nasal obstruction may be important.

Review of the zoologic literature reveals that the septal SB is conserved in several other mammals and has been identified in rats, rabbits, and cats\textsuperscript{9} consistent with an atavistic organ. The histologic characteristics of the SB in these animals included cavernous endothelial-lined spaces\textsuperscript{10} similar to the findings of the present study. Some researchers have questioned whether the SB could itself represent a vestigial vomeronasal organ analogous to those in other mammals used for the detection of pheromones.\textsuperscript{10} However, to our knowledge, no studies have demonstrated a direct neurologic connection between the anterior septum and the central nervous system in humans. More work is needed to evaluate the role of the SB in nasal physiologic function and obstruction, and such work might lead to new treatment options.

In conclusion, the septal SB is a normal 2 × 3-cm fusiform structure located anterior to the middle turbinate and superior to the inferior turbinate approximately 2.5 cm above the nasal floor. The proximity of the SB to the nasal valve region in conjunction with its composition of a large number of venous sinusoids suggests a role in nasal airflow regulation, but the clinical significance of this structure is presently unclear. Further research is required to determine the role of the SB in the pathophysiologic characteristics and possible treatment of nasal obstruction.

Submitted for Publication: September 14, 2009; final revision received June 25, 2010; accepted July 28, 2010.

Correspondence: Dary J. Costa, MD, Department of Otolaryngology–Head and Neck Surgery, St Louis University Hospital, 3635 Vista Ave, Sixth Floor, FDT, St Louis, MO 63110 (costadj@slu.edu).

Author Contributions: Dary J. Costa had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Costa, Sanford, and Sindwani. Acquisition of data: Costa, Sanford, Janney, Cooper, and Sindwani. Analysis and interpretation of data: Costa, Sanford, Janney, and Sindwani. Drafting of the manuscript: Costa, Sanford, and Sindwani. Critical revision of the manuscript for important intellectual content: Costa, Sanford, Janney, Cooper, and Sindwani. Statistical analysis: Costa and Janney. Administrative, technical, and material support: Costa, Sanford, Janney, Cooper, and Sindwani. Study supervision: Sanford and Sindwani.

Financial Disclosure: None reported.

REFERENCES

2. Ng BA, Ramsey RG, Corey JP. The distribution of nasal erectile mucosa as visualized by magnetic resonance imaging. Ear Nose Throat J. 1999;78(3):159-166.