Giant Pneumatized Ethmoid Bulla: A Rare Anatomical Variation

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All authors have contributed sufficiently, approved the final text, and agreed on its submission to the Journal. A.O, A.Z and E.M have contributed to literature review, data collection and reporting and writing the original manuscript. A.O and A.H have constructed the idea, followed-up the patient, supervised the course of the article and reviewed it before submission.

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Consent
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Human And Animal Rights
If reporting experiments on human or animal subjects, please indicate if ethical standards followed the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5).

ABSTRACT

Pneumatization of the Ethmoid bulla varies greatly, and anatomical variations of the paranasal sinuses are quite common. However, giant ethmoid bulla prevalence in the published literature is relatively low. A 38-year-old woman presented with nasal obstruction and recurrent attacks of rhinosinusitis. The endoscopic examination showed a deviated nasal septum to the left, edematous left middle meatus, and hypertrophied inferior turbinates. The CT scan of the paranasal sinuses revealed an enlarged pneumatized ethmoid bulla, S-shaped nasal septum, bilateral inferior nasal turbinates hypertrophy, and obstructed left ostiomeatal complex (OMC), whereas the right OMC was patent. The patient underwent septoplasty and limited functional endoscopic sinus surgery. All symptoms were alleviated, and the patient remained symptom free after 6 months. Prospective studies should evaluate patients with sinonasal manifestations with radiologic evaluation complemented by nasal endoscopy to detect and rule out anatomical variations of the OMC region as a causative agent.

CASE REPORT

BACKGROUND

The ostiomeatal complex (OMC) occupies the area between the middle turbinate and the lateral nasal wall in the middle meatus. It represents the region for drainage and ventilation of anterior ethmoid, maxillary, and frontal sinuses; this narrow region's obstruction is a significant contributor to chronic sinusitis. Concha bullosa, Haller cell, and Agger nasi are common anatomical variants of the structures of the OMC [1].

Ethmoid bulla, also known as bulla ethmoidalis, is an anterior ethmoidal air cell that lies just posterior to the free edge of the uncinate process of the ethmoid bone. Anatomically, it is one of the most consistent air cells within the middle meatus and, therefore, serves as a reliable anatomic landmark. There is a wide variation in its degree of pneumatization, from giant ethmoid bulla to failure of pneumatization termed torus ethmoidalis [2]. The use of computed tomography (CT) scans

has been essential in detecting and accurately determining the size and scope of the condition [3]. Functional endoscopic sinus surgery (FESS) corrects these anatomical abnormalities and reestablishes the normal physiology of the paranasal sinuses [4]. Enlarged pneumatized ethmoid bullae result in nasal passage blockage and repeated episodes of acute and chronic inflammation of the nose and sinuses [5]. To the best of our knowledge, based on a comprehensive review of various databases, only two reports pertaining to the enlargement of the ethmoid bulla have been published. The purpose of this study is to describe the successful diagnosis and management of a patient with giant pneumatized ethmoid bulla.

CASE REPORT

A 38-year-old woman presented to the otorhinolaryngology outpatient clinic with a long-term history of nasal obstruction of the left nasal cavity more than the right side and frequent attacks of rhinosinusitis on an on-and-off basis. Apart from these complaints, she had no other otolaryngologic symptoms. The patient reported no history of nasal trauma. Her comorbidities included urticaria and bronchial asthma controlled with a budesonide/formoterol fumarate hydrate inhaler. Furthermore, the patient's social and family medical history was noncontributory, and further review of the systems was unremarkable.

Upon general examination, the patient was alert and oriented, and vital parameters were stable. She was overweight, with a height of 160 cm and a weight of 66.5 kg (BMI 26 kg/m^2). On focus examination, an endoscopic examination of the nasal cavity was performed using a rigid 0° scope, which revealed normal nasal mucosa and clear nasopharynx; the nasal septum was deviated to the left with edematous left middle meatus and hypertrophied inferior turbinates, as shown in Figure 1. During the diagnostic nasal endoscopy, no purulent discharge or signs of inflammation were evident. The findings of routine laboratory tests were within normal limits. The patient underwent a non-contrast CT scan of the paranasal sinuses. The scan showed an enlarged pneumatized ethmoid bulla, S-shaped nasal septum, bilateral inferior nasal turbinates hypertrophy, and obstructed left OMC, whereas the right OMC was patent. Figure 2 demonstrates the findings. In addition, the left maxillary sinus was hypoplastic, whereas the remaining paranasal sinuses appeared aerated.

In light of the clinical and radiological findings, a diagnosis of giant pneumatized ethmoid bulla and deviated nasal septum was established. The management plan for the patient's case included septoplasty and limited FESS. Intraoperatively, the nasal septum was found to be S-shaped deviated, and the middle turbinate was medialized and adherent to the nasal septum due to the pressure effect on the pneumatized ethmoid bulla, as shown in Figure 3. The lamina papyracea was positioned medial to the middle meatal antrostomy. The maxillary sinus was hypoplastic but aerated due to the presence of accessory ostium. The ethmoid bulla was opened using a microdebrider to preserve the lateral wall of the middle turbinate. Then, uncinectomy and middle meatal antrostomy were carried out, followed by an endoscopic septoplasty. Postoperatively, the patient was examined 1 week, 1 month, and 6 months following surgery. She reported significant relief of her symptoms with evident improvement of the nasal cavity on endoscopic examination during the 6-month follow-up period.

DISCUSSION

Clinical & Imaging Findings

We present a case report of a patient with a rare anatomical variation of the anterior ostiomeatal complex; the giant pneumatized ethmoid bulla is a rare entity in medical literature and routine clinical practice. To the best of our knowledge, according to a thorough search of different databases, only two reports have been published for ethmoid bulla enlargement with a demonstration of the association between this rare anatomical variation and chronic rhinosinusitis [5,6]. We present the third case of a patient with giant pneumatized ethmoid bulla and deviated nasal septum. The purpose of our case is to raise the awareness of otolaryngologists with regard to the anatomical variations of the ostiomeatal complex region in the evaluation of patients who present with sinonasal symptoms. Anatomical variations of the paranasal sinuses are quite common. However, the reported giant ethmoid bulla prevalence in the published literature is relatively low. A study published in 2016 examined the frequency of anatomical variations in the sinonasal region and the association between these variations and mucosal diseases, the giant ethmoid bulla was present in 6.3% of patients with sinus disease [7].

The most salient feature, in this case, was nasal obstruction, which is in line with what has been presented in another case report [6]. The explanation of this finding is probably that ethmoid bulla enlargement may cause the middle turbinate to be pushed medially, thereby resulting in the septum coming into contact with the turbinate, which leads to the obstruction of the ostiomeatal complex, making the patient prone to rhinosinusitis [8].

The anatomical variations of the paranasal sinus structures may predispose patients to recurrent sinusitis. A retrospective study was conducted to identify the incidence of lateral nasal wall anatomic variations among 200 patients with persistent symptoms of rhinosinusitis following medical treatment failure and their correlation with paranasal sinus disease [9]. The study concluded that some variations in the anatomical structure of the paranasal sinus could contribute significantly to the pathogenesis of chronic rhinosinusitis, thus potentially increasing the risk of sinus mucosal. In a published case of a 78-year-old man who presented with nasal obstruction for a month, the nasal endoscopy revealed a large projecting mass-like lesion; the paranasal CT scan demonstrated a large ethmoid bulla (dimensions 1.5 cm x 3 cm) filled with low-density material, and septal deviation to the right side was evident. Following functional endoscopic sinus surgery, including complete removal of the bulla, the patient's symptoms were alleviated entirely[6]. According to a case report published in 2015, a 23-year-old woman presented with recurrent acute

and chronic rhinosinusitis with an obstruction of the ethmoid infundibulum caused by inferior and anterior pneumatization of the enlarged pneumatized bulla ethmoidalis [5].

Treatment & Prognosis

The treatment of enlarged ethmoid bulla is limited FESS. Endoscopic partial middle turbinate resection is used to manage enlarged ethmoid bullas [4]. The frequency of paranasal sinus surgeries has increased due to advancements in endoscopic techniques [10]. Due to the anatomic variations in this region, there is an increased risk of surgical complications, thus, emphasizing the importance of meticulous evaluation of paranasal sinus CT scans before surgery. Currently, there is a paucity of literature, and further research in this area is needed to assess any potential unforeseen long-term complications. Radiologic evaluation by CT should complement nasal endoscopy in diagnosing and delineating its extent. Our case raises the awareness of otolaryngologists regarding the anatomical variations of the ostiomeatal complex region when evaluating patients with sinonasal manifestations.

TEACHING POINT

In conclusion, we described a rare cause of nasal obstruction secondary to enlarged ethmoid bulla in a 38-year-old woman. Careful and detailed radiological and endoscopic investigations led to the successful diagnosis and management of this anatomical variation. Prospective studies should evaluate patients with sinonasal manifestations with radiologic evaluation complemented by nasal endoscopy to detect and rule out anatomical variations of the ostiomeatal complex region as a causative agent.

QUESTIONS

Question 1: Which of the following anatomical variations are commonly associated with the obstruction of ostiomeatal complex (OMC)?

A. Concha bullosa (applies)
B. Presence of haller cell (applies)
C. Presence of agger nasi
D. Deviated nasal septum (aaplies)
E. Enlarged inferior turbinate

Explanation: The ostiomeatal complex is a critical area for sinus drainage and ventilation, and its obstruction due to presence of anatomical variation of the septum or ethmoid cavity can lead to sinusitis.

Question 2: What symptoms does a patient with obstructed osteomeatal complex (OMC) can present with?

A. Nasal obstruction (applies)
B. Recurrent rhinosinusitis (applies)
C. Nasal trauma
D. Hearing loss
E. Chronic cough

Explanation: Obstructed OMC can lead various symptoms related to nasal airway obstruction and/or sinuses drainage obstruction.

Question 3: What are the common paranasal sinus CT scan findings that can be seen in obstructed OMC?

A. Maxillary sinusitis (applies)
B. Frontal sinusitis (applies)
C. Sphenoid sinusitis
D. Inferior nasal turbinates hypertrophy
E. Deviated nasal septum

Explanation: Obstructed OMC can lead to sinusitis of the maxillary, ethmoid and frontal sinuses, which can be seen as partial or complete opacity of the sinuses.

Question 4: What surgical procedures can be performed to alleviate symptoms in patient with obstructed OMC?

A. Septoplasty (applies)
B. Functional endoscopic sinus surgery (FESS) (applies)
C. Turbinoplasty
D. Rhinoplasty
E. Turbinectomy

Explanation: The surgical goal in OMC obstruction is to remove the anatomical variants that can lead to the obstruction and keep the OMC patent.

Question 5: Why is it important to evaluate anatomical variations of the paranasal sinuses?

A. They can contribute to chronic rhinosinusitis (applies)
B. They are always symptomatic
C. They have no impact on sinus drainage
D. They are rare and not clinically significant
E. They always require surgical intervention

Explanation: Anatomical variations of the paranasal sinuses can contribute significantly to the pathogenesis of chronic rhinosinusitis by obstructing sinus drainage pathways.

REFERENCES

1. Bandyopadhyay R, Biswas R, Bhattacherjee S, Pandit N, Ghosh S. Osteomeatal Complex: A Study of Its Anatomical Variation Among Patients Attending North Bengal Medical College and Hospital. *Indian Journal of Otolaryngology and Head & Neck Surgery*. 2015; 67(3): 281-286. PMID: 26405665.
2. Ostiomeatal Complex. *Diagnostic Imaging: Oral and Maxillofacial*. 2017: 72-75. doi:10.1016/B978-0-323-47782-6.50018-1
3. Chaturvedi DA. A study on the incidence of Anatomical abnormalities in the osteomeatal complex among chronic rhinosinusitis patients. *Journal of Medical Science and clinical Research*. 2019; 7(8).
4. Padmalatha M, Garudadri S. A study on correlation between CT findings and the endoscopic findings in Functional Endoscopic Sinus Surgery of chronic rhinosinusitis. ~ *118 ~ International Journal of Radiology and Diagnostic Imaging*. 2021; 4(3): 118-124.
5. Warman M, Willen S, Catalano PJ. Nasal obstruction and recurrent sinusitis caused by bilateral pneumatized ethmoid bullae. *Ear Nose Throat J*. 2015; 94(12): E17-E18. PMID: 26670760.

6. Kim BJ, Kim JS. A case of large ethmoid bulla causing chronic rhinosinusitis: 'Bulla bullosa.' *Ear Nose Throat J*. 2022; 1455613221106223. PMID: 35649129.
7. Dasar U, Gokce E. Evaluation of variations in sinonasal region with computed tomography. *World J Radiol*. 2016; 8(1): 98-108. PMID: 26834948.
8. Roozbahany NA, Nasri S. Nasal and paranasal sinus anatomical variations in patients with rhinogenic contact point headache. *Auris Nasus Larynx*. 2013; 40(2): 177-183. PMID: 22854054.
9. Fadda GL, Rosso S, Aversa S, Petrelli A, Ondolo C, Succo G. Multiparametric statistical correlations between paranasal sinus anatomic variations and chronic rhinosinusitis. *Acta Otorhinolaryngologica Italica*. 2012; 32(4): 244-251. PMID: 23093814.
10. Govindaraj S, Adappa ND, Kennedy DW. Endoscopic sinus surgery: evolution and technical innovations. *J Laryngol Otol*. 2010; 124(3): 242-250. PMID: 19930748.
11. Sohrabi C, Mathew G, Maria N, et al. The SCARE 2023 guideline: updating consensus Surgical CAse REport (SCARE) guidelines. *Int J Surg*. 2023; 109(5): 1136-1140. PMID: 37013953.

FIGURES

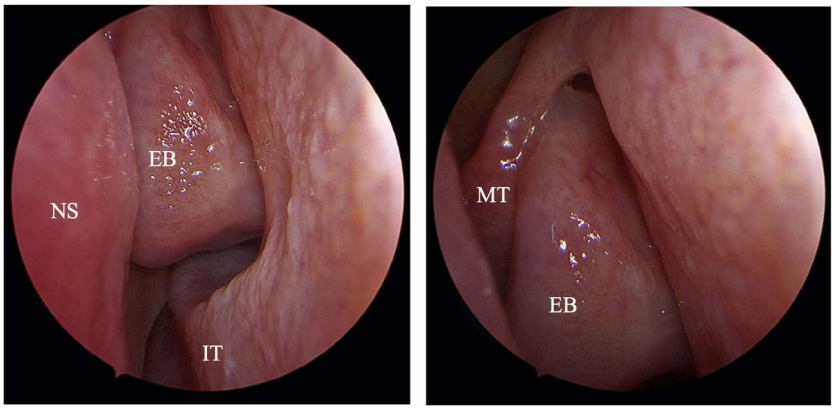

Figure 1: Endoscopic images of left nasal cavity examination showing enlarged pneumatized ethmoid bulla (EB) and healthy-looking nasal mucosa using 0-degree nasal endoscopy. The nasal septum (NS), inferior turbinate (IT) and middle turbinate (MT) are well-demarcated.

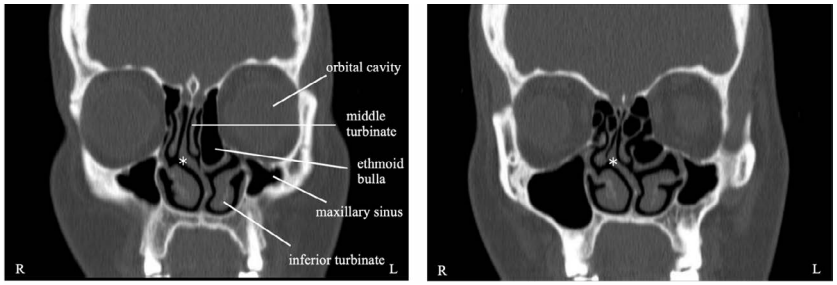

Figure 2: Coronal cuts of non-contrasted computed tomography scan of the paranasal sinuses at the level of anterior ethmoid cavity. The scan shows the pneumatized left ethmoid bulla which causing deviation of the nasal septum (asterisks). The scan also shows left hypoplastic maxillary sinus and bilateral enlarged inferior turbinates. The rest of the paranasal sinuses are clear.

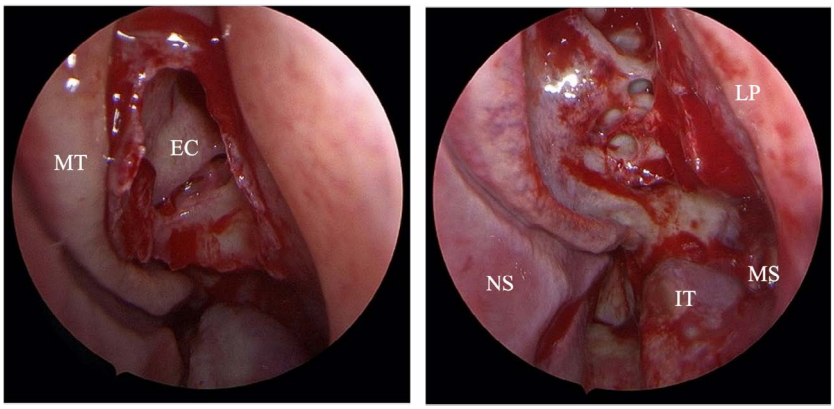

Figure 3: Intraoperative endoscopic images of the left nasal cavity using a 0-degree endoscope showing the middle turbinate (MT), ethmoidal cavity (EC), nasal septum (NS), lamina papyracea (LP), maxillary sinus (MS), and inferior turbinate (IT).

KEYWORDS

Nasal Obstruction, Rhinosinusitis, Nose, Case Reports, Ethmoid Bulla.

ABBREVIATIONS

OMC = OSTEOMEATAL COMPLEX
CT = COMPUTED TOMOGRAPHY
FESS = FUNCTIONAL ENDOSCOPIC SINUS SURGERY
MT = MIDDLE TURBINATE
EC = ETHMOIDAL CAVITY
NS = NASAL SEPTUM
LP = LAMINA PAPYRACEA
MS = MAXILLARY SINUS
IT = INFERIOR TURBINATE

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