

LITERATURE REVIEW

The inferior concha bullosa: A rare condition with great functional impact

Irine Aleyamma Thomas¹, Neenu Anna Joseph¹, Ramiya Ramachandran Kaipuzha²,
Davis Thomas Pulimoottil¹, Sneha Mary Joy¹, Akhila Krishna Leena Rajeev¹, Aatma Sajith Nair¹

¹Department of ENT, Al Azhar Medical College and Super Specialty Hospital, Thodupuzha, Kerala, India

²Department of Otorhinolaryngology, Jahra Hospital, Al Jahra, Kuwait

ABSTRACT

BACKGROUND. Pneumatization of the turbinate is also known as concha bullosa (CB). Concha bullosa is most commonly found in the middle turbinate; its occurrence in the inferior turbinate is very rare.

MATERIAL AND METHODS. A search of the literature was conducted using PubMed, Medline, Google and Google Scholar search engines using the keywords “inferior turbinate and concha bullosa”, “inferior turbinate and pneumatization”, covering the period from 1990 to 2024. Only case reports published in English were included in the study.

RESULTS. We found twenty publications with a total of 21 cases that fit the above inclusion criteria for the analysis, with our case being the 22nd. Our patient was a 32-year-old male who presented to the ENT outpatient department with complaints of nasal obstruction for two years. Diagnostic nasal endoscopy was performed and a diagnosis of deviated nasal septum (DNS) to the right and left inferior turbinate hypertrophy was made. He was started on intranasal steroids and decongestants but did not improve. Hence, CT PNS was done and revealed a left inferior concha bullosa along with right-sided DNS. Septoplasty was carried out and the left inferior turbinate was excised. Gross appearance of the turbinate confirmed the diagnosis.

CONCLUSION. Pneumatization of the inferior turbinate is a very rare anatomical anomaly. It is often asymptomatic and diagnosed incidentally on a CT scan. It can present as nasal obstruction, recurrent rhinosinusitis, and headaches. Treatment depends on the severity of symptoms.

KEYWORDS: pneumatization, inferior turbinate, concha bullosa, nasal obstruction.

INTRODUCTION

The turbinates are key anatomical structures located on the lateral nasal wall. A significant portion of inhaled air flows between the inferior and middle turbinates. Among them, the inferior turbinate is the largest and is situated in the internal nasal valve region^{1,2}. It plays a crucial role in humidifying, heating, and filtering inhaled air, as well as directing nasal airflow, contributing to approximately two-thirds of nasal airflow resistance. Structurally, turbinates consist of a pseudostratified columnar ciliated respiratory epithelium with a thick, vascular, and erectile glandular tissue layer. Due to this composition, even slight changes in the size of the inferior turbinate can have a considerable impact on nasal airflow^{3,4}.

Anatomically, the superior and middle conchae formed from the ethmoid bone, while the inferior concha is a separate bone. Pneumatization of the nasal turbinates, known as concha bullosa (CB), is a common anatomical variation of the lateral nasal wall, characterized by the presence of air cells within the turbinates. CB most frequently occurs in the middle turbinate, while its presence in the superior and inferior turbinates is considered rare^{5,6}. The exact cause and mechanism of turbinate pneumatization remain unclear. Inferior concha bullosa (ICB) was first identified by Zinreich et al.⁷ in 1988. Although ICB is typically asymptomatic, it may contribute to nasal obstruction or inferior turbinate hypertrophy in some cases. Unlike middle turbinate concha bullosa, which is

Corresponding author: Dr. Irine Aleyamma Thomas, Department of ENT, Al Azhar Medical College and Super Specialty Hospital, Ezhalloor P.O., Thodupuzha, Idukki District, Kerala - 685605

ORCID: <https://orcid.org/0000-0002-0189-6393>

e-mail: thomasirine@yahoo.in

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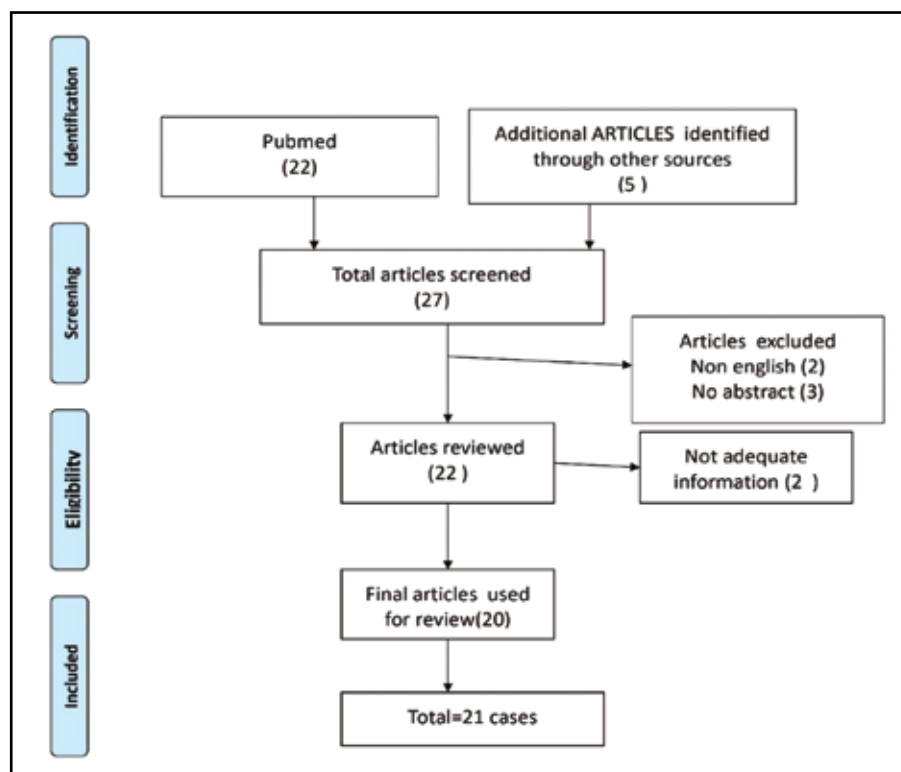


Figure 1. PRISMA flow diagram summarizing the methodology of the literature search.

frequently reported, ICB remains a rare entity with limited literature available. The objective of this review is to consolidate existing knowledge regarding the etiology, diagnosis, and treatment approaches for ICB and we describe such a case of inferior concha bullosa.

MATERIAL AND METHODS

A search of the literature was conducted using PubMed, Medline, Google and Google Scholar search engines using the following keywords: “inferior turbinate and concha bullosa”, “inferior turbinate and pneumatization”. The study was performed between 1990 and 2024. We included only case reports of both adults and children, in English language, as shown in Figure 1.

RESULTS

In this review, we included 20 case reports, wherein a total of 21 patients were diagnosed with inferior turbinate CB based on history assessment, physical examination, and imaging. The mean age of the patients was 29 years old, and the majority being females, comprising 57.2% of the cases, while 42.8% were males. All 21 patients (100%)

presented with complaints of nasal obstruction, followed by headache in 76.1% of the patients and rhinorrhoea in 61.9% of the cases. Nasal endoscopy and Computed tomography (CT) – coronal and axial cuts of the paranasal sinuses (PNS) – were performed for all patients.

The site of ICB was bilateral in nine cases (42.9%), followed by left-sided in eight cases (38.1%) and right-sided in four cases (19%). Of the total 21 cases, 5 cases had inferior, middle, and superior turbinate pneumatization, 11 had both middle and inferior turbinate pneumatization and 5 had inferior turbinate pneumatization only. There was one infected pneumatized ICB and in 3 cases, ICB was found communicating with the maxillary sinus. Our case is consistent with prior cases of ICB published (Table 1).

In our review of 21 cases, we observed that fourteen underwent surgical procedures (66.76%), three patients received only medical interventions (14.2%) and three received a combination of both medical and surgical treatments (14.2%). All patients showed positive outcomes, and there were no reported complications related to surgery. This was similar to the systematic review conducted in 2021 by Alnatheer et al., which showed that 54% of cases may necessitate surgical intervention, while 23% may require medical management, and another 23% may need a combination

Table 1. Summary of published case reports of inferior concha bullosa.

Sl no.	Reference	No of cases	Age	Gender	Etiology	CT findings	Intervention (medical /surgical)	Outcome
1	Dogru et al. ⁸ , 1999	1	35	Female	Nasal obstruction Headache	Right middle concha bullosa (MCB) Right ICB with septal contact	Surgical	Low
2	Aydin et al. ⁹ , 2001	1	35	Female	Nasal obstruction Sneezing Nasal discharge Facial pain on the left side	Bilateral ICB, contact with the septum on the left side DNS to the left	Surgical	Moderate
3	Cankaya et al. ² , 2001	1	35	Male	Headache Nasal obstruction	MCB Right ICB	Surgical	Moderate
4	Ozcan et al. ¹⁰ , 2002	1	35	Female	Nasal obstruction Facial pain	ICB –Bilateral Left MCB, posterior septal pneumatization, and right septal deviation	Surgical	Moderate
5	Uzun et al. ⁴ , 2004	1	25	Male	Nasal obstruction Headache	Right MCB and ICB DNS to the left	Surgical	Moderate
6	Göçmen et al. ¹¹ , 2005	1	52	Male	Bilateral nasal obstruction Purulent nasal discharge Facial pain Headache	Bilateral chronic fronto-ethmoidal-maxillary rhinosinusitis and bilateral MCB and right infected ICB, right DNS	Surgical	Moderate
7	Kiroglu et al. ¹² , 2006	1	14	Female	Nasal blockage and nasal pain Purulent discharge on the left side of nose	Left ICB Mild right nasal septal deviation	Medical and surgical	Moderate
8	Giourgos et al. ¹³ , 2010	1	11	Female	Recurrent episodes of bilateral nasal obstruction Rhinorrhoea Postnasal drip Nocturnal cough	Left ICB Bilateral pneumatization of the uncinate process and Haller cells	Medical	Moderate
9	Pittore et al. ³ , 2010	1	24	Female	Rhinorrhoea Nasal obstruction	Polypoid mucosal thickening in the maxillary antrum and ethmoid air cell, bilaterally Occlusion of the left infundibulum Left ICB	Surgical	Moderate
10	Fidan ¹⁴ , 2012	1	17	Female	Rhinorrhoea Nasal obstruction	Bilateral concha bullosa in all turbinates	Medical and Surgical	Moderate
11	Ozturan et al. ¹⁵ , 2013	1	23	Male	Nasal congestion Nasal drip Intermittent facial pain	Inferior, middle and superior conchae were pneumatized bilaterally The nasal septum was slightly deviated to the right Bilateral agger nasi cells	Surgical	Moderate
12	Toplu et al. ¹⁶ , 2012	1	37	Female	Nasal obstruction Persistent headache Postnasal discharge	Bilateral inferior CBs, directly communicating with the ipsilateral maxillary sinuses Septated right middle CB Bilateral superior CBs Right uncinate pneumatization Nasal septal deviation to the left side	Medical and Surgical	Moderate
13	San et al. ¹⁷ , 2014	1	20	Female	Nasal obstruction Postnasal drip Intermittent headache	Pneumatization of the inferior, middle, and superior turbinates, bilaterally Moderate nasal septum deviation to the left Inflammatory mucosal thickening in the right maxillary sinus	Surgical	Moderate
14	Sapmaz et al. ¹⁸ , 2014	1	23	Female	Continuous headache and breathlessness	Pneumatization in the left inferior, middle and superior turbinates	Surgical	Moderate
15	Erdur et al. ¹⁹ , 2017	1	13	Female	Nasal obstruction Facial pain Postnasal discharge	Bilateral middle and inferior concha bullosa	Surgical	Moderate
16	Koo et al. ²⁰ , 2018	1	14	Male	Nasal obstruction Chronic headache Purulent nasal discharge	Bilateral pneumatization of the inferior turbinate Concha bullosa of the left inferior turbinate	Surgical	Moderate

Sl no.	Reference	No of cases	Age	Gender	Etiology	CT findings	Intervention (medical/surgical)	Outcome
17	Alkhalidi et al. ²¹ , 2021	2	32	Male	Bilateral nasal obstruction Headache	Right DNS Bilateral MCB, paradoxical right middle turbinate Left ICB	Medical	Moderate
			28	Male	Right nasal obstruction Headache Recurrent rhinosinusitis	Bilateral MCB, predominantly on the left side Left ICB, bilateral inferior turbinate hypertrophy	Medical	Moderate
18	Erdoğan et al. ²² , 2022	1	43	Male	Nasal obstruction Headache	DNS to the right Paradoxical left middle turbinate Left ICB connected with the left maxillary sinus Left uncinate bullosa attached to the lamina papyracea, and supraorbital ethmoid cell	Surgical	Moderate
19	Elamaireh et al. ²³ , 2024	1	30	Female	Right nasal obstruction Headache	Right ICB Left inferior turbinate hypertrophy Bilateral paradoxical middle turbinates Left chronic maxillo-ethmoidal rhinosinusitis	Medical	Moderate
20	Kim et al. ²⁴ , 2024	1	62	Male	Nasal obstruction Mucopurulent rhinorrhoea	Right maxillary sinusitis Left ICB Left MCB Partial bilateral ostio-meatal unit obstruction	Surgical	Moderate
21	Our study	1	32	Male	Nasal obstruction	Left inferior concha bullosa DNS to the right	Surgical	Moderate
MCB – middle concha bullosa; ICB – inferior concha bullosa; CB – concha bullosa; DNS – deviated nasal septum								

Several surgical techniques have been proposed for addressing ICB, including inferior turbinate out-fracturing, concha crushing, surgical excision of the turbinate free edge, turbinate submucosal diathermy, and turbinoplasty utilizing a microdebrider (Table 1). The selection of the most appropriate procedure depends on the size and extent of the ICB, as well as whether it is unilateral or bilateral.

OUR EXPERIENCE

A 32-year-old male presented to the ENT Outpatient Department with complaints of left-sided nasal obstruction for two years. There was no history of allergy, recurrent rhinitis, anosmia or headache. Diagnostic nasal endoscopy was performed and revealed a right-sided deviated nasal septum (DNS) and left inferior turbinate hypertrophy. The patient was started on nasal decongestants and intranasal steroids but showed no improvement. Hence, computed tomography of the nose and paranasal sinuses was done, which revealed a left inferior concha bullosa (Figure 2).

Pre-anaesthetic clearance was obtained, and the patient underwent septoplasty and partial left inferior turbinoplasty, preserving the medial mucosa. Gross appearance of the resected turbinate con-

The postoperative period was uneventful. The patient was asymptomatic with no recurrence at the one-year follow-up

DISCUSSIONS

Chronic nasal obstruction is a common symptom that we encounter within the field of otolaryngology, with septal deviation identified as the primary cause, followed by hypertrophy of the inferior turbinate. The nasal turbinates, located on the lateral walls of the nasal cavity, play essential roles in various physiological functions, including the warming, humidification, filtration, and regulation of airflow during inhalation. Alterations in the bony structure or an increase in the volume of the erectile mucosa of the turbinates can significantly impact nasal airflow⁷. Common contributors to inferior turbinate hypertrophy include compensatory changes due to longstanding septal deviation, as well as generalized mucosal conditions associated with allergic and vasomotor rhinitis, which result in mucosal thickening without corresponding hypertrophy of the underlying bone²⁶. Additionally, a pneumatized inferior turbinate has emerged as a newly recognized factor contributing to nasal obstruction.

Although this anatomic variation was first de-



Figure 2. Computed tomography of the nose and paranasal sinuses (coronal view) showing left inferior concha bullosa (white arrow).

scribed by Zinreich et al.⁷ in 1988, the first cases of pneumatization of the inferior turbinate were reported by Dogru et al.⁸ (1999) and Dawlaty²⁷ (1999), who suggested that a pneumatized inferior turbinate might be of congenital origin. Various theories have been accepted for the development of a pneumatized inferior turbinate (PIT). The first theory states that a mis-invagination of the epithelium occurs during the ossification of the inferior turbinate chondral framework in foetal development, resulting in a double lamella²¹. The second theory proposes that the formation of air-filled cavities within the inferior concha is secondary to a pathological condition of the maxillary sinus. The third theory indicates that the pneumatization of the maxillary sinus during foetal life may extend abnormally into the inferior turbinate.

The majority of patients are asymptomatic. Common symptoms of inferior concha bullosa include nasal obstruction or congestion, facial pressure or pain, headaches and recurrent sinus infections, as summarised in Table 1.

In most instances, asymptomatic inferior concha bullosa (ICB) does not require management. The primary goal of treatment is to enhance the nasal airway while maintaining the function of the nasal mucosa and minimising complications. For symptomatic patients, initial medical management may involve the use of intranasal steroids and vasoconstrictive agents. If these treatments fail to relieve symptoms, surgical options may be considered.

CONCLUSIONS

Is an extremely rare anatomic anomaly. Although often asymptomatic, it can result in nasal obstruction and sinonasal diseases. ICB should be kept in mind



Figure 3. Gross appearance of the postoperative left inferior turbinectomy specimen showing the inferior concha bullosa (black dot).

in patients having persistent nasal obstruction and hypertrophied inferior turbinate refractory to vasoconstrictors. CT imaging is the key diagnostic tool, and management ranges from conservative treatment to surgical intervention, depending on the severity of symptoms. Further studies with larger patient cohorts are needed to establish optimal treatment guidelines. Additionally, long-term outcomes of different surgical techniques should be explored to establish standardized management guidelines.

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Authors' information

Irine Aleyamma Thomas, MS., DNB., Assistant Professor, Department of ENT, Al Azhar Medical College and Super Specialty Hospital, Thodupuzha, Kerala, India. E-mail: thomasirine@yahoo.in. ORCID: <https://orcid.org/0000-0002-0189-6393>.

Neenu Anna Joseph, DLO., MS., Assistant Professor, Department of ENT, Al Azhar Medical College and Super Specialty Hospital, Thodupuzha, Kerala, India. E-mail: neens461@gmail.com. ORCID: <https://orcid.org/0000-0001-9978-1801>.

Ramiya Ramachandran Kaipuzha, MS., Registrar,

Department of Otorhinolaryngology, Jahra Hospital, Al Jahra, Kuwait. E-mail: ramiyaramk@gmail.com. ORCID ID: <https://orcid.org/0000-0002-0021-4362>.

Davis Thomas Pulimoottil, MS., Professor, Department of ENT, Al Azhar Medical College and Super Specialty Hospital, Thodupuzha, Kerala, India. E-mail: davisthomasp@yahoo.in. ORCID: <https://orcid.org/0000-0001-6572-8789>.

Sneha Mary Joy, MS., Assistant Professor, Department of ENT, Al Azhar Medical College and Super Specialty Hospital, Thodupuzha, Kerala, India. E-mail: snehamaryjoy@gmail.com. ORCID: <https://orcid.org/0000-0001-6865-835X>.

Akhila Krishna Leena Rajeev, MBBS., Junior Resident, Department of ENT, Al Azhar Medical College and Super Specialty Hospital, Thodupuzha, Kerala, India. E-mail: aakhilakrishnalr@gmail.com. ORCID: <https://orcid.org/0009-0006-5706-6918>.

Aatma Sajith Nair, MBBS., Junior Resident, Department of ENT, Al Azhar Medical College and Super Specialty Hospital, Thodupuzha, Kerala, India. E-mail: aathmasajith@gmail.com. ORCID: <https://orcid.org/0009-0002-6525-3124>.

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