

**A Retrospective Study of Mucus Retention Cysts in the Paranasal Sinuses**Shahanaz Ahamed M<sup>1</sup>, Arun Ingale<sup>2</sup><sup>1</sup>Department of Paediatric Neurology, SAT Hospital, Government Medical College, Thiruvananthapuram, Kerala, India<sup>2</sup>Department of ENT, Gadag Institute of Medical Sciences, Gadag, Karnataka, India

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Conflict of interest: Nil

**Abstract:****Objectives:** This study was specifically designed for evaluating paranasal sinusitis among the pediatric population. We aim to identify the rare cases of mucus retention cysts or mucocele among pediatricians.**Methodology:** This retrospective study was conducted in Gadag Institute of Medical Sciences, Gadag, Karnataka. Total 450 cases were recruited within two years of study follow-up. Data was collected from 2018-2020. Patients above ten years were omitted. On the other hand, patients with acute rhinosinusitis, chronic sinusitis, allergic fungal sinusitis, Choanal Atresia, nasal polyps, Mucocele, and fibrous dysplasia were included a definition of paranasal sinusitis. CT scans were performed to evaluate the medial mucosa thickness and presence of concha bullosa. The 3mm or more than 3mm thickness of mucosa was defined as sinusitis, whereas concha bullosa was defined as pneumatization of both lamellar and bulbous parts of the middle turbinate. Complete information related to endoscopic sinus surgery was also observed in research. To evaluate the correlation between the disease severity and middle ear problems, otological examinations were conducted by trained medical staff.**Results:** In our study, the age range of participants was in between 0- 10 years. In our research, most of the female population demands endoscopic sinus surgery with a mean age of 7.3 years. In our study, we observed three male cases of CSF with a mean age range of  $7.3 \pm 2.3$  years who needs ESS surgery. In this study, CSF was frequently observed in patients above than five-year age group.**Conclusion:** Our results confirmed the independent relationship between pediatric allergic rhinitis and otitis media. However, mucocele in the pediatric population is very rare. Slow growth and asymptomatic symptoms of mucocele need long longitudinal prospective studies rather than retrospective ones.**Keywords:** Paranasal sinuses, Allergic rhinosinusitis, Mucocele, Retrospective study.

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**Introduction**

Pediatric nasal disorders and nasal sinus diseases are of inflammation nature. Congenital anomalies like nasal spectrum and other pathological disorders rarely required medical therapy from Otolaryngologist. Genetics and mucosa immunological functions play an essential role in the formation of the pediatric airway tract. During growth, age child suffers from much paranasal sinusitis due to constant changes in anatomy.

At different age periods of child development, nasal sinus disorders occurred due to facial growth. Epidemiological examinations and evidence-based studies are often lacking in the pediatric population. Diseases like acute and chronic rhinosinusitis, allergic rhinosinusitis, and adenoid illness that occurred in paranasal sinuses help to recognize the wide range of infections among children. In previous literature terms, the common cold is widely used for defining acute rhinosinusitis, which

developed after the viral infection. This common cold can be resolved within ten days, but some patients with complications, including bronchial asthma or chronic bronchitis, need antibiotic treatment. On the other hand, cold, which persuade more than 12 weeks, and inflammatory changes are widely categorized under the definition of chronic rhinosinusitis. Studies demonstrate that 40% pediatric population of England is suffering from allergic rhinitis. This condition occurs due to nasal obstruction, which creates a disturbance in the growth of facial growth. In many studies, CT imaging shows reservation of nasal sinus after successful medication. But some cases need surgical intervention. Nasal sinus surgery is widely used as an effective treatment of paranasal sinusitis.

In many regions of the world, endoscopic sinus surgery is highly used to manage chronic rhinosinusitis cases which failed to treat through

conservative treatment [11]. A very little literature on paranasal sinusitis among the pediatric population was produced in recent decades. This gap needs to be filled for future references. This study was specifically designed for evaluating paranasal sinusitis among the pediatric population. We aim to identify the rare cases of mucus retention cysts or mucocele among pediatricians.

### Material and Methodology

This retrospective study was conducted in Gadag Institute of Medical Sciences, Gadag, Karnataka. Total 450 cases were recruited within two years of study follow-up. For this study, we noted complete demographic and clinical information of the patients along with the computed tomography imaging of temporal bones or paranasal sinuses. The cases of chronic rhinosinusitis were considered as indicators of paranasal CT. The symptoms of rhinosinusitis were identified through the criteria of the American Academy of Otolaryngology-Head and Neck Surgery. All the patients with a history of nasal surgery, S-shaped septal deviation, haemotympanum were not part of the research. Patients above ten years were omitted.

On the other hand, patients with acute rhinosinusitis, chronic sinusitis, allergic fungal sinusitis, Choanal Atresia, nasal polyps, Mucocele, and fibrous dysplasia were included the definition of paranasal sinusitis. CT scans were performed to evaluate the medial mucosa thickness and presence of concha bullosa. The 3mm or more than 3mm thickness of mucosa was defined as sinusitis, whereas concha bullosa was defined as pneumatization of both lamellar and bulbous parts of the middle turbinate. Complete information related to endoscopic sinus surgery was also observed in research.

For CT imaging, we used a multidetector CT system. Imaging parameters included 120 kVp, 150 mA, a slice thickness and reconstruction interval of 0.5 mm, a pitch factor of 1.4, a matrix size 512 × 512, a field of view of 20 cm × 20 cm, a window width 2700, and a window level 350. Data collection was done through survey technique, whereas identification of mucus retention cysts was made through snowball sampling technique. In this technique, we asked senior ENT physicians to identify the probability of mucus retention cysts among the selected patients. The primary purpose of establishing the survey was to protect the patient's privacy and enhance the chance of voluntary participation. The research was conducted after ethical approval from the

institution, and the principles of Helenski were followed at all stages of research. Written consents were asked from the patient's guardians, and they had complete information on the pros and cons of the study with comprehensive information related to research objectives. No detailed information was disclosed to patients to refrain the participants from any hustle.

To evaluate the correlation between the disease severity and middle ear problems, otological examinations were conducted by trained medical staff. Face-to-face interviews were conducted for the economic background of the patients. To access the relationship between sinusitis and ear disease, 40 trained otolaryngologists were provided by the institution. In this research, we were highly concerned with the relationship between otitis media and sinusitis. For the evaluation of otitis media, diagnosis criteria were set by a senior ENT physician. Blister formation, swelling, redness, perforated eardrum associated with otorrhea, middle ear effusion, and changes in the color of the eardrum were defined criteria of otitis media. These clinical observations were done through Otoscopy, whereas type B and C middle ear effusion were noted through the tympanometry test. Patients with Down syndrome, cochlear implants, with facial deformities like cleft palate were further excluded from the research. On the other hand, patients underwent through total serum immunoglobulin E test and nasal cytology for eosinophils test for the confirmation of rhinitis. ENT specialists provided primary data of the research, and we converted it into binary data (e.g., yes or no). Demographic information related to household income was divided into four quartiles for a better understanding of outcomes.

Patient demographic information was represented in weighted percentage, whereas mean and standard deviations were used for measuring the disease severity. The relationship between otitis media and sinusitis was computed through Chi-square. The confidence interval was set as 95% with a 0.05 significant p-value.

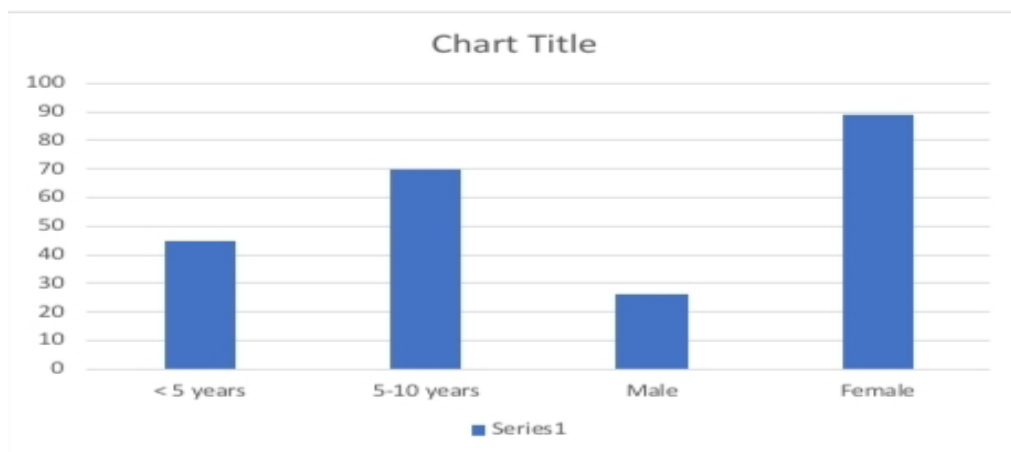
### Results

The mean age of participants was observed as  $7.6 \pm 0.4$ . We observed that 345 cases of allergic rhinosinusitis during the follow-up period. These allergies also cause middle ear problems. The weighted percentile of the female population was reported as  $49.5 \pm 2.4$ , whereas the weighted percentile of male pediatric was noted as  $50.5 \pm 2.4$ . (Table 1).

**Table 1: Demographic characteristics of enrolled students**

Characteristics	Weighted % ± S	p-value
Age, Weighted Mean ± SE	7.6 ± 0.4	
Gender		0.802
Female	49.5 ± 2.4	
Male	50.5 ± 2.4	
Allergic rhinitis		0.002
Yes	26.5 ± 3.3	
No	73.5 ± 2.4	
Levels of income for households		0.077
4th quartile	9.8 ± 1.7	
3rd quartile	31.7 ± 2.9	
2nd quartile	25.8 ± 3.3	
1st quartile	33.4 ± 3.6	
Otitis media		
Yes	73.4 ± 2.3	
No	26.5 ± 2.4	

In our study, the age range of participants was in between 0- 10 years. (Figure 1) In our research, most of the female population demands endoscopic sinus surgery with a mean age of 7.3 years. In our study, we observed three male cases of CSF with a mean age range of 7.3 ± 2.3 years who needs ESS surgery. In this study, CSF was highly regarded in patients above than five-year age group.



**Figure 1: Age distribution of patients who underwent ESS**

In this study, allergic fungal sinusitis is another variable of discussion. Among these, 346 cases with otitis, whereas 44 cases of ASF alone were reported. Total 68.2% cases were reported in patients above five years old. The majority of the female population (16.5%) were affected by

allergic fungal sinusitis. Total 19 cases of mucus retention cysts observed on the frontal and sphenoid were reported. Actual three patients (2.60%) were informed with CRS plus Nasal Polyposis. Only 1 (0.8%) had fibrosis dysplasia with sinusitis.(Table 2)

**Table 2: Clinical Evaluation of patients who need endoscopic sinus surgery**

Variables	Description n = 115
Age (years)	
< 5 years	45 (40%)
5-10 years	70 (60%)
Gender	
Female	89 (77.3%)
Male	26 (22.6%)
Pathological groups	
Choanal atresia	2 (1.73%)
CRS	24 (20.8%)
Mucocele	19 (16.5%)

AFS	44 (38.2%)
CSF rhinorrhea	3 (2.6%)
NASAL POLYPOSIS	12 (10.43)
Acute sinusitis	5 (4.3%)
AFS+ NASAL POLYPOSIS	2 (1.73%)
CRS + NASAL POLYPOSIS	3 (2.6%)
Fibrous dysplasia	1 (0.86%)
Operation	
Endoscopic CSF Repair	17 (14.7%)
Functional ESS	54 (46.9%)
Endoscopic repair of Choanal atresia	11 (9.56%)
Endoscopic tumor excision	18 (15.6%)

Study observations revealed that 8 cases of 8-year children were diagnosed with left side sphenoid lesions.

These children had severe headaches and vomiting over two week's period. They also had visual impairment but without diplopia. Under the CT device, these lesions were observed. These children did not have any history of convulsion. Patients had no facial tenderness, nasal blockage, or epistaxis. With the help of endoscopic sinus surgery, mucocele was mercurialized. On the other hand, 7 cases of mucocele at frontal sinuses were

reported. These patients were above 11 years old with one monthly complaint of right frontal bone depression. Before month they did not have any symptoms like no headache was reported. Their ENT examinations were standard. CT imaging reflects a low attenuation lesion filling of the right frontal sinuses. These lesions were had thick enhancing anterior and posterior walls.

There is no intracranial extension or thickening of the adjacent pachymeninges. In table 3, we observed a significant correlation of allergic rhinosinusitis with otitis media.

**Table 3: Correlation of Allergic rhinitis with a middle ear problem**

Variables	Otitis with allergic rhinitis		p-value
	Yes (n= 345)	No (n=126)	
Age group			0.311
1-5 years	26.8	73.2	
6 years	32.9	67.1	
7 years	39.5	61.4	
8 years	21.3	79.4	
9 years	29.2	73.8	
10 years	30.2	69.8	

### Discussion:

Chronic rhinosinusitis is severe inflammation ease that lasts more than 12 weeks. Though the exact location of inflammation is not found yet, many publications produce to see the correlation between chronic rhinosinusitis and factors which triggered it. Factors like microorganisms, allergic and nonallergic immunologic inflammation, as well as noninfectious and nonimmunologic causes such as abnormalities in leukotriene production, are considered as significant reasons for chronic rhinosinusitis. Chronic inflammation leads to the production of nasal polyps in the nasal mucosa. Generally, the male population is prone to nasal polyps along with chronic rhinosinusitis as compared to females. Since past decades ratio of nasal polyps is high among adults when comparing with the pediatric population. Environmental factors also play an essential role in the development of disease in the upper airways. Active tobacco smoking is one of the prominent

reasons for nasal polyps in chronic rhinosinusitis patients. The exact prevalence of chronic rhinosinusitis is unknown because very few cases are presented to the ENT department. An estimated shows that the 3-year group has a 5-6% prevalence of episodic CRS. Every year average of 6-8 children is suffering from an upper respiratory infection, and almost 5-10% of cases are affected by chronic rhinosinusitis. This disease causes high pressure on the healthcare sector due to the requirement for more resources. In 1996, \$1.8 billion was spent on the management of rhinosinusitis under the age of 12. Studies conducted on the quality of life of rhinosinusitis patients revealed that chronic rhinosinusitis also causes other chronic diseases like an arthritic disease.

Clinical evidence shows the occurrence of nasal mucosal immune reactivity at polyps with allergic and nonallergic rhinitis. Researches demonstrate that smoking can cause severe effects on sinonasal

mucosa and induce nasal responses like nasal irritation, nasal congestions, and rhinosinusitis. In the childhood period, chronic rhinosinusitis with polyps is rare before the age of adolescence. A very little literature related to pediatric nasal polyps produced in the past, so it's hard to establish the exact prevalence ratio among them. Mostly these nasal polyps can be arises in those children who were suffering from bronchial asthma. Researchers observed a 1.8% frequency of nasal polyps with chronic rhinosinusitis among these patients. Nasal polyps in a pediatric population under the age of 2 suggest a probability of the defect in the neural tube (encephalocele). In our study, we observed 27 (5.5%) cases of chronic rhinosinusitis, whereas 3 (0.06%) patients were suffering from chronic rhinosinusitis with nasal polyps, which were treated with endoscopic sinus surgeries.

We observed 115 cases of the paranasal disease, which needs endoscopic sinus surgery (ESS). Results obtained from endoscopic sinus surgery are difficult to compare with other studies due to their high variations. In our study, the age range of participants was in between 0- 10 years. The mean age was observed as 6.8 years. These results are in parallel to the previous study of Gross et al. [1], and Muntz [8]. In the Muntz [8] survey, the mean age of the sample was reported as 6.6 years. In the previous study of Küttner et al. [9], their age range was within 5-15 years, whereas the sample means Duplechain et al. [10], was reported as 1.9 to 16.9 years.

In many regions of the world, endoscopic sinus surgery is highly used to manage chronic rhinosinusitis cases which failed to treat through conservative treatment [11]. The study of Huang et al. [24]. described two primary goals of endoscopic sinus surgery in which they claim that with the least invasive procedure, it helps to re-establish the patent physiological relationship between the nasal cavity and the diseased paranasal sinuses and to preserve the sinus mucosa anatomy. The study of Chang et al. reported the advantages of pediatric endoscopic sinus surgery in terms of wound healing and ventilation. This technique also helps to reduce the risk of the growing bone and helps in the drainage of the sinus from natural pathways. In our study, the most female population demands endoscopic sinus surgery with a mean age of 7.3 years. Among them, most of them were suffering from nasal polyps and acute sinusitis. Comparing these results with the previous study of Elsis et al., we observed a high male prevalence of CRS who demand PESS surgery with a mean age of 12.5 years. In a survey by Elsis et al., a total of 93.3% of cases were reported with CRS without nasal polyps and the remaining 6.7%. CRS cases with nasal polyps. Nasal obstruction and nasal discharge were the prominent symptoms of the study.

Breakdown in the structural integrity of subarachnoid space and nasal cavity causes CSF rhinorrhea. It can be classified as traumatic or nontraumatic, which needs endoscopic sinus surgery [27]. Nontraumatic CSF is further classified into two categories congenital or idiopathic, depending on the underlying CSF pressure (elevated or normal) [28,29]. In our study, we observed three male cases of CSF with a mean age range of  $7.3 \pm 2.3$  years who needs ESS surgery. In this study, CSF was highly regarded in patients above than five-year age group. These results correspond to the previous study of Chappity et al. [30]., a study in which they reported 5 cases with age less than five years. In their study, all patients were treated with ESS without any post-operative complications, including CSF leak or meningitis. In our study, two cases had meningoencephalocele before surgery which was managed through reduction.

In our study, allergic fungal sinusitis is another variable of discussion. It is defined as fungal mucin, which uniquely causes allergy. This fungal sinusitis has thick tenacious, eosinophilic secretion [31]. In areas with high temperatures, AFRS are commonly observed. In the past, a lot of literature on AFRS produced related to adults, but minimal publications are present that define disease and recurrence in the pediatric group [32]. In our study, we found 44 cases of AFRS. Among these, 346 subjects with otitis, whereas 44 cases of ASF alone were reported. Total 68.2% cases were reported in patients above five years old. The majority of the female population (54.5%) were affected by allergic fungal sinusitis. Althomaly et al.'s research observed unilateral left allergic fungal rhinosinusitis in an 8-year-old girl, which was managed by ESS; they further cleaned left sinuses from mud, polyps, and mucin.

In a previous study by Teo et al. [34], a total of 56% of postoperative complications were observed, whereas Brockmeyer [35,36] reported only 11% complications. Regarding tumor information, we observed 19 cases of the tumor. Among them, 77.8% need ESS surgery for extraction. Two patients had Meningocele, Acute Sinusitis, whereas 10 cases of mucus retention cysts observed on the frontal and sphenoid were reported. Total 4 cases (21.05%) were reported with CRS plus NASAL POLYPOSIS. Only three patients (15%) had fibrosis dysplasia with sinusitis.

**A mucocele or mucus retention cysts:** Mucocele is slowly growing mucus which contains lesion in paranasal sinuses and lined by respiratory epithelium [37-40]. Bone resorption can occur in severe cases of mucocele. In the pediatric group, mucocele or mucus retention cysts are very rare [41]. The slow growth of mucocele may remain for an extended period without any symptoms [42]. In

adults, the most common site of mucocele is frontal ethmoidal sinuses which cause headache, periorbital swelling [43,44]. Patients with mucocele may observe a reduction in ocular mobility [45]. Mucoceles occurred in sphenoid sinuses have symptoms like visual disturbance and headache [46,47]. The previous study by Sethi et al. [48], they observed sphenoid sinus mucocele presenting with isolated oculomotor nerve palsy.

These lesions were misdiagnosed at the initial stage, and they were defined as skull base tumors. In our study, 8 cases of 8-year children were diagnosed with left side sphenoid lesions. These children had severe headaches and vomiting over two week's period. They also had visual impairment but without diplopia. Under the CT device, these lesions were observed. These children did not have any history of convulsion. Patients had no facial tenderness, nasal blockage, or epistaxis [49,50]. With the help of endoscopic sinus surgery, mucocele was mercurocized.

On the other hand, 11 cases of mucocele at frontal sinuses were reported. These patients were above seven years old with one monthly complaint of right frontal bone depression. Before month they did not have any symptoms like no headache was reported. Their ENT examinations were standard. CT imaging reflects a low attenuation lesion filling of the right frontal sinuses. These lesions were had thick enhancing anterior and posterior walls. There is no intracranial extension or thickening of the adjacent pachymeninges. In a previous study of Agha [51], they treated frontal mucocele with successful endoscopic sinus surgery, but one of their participants need revision of endoscopic surgery.

**Relationship of Sinusitis and Middle Ear problem:** Inflammation of the ear caused by bacterial infiltration into the tympanic cavity is known as otitis media. Young children have high exposure to otitis media, but minimal cases of affected newborns were observed in the last decades [52,53]. The majority of the patients were observed in 2 year age group, and the peak death rates from otitis media were reported under the 5-year child age group [54,55]. Minimal cases of otitis media were registered in school-going children.

In past literature, researchers observed a high prevalence of otitis media in the 3.7- 8.78% prevalence of disease in the toddler group [56-61]. Many researchers reported a high ratio of otitis media in developing countries as compared to developed ones [58]. Lack of diagnosis and treatment at the initial stage caused the severity of otitis due to frequent recurrence [62]. A previous study reported that every 5 out of 100 children were diagnosed with recurrent otitis [63]. In recent

decades the United States observed a high ratio of otitis in school-going children, whereas otitis media is the 6th most recurrent disease in the South Korean region [64].

Otitis media is not a chronic illness, but it may affect the listening and speaking abilities of children. At a severe stage of disease, children may lose their hearing ability [65,66]. Many studies reported a relationship between low socioeconomic status, breastfeeding, allergic disorders, and chronic rhinosinusitis with otitis media [67,68]. Several studies reported a significant correlation of allergic rhinosinusitis with the severity of otitis [69]. In a previous study of Kim et al. [70], they observed allergic rhinitis and day nursery as an independent contributor to otitis. But this study faces many criticisms from different researchers due to the small sample size [71,72]. In this study, we observed the relationship of otitis with allergic rhinitis among 8-year-old old patients. In our study, we observed a 26.6% ratio of otitis media which was quite similar to the previous research of Daegu [73] and Bucheon [74] and Gunsan [75]. In the Daegu study, the prevalence of otitis was observed. 16.4%, Bucheon in 15.8%, whereas Gunsan had 14.5% population with otitis.

Comparing our results with other studies, we observed a high prevalence of otitis media with effusion among our population as compared to Anatolia68 (10.4%) Istanbul [76] (8.7%), and the UK [77] (10.5%) in 5 years of preschool children. In our study, a high prevalence of otitis media occurs due to dysfunction of Eustachian tube inflammation reaction. We observed that allergic responses, especially allergic rhinosinusitis caused cells in the mucosa and inflammatory cells in the nose and nasopharynx, lead to release in cytokine release and end into occlusion of Eustachian tubes to develop otitis media. Occlusion in the eustachian line disturbs middle ear ventilation and enhances nitrogen absorption in the middle ear [78-80].

## Conclusion

Our results confirmed the independent relationship between pediatric allergic rhinitis and otitis media. All children with allergic sinusitis need proper testing of the ear to diagnose the disease severity and for early management. Endoscopic sinus surgery is effective for managing CRS, CSF Rhinorrhea, AFS. Endoscopic sinus surgery also helps to control the mucocele. However, mucocele in the pediatric population is very rare. Slow growth and asymptomatic symptoms of mucocele need long longitudinal prospective studies rather than retrospective ones.

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