Original Article

Rhinolithiasis: Mineralogical, chemical composition, clinical and radiological features of rhinoliths

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ABSTRACT

Objectives: This study aims to present our large series of rhinolithiasis and mineralogical, chemical composition and radiological features of rhinoliths to shed light into the etiology and pathogenesis of rhinolithiasis.

Patients and Methods: A total of 35 patients (5 males, 30 females; mean age 24.7±15.0 years; range, 5 to 70 years) with rhinolithiasis treated in our hospital between January 2011 and March 2016 were retrospectively analyzed. All patients were divided into four groups according to their age: 0-10, 11-30, 31-50, and 51-70 years. Data including age, gender, signs and symptoms, and accompanying nasal and extranasal pathologies were recorded. Mineralogical, chemical analysis of rhinoliths, nasal swab examination findings, and psychiatric consultation results were evaluated.

Results: A statistically significant difference was found in symptoms between the groups according to the age group. Mineralogical, biochemical analysis was performed for 13 patients. The analysis revealed calcium carbonate and magnesium phosphate in six patients, magnesium carbonate and magnesium phosphate in three patients, magnesium oxalate and magnesium phosphate in two patients, and calcium oxalate and calcium phosphate in two patients. Normal bacterial flora was found in nasal swab culture results. Only one patient was diagnosed with learning disorder on psychiatric consultation.

Conclusion: Rhinoliths are nasal stones which leads to long-standing nasal obstruction and discharge and nasal and oral malodor. Physicians should be aware unusual presentations, complicated conditions, and co-existing pathologies which can be encountered. A detailed evaluation by rigid nasal endoscopy and radiological evaluation with paranasal sinus computed tomography should be performed.

Keywords: Nasal stones, rhinolith, rhinorrhea.

Rhinoliths are calcareous concretions formed by the calcification of intranasal foreign bodies.[1] Exogenous or endogenous foreign materials may be the nidus for rhinoliths.[2,3] The formation of rhinoliths can be secondary to an endogenous (i.e., teeth, blood clots, or sequestra) or exogenous (i.e., fruit seeds, beads, buttons, pebbles, or gauze) nidus lodged in the nasal cavity.[2,3] The nidus may also reach the nasal cavity posteriorly through the nasopharynx by vomiting, coughing, and sneezing.[4,5] Chronic inflammation occurring around the nidus, acute or chronic

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inflammation, interruption or blockage of nasal secretions, deposition of mineral salts, mainly calcium and magnesium, and enzymatic activity of bacterial pathogens are the factors which cause the formation of rhinoliths.[3,6] This process takes many years.

Diagnosis of rhinoliths typically includes a history of unilateral nasal obstruction or discharge, facial pain, and foul-smelling nasal discharge. However, complicated conditions or co-existing pathologies may be encountered.[7,8] Therefore, endoscopic evaluation and radiological examination, particularly with computed tomography (CT), are very helpful before the intervention.[2]

In the present study, we aimed to present our large series of rhinolithiasis and mineralogical, chemical composition and radiological features of rhinoliths and discuss the epidemiology, pathogenesis, diagnosis, and treatment of rhinoliths.

PATIENTS AND METHODS

A total of 35 patients (5 males, 30 females; mean age 24.7±15.0 years; range, 5 to 70 years) with rhinolithiasis treated at University of Health Sciences, Kanuni Sultan Süleyman Training and Research Hospital between January 2011 and March 2016 were retrospectively analyzed. All patients were divided into four groups according to their age: 0-10, 11-30, 31-50, and 51-70 years. Data including age, gender, signs and symptoms, and accompanying nasal and extranasal pathologies were recorded. Mineralogical, chemical analysis of rhinoliths, nasal swab examination findings, and psychiatric consultation results were evaluated. Anterior rhinoscopic and nasal endoscopic examinations and paranasal CT were performed, and nasal swabs were obtained. Mineralogical analysis of rhinoliths was also performed via spectrophotometry. All patients were called for the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-V)-based clinical interview by a psychiatrist to identify comorbid psychiatric diseases. The relationship between age groups and admission symptoms were examined. A written informed consent was obtained from each patient or each parent. The study protocol was approved by the Clinical Research Ethics Committee, Union General Secretariat of Public Hospitals, Istanbul Çekmece Region (No: 2016.9.12). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

Statistical analysis was performed using the NCSS (Number Cruncher Statistical System) version 2007 Statistical Software (NCSS LLC, Kaysville, UT, USA). Descriptive data were expressed in mean ± standard deviation (SD), median (min-max), or number and frequency. Qualitative data were analyzed using the Fisher's exact test and Fisher-Freeman-Halton test. A p value of <0.05 was considered statistically significant with 95% confidence interval (CI).

RESULTS

Four patients (11.4%) were in the 0-10 years, 23 patients (65.7%) were in the 11-30 years, five patients (14.2%) were in the 31-50 years, and three patients (8.5%) were in the 51-70 years of age group. Rhinoliths were located in the right side in 12 patients (34.3%) and in left side in 23 patients (66.7%). Baseline demographic and clinical characteristics of the patients are shown in Table 1.

Anterior rhinoscopy and rigid nasal endoscopy and paranasal CT were used as the diagnostic tools. Yellow-brown colored foreign bodies with irregular borders were seen on anterior rhinoscopy and an image of a patient is shown in Figure 1. On paranasal sinus CT, we observed irregular, calcified lesions located in the nasal cavities with densities similar to the cortical bone and centrally located hypodense nidus and an image of a patient is shown in Figure 2. Rhinoliths were observed at the level of the inferior turbinate in 30 patients, between the inferior and middle turbinate in two patients, and posterior to the nasal cavity near the nasopharynx in three patients (Figures 2 and 3). None of the patients had bilateral rhinolithiasis.

Twenty-seven patients (77.1%) complained of purulent nasal discharge, 27 patients (77.1%) had nasal obstruction, 33 patients (94.4%) had nasal and oral malodor, 16 patients (45.7%) had headache, and 16 patients (45.7%) had recurrent epistaxis (Table 1). The rate of purulent nasal

Table 1. Baseline demographic and clinical characteristics of patients

	n	%	Mean±SD	Median	Min-Max
Age (year)			24.7±15.0	20	5-70
Gender					
Male	5	14.3			
Female	30	85.7			
Symptoms					
Purulent nasal discharge	27	13.5			
Nasal obstruction	27	13.5			
Nasal and oral malodor	33	16.5			
Headache	16	8.00			
Recurrent epistaxis	16	8.00			
Coexisting nasal illness					
Septal deviation at the left side	6	3.00			
Septal deviation at the right side	11	5.50			
Sinusitis	17	8.50			
Age (year)					
0-10 ages	4	2.00			
11-30 ages	23	16.5			
31-50 ages	5	2.50			
51-70 ages	3	1.50			
Side of rhinolith					
Left side	23	11.5			
Right side	12	6.00			

SD: Standard deviation; Min: Minimum; Max: Maximum.

discharge, nasal obstruction; nasal and oral malodor and headache and recurrent epistaxis were not statistically significantly different according to the age groups (p>0.05). However, with an increasing number of patients in the age groups, purulent nasal discharge and nasal obstruction were found to be less. Headache tended to increase with age and was found to be close to the significance level (Table 2).

Figure 1. A view of anterior rhinoscopic examination of rhinolith in nasal cavity.

Considering accompanying nasal pathologies, there was left-sided septal deviation in seven patients (20.0%), right-sided septal deviation in 11 patients (31.4%), and sinusitis in 17 patients (48.6%) and an image of a patient with sinusitis is shown in Figure 4. There was no significant correlation between the involvement side of septal deviation and rhinoliths (p>0.05) (Table 3).

Two patients had chronic otitis media with cholesteatoma; one was ipsilateral (Figure 5) and the other contralateral to rhinolithiasis. One patient had also a neck mass diagnosed as lymphoma.

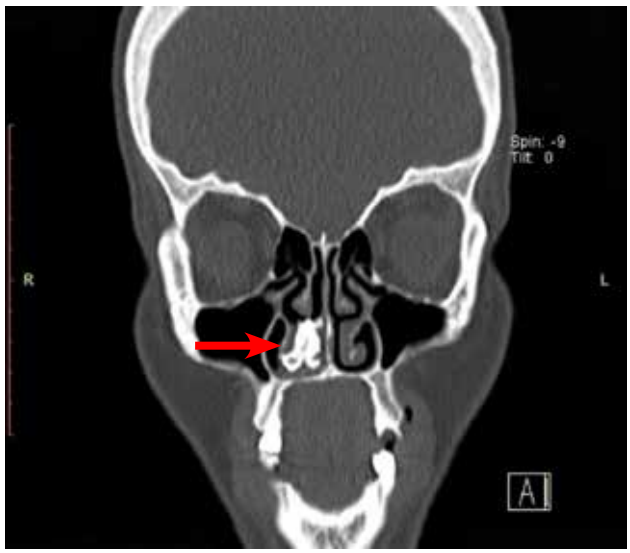

Figure 2. *Coronal computed tomography showing a calcified space-consuming lesion occupying much of right nasal cavity.*

Figure 3. *Coronal computed tomography showing a calcified lesion posterior to nasal cavity near to nasopharynx.*

Mineralogical and biochemical analysis of rhinoliths by spectrophotometry was performed in 13 patients. Mineralogical analysis of rhinoliths revealed CaCO3+Mg3 (PO4) (calcium carbonate and magnesium phosphate) in six, MgCO3+Mg3 (PO4) (magnesium carbonate and magnesium phosphate) in three, MgC204+Mg3 (PO4) (magnesium oxalate and magnesium phosphate) in two, and CaC2O4+CaHPO4 (calcium oxalate and calcium phosphate) in two patients. Nasal swab examination was performed in 13 patients. Cultures showed normal flora with absence of pathological bacteria. There was no history of foreign body aspiration into the nose in any of the patients. Psychiatric consultation revealed that only one patient was diagnosed with learning disorder.

Twenty-nine patients were operated under general anesthesia and six patients were operated under local anesthesia. A cotton pad with adrenaline and pantocaine was placed on the anterior side of the mass in patients operated under local anesthesia. Interventions were performed with forceps in 21 patients and with curette and forceps in 14 patients under rigid nasal endoscopy. Rhinoliths were extracted from the nasal cavity in 28 patients and from the oropharynx after being pushed toward the nasopharynx in seven patients. Only three patients required nasal packing, which were removed three hours after the operation. Following the operation, all patients were given oral antibiotic therapy and advised to perform nasal irrigation with saline.

Table 2. Relationship between symptoms according to age groups

	0-10 ages (n=4)		11-30 ages (n=23)		31-50 ages (n=5)		51-70 ages (n=3)		
Symptoms	n	%	n	%	n	%	n	%	*p*
Purulent nasal discharge	4	100.0	19	82.6	3	60.0	1	33.3	0.111
Nasal obstruction	4	100.0	19	82.6	3	60.0	1	33.3	0.111
Nasal and oral malodor	4	100.0	22	95.6	5	100.0	2	66.6	0.227
Headache	0	0.0	10	43.4	3	60.0	3	100.0	0.058
Recurrent epistaxis	2	50.0	11	47.8	3	60.0	0	0.0	0.507

Fisher-Freeman-Halton test.

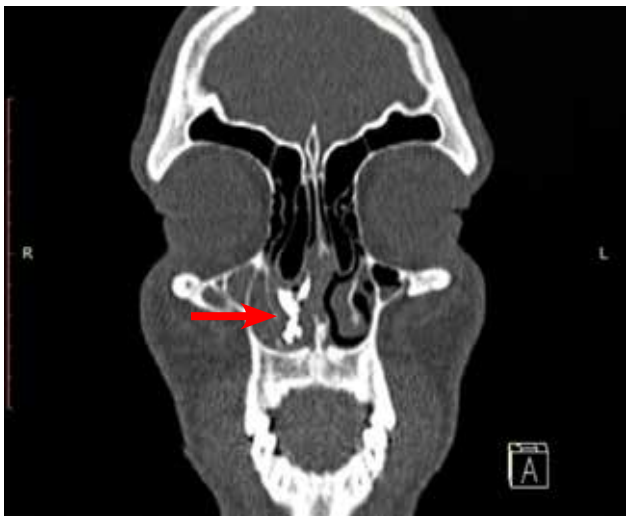

Figure 4. *Coronal computed tomography showing a calcified space-consuming lesion occupying much of right nasal cavity with right maxillary sinusitis.*

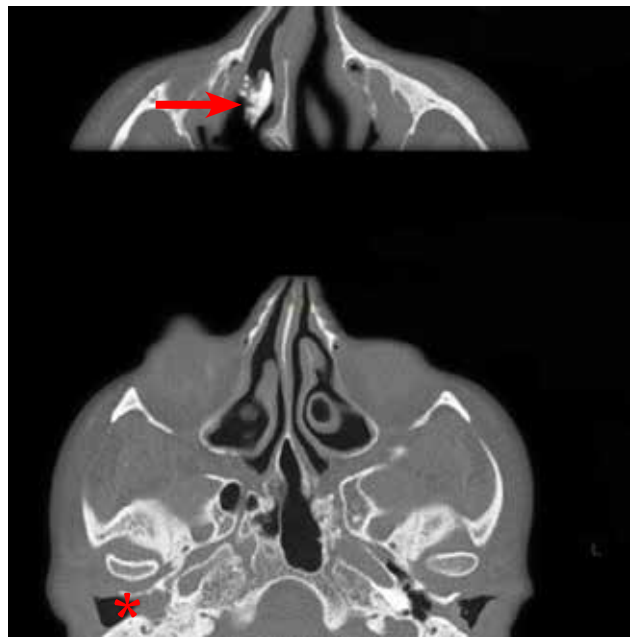

Figure 5. *Axial computed tomography scan showing rhinolith (arrow) in left nasal cavity with chronic otitis media (star) at the same side.*

DISCUSSION

Previously, several mechanisms about the formation of rhinoliths have been proposed. However, there is no precise information how it occurs exactly. Thus, examination of the patients with rhinoliths and researches on the etiology of this disease are important to contribute to the literature.

In the present study, we examined the sex and age distribution of cases and distribution of symptoms according to the age groups. In our series, disease was seen in a significantly higher proportion of female patients consistent with the literature.[9,10] In their study, Polson et al.[10] attempted to explain this situation with mechanical differences about nasal cleansing between males and females. Otherwise, we believe that the predisposing endogenous mechanisms for the formation of calculi may be more active in women, such as enzymatic or hormonal. In our opinion, it is deserved to be investigated in further studies. Rhinoliths may occur at a wide age range from six months to 86 years.[9,10] The majority of the patients were less than 30 years of age in our series.

The common presentations of rhinolithiasis are unilateral nasal obstruction or discharge, facial pain, and foul-smelling nasal discharge. Headache, epistaxis, anosmia, epiphora, and nasal or facial edema may be other symptoms.[7,8] In our study, although unilateral nasal obstruction and discharge were common consistently with the literature, nasal and oral malodor and headache were also seen in a high number of patients. Nasal discharge and congestion were significantly common under 10 years of age.

Table 3. Relationship between side of rhinolith and side of septal deviation

	Septal deviation at the left side (n=6)		Septal deviation at the right side (n=11)		
Side of rhinolith	n	%	n	%	*p*
Left	3	50.0	9	81.8	0.280
Right	3	50.0	2	18.2	

Fisher's exact test.

With an increasing age, the frequency of these symptoms decreased. Probably, the decrease of the secretions may play a role in this regard or the patients become used to these symptoms and they do not need to specify them. Over 50 years of age, headache became the most common compliant of our patients. Nonetheless, two female patients who complained from headache were referred to us from neurology outpatient clinic after the detection rhinoliths by cranial CT.

Clinically, rhinoliths are typically encountered in the floor of the nasal cavity, either between the inferior turbinate and the nasal septum or between the inferior turbinate and maxillary sinus wall.[2,8] In our study, rhinoliths were observed at the level of inferior turbinate in 30 patients, between inferior and middle turbinate in two patients, and posterior to the nasal cavity near to the nasopharynx in three patients. In our series, rhinoliths were seen predominantly in the left side and this result is not consistent with the previous proposal suggesting that most individuals are right-handed and insertion of foreign body into the right nasal cavity is more convenient.[11]

Rhinoliths may push the septum by expanding the nasal cavity and may cause the deviations. From another point, due to the septal deviation, the blockage on the flow of nasal secretions may be the factor for formations of rhinoliths. Hadi et al.[3] reported that one-half of their cases had septal deviation on the opposite side of the septal deviations. In an attempt to put forward the relationship between rhinoliths and the septal deviation, we analyzed the side of rhinoliths and the septal deviations. However, we found no significant correlation.

Rhinoliths may cause complications include such as perforation of hard nasal septum or hard plate, lateral wall destruction, chronic sinusitis, extension of lesion into maxillary sinus or rarely cranium.[6,8,12] Ozdemir et al.[4] reported a squamous cell carcinoma in the nasal cavity with rhinolithiasis and they explained this condition with chronic irritation due to the rhinolith. Atmaca et al.[13] also described a girl with rhinolithiasis complicated by sinusitis, frontal osteomyelitis, and epidural abscess. Furthermore, Ozcan et al.[14] reported a case of rhinolithiasis with a nasal polyp and claimed that nasal polyps might lead to calcification and formation of rhinoliths. In our study, sinusitis was present in 17 patients (48.6%). In addition, to the best of our knowledge, this is the first case to describe chronic otitis media with cholesteatoma in one patient on the same side of rhinoliths. This may resulted from the obstruction of the nasal cavity, the middle ear ventilation disorder, and recurrent otitis media. The other patient with cholesteatoma on the opposite side of rhinoliths may be evaluated as an incidental formation.

To further research the etiological factors and mineralogical, chemical analysis of rhinoliths, nasal swab examinations in a substantial number of patients and psychiatric evaluation of all patients were performed. There are many studies about rhinolithiasis in the literature. Mineral deposition on exogenous or endogenous nidus is the most widely accepted mechanism in pathogenesis.[2,3] However, a few of them have revealed the consisting of minerals. It is well-known that high amounts of calcium, phosphorus, and carbon are detected in the content of rhinoliths. These studies have also shown deposits of calcium oxalate, calcium phosphate, calcium carbonate, magnesium phosphate, calcium stearate, sodium-containing whitlockite growth rings, and amorphous iron oxide.[3,7,10,15-17] In our study, mineralogical analyses were performed in a substantial number of patients (n=13), being higher compared to previous studies. Mineralogical analysis of rhinoliths revealed calcium carbonate and magnesium phosphate in six, magnesium carbonate and magnesium phosphate in three, magnesium oxalate and magnesium phosphate in two, and calcium oxalate and calcium phosphate in two patients. In a remarkable number of cases, magnesium phosphate was found. Although the possible link seems to be interesting, we draw attention to an issue that accumulation of magnesium phosphate in kidney stones is associated with infections.[18] This finding suggests that chronic infections in the nasal cavity may play role in the formation of rhinoliths. The absence of any positive medical history about insertion of a foreign body into the nasal cavity in any patients has further increased our suspicions on this subject.

The nasal swab to investigate the nasal colonization showed no pathogen growth, except for flora bacteria. Nasal swab examination seems to be unnecessary for the treatment likely due to the chronic infectious condition of itself. Although there was no history of foreign body aspiration into the nose in any of the patients, psychiatric evaluation was performed for all patients to investigate whether there was a nasal foreign body insertion habit secondary to psychiatric disorders against the possibility of information storage. However, we identified no mental disorder in any patients, except for a case with learning disorder. The majority of our patients were adults and their psychiatric evaluations were made while they were adult. However, we thought that they probably attempted to put foreign bodies in childhood. Thus, psychiatric problems in childhood can be missed by theclinical evaluation made in adult age.

Diagnosis of rhinolithiasis based on typically clinical symptoms, physical examination, particularly with rigid nasal endoscopy and radiological examination, include X-ray and paranasal sinus CT.[12,19] Computed tomography helps in the diagnosis of rhinoliths, differentiation of other benign or malign entities and planning the surgical approach.[2,8,12] The basis of treatment is surgical removal of rhinoliths under local or general anesthesia. Rhinoliths can be usually extracted via anterior approach by rigid nasal endoscopy or, less frequently, can be pushed and removed from the oropharynx.

In conclusion, rhinoliths are nasal stones which leads to long-standing nasal obstruction and discharge and nasal and oral malodor. Physicians should be aware that unusual presentations, complicated conditions, and co-existing pathologies which can be encountered. Therefore, a detailed evaluation by rigid nasal endoscopy and radiological evaluation with paranasal sinus CT should be performed. Although the exact pathogenesis of rhinolithiasis has not been known yet, chronic infections in the nasal cavity may play a role in the formation of rhinoliths. Nonetheless, further etiological investigations are needed to explain the pathogenies of this rare disease. In particular, the mechanisms which can explain why this disease is common in females should be addressed into further studies.

Declaration of conflicting interests

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