Cysts of the maxillary sinus: a literature review
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**Background:** Patients with isolated mucosal cysts of the maxillary sinus (MMC) often undergo surgical treatment despite the absence of relevant symptoms. Some physicians believe that MMC might increase in size and cause complications in the future. The anticipated value of this study is to consolidate and improve the understanding of MMC based on published data and to contribute to avoiding unnecessary interventions.

**Methods:** We performed a comprehensive review of the literature regarding definition, etiology, epidemiology, natural course, and best treatment of MMC.

**Results:** Among the 988 papers found in the literature search, 33 studies were selected to be relevant. Among those studies, there are only a few prospective controlled studies. Their prevalence rates range broadly from 3.6% to 35.6% according to different diagnostic methods as well as different indications for imaging. Recent prospective studies showed no correlation of MMC with sinonasal complaints or Lund-Mackay computed tomography (CT) score. The natural course is characterized by a decrease in size of MMC in 30% of the cases, an unchanged status in 50% to 60%, and an increase in 8% to 20% of the cases.

**Conclusion:** MMC are harmless, mostly asymptomatic lesions that usually do not need surgical treatment. If surgery is indicated, endonasal endoscopic techniques should be the gold-standard approach. © 2013 ARS-AAOA, LLC.

**Key Words:** maxillary sinus cyst; review; FESS; epidemiology; natural course

How to Cite this Article:

Mucosal cysts of the maxillary sinus (MMC) are common findings in imaging studies. Their prevalence is found to be up to 35.6%. There is some controversy over whether MMC are responsible for a variety of sinonasal symptoms and which treatment is best for them.1,2 MMC have to be differentiated from other origins of unilateral maxillary sinus opacification, such as inverting papilloma, mucocele, chronic rhinosinusitis with nasal polyps, or mycetoma,3,4 in order to perform proper management, which may be endonasal endoscopic middle meatus antrostomy with or without cyst removal.5

Despite the absence of quantitative analysis, it is known from daily experience that many operations are performed in order to treat isolated MMC without any symptoms. One justification for this intervention is that MMC may increase in size and cause future complications.

The purpose of this study was to perform a comprehensive literature review on isolated cysts of the maxillary sinus with regard to their etiology, prevalence, natural course, and treatment results. The anticipated value of this study is to consolidate and improve the understanding of MMC based on published data and to contribute to avoiding unnecessary operations.

**Materials and methods**
The literature search for this review was conducted using the comprehensive database Ovid Medline. Keywords were used in the search in alternating combinations and linked via the operators “AND” and “OR”.

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Inclusion criteria were as follows:

- Corresponding keywords: mucosal cyst, antral cyst, maxillary sinus, retention cyst, cyst paranasal sinuses, intramural cyst, antrum;
- Isolated MMC without any other disease of the maxillary sinus;
- English or German language;
- Original papers.

Exclusion criteria were as follows:

- Odontogenic cysts;
- Other diseases of the maxillary sinus such as mucoceles, concomitant chronic rhinosinusitis, antrochoanal polyp, mycetoma.

Additional literature was found while reviewing the reference lists of selected papers and particularly reviews. After excluding duplicate papers, 33 clinical studies remained. The final results were controlled with a “basic search” including the words “mucosal maxillary cysts” in the Ovid Medline Search Engine. Studies that provided information about cysts of the paranasal sinuses in general and not only about the maxillary sinus were reviewed only with regard to MMC. The review process is summarized in Figure 1.

Results

Definition: radiology

The MMC are defined, in terms of a panoramic radiograph or Water’s view radiograph, as rounded dome-shaped shadows originating from the wall or floor of the sinus.1,6

Definition per computed tomography (CT) scan includes the following criteria5,7–9:

1. Homogenous dome-shaped cysts with sharp demarcation of the lateral border;
2. Absence of bone destruction;
3. Absence of communication with tooth roots (to exclude odontogenic cysts);
4. A smooth, spherical outline along the free border of the cysts.

Epidemiology

The prevalence rates ranged from 1.4% to 35.6%1,3,6–8,10–12 indicating a significant selection bias.

There are different possible explanations of the wide range of prevalence rates:

- The different accuracy of diagnostic methods to detect MMC, which is better for CT and MRI compared to panoramic radiographs or Water’s view, whereas CT scan and MRI have an almost similar diagnostic value concerning the identification of maxillary sinus mucosal cysts.13 Differentiating the prevalence rate according to the diagnostic method, the following results could be obtained:

  Using MRI in 7.4% of 6831 patients9;
  Using CT in 21.6% of 1167 patients (range, 12.4–35.6%).7,8,11

- Using radiographs (Water’s view, panoramic view) in 3.6% of 28265 patients (range, 1.4–14.0%).1,6,10,12,14

- Geographical influences.
- Different population samples (health care check up, patients with orbital diseases, patients in the maxillofacial setting, patients screened because of headache and suspected sinus disease).

The high prevalence rates achieved by using the more accurate diagnostic methods of CT scan and MRI indicate a more realistic result, but the significant differences between these studies prevent a pooling of data and clear interpretation.

MMC represent 89.5% to 92.7% of all paranasal sinus cysts.9,15 They can be found in all walls of the maxillary sinus (inferior, superior, medial, lateral, anterior, and posterior) with the majority of the latter located on the floor (average prevalence of 66%).1,5,7,8,10,11,16
Definition: histology/etiology

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Schuknecht and Lindsay\textsuperscript{17} described 2 types of maxillary sinus cysts and referred to them as nonsecreting or secretory cysts. The later were classified as retention (glandular) cysts or mucoceles. Gardner\textsuperscript{18} modified this classification into nonsecreting cysts, secreting cysts (retention cysts), and mucoceles.

The nonsecreting cysts (also referred to as “pseudocysts”)\textsuperscript{18,19} are not lined with epithelium. They are characterized by a very thin membrane with an inner layer of compressed connective tissue cells and are suspected to arise in the subepithelial connective tissue due to a retention of fluid.

The secretory or retention cysts are cystic formations due to obstruction of the mucosal glands and are less common than the nonsecreting cysts.\textsuperscript{7,20} The mechanism of their formation could possibly be a plug of inspissated mucus of the duct of a seromucinous gland of the sinus, which results in dilatation of the duct into a cystic structure.\textsuperscript{18}

The secretry cysts are lined by epithelium.

Various etiologic factors like allergy, barotrauma, rhinitis, dental disease, inflammatory process, and chronic rhinosinusitis have been proposed. According to this review, odontogenic cysts\textsuperscript{21} are excluded.

Van Alyea\textsuperscript{22} suggested that the cysts could be an allergic manifestation, where the allergic edema eventually causes the mucosa to rupture and form a cyst. Berg et al.\textsuperscript{23} suggested the consistency of MMC with an inflammatory process due to high levels of immunoglobulins, complement, and antiproteases found in cyst aspirates. Levels of immunoglobulin E (IgE) and eosinophils were not raised, suggesting that allergy may not be a significant factor for the development of MMC. The same author concluded that the choanal polyp could possibly develop from an expanding maxillary cyst protruding through the maxillary ostium and into the nasal cavity.\textsuperscript{24} This conclusion was made after comparing the macroarchitecture and the microarchitecture of the antral cyst of the choanal polyp to the structure of the common intramural cyst of the maxillary sinus.

Weather conditions have been considered to play a role for the formation of MMCs but statistical analyses did not reveal any correlation of the MMC with relative air humidity or mean temperature.\textsuperscript{6}

After studying the fluids of these pseudocysts, on the basis of their high specific gravity, high protein concentration, and ability to coagulate, Lindsay\textsuperscript{25} concluded that they were not caused by an allergic reaction but an exudate resulting from a disturbance of the water balancing mechanisms caused by infection. Mills\textsuperscript{26} on the other hand, argued these cysts are due to an extravasational rupture of a blocked mucous gland and that extrusion of these cysts through a normal or accessory ostium is suspected to be the most common cause of an antrochoanal polyp.

Recent prospective and comparative studies investigated the relationship between MMC and underlying diseases of the sinonasal mucosa and paranasal drainage pathway.

Kanagalingam et al.\textsuperscript{7} did not find any correlation between MMC and allergy, asthma, dental problems, or blocked osteomeatal complex. In addition to the above conclusion concerning the relationship of MMC with the osteomeatal complex, Bhattacharyya,\textsuperscript{8} Harar et al.,\textsuperscript{11} and Albu\textsuperscript{5} showed no correlation between the status of the osteomeatal complex and the presence of MMC. Nevertheless, Harar et al.\textsuperscript{11} found a significantly higher rate of CT evidence for CRS (52.7% vs 41.3%) in patients with MMC vs patients without MMC. They hypothesize that it is theoretically possible, that the initial event leading to the formation of these cysts is an osteomeatal complex obstruction, with the osteomeatal complex subsequently becoming patent while the cyst persists.\textsuperscript{11}

Symptoms

Symptoms that have been historically related to MMCs include headache, nasal obstruction, facial pain, postnasal drip, and nasal discharge. Additionally, MMC were suspected to be a focus in patients with general fatigue, dizziness, fewer of unknown origin, or arthritis.\textsuperscript{12} Patients with MMC were reported to have a respiratory allergy in 18% to 83.5% and sinonasal symptoms in 10% to 67.5%.\textsuperscript{1,2,14,16}

But in all these studies, there was a selection bias of patients with a lack of a control group or a lack of a systematic differential diagnosis of other sinonasal diseases which could be responsible for sinonasal symptoms. This problem was addressed very early by Wright in 1946, who reported that he has seen no case of a small cyst which caused pain or pressure. But he described 9 cases with MMC completely filling the antrum with pain and soreness in the face, pain in the teeth, and in 1 case, numbness of the upper lip. The discomfort was relieved immediately on decompression of the cyst by puncture.

Additionally, a sudden gushing of a yellowish fluid from the nostrils in the case of a spontaneous rupture can be directly related to MMC.\textsuperscript{12}

For example, in a retrospective study, Hadar et al.\textsuperscript{2} presented a case series of 60 patients with MMC who underwent surgery because of 1 the following symptoms: headache or facial pain in the frontal, orbital, cheek, or nasal area, nasal discharge, nasal obstruction, recurrent sinusitis, postnasal drip and dizziness. No other data regarding additional diagnosis and sinonasal diseases were given. Rhodus\textsuperscript{14} concluded that more than one-half of the 54 patients diagnosed with MMC had accompanying signs or symptoms of disease. But there was no diagnosis regarding other sinonasal diseases, no endoscopic findings of the nasal cavity, or CT scans of the sinuses.

On the other hand, recent prospective comparative studies showed no correlation of sinonasal symptoms with MMC.\textsuperscript{5,7} Albu\textsuperscript{1} did not reveal any correlation between the size of the MMC and facial pressure or nasal obstruction or nasal discharge in his prospective randomized study of 80 patients. Kanagalingam et al.\textsuperscript{7} correlated the presence
of MMC in CT scans of the orbit in 257 patients with sinonasal symptoms and the Lund-Mackay CT score and found no correlation of MMC to nasal complaints. Wang et al.\textsuperscript{16} found that no patient with an enlarged MMC, even those with cysts that almost occupied the entire maxillary sinus, showed any symptoms during a follow-up of 38 to 102 months.

**Natural course**

All possible courses of MMC, ranging from spontaneous disappearance, unchanged presence to a significant increase, have been reported.\textsuperscript{1,12,14,16,27,28} There were 4 studies using Water’s view or panoramic radiograph as diagnostic tools.\textsuperscript{1,16,27,28} By pooling the data of 80 MMC, which were followed up for 2 to 102 months, 20% disappeared completely, 12.5% decreased in size, 47.5% remained unchanged, and 20% increased (Table 1).

Casamassimo and Lilly\textsuperscript{1} found no relationship between changes in size and the interval to reexamination. Wang et al.\textsuperscript{16} concluded, if cysts do not change significantly in size within 48 months, they will keep their size in the long term.

In 2011, Moon et al.\textsuperscript{9} analyzed 133 patients with cysts of the paranasal sinuses found during health checkup using brain MRI, who underwent MRI more than twice with a minimum follow-up of 24 months. The mean duration of follow-up was 40.38 ± 16.09 months (range, 24.0–109.8 months). A total of 119 patients had MMC. Bilateral cysts were found in 10.5%; 17% disappeared completely, 12% decreased in size, 62% remained unchanged, and 11% increased (Table 1).

MMC were present in 119 of these 133 patients and decreased in size from 15.49 ± 6.94 mm to 13.35 ± 9.22 mm.

Further analysis showed that the longer the follow-up period was, the more cysts changed their size. For a follow-up of 24 to 36 months, 73% of all cysts remained unchanged, 5% increased, and 22% decreased or disappeared. For a follow-up of more than 48 months, 42% remained unchanged, 15% increased, and 43% decreased or disappeared.

An initial size of >20 mm and bilateral location were significant predictors for cyst increase.

An obstruction of the natural ostium was found in 6 cases (4.5%). Sinusitis associated with cysts developed in 4 of 133 patients (3.0%; 1 of them had bilateral cysts, 3 of 4 had an increase in size during follow-up).

In summary, there is a substantial rate of spontaneous regression of MMC of about 30%, evaluating the data of all the abovementioned studies. Only a smaller portion of 8% to 20% increase in size. In contrast to Casamassimo and Lilly\textsuperscript{1} and Wang et al.\textsuperscript{16} the more precise study (longer follow-up and better diagnostic method) of Moon et al.\textsuperscript{9} indicates that paranasal sinus cysts, and MMC in particular, will increasingly change in size with a longer follow-up. Obviously, only a very small part of the patients will develop symptoms (3% in Moon et al.\textsuperscript{9}).

**Treatment**

Most papers conclude that that majority of the patients with MMC do not need any treatment.\textsuperscript{1,5,7} Kanagalingam et al.\textsuperscript{7} stated that surgery in the sense of extracting MMC is mostly unnecessary because the cysts do not reflect sinonasal disease.

Only patients with complaints should be treated.\textsuperscript{29}

Before endonasal endoscopic sinus surgery, transoral approaches with or without Caldwell-Luc operation or puncture and cyst aspiration through the inferior nasal meatus have been performed.\textsuperscript{29–31}

More recently, the endonasal endoscopic approach is recommended.\textsuperscript{2,5} Whereas Busaba and Kieff\textsuperscript{32} reported a recurrence rate of 60%, Hadar et al.\textsuperscript{2} showed symptomatic improvement in 92% of 60 patients with symptomatic MMC by means of endoscopic middle meatal antrostomy. Albu\textsuperscript{5} performed a prospective randomized study on 80 patients with MMC filling at least 50% of the maxillary sinus; 41 patients received endoscopic ethmoidectomy and middle meatal antrostomy with cyst detachment, whereas

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**TABLE 1. Natural course of MMC**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Diagnostic method</th>
<th>n</th>
<th>Follow-up (months)</th>
<th>Disappearance</th>
<th>Decrease</th>
<th>Unchanged</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wang et al.\textsuperscript{16}</td>
<td>Water’s view</td>
<td>18</td>
<td>38–102</td>
<td>7</td>
<td>39</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Casamassimo and Lilly\textsuperscript{1}</td>
<td>Water’s view</td>
<td>34</td>
<td>2–36 (10, on average)</td>
<td>6</td>
<td>18</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Gothberg et al.\textsuperscript{27}</td>
<td>Panoramic, Water’s view</td>
<td>11</td>
<td>9–59</td>
<td>2</td>
<td>18</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Halstead\textsuperscript{28}</td>
<td>Panoramic</td>
<td>17</td>
<td>4–55</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Sum</td>
<td>Normal X-ray</td>
<td>80</td>
<td></td>
<td>16</td>
<td>20</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Moon et al.\textsuperscript{15}</td>
<td>MRI</td>
<td>133\textsuperscript{a}</td>
<td>24–110 (40.38 ± 16.09; on average)</td>
<td>23</td>
<td>17</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

\textsuperscript{a}From these 133 cysts, 119 were located in the maxillary sinus. In 10 of 119 patients MMC increased (8%).

MMC = mucosal cysts of the maxillary sinus; MRI = magnetic resonance imaging.
MMC represent homogenous dome-shaped cysts with sharp demarcation of the lateral border and a lack of bone erosion in radiology. Histologically they are characterized by retention of fluid surrounded by a very thin membrane with an inner layer of compressed connective tissue cells.

There is no clear evidence about the etiology of MMC. Theories include that they can be an inflammatory exudate into the submucosal connective tissue or caused due to a rupture of mucous glands. Additionally, it is hypothesized that MMC persist after the initial leading of osteomeatal complex obstruction with the osteomeatal complex subsequently becoming patent.

Recent well-designed studies show clearly that MMC do not correlate with sinonasal symptoms or Lund-Mackay CT score or ostiomeatal disease. MMC are diagnosed in 3.6% to 35.6%, depending on the diagnostic method used (normal X-ray, 3.6% on average; CT, 21.6%; MRI, 7.4%) and the specific indication for the investigation. After comparing the reviewed studies in terms of radiological method used and their study population, it seems that the study of Moon et al. presents the most realistic prevalence rate of the MMC in the general population. Moon et al. used MRI as a diagnostic tool. MRI has a higher sensitivity in comparison to panoramic radiographs and the same sensitivity in comparison to CT scan. MRI was performed for routine health checkup. This means that the population examined is as random as possible, not showing any sinonasal symptoms or general disease. Further, the number of people examined amounts to 6831, so that this study is the one with the biggest number of people. Taking into consideration these data, the realistic prevalence of MMC in the general population is about 7%.

The third decade is the age at which a higher prevalence of MMC is observed. Although the highest number of MMC occurs in the third decade of life, when this number is adjusted for the age distribution of the overall sample, no preference of any age group is observed. The same conclusion is drawn by the study of Rodriguez et al. The study of Casamassimo and Lilly does not provide appropriate data in order to correlate the age of the general population examined with the presence of MMC. According to the above studies, there is no preference of the MMC to any age group.

MMC are mostly asymptomatic. The natural course is characterized by a decrease in size (about 30%) or unchanged status (50–60%) and an increase in only 8% to 20%, which does not necessarily cause symptoms. In the most extensive study available, only 4 of 133 patients with paranasal sinus cysts developed acute sinusitis.

Symptoms that could be related to MMC in individual cases are as follows:

- Pain or pressure in the maxillary sinus;
- Numbness of the infraorbital nerve, particularly if there is direct contact between a cyst and the infraorbital nerve without surrounding bone;
- Sudden gushing of yellowish fluid from the nostril;
- Nasal discharge or acute sinusitis if a large MMC blocks the natural ostium;
- Development of an antrochoanal polyp.

Due to the benign nature of MMC, their favorable course and in the majority of cases, the absence of any symptoms, treatment of MMC is mostly not necessary and should be only performed in clearly symptomatic cases.

Even if this was not the focus of the available literature, it is obvious from these data that control examinations of individuals free of complaints are not considered to be necessary.

In individual cases with suspected symptoms, MRI seems to be the most acceptable radiological examination method as the patient is exposed to the lowest radiation levels possible and the content of the cyst can be clearly analyzed.

Symptomatic MMC should be treated endoscopically via the endonasal approach. Using an angled optic, the natural ostium should be enlarged and the cyst completely excised in order to have the best preconditions for relief of symptoms, recovery and to prevent recurrence.

Conclusion

MMC are mainly harmless, asymptomatic lesions that in most cases do not need medical or surgical treatment. Their prevalence in the general population is about 7%. Most of the MMC tend to show a spontaneous regression or remain the same size. Symptoms like nasal obstruction, nasal discharge, or postnasal drip should not be directly associated with the existence of the MMC. Persisting symptoms that are clearly attributed to MMC are an indication for surgery. Endoscopic endonasal techniques are the gold-standard approach. In these cases the complete cyst removal should be the surgical goal.

References

Cysts of the maxillary sinus


