



Case Report

Small Primary Maxillary Sinuses: Different Clinical Entities but Same Surgical Hazard

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Abstract

Paranasal sinus cavities are air filled spaces surrounding the nasal cavities. They communicate to the nasal cavity through an ostium. They can be normally, poorly or highly pneumatized. Small maxillary sinuses can be secondary or primary. Secondary small maxillary sinuses are usually the consequence of a surgery such as a Caldwell Luc procedure, Rouge Denker procedure, or medial maxillectomy. We report a series of 21 primary small maxillary sinuses seen in the ENT department of the CHU UCL Namur between 2015 and 2021. We classify them into 3 different subtypes: hypoplastic maxillary sinus, chronic atelectasia of the maxillary sinus and the Silent Sinus Syndrome. We report the clinical presentations and the imaging associated to each entity, the type of surgery performed and the surgical risk. These small sinuses require a middle antrostomy to halt the process of implosion. The procedure exposes to the risk of damaging the medial orbital wall because the uncinat process is lateralized and fused to the priorbit. The middle antrostomy must be done cautiously from backward to forward.

Keywords: Small maxillary sinus; Hypoplasia of the maxillary sinus; Chronic atelectasia; Silent sinus syndrome; Imploding antrum syndrome; Middle antrostomy

Introduction

Paranasal sinuses are air-filled cavities surrounding the nasal cavities. They are lined by a respiratory epithelium. They communicate to the nasal fossae through an ostium. The origin of the sinuses is not well known. There are 2 theories: the one proposed by Zukerkandl claiming that the paranasal sinuses originate from the nasal capsule and the one edited by Jankowski in his book « Evo/Devo » [1]. He suggests that the paranasal sinuses result from the resorption of the bone marrow with subsequent liberation of air bubbles and NO. According to him, the maxillary, frontal and sphenoid sinuses are true sinuses. The ethmoid sinus is not a paranasal sinus per se but is considered as the vestigial of the olfactory organ. The sinus cavities can be normally, highly or poorly pneumatized. The aim of this paper is to present a retrospective study conducted in the ENT department of the CHU UCL Namur site of Godinne between January 2015 and January 2021. We report a cohort of patients with small primary maxillary sinuses. We classify them into 3 categories. We report the clinical

presentations and the imaging associated to each entity, the type of surgery performed and the surgical risk.

Patients and Method

The series included 21 patients. All were adults except one young adolescent age of 16. There are 11 females and 10 males. Their mean age was respectively 54 yo for the ladies (range: 16-79) and 48 yo for the men (range: 33-75). We found 3 different subtypes of small primary maxillary sinuses:

The hypoplastic maxillary sinus: N=5

The chronic atelectasia of the maxillary sinus (CMA): N=6

The silent sinus syndrome: N = 10.

Clinical presentations

- For the hypoplastic maxillary sinus (N=5), one was diagnosed incidentally on a CT scan of the paranasal cavities performed in the preoperative evaluation for a DCR. The others were diagnosed on a sinus CT scan during a diagnostic workup for chronic sinonasal complaints.
- The chronic atelectasia of the maxillary sinus (N=6) was

found in 5 patients on a sinus CT scan performed in patients with chronic sinonasal complaints. One CMA was diagnosed on a CT performed after a nasal trauma.

- C. The Silent Sinus Syndrome was diagnosed in 10 patients. 3 of them were asymptomatic. The disease was diagnosed on a sinus CT scan performed in the preoperative workup for a DCR, a sinus lift or a rhinoplasty. 7 patients had symptoms of chronic rhinosinusitis. 2 patients had also some ophthalmological signs and 2 had some cosmetic asymmetry of the face.

Imaging

The table summarizes the radiological findings.

Type	N=	Opacity of the Maxillary sinus	Retraction of the ISW	Collapse of the orbital floor
Hypoplastic	5	3 + and 2 clear sinus	0	0
Atelectasic	6	+	+	0
Silent sinus syndrome	10	+	+	+

Legend: ISW: intersinus wall

Treatment

All the patients with an atelectasia or a Silent sinus syndrome were operated. Concerning the hypoplastic maxillary sinus 1 patient was asymptomatic and was not operated. When surgery was indicated a middle antrostomy was performed under general anaesthesia from backward to forward.

Outcomes

All the patients except one were asymptomatic after the surgery. One seeks medical advice for a placement of an orbital implant due to the persistence of a facial asymmetry but until now the procedure has not yet been done.

Complication

We have noticed no ophthalmological complication after the surgery such as subcutaneous emphysema, diplopia or orbital injury. We have had no closure of the middle antrostomy.

Discussion

Small maxillary sinus can be secondary or idiopathic.

- Secondary small maxillary sinuses

Typically they result from a surgery. Caldwell Luc procedure, Rouge Denker procedure or medial maxillectomy classically lead to the development of a huge fibrosis within the sinus cavity with subsequent retraction of all the sinus walls. On CT scan of the paranasal cavities this looks like an opacified sinus usually associated to a neoosteogenesis and a retraction of the sinus walls. On the MRI the opacity can be very heterogeneous. This examen makes possible the differentiation between a post-surgical fibrosis and a retention cyst or a post-surgical mucocele. Figure 1a & b illustrate typical findings on a CT scan and MRI after a Rouge Denker procedure.



Figure 1a: Coronal CT: On right side, typical findings after a Rouge Denker procedure on the right side. Fibrosis within the sinus cavity, sequelae of inferior turbinectomy and neoosteogenesis. **Figure 1b:** MRI-coronal cut. Heterogeneous opacity of the sinus contents due

to postsurgical fibrosis-no mucocele.

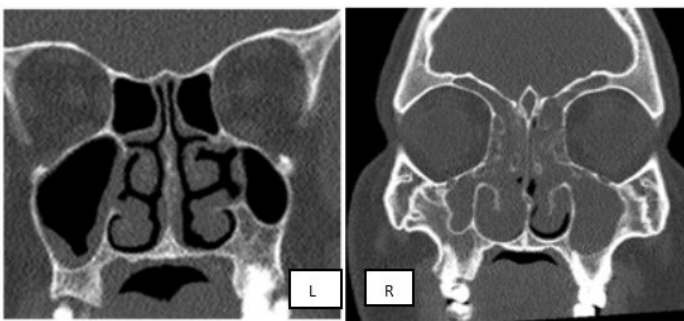
When the patient is symptomatic (facial pain or swelling during an acute infection) and presents with a postsurgical mucocele, surgery can be performed. It consists of a marsupialisation of the mucocele performed via either an inferior antrostomy or an middle antrostomy. The latter is associated to a surgical risk of penetration into the periorbit.

- **Primary small maxillary sinuses**

According to our series, we individualized 3 different subtypes of small primary maxillary sinuses: the hypoplastic maxillary sinus, the chronic atelectasia of the maxillary sinus and the Silent Sinus Syndrome.

The hypoplastic maxillary sinus (N=5)

This is a constitutional problem implying a congenital abnormality of the maxilla. According to Jankowski's theory, this entity results from an incomplete development of the maxillary sinus due to a partial resorption of the bone marrow [1]. This entity can be underdiagnosed as it can be asymptomatic as we have noticed in 1 patient out of 5 in our series. The disease was diagnosed on a CT scan performed before a DCR. However in most of the cases the diagnosis is made on an imaging, usually a CT scan, performed during a diagnostic workup for chronic sinonasal complaints. On the imaging the sinus can be free of disease (N=2) but more often is completely or partially opacified in case of chronic rhinosinusitis (N=3). The volume of the sinus cavity is small and the alveolar recess is thick. The orbital floor is in place and intact. The uncinate process is lateralized but not concave or fused with the periorbit. Figures 2a and 2b illustrate 2 hypoplastic maxillary sinuses: one without any opacification of the sinus and the other associated to a chronic rhinosinusitis. When surgery is indicated a middle antrostomy is the option. Our series include 5 patients with an hypoplastic maxillary sinus. Only 3 of them were operated.



Figures 2a: Left hypoplastic maxillary sinus free of disease with a thick alveolar recess. **2b:** Coronal CT scan showing a right hypoplastic maxillary sinus full of disease associated to chronic bilateral ethmoidal sinusitis. The alveolar recess is particularly thick as well.

Chronic atelectasia of the maxillary sinus (CMA) (N=6)

This results from an acquired and evolving process leading to a retraction of the bony walls of the sinus. It is usually diagnosed on a sinus CT scan performed in a patient with a medical history of sinonasal complaints. There are different stages of atelectasia, classified as type 1, 2 and 3 [2-5]. The first stage of the atelectasia is characterized by a retraction of the intersinus wall at the level of the middle meatus followed by a collapse of the other bony walls. The sinus can be opaque or filled by secretion or by a hyperplastic sinus mucosa. Type 3 is generally considered as the ultimate stage of evolution and is regarded as an imploding maxillary sinus. Figures 3a & 3b illustrate a typical case of atelectasia of the maxillary sinus. The orbital floor is intact. Figure 4 illustrates a case where the radiologist protocolled the CT as a middle antrostomy. This confirms that this syndrome is more often recognized by rhinologists and to a lesser extent to general radiologists. 2 important findings must be noticed: the first is the absence of inward retraction of the orbital floor. The second is the lateralisation of the uncinate process which is concave and fused to the periorbit. Recognition of such anomalies of the uncinate process is of utmost clinical significance in order to avoid inadvertent intraoperative damage to the adjacent medial orbital wall. Some anatomical variations maybe associated to the lateralization of the uncinate process such as an ipsilateral septal deformity or a lateralization of the middle turbinate. In our series, all the patients had sinonasal complaints but no ophtalmological signs. All the patients underwent a middle antrostomy to halt the process. A septoplasty or an ethmoidectomy can be associated to the middle antrostomy according to the associated anatomical abnormalities or pathologies demonstrated on the CT scan.

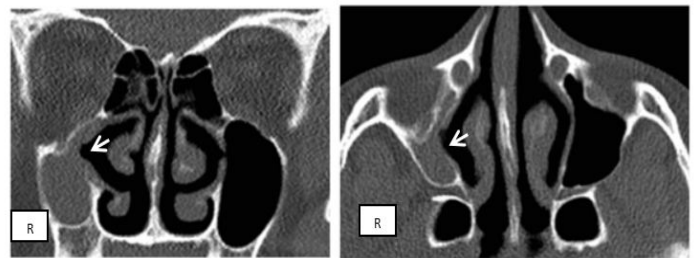


Figure 3a: Coronal CT scan: Chronic atelectasia of the right maxillary sinus which is completely opaque.

Lateralization of the uncinate process that is concave (arrow). **3b:** Same patient-Sinus CT scan-axial cut-atelectasia of the right maxillary sinus- Lateralization of the uncinate process fused to the periorbit. (arrow)



Figure 4: Patient with a significant retraction of the left intersinus wall misdiagnosed as a middle antrotomy by the radiologist.

The Silent Sinus Syndrome

Silent Sinus Syndrome (SSS) was first described by Soparkar, et al. in 1994 [4]. He was an ophthalmologist. SSS was characterized by a progressive unilateral painless enophthalmos and hypoglobus associated to a collapse of the maxillary sinus and orbital floor. The patient has no past history of a rhinosinusitis, trauma or surgery. Since that time, several cases have been documented and published mostly in the otolaryngology and ophthalmology literature [5-12]. Since the first description the terminology has evolved as many patients reported sinus-related symptoms, which by definition distinguished CMA III from SSS. However, in agreement with De Dorlodot et al [3] we consider that type III Chronic maxillary atelectasia and SSS are 2 faces of the same clinical entity. With time we noticed that the symptomatology associated to the implosion of the antrum is protean and various. The symptomatology is closely related to the severity of the implosion. That is the reason why we propose to call it « The imploding antrum syndrome » as proposed in 2003 by J Rose [13].

The Clinical Presentation

The imploding antrum syndrome is certainly an underdiagnosed syndrome. It can be diagnosed by an ophthalmologist, an ENT, a radiologist or a plastician. Many cases remain asymptomatic for a certain period of time and the clinical presentation depends on the severity of the collapse of the maxillary sinus. Typically the disease affects an adult in the third through the fifth decade of life. This was confirmed in our study. There is no gender predilection. Some exceptional cases have been reported in children [14-16]. We present one case in a 16-year-old female. The

patient can report sinonasal complaints associated or not to a facial asymmetry. At an advanced stage of the disease the patient presents with a progressive painless enophthalmos and hypoglobus. We can observe a deep superior sulcus. This is usually diagnosed by the ophthalmologists. Patients seen in ENT have less ophthalmological complaints. In all the cases the visual acuity is normal. The nasal endoscopy, performed by an ENT, demonstrates a lateralisation of the uncinate process, a widening of the middle meatus, a retraction of the intersinus wall, associated sometimes with an ipsilateral septal deformity, a contro-lateral concha bullosa or a lateralisation of the middle turbinate at various degrees. Figure 5 shows the widening of the right middle meatus.

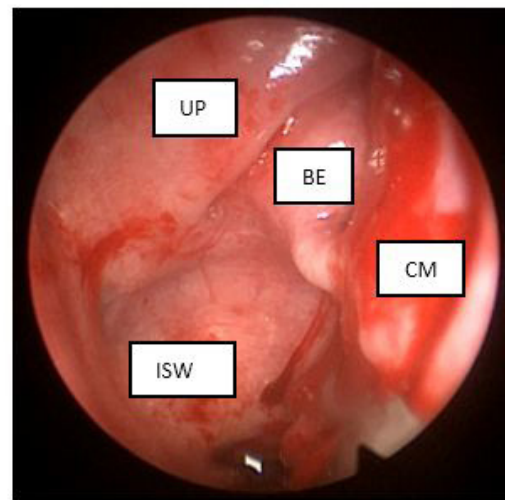


Figure 5: Nasal endoscopy demonstrating a widening of the right middle meatus - Retraction of the posterior fontanelle.

Legend: UP: uncinate process / BE: bullae ethmoidalis / CM: middle turbinate / ISW: intersinus wall

Radiological Findings [2-5,10,13,16-19]

The imploding antrum syndrome is characterized by a more or less severe collapse of all the sinus bony walls. Particularly there is a downward retraction of the orbital floor. Due to the sinus collapse the sinus volume is significantly reduced and the orbital volume is increased. Figures 6a-6c illustrate perfectly well the collapse of the maxillary sinus with downward retraction of the orbital floor.

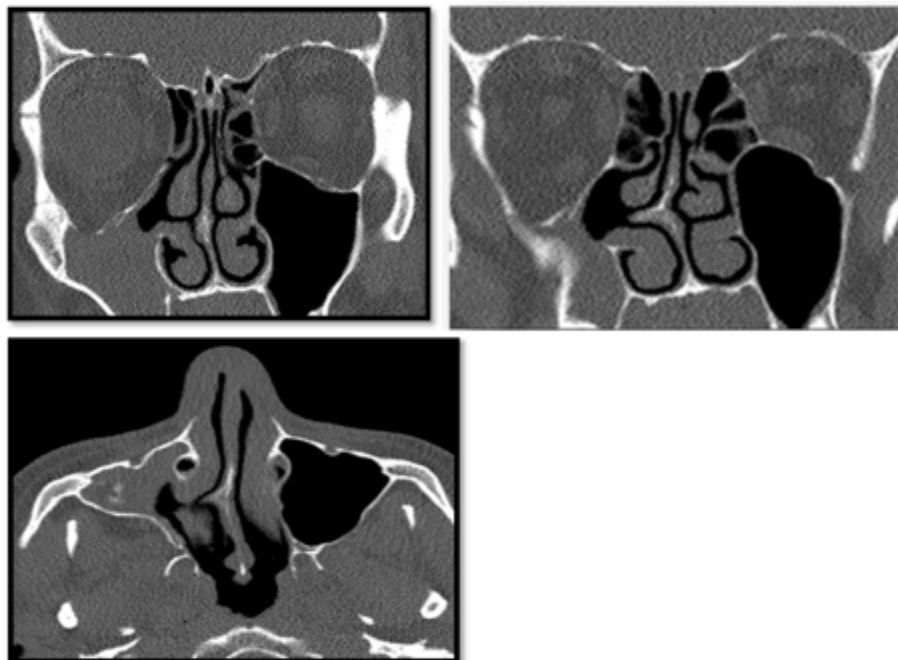


Figure 6a: Coronal CT scan demonstrating a retraction of the orbital floor on the right side, a retraction of the intersinus wall, an opacified maxillary sinus and a large increase of the right orbital volume. **6b:** Coronal CT-atelectasia of the right maxillary sinus- ipsilateral septal spur. **6c:** Axial cut-right maxillary sinus atelectasia-severe retraction of the posterior wall of the maxillary sinus.

Figure 7a & b: MRI:

Figure 7a shows a typical Silent sinus syndrome on T2 weighted sequence. Collapse of the orbital floor and secretion within the maxillary sinus

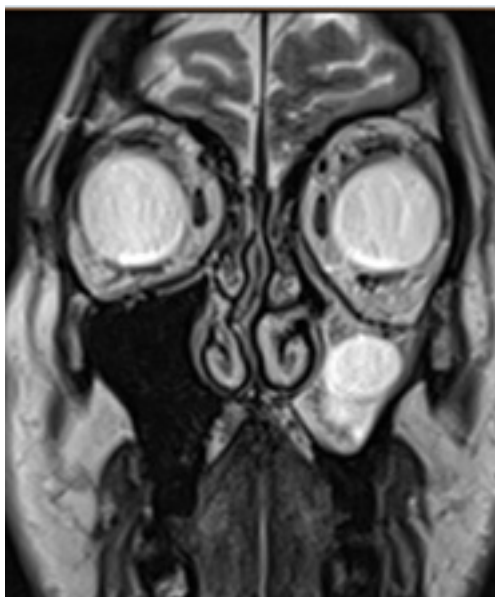
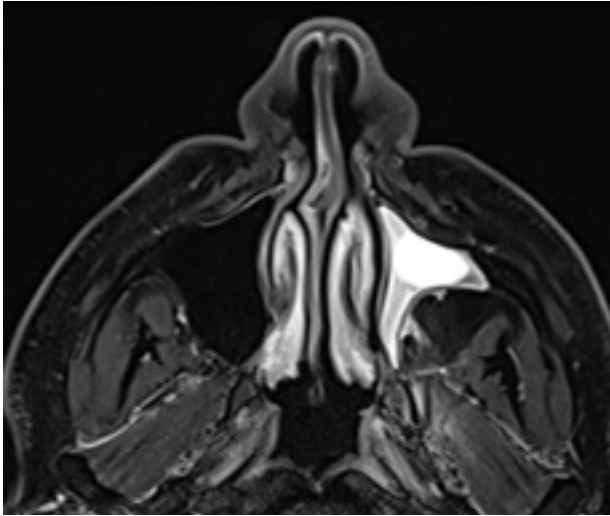


Figure 7b shows the Silent sinus Syndrome on the left maxillary sinus on T2 sequence ; Retraction of the posterior wall and secretion within the maxillary sinus



Figures 7a & b show the findings on an MRI. This exam is not absolutely necessary to make the definite diagnosis but demonstrates the absence of expanding process in the pterygopalatine fossa.

Physiopathology

Little is known about the exact physiopathology of the implosion of the maxillary sinus. One proposed mechanism for the imploding antrum syndrome is that chronic ostiomeatal obstruction leads to hypoventilation of the maxillary sinus, with the production of negative intrasinus pressure. Longstanding negative pressure creates a centripetal force, resulting in an atelectatic maxillary sinus [1,3]. As a consequence of this functional endoscopic surgery improves significantly the majority of the patients.

Treatment [2,3,5,13,17-20]

It consists of a middle antrostomy in order to halt the implosion of the sinus. The surgical risk is the penetration into the periorbit due to the particular position and shape of the uncinate process. Therefore the middle antrostomy must be done from backward to forward. We recommend starting the procedure with a medialisation of the uncinate. Figure 8 shows the medialisation of the right uncinate process. Then we use cutting instruments to go further. The middle antrostomy must include the natural ostium to prevent any postsurgical recycling. When the patient has a significant hypoglobus a reconstruction of the orbital floor with bone allograft and porous polyethylene sheets is recommended. The question is when to do it as many cases show an increase of the sinus volume after the endonasal surgery. In our series no patient needed a repair of the orbital floor.

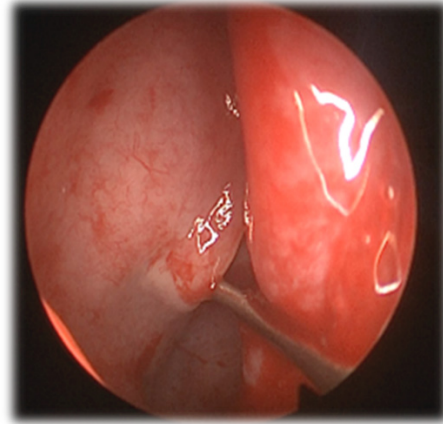


Figure 8: Endoscopic view of the right middle meatus showing the medialisation of the uncinate.

Conclusion

Small primary maxillary sinuses are underdiagnosed because some of them remain asymptomatic for a certain period of time and are therefore incidental findings on an imaging. The symptomatology depends on the severity of the collapse of the maxillary sinus. It is interesting to make the differentiation between hypoplasia of the maxillary sinus which is constitutional and a chronic atelectasia of the maxillary sinus and the imploding antrum syndrome, all of them are evolving diseases. Chronic atelectasia and Silent sinus syndrome are 2 faces of the same clinical entities. In opposition to the first publication many patients have complaints associated to the maxillary collapse and so it is logical to call this ‘an imploding antrum syndrome’. The imaging usually the CT scan makes the definitive diagnosis. Because atelectasia and implosion are evolving problems, a middle antrostomy must be done to halt the process even in asymptomatic patients. It must be done cautiously from backward to forward to avoid any damage to the periorbit. Repair of the orbital floor is an option in severe cases but in our series no patient needed such a procedure. In case of hypoplastic maxillary sinus not associated to any sign of sinusitis a wait and see attitude is recommended.

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