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Radiology in Focus

Sinusitis in the hypoplastic maxillary antrum: the crucial role of radiology in diagnosis and management

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Abstract
Maxillary sinus hypoplasia (MSH) is occasionally encountered in otorhinolaryngological practice. The hypoplastic sinus is liable to mucus retention, and cases of MSH usually present as a persistent maxillary sinusitis. Endoscopic surgery has been recommended as an effective treatment for the sinus infection. However, MSH is associated with anomalies of the lateral nasal wall which, if not recognized pre-operatively, can lead to inadvertent surgical damage to the orbit. Although some of these abnormalities can be evident endoscopically, the role of imaging in diagnosis and identification of important surgical landmarks is paramount. A posteriorly placed middle meatal antrostomy is recommended as the surgical treatment of choice.

Key words: Maxillary Sinus; Surgical Procedures, Operative; Endoscopes; Tomography, X Ray Computed

Introduction

Maxillary sinus hypoplasia (MSH) is an infrequently encountered abnormality. Reported incidence figures range from 1.73 per cent to 10.4 per cent for unilateral and 3.6–7.2 per cent for bilateral MSH in the general adult population.[1–3] Figures of 13.2 per cent and 1.4 per cent for unilateral and bilateral MSH, respectively, have been reported in the symptomatic paediatric population.[4] Mucus retention in the abnormal antrum is a well-described feature of MSH,[5] and cases therefore present in otolaryngological practice with clinically significant sinus infection. Medical treatment of MSH-associated sinusitis is ineffective and endoscopic sinus surgery is advocated as definitive therapy.[5] However, the infected hypoplastic sinus is typically associated with other abnormalities of the orbit and lateral nasal wall which, taken together, make a conventional middle meatal antrostomy (i.e. via the anterior fontanelle of the lateral nasal wall) hazardous. These patients are at high risk of orbital damage during surgery.[3] Coronal plane computed tomography (CT) imaging of the paranasal sinuses plays a crucial role providing the surgeon with an anatomical 'map' in order to treat disease adequately and avoid surgical morbidity. This is illustrated in the cases reported here.

Case report 1

A 35-year-old male (Patient A) was referred with an 11-year history of persistent left-sided nasal obstruction, facial pain and hyposmia. Coronal CT scans of the paranasal sinuses revealed a hypoplastic, opacified left maxillary sinus. The uncinate process was absent, and the infundibular tract poorly defined. The middle turbinate was hypoplastic. The ipsilateral orbit was increased in volume anteroinferiorly, adjacent to the root of the inferior turbinate in the region of the anterior fontanelle (Figure 1). A more posterior view demonstrated that the membranous covering over the posterior fontanelle was displaced laterally (Figure 2). Endoscopic sinus surgery was undertaken. At operation, no uncinate process was unidentifi-

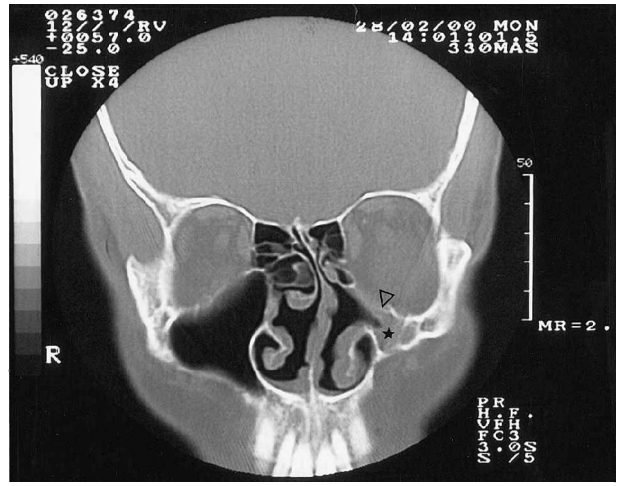

Fig. 1

(Patient A) Coronal CT sinus scan, anterior view. The hypoplastic maxillary sinus is opacified (star) and the ipsilateral orbital volume is increased. Note the inferomedial orbital margin is immediately adjacent to the superior margin of the inferior turbinate (open arrowhead).

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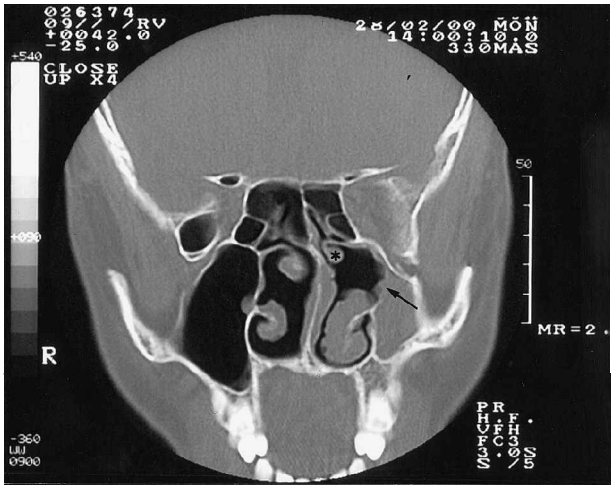

FIG. 2

(Patient A) Coronal CT, posterior view, showing the lateral bowing of the antronasal wall at the posterior fontanelle (black arrow) and hypoplasia of the middle turbinate (asterisk).

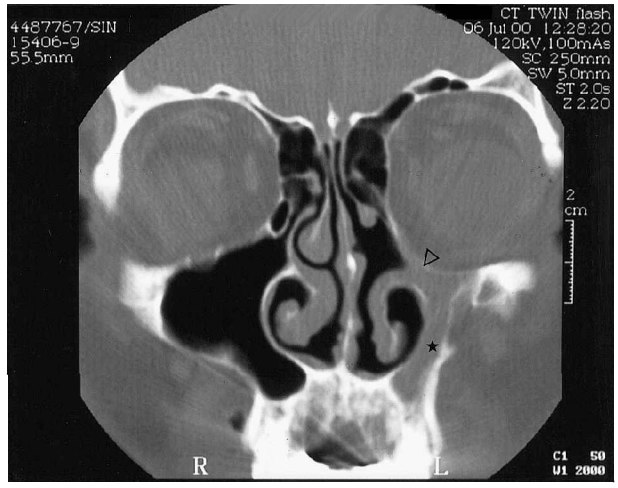

FIG. 3

(Patient B) Coronal CT sinus scans, anterior view. As in Figure 1 the hypoplastic maxillary sinus is opacified (star) and the ipsilateral orbital volume is increased. Note the inferomedial orbital margin is immediately adjacent to the superior margin of the inferior turbinate (open arrowhead).

able. The membranous covering over the posterior fontanelle was removed to create a posteriorly situated middle meatal antrostomy. Thick, viscid mucus was aspirated from the sinus. The bulla ethmoidalis was uncapped. At three months post-operatively, the patient was asymptomatic; the surgical antrostomy was noted to be widely patent at endoscopy and he was discharged from further follow-up.

Case report 2

A 49-year-old male (Patient B) was referred with a four-week history of left maxillary pain which was temporarily relieved with antibiotic therapy. He had also noticed widening of the left palpebral fissure. There were no other nasal symptoms. On examination, there was evidence of a widened left palpebral fissure but no proptosis or other facial deformity. Nasendoscopy revealed septal deviation to the left, an apparently absent left middle turbinate and a laterally bowed antronasal wall in the middle meatus posteriorly. A coronal CT scan of the paranasal sinuses revealed a series of abnormalities identical to those seen in Patient A. Specifically, the maxillary sinus and middle turbinate were hypoplastic, with associated narrowing of the infundibular tract. No uncinate process was identifiable. Soft-tissue density opacification of the maxillary antrum was evident (Figure 3). The posterior fontanelle was displaced laterally (Figure 4). He was scheduled for endoscopic sinus surgery, and the radiological findings were confirmed at operation. A posterior middle meatal antrostomy was created as described in Patient A. Thick, viscid mucus was again drained from an infected maxillary antrum mucocele. At follow-up, two months post-operatively, the antrostomy remained patent and the patient was asymptomatic.

Discussion

Studies of MSH have identified several distinct aetiologies for this condition. Hypoplasia of the maxillary sinus may be part of a primary developmental abnormality of the lateral nasal wall, or arise as a secondary acquired process.[2,6] The developmental basis of MSH remains unclear. It has been suggested that an abnormal formation of the uncinate process may lead to impaired development of the maxillary sinus.[3] Other observers, noting that both the maxillary sinus and uncinate process have a common origin from the cartilaginous nasal capsule, postulate an abnormality of the cartilaginous capsule. This results in abnormal development of the entire lateral nasal wall, accounting for the high frequency of associated lateral nasal wall structures, such as the uncinate, middle turbinate and ethmoid infundibulum abnormalities seen with MSH.[7] Acquired MSH can result from facial trauma or surgery to the developing sinus. Unilateral or bilateral reduction in maxillary sinus volume has been reported following endoscopic sinus surgery in childhood.[8] The proposed mechanisms include activation of osteogenesis within the maxilla and the removal of pneumatization centres, caused by sinus inflammation, combined with the effect of surgical trauma. Systemic disorders such as thalassaemia, Wegener's granulomatosis, fibrous dysplasia and Paget's disease have been associated with MSH.[2] In the cases described in this report, there was no history of

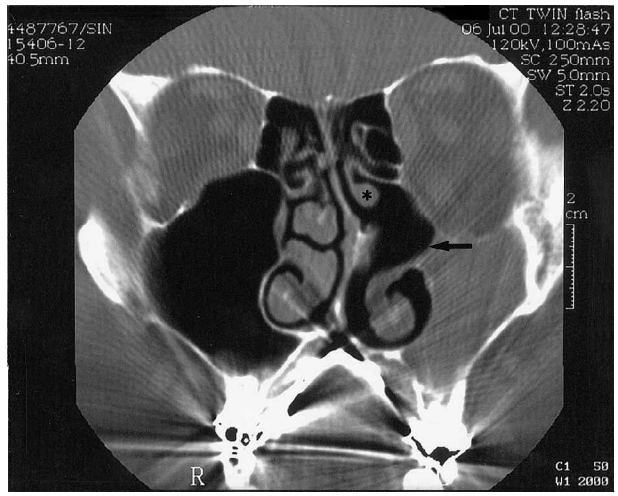

FIG. 4

(Patient B) Coronal CT, posterior view, showing the lateral bowing of the antronasal wall at the posterior fonatanelle (black arrow) and hypoplasia of the middle turbinate (asterisk).

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antecedent sinusitis or surgery, and no evidence of systemic disease. It would seem, therefore, that in our cases a primary developmental anomaly is the most likely aetiology.

A radiologically-based classification system has been proposed for MSH by Bolger and co-workers.[3] In a review of 202 consecutive CT scans, they found 21 instances of MSH. They identified three clinical types of maxillary sinus hypoplasia. Type I (14 patients) is characterized by mild MSH, a normal uncinate process and a patent infundibular tract. Type II hypoplasia was seen in six patients, and is exemplified by the cases presented in this report. It is characterized by an absent or hypoplastic uncinate process and an absent or ill-defined infundibular passage with a moderate degree of MSH and a contractile mucocele. Type III (one patient) is characterized by profound MSH, the sinus being reduced to a narrow cleft, and an absent uncinate process. It should be noted that types I and III hypoplasia are less likely to present problems in clinical practice; type I sinuses have a normal drainage tract and therefore no inherent tendency to sinusitis or anatomical difficulties at operation, while type III sinuses have no antral airspace and cannot become infected.

The associated between type II hypoplasia and chronic sinusitis has been well described.[3] It seems likely that sinusitis and mucocele formation are secondary phenomena in these cases; the aberrant lateral nasal wall anatomy causes ostial obstruction and hence accumulation of sinus secretion, which may eventually become infected. A unique feature of MSH-associated mucoceles is the fact that they appear to be contractile, rather than expansile. Other mucoceles of the paranasal sinuses are expansile, causing symptoms from compression of surrounding structures and, in the case of the maxillary sinus, displacing the lateral nasal wall medially[9,10] In MSH-associated sinusitis, the membranous lateral nasal wall of the posterior fontanelle is actually displaced laterally, as if sucked into the maxillary sinus.[3] This physical sign is readily apparent on nasendoscopy, and should alert the clinician to the possibility that there may be underlying MSH. Furthermore, the laterally bowed posterior fontanelle serves as a landmark at operation, as it marks the preferred site of antrostomy formation. In the cases reported here, the uncinate process could not be identified and the inferomedial wall of the orbit was virtually touching the inferior turbinate. Hence, there was inadequate space available to perform a conventional anterior fontanelle middle meatal antrostomy. An inferior meatal antrostomy would also be hazardous, as the abnormally low inferior orbital wall could be easily damaged when the lateral nasal wall is penetrated. A posterior fontanelle antrostomy is not normally recommended in sinus surgery, as it may lead to futile mucus cycling between the surgical antrostomy opening and the normal, more anteriorly placed, ostium.[11] However, in MSH-associated sinusitis, there is no natural anterior ostium and this complication cannot occur. The surgeon should identify the membranous covering in the area of the posterior fontanelle. This can then be removed to fashion an antrostomy safely.

Conclusion

Otolaryngologists should be well aware of the specific disease entity of maxillary sinus hypoplasia which, although uncommon, presents in routine practice as chronic sinusitis. Clues to its presence endoscopically include a laterally displaced posterior fontanelle, a hypoplastic middle turbinate and an absent uncinate process. The definitive diagnosis, including a delineation of associated anatomical anomalies, can only reliably be made radiologically. Endoscopic sinus surgery is an effective therapeutic option for treatment of the associated sinusitis. If contemplated, surgery should be preceded by a careful pre-operative assessment of the anatomical landmarks using detailed high quality coronal CT scanning of the paranasal sinuses. The surgical antrostomy should be sited posteriorly in the middle meatus to avoid orbital damage. On a broader front, this report reinforces the principle that, in the interest of safety, CT scanning of the paranasal sinuses should be standard practice prior to any endoscopic sinus surgery regardless of the underlying pathology.

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