Endoscopic Treatment of Frontal Sinus Mucocoeles with Lateral Extension

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Abstract To describe a new and useful criterion to identify endoscopically approachable lateral frontal sinus mucocoeles. We retrospectively reviewed all patients diagnosed with frontal mucocoele with lateral extension who underwent endoscopic sinus surgery (ESS) at the Department of Otorhinolaryngology, San Raffaele Scientific Institute over a 4 year period, from January 2008 to March 2012. We analyzed patient charts, pre- and post-operative imaging, operative reports, postoperative periods, and follow-up records. Our series is composed of seven patients, four males and three females, with a mean age of 56 years. Symptoms at presentation varied depending on the extent of mucocoele growth and orbital and intracranial invasion. Mucocoele extension medially to a virtual sagittal plane tangential to the medial side of the ocular globe was also evaluated with computed tomography, to determine the appropriateness and feasibility of an ESS procedure. After pre-operative investigations, patients underwent marsupialization of the mucocoele with ESS. Postoperative follow-up ranged from 1 to 4 years. At present, all patients remain free of disease, as documented by radiological imaging. In defining endoscopically approachable lesions, it is essential to determine their extension beyond a virtual sagittal plane tangential to the medial side of the ocular globe. The success of the endoscopic procedures described was undoubtedly linked to the localization of the mucocoele medial wall. This criterion is more important than the size

of the mucocoele, and accurate computed tomography evaluation can identify those mucocoeles approachable with ESS, even if laterally extended.

Keywords Mucocoele · Frontal sinus · Lateral mucocoele · ESS · FESS

Introduction

A mucocoele is a rare, pseudo-cystic, epithelium-lined lesion of the paranasal sinuses, containing mucus, which is capable of slow expansion and bone erosion. Many theories have been proposed to explain the physiological mechanisms responsible for both mucocoele formation and growth, including included cystic degeneration of a seromucinous gland and pressure erosion, although histopathological and molecular analyses performed by Lund et al. [1, 2] have started to unveil a dynamic process of bone resorption in which inflammatory cytokine cross-talk between bone and epithelium and production of prostanoids play a crucial role, along with sinus obstruction [3, 4].

The frontal sinus, ethmoidal cells or both are the most frequently affected sites [4, 5]. The definitive treatment of frontal mucocoeles is surgical [4]. Until the 1980's, mucocoeles were exenterated mainly using external approaches. Leading surgical techniques were Lynch–Howarth [6, 7] incision and osteoplastic frontal sinusotomy as described by Bockhmül et al. [8] and by Weber et al. [9]. In 1989, Kennedy et al. [10] proposed an alternative endoscopic approach that showed no recurrences after a mean follow-up of 18 months. Today, marsupialization of mucocoeles using endoscopic sinus surgery (ESS) is considered the first choice of treatment, with both low morbidity and recurrence rates [3, 4, 10–14]. External approaches to frontal

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sinus are still used, alone or combined with ESS, in far lateral located lesions, but no clear-cut definition of the limits of a successful endoscopic procedure has been given [4, 15, 16].

We present a retrospective review of fronto-orbital mucocoeles with lateral extension, all treated with an endoscopic endonasal technique leading to complete recovery. Based on our experience, we consequently evaluate and propose criteria to better identify endoscopically approachable lateral frontal mucocoeles.

Materials and Methods

We retrospectively reviewed all patients diagnosed with frontal mucocoele with lateral extension who underwent ESS at the Department of Otorhinolaryngology, San Raffaele Scientific Institute over a 4 year period, from January 2008 to March 2012. We analyzed patient charts, pre- and post-operative imaging, operative reports, post-operative periods, and follow-up records.

Before surgery each patient underwent ear, nose and throat (ENT) examination, which included nasal endoscopy. Patients with ocular symptoms were also examined by an ophthalmologist. Computed tomography (CT) scan and magnetic resonance imaging (MRI) of the paranasal sinuses completed pre-operative work-up.

All mucocoeles were managed by ESS with no exceptions, and a single surgeon (MT) performed all operations. Surgical technique included anterior ethmoidectomy and either Type I, IIa or IIb frontal sinus drainage according to Draf [17, 18]. Mucocoeles were drained using angled instrumentation: 30° and 70° endoscopes and 90° instruments. Postoperatively, each patient was assessed by angled nasal endoscopy for supraorbital and frontal recess patency. Postoperative screening CT scans were performed at 3 months after surgery.

Results

Our series is composed of seven patients, four males and three females, with a mean age of 56 years. The previous ENT history of all patients was unremarkable. Symptoms at presentation varied depending on the extent of mucocoele growth and orbital and intracranial invasion (Figs. 1, 2). Four subjects were referred initially to an ophthalmologist because they presented with ocular symptoms related to eye proptosis such as diplopia and visual loss (Fig. 3). Upon eye examination epiphora, eyelid ptosis and lid swelling were also evident. Another two patients complained of facial pressure and headache. One patient presented syncope as a symptom at onset; CT scan later

revealed posterior frontal sinus wall erosion and severe frontal lobe displacement (Fig. 4). Otorhinolaryngological examination was performed in all cases, and all patients underwent pre-operative nasal endoscopy. Lateral extension, size and bone invasion of the mucocoeles were assessed through CT and/or MRI. Four mucocoeles extended into the orbit, one was confined to the frontal sinus and two eroded the posterior wall of the frontal sinus, invading the anterior cranial fossa. Mucocoele extension medially to a virtual sagittal plane tangential to the medial side of the ocular globe was also evaluated to determine the appropriateness and feasibility of an ESS procedure (Fig. 5). After pre-operative investigations, patients underwent marsupialization of the mucocoele with ESS.

Postoperative follow-up ranged from 1 to 4 years and was performed by nasal endoscopy using flexible fiberoptic and CT or MRI to demonstrate the absence of recurrence. At present, all patients remain free of disease, as documented by radiological imaging.

Discussion

Management of mucocoele has significantly changed since the introduction of ESS [4, 5]. Traditional teaching has emphasized the need for a complete removal of the sinus mucocoele lining to avoid recurrence [4]. Lund's works on the etiology of mucocoele has offered support to this concept. Those studies demonstrated increased levels of bone resorbing factors at the bone-mucosa interface, such as PGE2, interleukin 1 and tumor necrosis factor, in stark contrast with the mucosa of chronic rhinosinusitis or a mucus-filled sinus. Moreover, histological analyses did not show atrophic and thinned mucocoele epithelium, as expected in pressure erosion, but an active secretory mucosa. These findings, along with the known importance of sinus outflow obstruction, led surgeons to exenterate the mucocoele lining and obliterate the sinus [1–3]. The results of over 20 years of ESS approaches to mucocoeles show that these practices are unnecessary and add no benefit [3, 11–14].

In the past, frontal mucocoele exenteration was achieved through external approaches, mainly a Lynch–Howarth incision [6] or osteoplastic frontal sinusotomy [7].

The Lynch–Howarth incision is usually made in the supero-medial quadrant of the orbit. The lesion is then eliminated via complete removal of mucosal lining of the frontal sinus and a wide drainage to the nose is created. The procedure includes the removal of the bony anterior and lateral ethmoid walls [6, 7]. This may lead to soft tissue prolapse into the frontal recess and sinus drainage obstruction [4]. Cicatrization of the incision is usually aesthetically satisfying; nonetheless, in 1986 Rubin et al. found that webbing of the scar occurred in 6 % of cases [3, 5].

Fig. 1 Lateral mucocoele, pre- and post-operative imaging. Axial pre-operative CT (a), coronal pre-operative CT (d), axial post-operative CT (b), coronal post-operative CT (e), axial post-operative MR (c), coronal post-operative RM (f)

Fig. 2 Lateral mucocoele with orbital involvement, pre- and post-operative imaging. Axial pre-operative CT (a), coronal pre-operative CT (d), axial pre-operative MR (b), coronal pre-operative MR (e), axial post-operative CT (c), coronal post-operative CT (f)

Fig. 3 Lateral mucocele with orbital involvement. Clinical presentation before intervention and post-operative aesthetic result are shown

Fig. 4 Lateral mucocele invading anterior cranial fossa, pre- and post-operative imaging. Axial pre-operative CT (a), coronal pre-operative CT (d), sagittal pre-operative MR (b), coronal pre-operative MR (e), axial post-operative CT (c), coronal post-operative CT (f)

Osteoplastic frontal sinusotomy is performed through cutaneous incision and creation of an osteoplastic frontal flap. This allows for extensive visualization of the entire frontal sinus and allows to easily exenterate the mucocele and obliterate the cavity. The procedure is associated with significant morbidity and requires lengthier hospitalization [19].

Stripping of the mucocele lining and obliteration of the sinus are performed in all external approaches, but morbidity of these procedures is significant, especially if there is bone erosion and orbital or intracranial extension of the mucocele. The lining of the lesion may adhere to either the dura or the orbital periosteum, and its stripping increases the risk of dural injury and leakage of cerebral spinal fluid [19]. If mucosa is left behind and the sinus obliterated, a

recurrence of the mucocele is highly likely [19]. Cases of frontal sinusitis after a bicoronal approach have also been described [11].

Several advantages are conferred by an endoscopic procedure: hospital stay is reduced, some of the potential complications of external approaches are avoided and physiological aeration of the frontal sinus is restored [3, 6]. Recurrence rates in retrospective studies considering groups of over 100 patients are close to 1 % [4, 13].

However, not all frontal sinus mucocele are considered approachable through ESS alone [3, 4]. Many authors consider lateral localization of frontal mucocele a contraindication to ESS [3, 4, 11, 15], and endoscopic management of lateral frontal sinus lesions is rarely mentioned in

Fig. 5 Endoscopic approach to frontal mucocoele with lateral extension. Virtual sagittal plane tangential to the medial side of the ocular globe (*red line*), the lesion (**a**) and its borders (*green line*); angulated instrumentation reaching the mucocoele (**b**); frontal sinus patency after drainage (**c**); endoscopic follow up after 6 months (**d**)

the literature [15]. The choice of endoscopy is influenced by different factors: the extension and localization of the mucocoele, frontal sinus anatomy, expertise of the surgeon and the presence of cutaneous fistulae or malignancies [3, 4, 11, 12, 15, 16, 20].

Frontal mucocoele with lateral localization can be successfully treated with an endoscopic procedure alone, as in our case series. Along with traditional external approaches, several authors have proposed combined techniques, allowing for an “above and below” approach. These techniques combine ESS with external trephination of the frontal sinus [15] or ESS with a Lynch–Howarth incision [3], or ESS with external osteoplastic sinusotomy [4]. There is, however, no clear-cut definition of the criteria for choosing the best surgical approach [4, 15, 16]. On the other hand, precise definition of the limits of ESS has been proposed for management of osteomas and other benign lesions of the frontal sinus. Some authors, in fact, state that only frontal sinus lesions located medially to a virtual plane passing through the lamina papyracea are endoscopically removable [21, 22].

With regard to ESS treatment of mucocoeles, based on our experience, it is essential to determine mucocoele

extension beyond a virtual sagittal plane tangential to the medial side of the ocular globe (Fig. 5, red line). The success of the endoscopic procedures described in our series was undoubtedly linked to the localization of the medial wall of the mucocoele. In Fig. 5a, it is evident that the mucocoele medial wall (Fig. 5, green line) is positioned medially to the virtual sagittal plane previously described (Fig. 5, red line). This favorable conformation of the lesion permitted drainage and marsupialization using curved instrumentation (Fig. 5b–d). We considered mucocoele extension medially to the virtual sagittal plane described as the main selection criterion for ESS. We found that this criterion is more important than the size of the mucocoele. Smaller lesions, in fact, if located more laterally in the frontal sinus, would not be approachable endonasally. Accurate CT evaluation can, therefore, help identify those mucocoeles approachable with ESS.

In conclusion, our case series adds to the available evidence supporting ESS as a valid choice for the treatment of selected laterally extended frontal mucocoeles. We also define as approachable through ESS those mucocoeles that extend medially to a virtual sagittal plane tangential to the medial side of the ocular globe. Our definition of

endoscopically approachable mucocoeles is clear and offers an easily replicable model to determine which lateral frontal sinus mucocoeles are treatable with ESS.

Conflict of interest The authors declare that they have no conflict of interest.

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