Case Report

Prognostic factors for medicamentous and dental treatment failure in odontogenic sinusitis

Kartika Dwiyani*, Eka Dian Safitri, Josua Manalu*****
*Department of Otolaryngology Head and Neck Surgery,
Faculty of Medicine, Universitas Indonesia/ Persahabatan Hospital, Jakarta
**Clinical Epidemiology and Evidence Based Medicine Unit, Faculty of Medicine,
Universitas Indonesia/ Dr. Cipto Mangunkusumo National General Hospital, Jakarta
***Department of Otolaryngology Head and Neck Surgery, Faculty of Medicine,
Universitas Indonesia/ Dr. Cipto Mangunkusumo National General Hospital, Jakarta

ABSTRACT

Background: Odontogenic sinusitis refers to bacterial maxillary sinusitis caused by maxillary dental pathology, or complications from dental procedures. The therapeutic algorithm usually has two stages: conservative and surgical. If conservative therapy alone is successful in curing sinusitis, unnecessary sinus surgery can be avoided. But if conservative therapy fails, sinus surgery is usually required to remove the cause of the pathology. The effectiveness of conservative therapy varies in the range from 36 to 95%. **Purpose:** To investigate prognostic factors for medicamentous and dental treatment failure in odontogenic sinusitis. **Case illustration:** A 27 years old male with odontogenic sinusitis should undergo endoscopic sinus surgery although he had already received optimal conservative therapy. **Clinical question:** In patients with odontogenic sinusitis treated by conservative therapy, are smoking habits, high total Lund-Mackay score including osteomeatal complex (OMC) blockage, and history of dental procedure contribute as prognostic factors for medicamentosa and dental treatment failure? **Method:** Literature searching was performed through PubMed, Cochrane database and Hand-searching using keyword "odontogenic sinusitis". **Result:** Three valid prognostic cohort articles were appraised for the validity, importance, and applicability in our clinical scenario. The precision prognostic factor is high total Lund-Mackay score with odd ratio (OR) 95%, and confidence interval (CI) 2.0, 1.04-3.79. **Conclusion:** High total Lund-Mackay score is an important prognostic factor for conservative therapy failure, so that the sinus surgery should be performed.

Keywords: odontogenic sinusitis, conservative treatment, sinus surgery, Lund-Mackay score

ABSTRAK

Latar belakang: *Sinusitis odontogenik mengacu pada infeksi bakteri pada sinus maksilaris yang disebabkan oleh kuman, atau komplikasi tindakan pada gigi. Algoritma terapeutik biasanya memiliki dua tahap yaitu konservatif dan bedah. Efektivitas terapi konservatif bervariasi berkisar di antara 36 hingga 95%. Jika terapi konservatif berhasil menyembuhkan sinustis, maka bedah sinus dapat dihindari; tetapi jika terapi konservatif gagal, bedah sinus dibutuhkan untuk menghilangkan penyebabnya.* ***Tujuan:*** *Mengetahui faktor prognostik yang mempengaruhi kegagalan terapi medikamentosa dan pengobatan gigi pada sinusitis odontogenik.* ***Ilustrasi kasus:*** *Seorang laki-laki berusia 27 tahun dengan diagnosis sinusitis odontogenik harus menjalani operasi sinus endoskopi, walaupun telah mendapatkan terapi konservatif yang optimal.* ***Pertanyaan klinis:*** *Pada pasien sinusitis odontogenik telah diterapi konservatif, apakah kebiasaan merokok, skor total* Lund-Mackay *tinggi termasuk adanya penyumbatan kompleks osteomeatal (KOM), dan riwayat tindakan pada gigi, memengaruhi kegagalan terapi konservatif?* ***Metode:*** *Pencarian literatur dilakukan melalui* PubMed*,* Cochrane *dan* Hand-searching

*dengan menggunakan kata kunci "sinusitis odontogenik". **Hasil:** Tiga artikel kohort prognostik yang didapatkan, ditelaah kritis untuk dinilai validitas, esensi, dan kemampuan untuk dapat diaplikasikan dalam skenario klinis. Faktor prognostik yang presisi adalah skor total* Lund-Mackay *tinggi dengan* odd ratio (OR) *95% dan* confidence interval (CI) *2,0/1,04-3,79. **Kesimpulan:** Skor total* Lund-Mackay *yang tinggi adalah faktor prognostik penting dalam kegagalan terapi konservatif, sehingga bedah sinus harus dilakukan.*

Kata kunci: *sinusitis odontogenik, terapi konservatif, bedah sinus, skor* Lund-Mackay

Correspondence address: Josua Manalu. Department of Otolaryngology Head and Neck Surgery, Faculty of Medicine, Universitas Indonesia/ Dr. Cipto Mangunkusumo National General Hospital, Jakarta

INTRODUCTION

Odontogenic sinusitis (OS), also known as odontogenic maxillary sinusitis or maxillary sinusitis of dental origin, refers to bacterial maxillary sinusitis, with or without extension to other paranasal sinuses, secondary to either adjacent infectious maxillary dental pathology, or following complications from dental procedures. OS accounts for 10–14% of the total maxillary sinusitis. From all the total number of unilateral maxillary sinusitis, OS accounts for 75% of cases.[1]

The floors of maxillary sinus are close to molar roots, and varies in thickness up to 12 mm. It can be interrupted with exposed tooth roots in patients with bone loss. The respiratory epithelium (also known as the Schneiderian membrane) of the maxillary sinus can be in direct contact with periodontal membrane of the tooth roots, which provide a potential source of contamination.[2] From anatomical perspective, the second molar's roots are the closest to the sinus floor measuring an average of 1.97 mm, nevertheless some studies had concluded that the first molars are the most commonly affected by periodontal disease, and endodontic pathology as the cause of sinus infections.[1]

Iatrogenic injury is the most frequent cause of OS (around 56%), and majority of cases arise in people who have had dental procedures, such as dental extractions, and endodontic treatments. It can also result from odontogenic infections, for instance dental caries, endodontic infections, periapical lesions, etc.), and traumatic injuries of the maxillary bone.[3] Anaerobic bacteria, such as *Fusobacterium*, *Prevotella*, and *Porphyromonas*, are the majorities of the nasal microbiome of OS. *Peptostreptococcus* was also found in other studies.[4]

The important aspects of diagnosing OS are suspecting OS based on typical clinical features such as patient complaint of foul-smelling, purulent secretion from middle meatus on nasal endoscopic examination, unilateral maxillary sinus opacification, and possible dental pathology on CT scan, and odontogenic bacteria in sinus culture. Subsequently, the otorhinolaryngologist will confirm sinusitis, and dental provider will confirm odontogenic pathology as the sources of sinusitis.[5]

The radiological examination is important in the diagnosis of OS. Limited efficacy of two-dimentional (2D) imaging can be used, include periapical, panoramic, and Waters radiographs. All 2D studies frequently degrades anatomic relationships due to superimposition. By far, the most common imaging study currently used is a non-contrast computed tomography (CT) scan of the paranasal sinuses.[2,5] CT imaging of OS presents with unilateral maxillary

sinus changes marked by mucosal thickening, or total opacification. Regarding dental imaging, multiple studies have demonstrated cone-beam CT being superior to periapical radiography, for detecting periapical lesions from apical periodontitis. However, cone-beam CT is more costly, and is not as widely available.[5]

The target of therapy in OS is to eliminate the underlying cause, relieve symptoms, and restore the normal function of the sinus. The therapeutic algorithm usually includes two stages: conservative and surgical.[2,5] Conservative therapy consists of antibiotics, nasal steroids, decongestants, saline nasal irrigation, and dental treatments.[3] Among the results of studies examining the effectiveness of conservative therapy, there was a significant variation, with the results ranging between 36% and 95%. The duration of antibiotic treatment in OS should be at least 14 days, or at least 7 days after the resolution of symptoms, but some authors recommended antibiotic treatment for 21–28 days.[1] Appropriate antibiotic therapy for OS should initially be given targeting aerobe and anaerobe bacteria. For this reason, amoxicillin combined with clavulanate, which is a beta lactamase inhibitor, is preferred.[1,2]

If conservative therapy is successful in curing sinusitis, unnecessary sinus surgery can be avoided, which lowers the risk of perioperative complications and discomfort associated with sinus surgery, as well as overall medical costs. But, if conservative therapy fails, sinus surgery is usually required to remove the cause of the pathology, to allow the correct drainage and ventilation of the sinus, and to prevent disease recurrence.[6]

In the past, the classical Caldwell-Luc procedure was the main surgical management of maxillary sinus disease, but associated with the disadvantages of large trauma and many complications. At present, endoscopic sinus surgery (ESS) is regarded as the gold standard surgery. It has shown excellent effect, especially when the osteomeatal complex (OMC) is blocked. ESS provides a large middle meatal antrostomy, which improves visualization for the entire maxillary sinus through a smaller surgical window. It has small surgical trauma and optimal exposure, and provides maximum elimination of infection in maxillary sinus by opening OMC, and removing sinus lesion to restore normal drainage and ventilation, while preserving the healthy mucosa, thereby reducing possible complications.[4]

However, because the management protocol of OS is not well established, and there is no consensus for the optimal timing of endoscopic sinus surgery (ESS) for OS, doctors are often unsure about the best treatment strategy to follow – dental treatment first, ESS first, or both simultaneously.[7] The necessity to undergo ESS in the early stages is controversial, because some cases have been reported to be cured with just medical management and dental treatment. Moreover, if the causative teeth were not treated, sinusitis might persist after ESS.[7,8]

This study was aimed to identify prognostic factors in patients with OS that increase the likelihood of undergoing ESS after conservative treatment failure. We formulated our clinical question as P (Population): Odontogenic sinusitis patients treated by conservative therapies; Intervention/Comparation (I/C): Prognostic factors such as smoking history, high Lund-Mackay Score, ostiomeatal complex blockage, history of dental procedure prior to OS; and Outcome (O): no clinical improvement.

The proposed question in this study were the prognostic factors such as smoking habits, high Lund-Mackay score, ostiomeatal complex blockage, and history of dental procedure prior to OS. Did these factors affect medicamentosa and dental treatment failure in OS?

CASE ILLUSTRATION

A 27 years old male, after being treated by antibiotic, decongestant, and anti-inflammation,

was referred to ENT Department of Persahabatan Hospital with chief complaint foul-smelling purulent rhinorrhea and post nasal drip, along with nasal blockage, hyposmia and left maxillary facial pain for about 1 year. He was an active smoker since his adolescence, with the smoking frequency of around 8-10 cigarettes/day. History of dental cavities, implants, dental extractions, and trauma at dental region were all denied. Extraction of left upper third molar was already performed 1 month previously by dentoalveolar surgeon under local anesthesia.

On general physical examinations, no significant abnormalities were found. In the right nasal endoscopy examination, all within normal limits, while on the left nasal endoscopy examination it was found narrowed nasal cavity, inferior turbinate edema, purulent and pulsating discharge from middle meatus, bulging and edematous uncinate process, and occluded ostiomeatal complex. Patient was treated by conservative treatments included oral antibiotic, saline nasal irrigation, intranasal corticosteroid, and decongestant; and CT scan of paranasal sinuses was performed. From the CT scan of paranasal sinuses there were total opacification in the left maxillary sinus, partial opacification of anterior ethmoid sinus, obstructed ostiomeatal complex and periapical lucency at left second molar. Endoscopic sinus surgery was scheduled, and the patient was re-consulted the patient to the dentoalveolar surgeon for evaluation whether they had further management. Afterwards, they diagnosed the patient with irreversible pulpitis and planned for conservative treatment.

The endoscopic sinus surgery was performed. There was no complication during surgery. Three weeks after surgery, sinus ostium was broad opened and no purulent secretion was found.

METHOD

We defined the keywords based on PICO and searched the evidence through bibliographic database (PubMed, Cochrane, and Hand-searching) and selected with eligibility criteria. We included this study with a systematic review design, or prospective or retrospective cohort study. The study must be published in English between the year of 2014-2024. Odontogenic sinusitis (OS) only mentioned minimally in sinusitis guidelines. The recent 2020 European Position Paper on Rhinosinusitis (EPOS) briefly discussed OS as the cause of sinusitis, but did not discuss diagnostic or therapeutic recommendations. According to the consensus on diagnosing OS by Craig et al.[5], OS had received significantly less attention in the literature compared to rhinosinusitis, so this study covered the newest literatures in the past 10 years.

The inclusion criteria were: (1) a clinical diagnosis of sinusitis of suspected odontogenic origin, supported either by endoscopy or radiology; (2) ENT specialist and dentist agreement on the odontogenic focus; (3) had underwent conservative treatment e.g. antibiotic, steroid, and dental treatment. The exclusion criteria were: complicated odontogenic sinusitis (orbital, osseous, or intracranial involvement).

Type of prognostic factors in odontogenic sinusitis with conservative treatment, were all factors such as history of high Lund-Mackay score including ostiomeatal complex involvement, smoking, history of dental procedure prior to developing odontogenic sinusitis.

Type of outcome should be observed on how was the clinical improvement after medical and dental treatment. After a period of at least 2-4 weeks, a follow-up examination should be conducted to assess the healing progress of the odontogenic sinusitis. If there were no signs of healing, or if the symptoms persisted, sinus surgery might be required.

The evidence selected was appraised by at least two research members, using Oxford Centre for Evidence-based Medicine (CEBM) worksheet for prognostic study.

RESULT

Since the issue of OS was underreported, we expanded the method of literature searching by using only one term "odontogenic sinusitis", and all its synonyms. After conducting literature searching on two large data base Medline and Cochrane, also Hand-searching, it was found 309 articles related to our term.

A screening of duplication and title/ abstract were performed. Studies that did not match with the inclusion criteria were excluded. In the end, the authors obtained three studies to be appraised that fit to our clinical settings: Yoo et al.[8], Mattos et al.[9], and Kim et al.[10]

Two of three studies design were prospective cohort studies, and all of them evaluated prognostic factors that affected the failure of medical and dental treatment in OS. Yoo et al.[8] in their study evaluated 33 patients with OS due to dental caries and periapical abscess. They were initially managed with dental treatment, along with medication and saline nasal irrigation without ESS. They also evaluated smoking status and total Lund-Mackay score in two groups according to the results of medical management and dental treatment. After duration of antibiotic use of 23.95±11.32 days, and the time taken to cure was 37.23±26.07 days, twenty-two patients (67%) were cured by medication and dental treatment without ESS, while 11 patients (33%) had to undergo ESS. Patients with smoking habits and high Lund-Mackay score were recommended to undergo early ESS. Mattos et al.[9] collected data from previously constructed database and found 43 patients underwent treatment for OS. They were treated medically and referred to dental evaluation prior to pursuing ESS. They also evaluated Lund-Mackay score and the history of dental procedure as prognostic factors that contributed to the failure of conservative treatment in OS. Lund-Mackay scores were analyzed by each components, and OMC involvement was the only statistically significant. Twenty-one patients (48%) with OMC involvement and prior dental procedure had to undergo ESS. The last, Kim et al.[10], in their study, compared conservative and surgical groups for analysis. Nineteen patients who were treated for OS developing in relation to dental implant: 4 patients (21%) were successfully treated conservatively, while 15 patients (79%) underwent surgical treatment. They concluded that longer symptom duration, high Lund–Mackay CT score, complete obstruction of the ostiomeatal unit (OMU), and the damaged of maxillary sinus floor on coronal CT images, were significantly more severe conditions in the surgical group.

In this evidence-based case report, there were 3 prognostic studies for the failure of medical and dental treatment in patients with OS. All of these were the representative samples of patient with OS who underwent sinus surgery.

DISCUSSION

Odontogenic sinusitis (OS) is an inflammatory condition of the maxillary, or extended paranasal sinuses, that has a dental etiology. During conservative therapy, besides medical treatment, any dental hygiene treatment, treatment of dental pockets, root canal treatment, caries removal, and tooth extraction, must be performed if necessary. Sinus surgical treatment is advised if conservative treatment is ineffective.[2-4] In our Evidence Based Case Report (EBCR), high Lund-Mackay score, with a narrow range of confidence interval, was the most precision prognostic factor that contributed to the conservative treatment

failure in OS. In contrast, there was a wide range of contraindication in smoking, OMC involvement, history of dental procedure in those studies. However, these factors could have a role as potential prognostic factors although precision was not obtained, that could be caused by a too few numbers of research subjects.

The Lund-Mackay score is the most common method used for evaluating sinus CTscans according to the location of the lesions in the sinuses, depending on partial or complete opacification. It is used to assess the extent and degree of disease in chronic sinusitis. In the Lund-Mackay system, each sinus (maxillary, anterior ethmoid, posterior ethmoid, sphenoid, and frontal) is scored between 0 and 2 (0: no abnormality; 1: partial opacification; 2: total opacification). The ostiomeatal complex was scored as 0 (no obstruction) or 2 (obstruction).[8,11]

Study by Yoo et al.[8] concluded the mean of Lund-Mackay in non-ESS group was 3.36±1.22, which inline with another study by Mattos et al.[9] concluded that the non-ESS group mean score of 3.7. Both of their studies showed that there was a significant relationship between the Lund-Mackay score based on CT scan findings with patients' clinical status and treatment response. The Lund-Mackay was significantly higher in patients who did not respond well to medication (afterward requiring surgical treatment), than in patients who responded well to medication. Since a high Lund-Mackay score indicated that more sinuses were involved beyond the maxillary sinus, describing the extent of sinus involved were severe and wide, so ESS was required to achieve a complete cure.[8,9,12]

The frontal, maxillary, and anterior ethmoid air cells, ultimately share a common channel for drainage and ventilation, which is represented by the OMC. An extension of inflammation from the maxillary sinus to the OMC may lead to other sinuses becoming affected. Anatomic variations also can impair mucous drainage or narrow the OMC, which predispose the development of sinusitis and treatment failure. The understanding of the complex and variable anatomy of the sinuses and their drainage pathways is therefore imperative in successful management of OS.[11,12] Furthermore, the finding of OMC blockage may represent advanced or severe disease, that will be more difficult to treat with only conservative treatments. The OMC obstruction can be a consideration for clinician, concerning the potential need for ESS to relieve symptoms, and allowing a better treatment planning.[8]

Study of Yoo et al.[8] found that smoking patients with odontogenic sinusitis were the ones who eventually underwent ESS. Tobacco smoke stimulates the nasal mucosa, increases intranasal air resistance, and causes physiological responses such as nasal congestion and rhinorrhea. Study of Christensen et al.[13] summarized prominent findings about the possible effects of smoking on the sinonasal mucosa, from available in vitro and in vivo studies. In vitro studies had suggested number of possible mechanisms with smoking causing alterations in chloride ion transport, reduced mucociliary clearance, and/or reduced ciliary generation. In vivo results were also supporting with possible changes in histology, mucociliary transport and inflammatory cytokines underlying disease development. Finally, more recent studies had evaluated how smoking affects the microbiome of the sinonasal mucosa, and had shown that smoking both altered the sinonasal microbiome and increased the risk of biofilm formations. Lieu and Feinstein's research cited by Yoo et al.[8], also conducted a study on the prevalence of smoking and sinusitis, and found that smokers showed a significantly higher prevalence of sinusitis when compared with non-smokers. These results strengthened the possibility that smokers were more likely to require ESS after the failure of dental treatment.

Various odontogenic pathologies can cause OS, including pulpitis, periapical lesions, periodontitis, oroantral fistulas, or foreign bodies in the sinus related to dental treatment. The most common cause is periapical lesions (periodontitis) following root canal treatment (endodontic). When the root canals of teeth are incompletely filled with a filling material during endodontic treatment, insufficient root canal treatment causes pulpitis and pulp necrosis in the root canal at the root apex. The pathological studies of the causative teeth showed pulpal necrosis and apical lesions after the root canal treatment. The pulp inflammation causes apical lesions (apical periodontitis), consequently, odontogenic infection such as alveolar ostitis occurs. When the odontogenic inflammation is constantly presented at the floor of the maxillary sinus, the maxillary sinus is at risk of becoming inflamed.[7] Patients who had underwent a dental procedure prior to presenting to otolaryngologists with OS, may represent patients who either have a severe odontogenic infection, or may have had an iatrogenic etiology to their infection. These individuals may represent a population with more severe or recalcitrant disease, that requires ESS for symptoms resolution.[9]

In conclusion, high total Lund-Mackay is an important precision prognostic factor that contributed for medicamentous and dental treatment failure in odontogenic sinusitis. This is a crucial information for clinician, concerning the potential need for ESS, allowing an early better treatment planning for the patients. However, for the applicability, paranasal sinus CT at early phase for odontogenic sinusitis in our clinical setting is still become a consideration. It depends on health provider resources.

As the answer to our clinical question, the total Lund-Mackay score in our patient was 5, appreciably higher than those who did not need ESS, besides he had smoking history and OMC blockage. These could be the prognostic factors that might cause the failure of medicamentous and dental treatment, so that the ESS had to be performed in our patient. However, we recommended further research with suitable method to obtain accurate result.

REFERENCE

1. Martu C, Martu MA, Maftei GA, Diaconu-Popa DA, Radulescu L. Odontogenic Sinusitis: From Diagnosis to Treatment Possibilities-A Narrative Review of Recent Data. Diagnostics, 2022; 12(7):1600.
2. Newsome HA, Poetker DM. Odontogenic sinusitis: Current concepts in diagnosis and treatment. Immunol Allergy Clin N Am. 2020; 40(2):361-9.
3. Rangics A, Répássy GD, Gyulai-Gaál Rangics A, Répássy GD, Gyulai-Gaál S, Dobó-Nagy C, Tamás L, Simonffy L. Management of Odontogenic Sinusitis: Results with Single-Step FESS and Dentoalveolar Surgery. J Pers Med. 2023; 13(9):1291.
4. Lin J, Wang C, Wang X, Chen F, Zhang W, Sun H, et al. Expert consensus on odontogenic maxillary sinusitis multi-disciplinary treatment. Int J Oral Sci. 2024; 16(1):11.
5. Craig JR, Poetker DM, Aksoy U, Allevi F, Biglioli F, Cha BY, et al. Diagnosing odontogenic sinusitis: an international multidisciplinary consensus statement. Int Forum Allergy Rhinol. 2021; 11(8):1235-48.
6. Sabatino L, Pierri M, Iafrati F, et al. Odontogenic Sinusitis from Classical Complications and Its Treatment: Our Experience. Antibiotics (Basel). 2023; 12(2):390.
7. Sato K, Chitose SI, Sato K, Sato F, Ono T, Umeno H. Pathophysiology of current odontogenic maxillary sinusitis and endoscopic sinus surgery preceding dental treatment. Auris Nasus Larynx. 2021; 48(1):104-9.
8. Yoo BJ, Jung SM, Lee HN, Kim HG, Chung JH, Jeong JH. Treatment Strategy for Odontogenic Sinusitis. Am J Rhinol Allergy. 2021; 35(2):206-12.

9. Mattos JL, Ferguson BJ, Lee S. Predictive factors in patients undergoing endoscopic sinus surgery for odontogenic sinusitis. In Int Forum Allergy Rhinol. 2016; 6(7):697-700.

10. Kim SJ, Park JS, Kim HT, Lee CH, Park YH, Bae JH. Clinical features and treatment outcomes of dental implant-related paranasal sinusitis: A 2-year prospective observational study. Clin Oral Implants Res. 2016; 27(11): 100-4.

11. Gholam ADK, Gharibi R. Studying the relationship between the Lund Mackay score and response to medical treatment in patients with chronic sinusitis. Int Tinnitus J. 2020; 24(2):96-101.

12. Nandakumar BS, Niles NNA, Kalish LH. Odontogenic maxillary sinusitis: the interface and collaboration between rhinologists and dentists. J Otorhinolaryngol Hear Balanc Med. 2021; 2(4):8.

13. Christensen DN, Franks ZG, McCrary HC, Saleh AA, Chang EH. A Systematic Review of the Association between Cigarette Smoke Exposure and Chronic Rhinosinusitis. Otolaryngol Head Neck Surg. 2018; 158(5):801-16.