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Relationship between positive bacterial culture in maxillary sinus and surgical outcomes in chronic rhinosinusitis with nasal polyps

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ABSTRACT

Objectives: There are many studies on clinical prognosis following endoscopic sinus surgery (ESS) for the treatment of chronic rhinosinusitis with nasal polyp (CRSwNP). However, there are no independent reports on bacterial infection as a factor that influences surgical outcomes. We investigated the association between bacterial infection and surgical outcomes following ESS.
Methods: This retrospective review of medical records was performed on 71 patients with CRSwNP that was refractory to medical treatment and who were diagnosed between July 2007 and June 2012. The extent of the polyps and the Lund–Mackay CT score (L–M score) were preoperatively evaluated in all the patients. For this analysis, patients were classified into three groups (normal flora, culture-positive, and culture-negative) according to their intraoperative bacterial culture results. We compared the objective endoscopic findings between these groups at 6-months postsurgery.
Results: Bacteria were cultured in 55 of the 71 patients (77%). Of these, 43 patients (61%) demonstrated endoscopic improvement at the 6-month follow-up examination. The preoperative L–M score and polyp grade demonstrated no significant statistical differences in terms of surgical outcome, but the cure rate was statistically higher in culture-negative patients in comparison with normal flora and culture-positive patients (87.5% vs. 46.2% vs. 54.8, respectively).
Conclusion: Intraoperative culture results can be a prognostic factor for the clinical outcomes of ESS in CRSwNP patients. Hence, the intraoperative culturing of pathologic secretions and the postoperative administration of susceptible antibiotics could improve surgical results.

1. Introduction

Chronic rhinosinusitis (CRS) is defined as the inflammation of the paranasal sinuses for >12 weeks [1]. CRS is traditionally considered a disorder of bacterial etiology. The occurrence of bacterial infection in CRS can be either a primary cause or a result of inflammatory disease. In primary bacterial CRS, the colonized pathogens cause chronic immune system upregulation and inflammation [2]. The treatment of CRS first requires medical management. If medical treatment fails, surgery should be considered, including endoscopic sinus surgery (ESS) [3,4]. Among patients with CRS, the presence of a nasal polyp (NP) considerably decreases the surgical success rate from 50% to 70% [3]. NP demonstrates high recurrence rate and is a major cause of ESS failure [3,4].

Many studies to date have examined the prognostic factors that affect the success rate of ESS [3,5–7]. Although bacterial infection plays a major role in CRS, there have been no independent studies on the relationship between bacterial infection and surgical outcomes following ESS for the treatment of CRS, especially among patients with NP. Our present study evaluated the intraoperative bacterial culture results that influence the objective surgical outcomes of CRSwNP patients who underwent ESS.

2. Patients and methods

We included patients who underwent endoscopic sinus surgery for CRSwNP between July 2007 and June 2012. All patients had a history of medical treatment failure. We initially recruited 150 patients with intraoperative purulent secretion at the middle

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meatal antrostomy site. Of these cases, patients with history of previous ESS or diseases that may affect CRS prognosis (e.g., asthma, systemic disease, adrenal insufficiency, chronic kidney disease, transplantation) were excluded. A final study cohort of 71 patients was analyzed.

To evaluate the relationship between preoperative severity and prognosis, preoperative CT scans of the sinuses were staged by two independent otolaryngologists using the Lund–Mackay scoring system (L–M score) [8]. Patients were classified into two groups according to their L–M scores, which represent the severity and extent of disease: mild-to-moderate (score <15) or severe (score ≥16) [9]. Polyp extent was graded by nasal endoscopic examination according to the following scale: (I) polyps present within the middle meatus; (II) polyps present beyond the middle meatus; or (III) large polyps extending to or below the lower border of the inferior turbinate or polyps medial to the middle turbinate [9].

ESS was performed by a senior surgeon who co-authored this study (BJL), who aseptically obtained cultures from the maxillary sinus after middle meatal antrostomy using non-used Blakesley forceps. The culture bottle was transported to the microbiology laboratory for aerobic and anaerobic culturing immediately following the procedure. Quantitative cultures were performed. Each sample was inoculated to blood agar plate, MacConkey agar and chocolate agar, and then incubated at 37 °C in a 5% CO_2 incubator for aerobes. Brucella agar was incubated in an anaerobic atmosphere in anaerobic chambers. The plates were examined every day. All cultured bacteria were identified on the basis of standard microbiologic techniques. We classified the patients into three groups according to bacterial growth. The first group is the "normal flora group" such as *Staphylococcus epidermidis* and *Corynebacterium* species, second is the "culture-positive group" which is the growth group excluding normal flora and lastly, the "culture-negative group" without any bacterial growth. During the postoperative period, all patients were administered oral antibiotics (500 mg clarithromycin twice daily for the first 2 weeks, followed by 250 mg ciprofloxacin twice daily for 1 week). At 3-weeks postoperation, we also prescribed oral steroids (8 mg methylprednisolone twice daily for a week) with topical nasal steroids (ciclesonide for 1 month; Omnaris, Nycomed, Korea).

Objective postoperative outcomes were evaluated according to the endoscopic findings at 6-months postsurgery. All endoscopic photographs were taken using a 30-degree endoscopy at the outpatient department and evaluated by two board-certified otorhinolaryngologists. Secretion status (e.g., mucous, purulent, mucopurulent) and mucosal changes (e.g., polypoid, polyp) were also evaluated. Accordingly, patients were divided into two groups: healed or non-healed. The healed group was defined as patients with neither pathologic secretion nor polypoid mucosal swelling on endoscopic exam; all other patients were classified as non-healed. The chi-square test was used to analyze prognosis after bacterial culturing. Statistical analyses were performed using SPSS for Windows (version 12.0; SPSS, Inc., Chicago, IL). In this study, $p < 0.05$ was considered statistically significant.

3. Results

Bacteria cultures were obtained for 55 of the 71 study patients (77%). The culture-positive group included aerobes, anaerobes or both. The culture-positive group was then classified by bacterial species. Among the culture-positive group, patients with two or more cultured bacteria were 34 (61.8%). The one patient who mixed bacteria were cultured also had Peptostreptococcus species concurrently. The antibiotics-resistant bacteria were not cultured in our study including methicillin-resistant *Staphylococcus aureus*. Results of the bacterial strains are shown in Table 1. There were no significant differences found between groups in terms of the distribution of age or sex (Table 2). The mean preoperative L–M score was 14.2. According to this scoring system, 39 patients were classified in the mild–moderate group, while 32 patients were classified in the severe group. Twenty-four patients (68.5%) in the mild–moderate group were classified as healed vs. 19 patients (59.4%) in the severe group (Table 3). There was no significant difference between the L–M score and treatment outcomes ($p = 0.853$).

When classifying patients according to the extent of the polyps, 13 (65.0%) and 7 grade I patients (35.0%) were classified as healed and non-healed, respectively, vs. 16 (51.6%) and 15 grade II patients (48.4%) and 14 (70.0%) and 6 grade III patients (30.0%), respectively (Table 4). There was no significant difference found between the extent of nasal polyps and treatment outcomes.

Table 1
Bacterial culture results of the 71 CRS patients analyzed in this study.

Culture results	No. of patients (%)
Negative	16 (22.5)
Positive	55 (77.5)
Aerobe and facultative anaerobe	
Gram-positive	
Corynebacterium species	14 (25.5)
Staphylococcus aureus	3 (5.5)
Staphylococcus epidermidis	26 (47.3)
Staphylococcus hominis	1 (1.8)
Staphylococcus lugdunensis	1 (1.8)
Streptococcus milleri	1 (1.8)
Streptococcus viridans	2 (3.6)
Gram-negative	
Acinetobacter baumani	1 (1.8)
Enterobacter aerogenes	6 (10.9)
Haemophilus influenza	5 (9.0)
Klebsiella pneumonia	2 (3.6)
Pseudomonas aeruginosa	1 (1.8)
Pseudomonas stutzeri	1 (1.8)
Anaerobe bacteria	
Gram-positive	
Peptostreptococcus species	1 (1.8)
Peptostreptococcus magnus	2 (3.6)
Peptostreptococcus micros	4 (7.2)
Propionibacterium acne	19 (34.5)
Mixed bacteria	1 (1.8)

Table 2
Age and sex distribution of the study patients according to culture results.

	Culture results			*p*
	Normal flora	Positive	Negative	
Age (years)	41.4 ± 20.3	39.6 ± 16.7	47.3 ± 18.1	0.349
Sex (M:F)	8:5	24:18	10:6	0.919

Table 3
Surgical outcomes of the mild–moderate and severe CRS groups.

	Lund–Mackay score		*p*
	Mild–moderate (%)	Severe (%)	
Healed	24 (68.5)	19 (59.4)	0.853
Non-healed	15 (31.5)	13 (40.6)	

Table 4
Comparison of surgical outcomes in CRS patient according to the extent of the polyps.

	Extent of polyps			*p*
	Grade I (%)	Grade II (%)	Grade III (%)	
Healed	13 (65.0)	16 (51.6)	14 (70.0)	0.377
Non-healed	7 (35.0)	15 (48.4)	6 (30.0)	

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