Clinical characteristics and immunological profiles of obese patients with chronic rhinosinusitis

Ju Ha Park

The Graduate School
Yonsei University
Department of Medicine

Clinical characteristics and immunological profiles of obese patients with chronic rhinosinusitis

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Ju Ha Park

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This certifies that the Master's Thesis of Ju Ha Park is approved.

Thesis Supervisor [MIN-SEOK RHA]

Thesis Committee Member [HYUNSOO CHO]

Thesis Committee Member [KYUNG HWAN KIM]

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Yonsei University
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ABSTRACT

Clinical characteristics and immunological profiles of obese patients with chronic rhinosinusitis

Objective: Accumulating evidence shows that obesity influences the immune system and promotes chronic inflammation. In this study, I aimed to investigate the clinical characteristics and immunological profiles of obese patients with chronic rhinosinusitis (CRS).

Methods: A total of 126 patients diagnosed with CRS with nasal polyp (CRSwNP) were included, and nasal tissue samples were obtained from the patients during the surgery. The patients were divided into obese and non-obese groups based on BMI. Data on patients' demographics, comorbidities, surgical history, CT severity, olfactory and gustatory function, and allergic sensitization status were collected. Infiltration of neutrophils and eosinophils into nasal tissues was analyzed. The expression of inflammatory mediators in nasal tissue homogenates were evaluated using Luminex multiplex immunoassays.

Results: The proportion of the obese group among the total patients was 43% (54/126). Compared to the non-obese group, the obese group showed a significantly higher frequency of refractory disease and tended to undergo more revision surgeries. Additionally, tissue neutrophil count and blood monocyte/basophil count were significantly elevated in the obese group than in the non-obese group. There were no significant differences in SNOT-22 score, Lund-Mackay CT score, JESREC score, prevalence of diabetes and asthma, olfactory function, and gustatory function between the two groups. Luminex assays revealed that the obese group expressed significantly lower levels of CCL13 and CCL26, and tended to express lower levels of IL-13. In contrast, a significantly higher level of MMP-2 was observed in the obese group than in the non-obese group.

Conclusion: In summary, obese patients with CRS exhibited poor treatment outcomes. Additionally, more pronounced neutrophilic inflammation and lower expression of type 2 inflammatory mediators were observed in obese patients compared to non-obese patients. These results indicated that obesity could affect the pathophysiology and treatment outcomes in patients with CRS.

Key words : Chronic rhinosinusitis, Obesity, BMI,

I. INTRODUCTION

Chronic rhinosinusitis (CRS) is defined as a chronic inflammation of the nasal and sinus mucosa lasting more than 12 weeks. (1) It can be clinically diagnosed when two or more of the following four cardinal symptoms persist for more than 12 weeks: nasal obstruction, postnasal drip, facial pain/pressure, and hyposmia. (2) Characteristic findings such as purulent discharge, mucosal edema, and nasal polyps (NPs) are observed on nasal endoscopic examination of patients with CRS. Traditionally, the phenotypes of CRS are classified into CRS with NPs (CRSwNP) and without NPs (CRSsNP), based on the presence of polyps. (2)

However, recent studies have revealed that even in patients with the same CRS, different inflammatory patterns appear with, and various subtypes exhibiting distinct pathogenic mechanisms. Since the mid-2010s, based on the heterogeneity of these inflammatory patterns, there has been a growing need for a new classification system of CRS reflecting its pathophysiology or pathogenic mechanisms, and the establishment of corresponding treatment strategies. Inflammatory endotypes, which reflect the inflammatory patterns, can be broadly categorized into the T2 endotype, where type 2 inflammation predominates, and the non-T2 endotype, where type 1 or type 3 inflammation is mixed. Since most studies conducted so far have focused on Western patients, the mechanisms of type 2 CRS, which is more prevalent in Western populations, have been relatively well elucidated. Type 2 inflammation is marked by elevated concentrations of type 2 cytokines such as IL-4, IL-5, and IL-13, elevated IgE levels, and tissue eosinophilia (3) When various respiratory stimuli, such as allergens and bacteria, irritate the airway mucosa, epithelial cells secrete IL-25, IL-33, and TSLP, which stimulate the differentiation of Th2 cells and type 2 innate lymphoid cells (ILCs). The type 2 cytokines IL-4, IL-5, and IL-13 secreted by these cells are widely recognized to contribute to disease pathogenesis. Among these cytokines, IL-5 is reported to act as a growth factor for eosinophils, primarily causing eosinophilic inflammation. In contrast, in non-T2 CRS, IFN-γ and IL-17A are reported to play important roles. IFN-γ induces differentiation into M1 macrophages, while IL-17A is known to promote neutrophilic inflammation. (4)

Obesity is a widespread global health issue, with its prevalence steadily increasing. Obesity arises from a multifaceted interplay of genetic, social, and environmental factors. (5) Obesity is associated with various complications such as hypertension, diabetes, cardiovascular disease, and non-alcoholic fatty liver disease, and increases the risk of cancer, autoimmune diseases, and infections. Additionally, obesity is known to induce chronic inflammation in various organs. It causes immune dysregulation due to metabolic overload, with changes in hormones that regulate immune cell metabolism and function contributing to inflammation. (6) In particular, several studies reported that adipokines, such as leptin, secreted during obesity lead to changes in both innate and adaptive immunity. These changes include an elevation in Th17 cells and a reduction in regulatory T cells. (7)

Recent studies have reported that obesity is one of the prominent risk factors for asthma as well as airway inflammation and decreased lung function. (8) Similarly, previous research has shown a significant association between obesity and CRS. In a prospective study, it was found that the higher the BMI, the greater the incidence of new cases of CRS. (9) In the obese group, more olfactory dysfunction and purulent discharge were observed, suggesting that obesity potentially have a notable impact on patients with CRSwNP, particularly those who experience recurrence after surgery. (10) Additionally, existing literature indicates that the association between obesity and CRSsNP is weaker compared to patients with CRSwNP. (10)

However, it remains unclear whether treatment outcomes and inflammatory patterns differ based on obesity in patients with CRS. Therefore, I aimed to investigate the clinical characteristics and immunological profiles of obese patients with CRS.

2. METHODS

2.1. Study subjects

From November 2021 to July 2023, a total of 126 patients with CRS who underwent endoscopic sinus surgery (ESS) at Severance Hospital were enrolled in this study. The diagnostic criteria for CRS followed the 2020 European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS) guidelines (2). Chronic inflammation of the nasal and sinus mucosa lasting more than 12 weeks with two or more of the following symptoms: 1) nasal obstruction/congestion/blockage, 2) sinus discharge, 3) facial pain/pressure, 4) reduced or lost sense of smell. The inclusion criteria for study participants were as follows: 1) adult patients aged 19 or older, 2) patients who underwent ESS after being diagnosed with CRS, 3) patients from whom sinus tissues were collected during surgery.

CRS was diagnosed based on patient history and sinus endoscopy, and the presence of NPs was confirmed through nasal endoscopy. Clinical information including patient's sex, age, height, weight, and preoperative blood test results were obtained. Additionally, comorbidities such as hypertension and diabetes, the presence of asthma, medication history including biologics, steroids, and immunosuppressants, revision surgery history, and treatment refractoriness were investigated. During surgery, NPs or sinus mucosa were collected, followed by neutrophil elastase and hematoxylin & eosin (H&E) staining to measure neutrophil and eosinophil counts. All patients underwent preoperative computed tomography (CT) to assess the presence and severity of CRS, which was quantified using the Lund-Mackay CT severity score (11). The Japanese Epidemiological Survey of Refractory Eosinophilic Chronic Rhinosinusitis (JESREC) scoring system was assessed based on whether the disease was unilateral or bilateral, the presence of NPs, blood eosinophilia, and the dominant shadow in the ethmoid sinuses on CT scans (12). Patients also completed questionnaires on allergic symptoms and 22-item Sino-Nasal Outcomes Test (SNOT-22), which indicates a disease-specific quality-of-life metric. Olfactory function was evaluated using the YOF test and VAS scores, while gustatory function was evaluated using the YSK gustatory test. Specific allergen sensitivities were confirmed through Multiple Allergen Simultaneous Testing (MAST) and skin prick tests. The definition of obesity followed the guidelines of the Korean Society for the Study of Obesity: a BMI of 18.5–22.9 kg/m² is considered normal, 23–24.9 kg/m² is overweight, and a BMI of 25 kg/m² or higher is classified as obese. (13)

2.2. Tissue homogenate preparation

Nasal tissue was obtained during ESS. The tissue (0.1 g) was diluted in 1 mL 0.9% NaCl solution containing a protease inhibitor cocktail 1X (Roche Diagnostics, Mannheim, Germany). Tissue Lyzer II (Qiagen, Hilden) was used to homogenize this mixture, and the supernatatns were stored at −80 °C until use.

2.3. Measurement of protein expression

The concentrations of cytokines in nasal tissue homogenates, including BMP-2, CCL2 (MCP-1), CCL3 (MIP-1α), CCL4 (MIP-1β), CCL8 (MCP-2), CCL13 (MCP-4), CCL17 (TARC), CCL19 (MIP-3β), CCL20 (MIP-3α), CCL24 (Eotaxin-2), CCL26 (Eotaxin-3), CCL28, CXCL10 (IP-10), CXCL13 (BLC/BCA-1), Oncostatin M (OSM), Periostin (OSF-2), TNF-α, TRANCE (RANK L), Osteoactivin (GPNMB), S100A8, TSLP, uPA (Urokinase), Myeloperoxidase (MPO), PDGF-BB, Fibronectin, G-CSF, GM-CSF, Granzyme B, IFN-gamma, IL-1β, IL-4, IL-5, IL-6, IL-8 (CXCL8), IL-10, IL-11, IL-12p70, IL-13, IL-17A, IL-17E (IL-25), IL-21, IL-23, IL-33, MMP-1, MMP-2, MMP-3, MMP-7, MMP-8, MMP-9, MMP-12 were analyzed using the Human Luminex Discovery Assay (R&D systems, Minneapolis, MN, USA), in accordance with the manufacturer's instructions. All protein levels in the tissue homogenates were normalized to the concentrations of total protein.

2.4. Statistical analysis

Statistical analyses were performed using SPSS (version 22.0; IBM Corporation, Armonk, NY, USA), GraphPad Prism (version 10.3.1; GraphPad Software, San Diego, CA, USA). Categorical variables were subjected to analysis through Fisher's exact test or the chi-square test. The Mann–Whitney U test was used to conduct comparative analysis between two distinct groups. P values less than 0.05 were considered to be statistically significant.

3. RESULTS

3.1. Clinical characteristics of obese and non-obese patients with CRS

This study included a total of 126 individuals diagnosed with CRS. According to their BMI, patients were classified into the obese (n=54) and non-obese (n=72) groups. Significant differences were found in demographic and clinical characteristics between the two groups **(Table 1)**. The ratio of male was higher in the obese group (85.2%) compared to the non-obese group (68.1%, p = 0.027). Additionally, the proportion of hypertension was remarkably higher in the obese group (31.5% vs. 9.7%, p = 0.027). However, no significant differences were observed in age, the prevalence of diabetes, or asthma history between the groups

The obese group demonstrated a significantly higher proportion of refractory disease (42.6% vs. 23.6%, p = 0.024), suggesting that obesity may predispose patients to more challenging disease courses. Revision surgeries were more frequent in the obese group (35.2% vs. 22.2%), although this difference was not statistically significant (p = 0.108). Other clinical factors, including Lund-Mackay CT score, JESREC score, and SNOT-22 score, exibitied no significant differences between the two groups.

3.2. Comparison of blood and nasal tissue inflammatory cell count between obese and non-obese patients

In the blood laboratory tests, the counts and proportions of each type of white blood cell were analyzed (**Table 2**). In obese patients, monocyte and basophil counts were significantly elevated in the obese group compared to the non-obese group (p = 0.024 and p = 0.035, respectively). There were no significant differences in the counts or proportions of eosinophils, neutrophils, and lymphocytes between two groups (**Figure 1A, 1B**). The average tissue eosinophil count was higher in the non-obese group; however this difference was not statistically significant (p = 0.146) (**Figure 1C**). However, the tissue neutrophil count was significantly elevated in the obese group compared to the non-obese group (p = 0.048) (**Figure 1D**).

Table 1. Clinical characteristics of obese and non-obese patients with CRS

	Obese (n = 54)	Overweight + Normal (n = 72)	P-Value
Sex			0.027[b]
Female, n (%)	8 (14.8%)	23 (31.9%)	
Male, n (%)	46 (85.2%)	49 (68.1%)	
Age, years	47.81 ± 15.93	48.47 ± 14.79	0.603[a]
Body mass index	28.03 ± 4.02	22.66 ± 1.64	0.001[a]
Hypertension, n (%)	17 (31.5%)	7 (9.7%)	0.002b
Diabetes mellitus, n (%)	9 (16.7%)	5 (6.9%)	0.086[b]
Asthma, n (%)	9 (16.7%)	14 (19.4%)	0.690[b]
Refractoriness, n (%)	23 (42.6%)	17 (23.6%)	0.024[b]
Revision surgery, n (%)	19 (35.2%)	16 (22.2%)	0.108[b]
Lund-Mackay CT score	14.61 ± 6.23	15.58 ± 5.53	0.428[a]
JESREC	10.96 ± 3.83	11.93 ± 3.81	0.142[a]
JESREC subtype, n (%)	36 (66.7%)	56 (77.8%)	0.164[b]
SNOT22	35.63 ± 18.65	37.13 ± 23.58	0.962[a]
Visual analogue scale	3.93 ± 3.03	3.23 ± 2.91	0.278[a]
Olfactory threshold test	16.11 ± 6.28	15.21 ± 7.04	0.409[a]
Gustatory function test	16.66 ± 4.17	16.41 ± 4.27	0.703[a]
Allergic sensitization, n (%)	35 (64.8%)	44 (61.1%)	0.671[b]

Data are presented as number (%) or mean ± standard deviation.

[a]Statistical analysis was performed using Mann-Whitney U test.

[b]Statistical analysis was performed using the Chi-square test.

Table 2. Laboratory test and leukocyte counts of the obese and non-obese groups.

	Obese (n = 54)	Overweight + Normal (n = 72)	P-Value
Tissue eosinophil count, #/HPF	79.16 ± 105.10	115.58 ± 153.50	0.146[a]
Tissue neutrophil count, #/HPF	29.11 ± 39.63	21.34 ± 43.81	0.048[a]
Blood eosinophil percent, %	4.61 ± 4.05	5.49 ± 4.45	0.129[a]
Blood eosinophil count, #/uL	333.15 ± 314.49	364.03 ± 318.91	0.340[a]
Blood neutrophil percent, %	55.87 ± 8.00	55.41 ± 9.35	0.844[a]
Blood neutrophil count, #/uL	4078.15 ± 1057.73	3774.72 ± 1313.57	0.075[a]
Blood lymphocyte percent, %	31.82 ± 7.24	32.05 ± 8.33	0.925[a]
Blood lymphocyte count, #/uL	2303.70 ± 712.53	2123.47 ± 704.41	0.151[a]
Blood monocyte percent, %	6.34 ± 1.58	5.92 ± 2.00	0.073[a]
Blood monocyte count, #/uL	457.22 ± 147.49	392.08 ± 136.05	0.024[a]
Blood basophil percent, %	0.68 ± 0.35	0.59 ± 0.30	0.184[a]
Blood basophil count, #/uL	49.63 ± 28.35	39.03 ± 22.53	0.035[a]
Serum Total IgE, kU/L	317.86 ± 450.10	201.36 ± 363.13	0.198[a]

Data are presented as number (%) or mean ± standard deviation.

[a]Statistical analysis was performed using Mann-Whitney U test.

[b]Statistical analysis was performed using the Chi-square test.

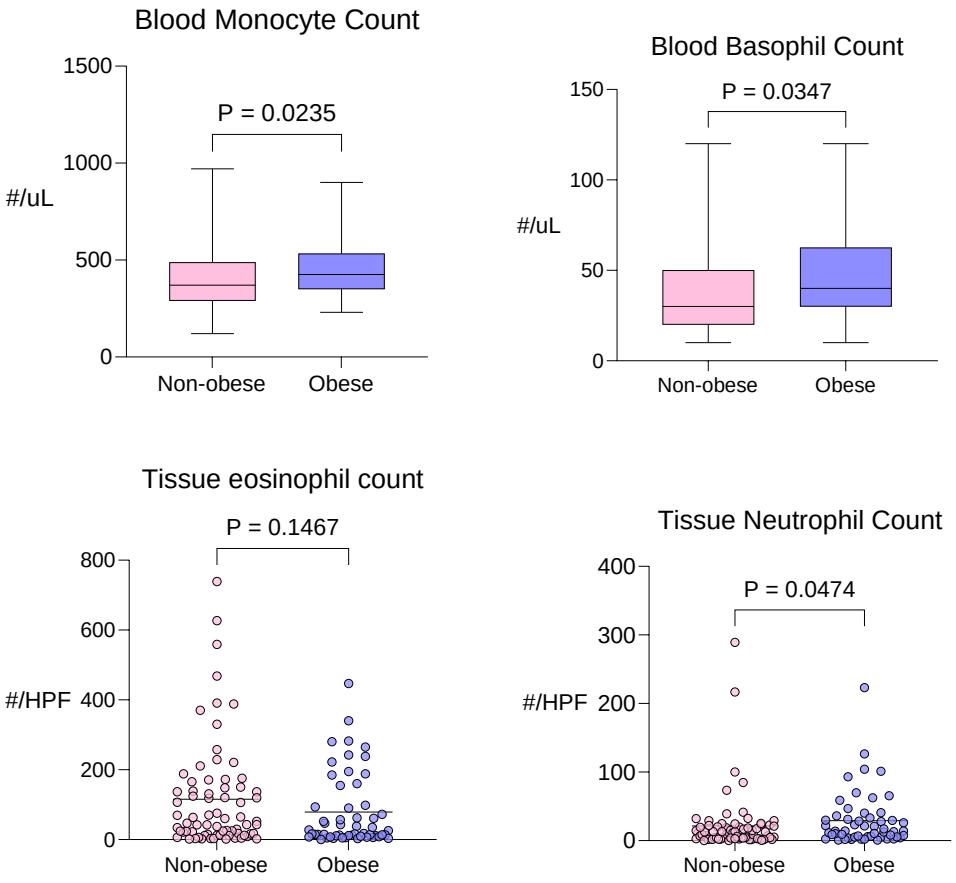

Figure 1. Blood monocyte/basophil and tissue eosinophil/neutrophil counts in the obese and non-obese groups

3.3. Distinct inflammation patterns in the nasal tissue between obese and non-obese patients

Using the Human Luminex Discovery Assay method, I measured the levels of 50 proteins in sinonasal tissues (**Table 3**). Those having significant differences between the obese and non-obese groups are shown in the heatmap (**Figure 2**). The expression levels of these cytokines were shown in **Figure 3**. The obese group expressed significantly lower levels of chemokines related to type 2 inflammation, including CCL13(MCP-4) ($p = 0.008$) and CCL26(Eotaxin-3) ($p = 0.015$), and tended to express lower levels of IL-13 ($p = 0.054$). In contrast, a significantly higher level of MMP-2 was observed in the obese group than in the non-obese group ($p = 0.048$).

Table 3. Immunologic profiles of the obese and non-obese groups.

Protein	Obese (n = 54)	Overweight + Normal (n = 72)	P-Value
BMP-2	19.34 ± 25.26	13.17 ± 8.56	0.294
CCL2 (MCP-1)	389.2 ± 288.03	448.6 ± 565.15	0.695
CCL3 (MIP-1α)	131.48 ± 209.19	102.74 ± 104.97	0.764
CCL4 (MIP-1β)	146.44 ± 140.44	221.4 ± 243.91	0.063
CCL8 (MCP-2)	59.84 ± 43.74	66.23 ± 75.27	0.968
CCL13 (MCP-4)	138.06 ± 186.75	261.74 ± 296.93	0.008
CCL17 (TARC)	29.09 ± 62.89	42.54 ± 62.74	0.223
CCL19 (MIP-3β)	83.45 ± 110.85	57.09 ± 39.26	0.400
CCL20 (MIP-3α)	134.64 ± 245.56	130.71 ± 210.5	0.908
CCL24 (Eotaxin-2)	1901.2 ± 2760.51	2997.79 ± 4202.01	0.107
CCL26 (Eotaxin-3)	68.14 ± 98.3	170.48 ± 258.42	0.015
CCL28	473.35 ± 1266.61	436.35 ± 945.95	0.576
CXCL10 (IP-10)	348.54 ± 1132.49	70.73 ± 81.69	0.368
CXCL13 (BLC/BCA-1)	152.6 ± 339.7	1108.71 ± 3790.38	0.084
Oncostatin M (OSM)	1541.68 ± 1810.68	1238.57 ± 1157.25	0.475
Periostin (OSF-2)	32339.19 ± 22122.24	50919.62 ± 104692.01	0.881
TNF-α	2.82 ± 3.78	3.72 ± 5.34	0.489
TRANCE (RANK L)	30.17 ± 26.21	32.95 ± 29.87	0.954
Osteoactivin (GPNMB)	8670.1 ± 9249.8	6363.41 ± 6136.94	0.174
S100A8	203.76 ± 242.77	195.66 ± 356.33	0.972
TSLP	1.5 ± 3.48	0.78 ± 0.93	0.678
uPA/Urokinase	600.86 ± 718.79	479.87 ± 390.49	0.908
Myeloperoxidase (MPO)	268872.35 ± 283240.27	233069.49 ± 267191.11	0.526
PDGF-BB	186.97 ± 318.12	156.24 ± 178.77	0.678
Fibronectin	238763.93 ± 287156.26	194855.64 ± 171471.6	0.327
G-CSF	192.85 ± 430.49	173.96 ± 488.34	0.702

GM-CSF	7.16 ± 10.97	5.89 ± 5.72	0.927
Granzyme B	462.32 ± 677.65	347.83 ± 673.5	0.333
IFN-γ	6.43 ± 18.92	6.83 ± 19.47	0.126
IL-1β	12.94 ± 23.93	8.39 ± 13.88	0.604
IL-4	32.51 ± 35.42	28.07 ± 14.73	0.764
IL-5	2.21 ± 3.78	3.54 ± 5.32	0.221
IL-6	9.46 ± 12.21	19.64 ± 41.27	0.636
IL-8 (CXCL8)	209.52 ± 203.97	287.76 ± 431.95	0.786
IL-10	2.26 ± 4.35	1.86 ± 2.43	0.991
IL-11	2328.8 ± 2024.15	2139.91 ± 1462.08	0.991
IL-12p70	2.42 ± 6.66	2.68 ± 10.71	0.818
IL-13	120.79 ± 135	188.83 ± 215.69	0.054
IL-17A	4.62 ± 9.4	3.56 ± 7.47	0.454
IL-17E (IL-25)	52.48 ± 50.08	58.16 ± 46.7	0.406
IL-21	7.01 ± 14.41	5.06 ± 4.02	0.413
IL-23	645.35 ± 477.94	730.9 ± 596.21	0.608
IL-33	833.24 ± 910.61	953.56 ± 1327.05	0.777
MMP-1	33.98 ± 46.21	45.76 ± 57.53	0.541
MMP-2	21452.83 ± 20050.94	13449.84 ± 8873.88	0.048
MMP-3	429.99 ± 387.22	442.75 ± 940.14	0.222
MMP-7	13606.46 ± 13347.02	12277.67 ± 14938.44	0.511
MMP-8	14130.23 ± 17912.21	15901.51 ± 22033.23	0.836
MMP-9	43283.93 ± 45039.47	57199.53 ± 112902.24	0.482
MMP-12	46.79 ± 80.12	27.15 ± 24.69	0.738

Data are presented as number (%) or mean ± standard deviation.

Statistical analysis was performed using Mann-Whitney U test.

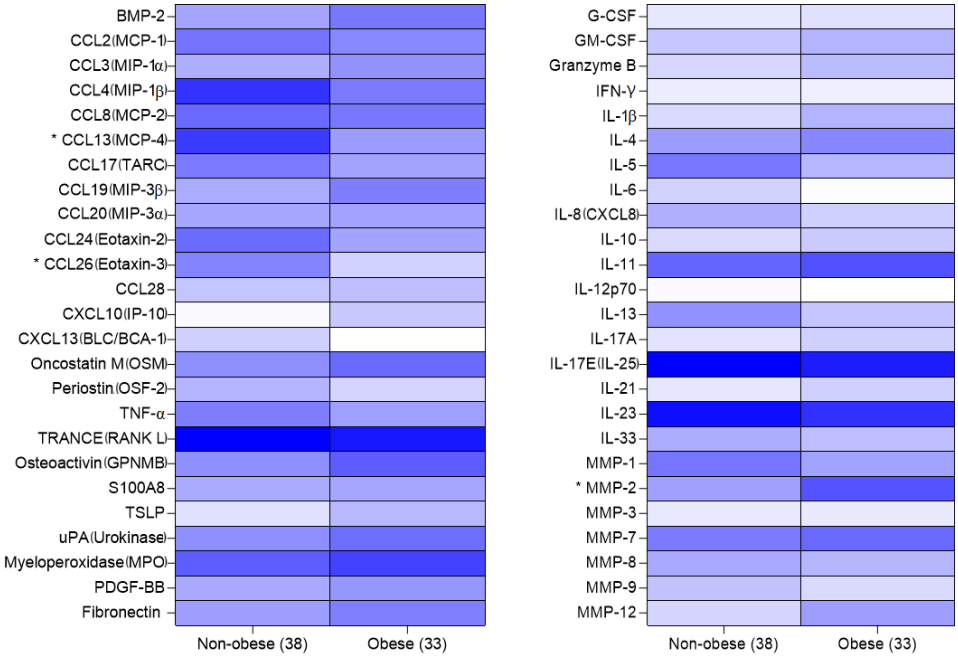

Figure 2. Heatmap showing expression levels of 50 proteins in sinonasal tissues from the obese and non-obese

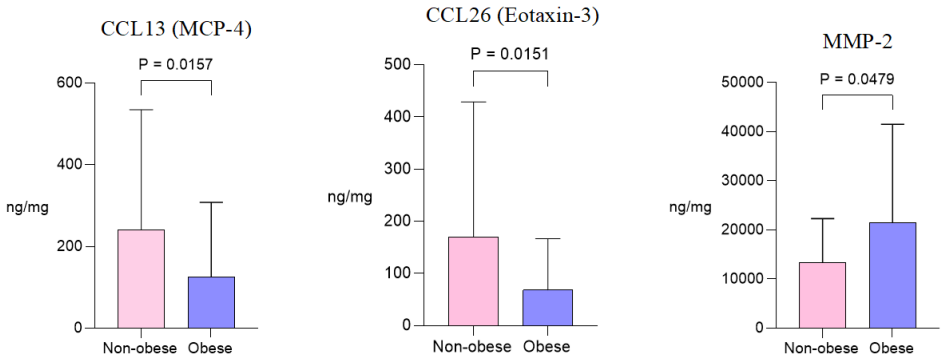

Figure 3. Expression levels of CCL13 (MCP-4), CCL26 (Eotaxin-3), and MMP-2 in the obese group and the non-obese groups

4. DISCUSSION

CRS is a multifactorial disease characterized by persistent inflammation of the nasal and sinus mucosa. My objective was to elucidate the clinical characteristics and immunological profiles of obese patients with CRS, contributing to the understanding of how obesity influences the pathophysiology of this condition.

My findings highlight notable differences in the clinical presentation and inflammatory profiles between obese and non-obese CRS patients. Notably, the obese group exhibited a higher frequency of refractory disease and a greater tendency to undergo revision surgeries. These observations align with previous research indicating that obesity is a significant risk factor for more severe forms of CRS, particularly those with NPs. Chen et al.(14) observed that elevated BMI is linked to a distinct phenotype of CRSwNP characterized by increased symptom burden and a higher recurrence rate post-surgery. In the study, patients with overweight and obesity exhibited an eosinophil/neutrophil-dominant cellular endotype and enhanced type 2/type 3 inflammation, which are less responsive to conventional treatments. Zhang et al.(15) showed that patients with obesity tend to be glucocorticoid-insensitive, which complicates treatment outcomes. Obesity-related cytokines may influence this insensitivity, although the exact mechanisms remain to be elucidated. The increased incidence of olfactory dysfunction and purulent discharge in obese patients further underscores the detrimental impact of obesity on CRS outcomes.

In this study, obese patients exhibited significantly higher blood basophil and monocyte counts compared to non-obese patients. This difference may be attributed to alterations in bone marrow function associated with obesity. Benova A et al.(16) showed that obesity induces a shift in hematopoietic stem cell (HSC) differentiation within the bone marrow, favoring myeloid progenitors over lymphoid progenitors. This shift, coupled with increased bone marrow cellularity and heightened secretion of pro-inflammatory cytokines, promotes the production of monocytes and basophils. Such bone marrow remodeling under obesogenic conditions not only amplifies systemic inflammation but also reflects the interplay between metabolic dysfunction and immune dysregulation, offering a plausible explanation for the observed differences in this study.

In terms of immunological profiles, my results revealed a pronounced neutrophilic inflammation in obese patients, evidenced by significantly higher tissue neutrophil counts than non-obese patients. This result is particularly noteworthy as it suggests a shift in the inflammatory response in obese individuals, potentially contributing to the chronicity and severity of their condition. Yu & Kim et al.(17) also showed that obese patients with CRS exhibit elevated tissue neutrophil counts compared to non-obese patients, and the infiltration of neutrophils within subepithelial areas is significantly associated with unfavorable surgical outcomes in CRSwNP. In this study, the higher monocyte and basophil counts observed in the obese group may indicate an altered immune response, with implications for the pathogenesis of CRS.

Interestingly, I found that obese patients exhibited lower expression levels of type 2 inflammatory mediators, such as CCL13/MCP-4, CCL26/Eotaxin-3, and IL-13, compared to non-obese patients. This contrasts with the traditional understanding of CRS, where type 2 inflammation is typically predominant, especially in patients with NPs. The reduced levels of these cytokines in the obese group suggest a complex interplay between obesity and the inflammatory pathways involved in CRS. It raises the possibility that obesity may predispose patients to a different inflammatory endotype, potentially characterized by a more neutrophilic response rather than the expected eosinophilic inflammation associated with type 2 dominance. Chaaban et al.(18) found that obese CRS patients exhibit lower levels of type 2 inflammatory mediators, including IL-33 and eotaxin-3 compared to non-obese group, indicating a potential type 2-low phenotype in obese groups. The presence of obesity may predispose patients to a neutrophilic inflammatory response, as seen in obesity-associated asthma, where increased inflammasome-mediated neutrophilic responses are noted.

The underlying mechanisms for these observations could be multifactorial. Obesity is associated with systemic low-grade inflammation, which is marked by elevated concentrations of pro-inflammatory cytokines such as TNF-α and IL-6, potentially leading to the suppression of type 2 immune responses. Furthermore, the chronic metabolic stress in obesity might skew the immune environment toward a neutrophil-dominant, type 1 or type 3 inflammatory pattern. This shift could result in decreased activation of eosinophil-associated pathways and reduced expression of type 2 cytokines and chemokines. Adipokines, such as leptin and adiponectin, may also affect this shift. Leptin, which is elevated in obesity, has been shown to modulate immune responses by enhancing type 1 and type 3 inflammation while downregulating type 2 pathways. Conversely, reduced adiponectin levels in obese individuals could further disrupt the balance between inflammatory pathways, potentially contributing to the observed reduction in type 2 mediators.

The implications of these findings are significant for the management of CRS in obese patients. The tendency for a more refractory disease course and the altered inflammatory profile may necessitate tailored therapeutic approaches for obese patients. For instance, targeting neutrophilic inflammation and associated pathways could be crucial in optimizing treatment strategies for obese CRS patients. Furthermore, the potential role of adipokines in modulating immune responses in obesity warrants further investigation, as they may offer insights into novel therapeutic targets.

5. DISCUSSION

In conclusion, this research underscores the necessity of recognizing obesity as a significant factor in the clinical presentation and immunological characteristics of CRS. The distinct inflammatory profiles observed in obese patients highlight the need for a nuanced understanding of CRS pathophysiology, which may ultimately lead to improved treatment outcomes. Future research should focus on elucidating the mechanisms underlying the relationship between obesity and CRS, as well as exploring the efficacy of targeted therapies in this population.

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Abstract in Korean

비만이 동반된 만성 비부비동염 환자의 임상적 특징과 면역학적 양상 분석

배경: 최근 여러 연구에서 비만이 면역 체계에 영향을 주고 만성 염증을 촉진한다는 결과가 있다. 이 연구에서는 만성 비부비동염을 가진 비만 환자의 임상적 특성과 면역학적 특성을 조사하고자 한다.

방법: 폴립을 동반한 만성 비부비동염으로 진단받은 총 126명의 환자를 대상으로 수술 중 비부비동 조직을 채취하였다. 환자들은 BMI에 따라 비만 그룹과 비만이 아닌 그룹으로 나뉘었으며, 환자의 인구통계학적 특성, 동반 질환, 수술 병력, CT 중증도, 후각 및 미각 기능, 알레르기 감작 상태에 대한 데이터를 수집하였다. 비부비동 조직 내 호중구와 호산구의 수치를 분석하였고, Luminex 다중 면역 분석법을 사용하여 염증 매개체의 발현을 조사하였다.

결과: 전체 환자 중 비만 그룹의 비율은 43% (54/126) 였다. 비만 그룹은 비만이 아닌 그룹에 비해 불응성 정도가 유의미하게 높았으며 재수술을 더 많이 받는 경향이 있었다. 또한 조직 호중구 수치와 혈중 단핵구/호염기수가 비만 그룹이 비만하지 않은 그룹에 비해 유의하게 높았다. SNOT-22 점수, Lund-Mackay CT 점수, JESREC 점수, 당뇨 및 천식 유병률, 후각 및 미각 기능에서는 두 그룹 간에 유의미한 차이가 없었다. Luminex 분석 결과, 비만 그룹은 CCL13과 CCL26의 수치가 유의하게 낮았으며, IL-13의 수치가 더 낮은 경향이 있는 것으로 나타났다. 반면, 비만 그룹은 비만하지 않은 그룹에 비해 MMP-2 수치가 유의하게 높은 것으로 관찰되었다.

결론: 요약하자면 비만을 동반한 만성 비부비동염 환자는 치료 결과가 좋지 않았다. 또한 비만 환자에서 비만이 아닌 환자에 비해 호중구 염증이 더 뚜렷하고, 제 2형 염증 매개체의 발현이 더 낮게 관찰되었다. 이러한 결과는 비만이 만성 비부비동염 환자의 병리 생리와 치료 결과에 영향을 미칠 수 있음을 시사한다.

핵심되는 말 : 만성 비부비동염, 비만, BMI