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Study groups and patient selection

ere were 3 subsets of patients. e rst subset consisted of patients with chronic rhinosinusitis with nasal polyps. e second subset consisted of patients with chronic rhinosinusitis without nasal polyps. e third subset served as the control group and consisted of patients who present with rhinologic problems that are not related to chronic rhinosinusitis.

All patients >18 years old who underwent rhinologic surgery were considered for the study. Patients with CRS de ned by symptom, endoscopic and radiographic criteria [16] were identi ed by the investigators. is was de ned as purulence in the middle meatus, presence of nasal polyps or radiographic evidence of paranasal sinus in ammation as well as 12 or more weeks of two of the following four symptoms: mucopurulent drainage, nasal obstruction, facial pain/pressure and decreased sense of smell. e presence or lack of nasal polyposis was determined by endoscopic evaluation. Control patients consisted of patients who presented to the practice with pathology such as septal deviation, cerebrospinal uid leak, turbinate hypertrophy, concha bullosa or unilateral masses that did not have radiologic, endoscopic or clinical evidence of CRS.

Data collection

Patient interviews were conducted to obtain data such as demographic factors, previous surgeries, previous antibiotic treatment, history of GERD and history of GI pathology. Gender was self-reported.

Statistical analysis

Student's t-test was used to compare the numbers of gut bacteria/fungi between patients. A level of statistical signi cance was set as $p<0.05$.

Results

ere were 16 patients who met the study criteria and agreed to participate. Seven patients had CRS with polyps (CRScP), 6 had CRS without polyps (CRSsP) and 3 were control patients. One control patient underwent surgery for inferior turbinate reduction and the other two for unilateral sinus masses. None of the three had endoscopic or radiologic evidence of chronic rhinosinusitis. Table 1 details the demographics of the three groups as well as other related medical conditions i.e. allergic rhinitis, gastroesophageal re ux disease and other gastrointenstinal related diagnoses such as in ammatory bowel disease. None of the patients in the study carried a GI-related diagnosis other than GERD. e presence of GERD was determined based on prior diagnosis by other physicians. e presence of allergic rhinitis was based on positive allergy testing.

Regarding the number of antibiotic courses the patients received, they were divided into two groups. e rst group received 0 or 1 antibiotic course in the past year, de ned as an oral or IV antibiotic spanning ve or more days. e second group received 2 or more antibiotic courses in the past year. Table 2 details these groups. e rst group received an average of 0.44 antibiotic courses in the prior year and the second group received an average of 3.7 antibiotic courses in the prior year.

Tables 3-5 reveal the number of di erent species of bacteria found in the sinus and gut for each patient, as well as the predominant organisms isolated. ere was only one patient who demonstrated any overlap between the sinus and gut bacteria. One patient in the CRScP group shows a predominance of *Pseudomonas aeruginosa* in the sinus as well as in the stool.

Table 6 compares the number of gut bacteria and fungi found in the stool based on antibiotics received. Overall, the group receiving fewer antibiotic courses had signi cantly more stool bacteria isolated (7.6 [SD 2.2] versus 5.1 [SD 2.3], p=0.043). ere was no signi cant di erence between the two groups in the number of gut fungi isolated (p=0.88).

Discussion

ough links between the sinus and gut microbiome have been 42.5197 588.83 Tm [(Dis)-9 (c)-6 (uss)4 (5t x19 (u)3 (s a/MCID 3(

postulated that changes in the gut microbiome may even initiate the onset of malignant transformation in the GI tract [24]. As it has been established that functional endoscopic sinus surgery can lead to reduced courses of antibiotics postoperatively [25], perhaps preservation of the GI microbiome can serve as an additional reason to consider earlier surgical intervention in patients with CRS.

One drawback of the study relates to the storage of the stool samples. e investigators instructed patients to refrigerate the stool samples a er collection at home. e patients may have variably adhered to these guidelines and the sample was unlikely to be refrigerated during transport to our facility. Gorzelak et al. [26] established that storage of samples at room temperature even beyond 15 min can reduce the diversity of extracted bacterial taxa. Another drawback of the study involves the nature of our patient set. Given that the patients were enrolled in a rhinologist's o ce, they tended to have diverse pathologies related to the sinuses but not related to the GI tract. None of the patients enrolled carried a known GI diagnosis. Given that some of the postulations regarding a link between the sinus and gut microbiome are based on patients with in ammatory bowel disease, it would improve the quality of similar study to include patients who carry these diagnoses.

Conclusion

Although there was minimal overlap between the sinus and gut microbiota in our study, further studies are needed with emphasis placed on patients with chronic diseases of the GI tract as well as in patients with CRS. Given that increasing numbers of antibiotic courses may lead to reduced diversity in the gut, preserving the gastrointestinal microbiome may be another reason to consider earlier surgical intervention in patients with chronic sinus disease.

Ethics Approval