

The aerobic-anaerobic bacteria pattern and its sensitivity pattern in chronic rhinosinusitis patients, in Medan, Indonesia



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ABSTRACT

Background: Rhinosinusitis is one of the most concerning illness due to high medical cost and its negative effect on the respiratory tract. The etiology of chronic rhinosinusitis remains unknown. The main cause of chronic rhinosinusitis with or without nasal polyp is bacterial infections; thus antibiotics remain a main therapeutic intervention. Prescription of broad spectrum antibiotics and the inappropriate combination of antibiotics are the main factors of antibiotic resistance. This study aims to obtain the pattern of aerobic and anaerobic bacteria in chronic rhinosinusitis patient (with or without nasal polyp) and its sensitivity pattern, in Medan, Indonesia.

Methods: This is a case series. Samples were patient with chronic rhinosinusitis who had undergone functional endoscopic sinus surgery (FESS).

Results: The most common aerobic bacteria found is *Klebsiella oxytoca* (21.7%), and it is sensitive to ceftriaxone, cefotaxime, levofloxacin, and meropenem. While for the anaerobic bacteria, one patient was positive for *Peptostreptococcus* and it is sensitive to chloramphenicol.

Conclusion: The most common bacteria in the maxilla in patients with chronic Rhinosinusitis with and without polyps in Medan are the aerobic bacteria *Klebsiella oxytoca* and anaerobic bacteria *Peptostreptococcus*. It is suggested that the antibiotic prescribed should be based on microbiology examination.

Keyword: Chronic Rhinosinusitis, polyp, non-polyp, bacteria, sensitivity

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INTRODUCTION

Rhinosinusitis remains a concerning health problem due to its high medical cost and its negative effect on the respiratory tract. The etiology of chronic rhinosinusitis remains unknown. It has been widely accepted that the main etiology of chronic rhinosinusitis is bacterial infections; thus antibiotics is a main therapeutic intervention. The incidence of rhinosinusitis in the United States of America is 14%.¹ The previous study by Multazar found that in 2008, 296 rhinosinusitis patient came to the Rhinology Division, Adam Malik Hospital, in Medan, Indonesia. There were 261 patients (88.18%) aged over 18 years old and 35 patients (11.82%) aged below 18 years old.^{2,3}

Inflammation of paranasal sinuses might be caused by infection or other non-infectious etiology. Evaluating the antibiotic treatment in chronic rhinosinusitis patient is hard. This is due to limited supporting data about antibiotic usage in chronic rhinosinusitis.^{3,4}

A study of aerobic and anaerobic bacteria of the meatus media and oropharynx found that the most common bacteria is *Streptococcus alpha* (15.4%), followed by coagulase-negative *Staphylococcus*

(16.4%), *Branhamella catarrhalis* (13.2%), *S. aureus* (19, 1%), *Klebsiella pneumonia* (16.4%) and *B. catarrhalis* (15.6%). The study also found that most of the bacteria were resistant to penicillin.⁵ Another study by Gani et al. found that the most common bacteria that caused chronic rhinosinusitis in the maxillary sinus is *Streptococcus viridans* (100%) and gram positive aerobic bacteria are sensitive to vancomycin.⁶

There was no data about the antibiotic resistant in chronic rhinosinusitis patient in Haji Adam Malik Hospital and Haji Medan Hospital; thus a study about the bacteria in chronic rhinosinusitis patient and its sensitivity pattern is needed. This study is only focused on maxillary sinusitis.

METHOD

This is a descriptive survey research, by describing the bacteria pattern found in the maxillary sinus of the chronic rhinosinusitis patients, with or without polyp, in the Adam Malik Hospital and Haji Medan hospital, Medan, Indonesia. This study used a case series design, by including all chronic rhinosinusitis cases, with or without polyp, that came to visit the ear nose throat department of Adam Malik Hospital and

its network hospital, Haji Medan Hospital, during May 2016 to August 2016 period. Patients with chronic rhinosinusitis that had undergone functional endoscopy sinus surgery (FESS) were included in this study. The inclusion criteria were age older than 15 years old, showed an isodense appearance of the maxillary sinus in the CT-scan, tumors were not the main etiology of the chronic rhinosinusitis, and patients must be antibiotic free during 48-72 hours before the FESS procedure. Patients who did not want to participate in this study were excluded.

All patients that met the inclusion criteria were then interviewed about the symptoms, continued with routine ENT examination and CT scan examination of paranasal sinuses. A chronic rhinosinusitis diagnosis then established based on the history and examination. Patients received an explanation of the study procedure before obtaining the informed consent from the patients. Patients with chronic rhinosinusitis that did not show any improvements were then given 48-72 hours interval of antibiotic free. After that period, mucosal tissue of the maxillary sinus sample was obtained through FESS approach. The tissue specimen was stored in microbiology tube contained NaCl 0.9% solution, and then it is transferred in less than two hours to the Microbiology Department, Medical Faculty of North Sumatra University / Haji Adam Malik Hospital, Medan, Indonesia. In the laboratory, aerobic bacteria identification was made by inserting the tissue in McConkey agar, then implanted and incubated in an incubator at the temperature of 37°C for 24 hours. The anaerobic bacteria were cultured in thioglycolate broth and brucella agar in anaerobic condition at the temperature of 37°C, enriched with defibrinated sheep blood 55,

vitamin K, and hemin. Before incubation, the implanted media were isolated by inserting it into the anaerobic vessel. Colony readings were performed 24 hours later, and if the bacteria growth is not sufficient, the incubation was postponed for another 24 hours. Bacteria identification was made by using Automatic Machine Vitex-2 Compact. An antibiotic sensitivity test was done manually by diffusion and dilution method. The results were interpreted as sensitive and resistant.

RESULTS

This is a descriptive study that was conducted at the Ear Nose Throat and Head-Neck Surgery Department of North Sumatra University Medical

Table 1 Age distribution and proportion of chronic rhinosinusitis patients, with and without polyps

Age (Year)	(n)	(%)
15-24	5	21.74
25-34	6	26.08
35-44	5	21.74
45-54	3	13.04
>54	4	17.4
Total	23	100

Table 2 Sex proportion and distribution of chronic rhinosinusitis patients, with and without polyps

Gender	(n)	(%)
Male	18	78.26
Female	5	21.74
Total	23	100

Table 3 Distribution and proportion of major complaints in chronic rhinosinusitis patients, with and without polyps

Age (Year)	(n)	(%)
Nasal congestion	19	82.61
Facial pain	3	13.04
Impaired sense of smell	0	0
PND/Post Nasal Drip	1	4.35
Total	23	100

Table 4 Distribution of sinus involvement in patients with chronic rhinosinusitis, with and without polyps

Sinus Involved (maxillary sinus)	(n)	(%)
Right	9	39.13
Left	14	60.87
Total	23	100

Table 5 Distribution of Aerobic Germ Patterns in Chronic Rhinosinusitis with and without Polyps

Pattern of Aerobic bacteria	(n)	(%)
Negative	8	35
Gram (+)		
<i>Staphylococcus aureus</i>	3	13
<i>Staphylococcus epidermidis</i>	1	4.3
Gram (-)		
<i>Klebsiella pneumoniae</i>	3	13
<i>Klebsiella oxytoca</i>	5	21.7
<i>Proteus vulgaris</i>	3	13
Total	23	100

Table 6 Distribution of Anaerobic Pattern Patterns in Chronic Rhinosinusitis With And Without Polyps

Anaerobic Germ Pattern	(n)	(%)
Negative	22	95
Gram (+)		
<i>Peptostreptococcus</i>	1	5
Jumlah	23	100

Table 7 Distribution of bacterial sensitivity patterns to antibiotics in patients with chronic rhinosinusitis with and without Polyps

Antibiotic	Aerobic										Anaerobic	
	Gram (+)				Gram (-)						Gram (+)	
	<i>Staphylococcus aureus</i>		<i>Staphylococcus epidermidis</i>		<i>Klebsiella oxytoca</i>		<i>Proteus vulgaris</i>		<i>Klebsiella pneumoniae</i>		<i>Peptostreptococcus sp</i>	
	N=3		N=1		N=5		N=3		N=3		N=1	
	S	%	S	%	S	%	S	%	S	%	S	%
Amikacin	-	-	-	-	5	100	2	66.7	0	0	-	-
Amoxicillin**	0	0	0	0	1	20	0	0	3	100	-	-
Ceftriaxone	3	100	1	100	5	100	3	100	3	100	-	-
Cefotaxime**	3	100	1	100	5	100	3	100	3	100	-	-
Ceftazidime	3	100	1	100	5	100	3	100	3	100	-	-
Cefuroxime**	3	100	1	100	5	100	3	100	3	100	-	-
Cefoperazone**/ sulbactam	3	100	1	100	5	100	3	100	3	100	-	-
Chloramphenicol	-	-	-	-	-	-	-	-	-	-	1	100
Ciprofloxacin**	3	100	1	100	5	100	3	100	3	100	-	-
Doxycycline*	3	100	1	100	-	-	-	-	-	-	-	-
Erythromycin	-	-	-	-	-	-	-	-	-	-	0	0
Kanamycin	-	-	-	-	-	-	-	-	-	-	0	0
Levofloxacin**	3	100	1	100	5	100	3	100	3	100	-	-
Meropenem	3	100	1	100	5	100	3	100	3	100	-	-
Penicillin**	0	0	0	0	0	0	0	0	0	0	0	0
Tetracycline**	0	0	0	0	0	0	0	0	0	0	-	-
Vancomycin*	3	100	1	100	-	-	-	-	-	-	0	0

Note:

S=Sensitive

R=Resistant

(*) = Antibiotic for gram (+) aerobic bacteria

(**) = Antibiotic for gram (+) and gram (-) aerobic bacteria

(-) = Sensitivity test to this antibiotic was not performed

School / H. Adam Malik Hospital and the hospital network (RS. Haji Medan), during May 2016 to August 2016 period. There were 23 patients who participated in this study. This study found that most of the chronic rhinosinusitis patients belong to the 25-34 age group (6 patients; 26.8%). According to sex, there were 18 male patients (78.26%) and five female patients (21.74%). Table 3 shows that in chronic rhinosinusitis patients with and without polyps, the most reported symptom was nasal congestion, which is reported by 19 patients (82.61%), while the least was post nasal drip, reported by one patient (4.35%).

On Table 4, it is shown that in chronic rhinosinusitis patients with and without polyps there were 14 patients with left maxillary sinus involvement (60.87%) and nine patients with right maxillary sinus involvement (39.13%).

In Table 5, it is shown that the most common aerobic bacterium found in chronic rhinosinusitis patient (with or without polyp), who participated in this study, was aerobic gram negative *K. oxytoca*. This bacterium was found in 5 patients (21.7%). While for the least bacterium found was aerobic gram positive *S. epidermidis*, found in 1 patient

(4.3%). There was no bacterial growth found in eight samples (35%).

In table 6, it is shown that the most common anaerobic bacterium found in chronic rhinosinusitis patient, with or without polyp, was *Peptostreptococcus*. This bacterial growth was observed only from one sample (5%), while the other samples showed no bacterial growth for anaerobic bacteria.

Table 7 shows the bacteria that was successfully cultured from 23 samples of maxillary sinus tissue of patients with chronic rhinosinusitis. For the aerobic gram positive bacteria, there are *S. aureus* (3 samples) and *S. epidermidis* (1 sample), while for the aerobic gram negative bacteria there are *K. pneumonia* (3 Samples), *K. oxytoca* (5 samples), and *Proteus vulgaris* (3 samples). For the anaerobic bacteria, only gram positive *Peptostreptococcus* is detected and only in one sample. There are no other anaerobic bacteria growths observed. *S. aureus* and *S. epidermidis* are sensitive to these following antibiotics: cefotaxime, ceftazidime, cefoperazone, levofloxacin, ciprofloxacin, doxycycline, vancomycin (all are 100%); and resistant to tetracycline, penicillin, and amoxicillin.

K. pneumonia is sensitive to these following antibiotics, amoxicillin, ceftriaxone, cefotaxime, ceftazidime, cefuroxime, cefoperazone, levofloxacin, meropenem (all are 100%); and resistant to these following antibiotics amikacin, penicillin, and tetracycline. *K. oxytoca* is sensitive to amikacin, ceftriaxone, cefotaxime, ceftazidime, cefuroxime, cefoperazone, ciprofloxacin, levofloxacin, meropenem (all are 100%); and resistant to penicillin and tetracycline. *K. oxytoca* is also mostly resistant to amoxicillin (only 1 out of 5 samples was sensitive).

P. vulgaris is sensitive to ceftriaxone, cefotaxime, ceftazidime, cefuroxime, cefoperazone, ciprofloxacin, levofloxacin, meropenem (all are 100%); and resistant to amoxicillin, penicillin, and tetracycline. *P. vulgaris* is also found to be partly sensitive (66.7%) to amikacin. The only anaerobic bacterium observed in this study, *Peptostreptococcus*, was tested for sensitivity towards chloramphenicol, erythromycin, kanamycin, penicillin, and vancomycin. The result shows that it is only sensitive to chloramphenicol.

DISCUSSION

In this study, there were 23 patients with chronic rhinosinusitis who participated in this study, with most of the participants belong to the 25-34 age group (26.8%). According to sex distribution, 18 patients were male (78.26%), and five patients were female (21.74%). The most reported symptom

was nasal congestion, which was reported by 19 patients (82.61%) while the least reported symptom was post nasal drip which was reported by one patient (4.35%).

This finding is consistent with another study in China which reported that the highest prevalence of chronic rhinosinusitis was found in the 15-34 years age group, with 280 patients (8.93%). Contrary to this study finding, in the Chengdu city prevalence of chronic rhinosinusitis in female patients were higher than male (9.9:8.9) due to female has more working activity, makes them susceptible to infection.⁷

A study in Korea also reported that most reported symptom being nasal congestion for more than three months.⁸

The culture result of the tissue specimen in chronic rhinosinusitis with or without polyp showed that most common aerobic bacteria is gram negative aerobic bacteria *K. oxytoca*, which was found in 5 patients (21.7%), while the least common aerobic bacteria is gram positive aerobic bacteria *S. epidermidis*.

This result is consistent with previous research in the intensive care unit of Fatmawati Hospital Jakarta from 2001 to 2002, where the most common pathogenic bacteria found was gram negative aerobic *Klebsiella sp*, followed by *S. epidermidis*, and *S. aureus*.⁹ In contrast with this study, a study conducted by Kenjono reported that *Staphylococcus*, the germicidal aerobic gram positive bacteria, was the most common bacteria found in chronic rhinosinusitis.¹⁰

Peptostreptococcus was the only anaerobic bacterium that was observed in this study. This bacterial growth was observed only from one sample (5%), while the other 22 samples (95%) showed no bacterial growth for anaerobic bacteria. Particularly in this patient, there was a gangrene of upper 1st molar observed. Another research conducted by Sumilat showed that patients with gangrenous dental caries at the M1 showed these following bacterial growth, *Actinomyces spp*, *Porphyromonas*, *Prevotella*, *Peptostreptococcus*, and *Fusobacterium spp*.¹¹

The difficulty of growing anaerobic bacteria, paired with sampling technique and transportation time, might be the reason of why there were no anaerobic bacteria growths in the other 22 samples. This finding is also similar to a study by Nigro, which found no anaerobic bacteria growth from the maxillary samples. This is due to transport factor, and sampling methods used.¹²

This study also found that for gram positive bacteria, the bacteria are sensitive to cefotaxime, levofloxacin, ciprofloxacin, vancomycin, each at 100%.

A study conducted by Li in 2016 revealed that the bacteria were sensitive to amikacin, daptomycin, linezolid, vancomycin, teicoplanin, amoxicillin and clavulanate potassium, and cefuroxim.¹³

While for the gram negative aerobic bacterium, it is sensitive to ceftriaxone, cefotaxime, levofloxacin, and meropenem, all at 100% and it also resistant to penicillin at 100%. Penicillin resistance was caused by bacterial adaptation to create the penicillinase enzyme that can split the beta ring of beta lactam, which turns penicillin into inactive penicilloic acid. This enzyme plays a huge role in the resistance towards penicillin. In *Peptostreptococcus* it is showed that it is sensitive to chloramphenicol. According to a study by Brook, *Peptostreptococcus* can be treated with clindamycin, amoxicillin-clavulanate, and chloramphenicol. The fact that *Peptostreptococcus* found in this study is only sensitive to chloramphenicol suggests that it is resistant towards another antibiotic, possibly due to adequate antibiotic treatment.

CONCLUSION

Chronic rhinosinusitis patient at Haji Adam Malik Hospital and Haji Mina hospital are mostly male (78.26%) and belong to the 25-34 years age group (26.8%), with most reported symptom being nasal congestion (82.61%). The gram negative aerobic bacterium, *K. oxytoca*, has the highest percentage (27.1%) while gram positive aerobic bacterium, *S. epidermidis*, has the lowest percentage (4.3%).

Only one sample was positive for anaerobic bacteria *Peptostreptococcus* (5%). Based on the sensitivity test, *S. aureus* and *S. epidermidis* are sensitive to cefotaxime, levofloxacin, ciprofloxacin, vancomycin; *K. pneumoniae*, *K. oxytoca*, and *P. vulgaris* are sensitive to ceftriaxone, cefotaxime, levofloxacin, and meropenem. While for anaerobic gram positive *Peptostreptococcus*, it is sensitive to chloramphenicol.

The therapeutic approach for chronic rhinosinusitis patient should be based on empirical data, although this data may change. Thus a microbial culture and sensitivity test should be performed before starting antibiotic treatment so that practitioner could prescribe the right antibiotic for the specific bacteria. Besides, the result of microbiology examination could be a precious data for the bacteria pattern and its sensitivity.

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