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AEROBIC BACTERIA AND FUNGAL ISOLATES IN MAXILLARY SINUSITIS OF ADULTS IN A RESOURCE POOR ENVIRONMENT

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ABSTRACT
Background: Infective rhinosinusitis is a common clinical condition which if left unattended to could result in various degrees of both morbidity and mortality. We aimed to identify aerobic and fungal organisms implicated in acute and chronic maxillary sinusitis and determine their antibiotic sensitivity patterns among adults in South Western Nigeria.
Materials and methods: This was a cross sectional study of adults with clinical and radiological diagnosis of maxillary sinusitis treated at the University College Hospital, Ibadan over a period of one-year. Semi- structured questionnaire was administered to each consented adult to obtain relevant demographic and clinical data. Maxillary antral proof puncture was done to obtain specimen for microscopy, culture and sensitivity for aerobic bacterial and fungal isolates. Descriptive statistics was used in the data analysis.
Results: Seventy-nine patients (49.4% males and 50.6% females) with acute maxillary sinusitis (17.7%), and chronic maxillary sinusitis (82.3%) were recruited into the study. The mean age of the patients was 32.9 years (SD=12.78; Range: 19-59). All patients presented with rhinorrhea while 92.8% had nasal obstruction. Fifty eight (73.4%) patients had history of antibiotic usage before presentation. Eight (57.1%) of the specimens from acute maxillary sinusitis cases and 40 (61.5%) of the specimens from chronic maxillary sinusitis yielded significant growth of bacteria and fungi respectively while 2 (3.5%) yielded mixed bacterial growth. Organisms commonly isolated from these specimens were *Streptococcus pneumonia*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Haemophilus influenzae,* and *Aspergillus* spp. The bacteria isolates were sensitive to Amoxicillin, Ciprofloxacin, Perfloxacin, Sparfloxacin and Ceftriaxone.

Conclusion: The leading aerobic bacterial isolates from acute and chronic maxillary sinusitis were *Streptococcus pneumonia* and *Staphylococcus aureus* respectively. Fungal infections are seen only in chronic cases. It is recommended that where there are no microbiologic laboratory facilities, any of Ciprofloxacin, Perfloxacin, Sparfloxacin, and Amoxicillin can be administered empirically to treat infective maxillary sinusitis.

Key words: Aerobic bacteria, Fungus, Maxillary sinus, Rhinosinusitis

LES BACTÉRIES AÉROBIES ET DES ISOLATS FONGIQUES DANS LA SINUSITE MAXILLAIRE D'ADULTES DANS UN ENVIRONNEMENT À FAIBLES RESSOURCES

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RÉSUMÉ
Contexte : rhinosinusite infectieuse est une condition clinique commun qui si laissé sans surveillance à pourrait donner lieu à des degrés divers de la morbidité et de la mortalité. Nous avons pour but d'identifier les organismes aérobies et fongiques impliqués dans la sinusite maxillaire aiguë et chronique et de déterminer leur sensibilité aux antibiotiques chez les adultes dans le sud-ouest du Nigeria.
Matériels et méthodes : Il s'agissait d'une étude transversale des adultes avec le diagnostic clinique et radiologique de la sinusite maxillaire traités à l'Hôpital du Collège universitaire, Ibadan sur une période d'un an. Semi- questionnaire structuré a été administré à chaque consenti des profils pour obtenir les données démographiques et cliniques.

La preuve de l'antre maxillaire crevaison a été fait pour obtenir l'échantillon pour la microscopie, la culture et la sensibilité pour les isolats fongiques et bactériennes aérobies. La statistique descriptive a été utilisé dans l'analyse des données.

Résultats : Soixante-neuf patients (49,4 % d'hommes et 50,6 % de femmes) avec une sinusite maxillaire aiguë (17,7 %), et la sinusite maxillaire chronique (82,3 %) ont été recrutés dans l'étude. L'âge moyen des patients était de 32,94 ans (ET = 12,78 ; Plage : 19-59). Tous les patients présentaient une rhinorrhée tandis que 92,8 % avaient l'obstruction nasale. Cinquante huit (73,4 %) patients avaient histoire de l'utilisation des antibiotiques avant la présentation. Huit (57,1 %) des échantillons de la sinusite maxillaire aiguë et 40 cas (61,5 %) des échantillons de la sinusite maxillaire chronique ont produit une croissance importante de bactéries et de champignons respectivement, tandis que 2 (3,5 %) a donné la croissance bactérienne mixte. Souvent les organismes isolés de ces spécimens ont été Streptococcus pneumonie, Staphylococcus aureus, Pseudomonas aeruginosa, Haemophilus influenzae, et de l'Aspergillus spp. Les bactéries étaient sensibles à l'Amoxicilline, la ciprofloxacine, Perfloxacin, la sparfloxacine et la ceftriaxone.
Conclusion : Le leader des isolats bactériens aérobies de sinusite maxillaire aiguë et chronique ont été Staphylococcus aureus Streptococcus pneumonie et respectivement. Organismes fongiques ne sont observées que dans les cas chroniques. Il est recommandé que, lorsqu'il n'y a pas d'installations de laboratoire microbiologique, l'autre de la Ciprofloxacine, Perfloxacin, la sparfloxacine, et de l'amoxicilline peut être administré de manière empirique pour traiter la sinusite maxillaire infectieux.

Mots clés : aérobie des bactéries, champignons, du sinus maxillaire rhinosinusite,

INTRODUCTION

Infective rhinosinusitis is a common clinical condition which if left untreated could result in various degrees of both morbidity and mortality (1, 2). It may start as non-infective rhinosinusitis and later become infected with bacteria. Often, there is involvement of more than one paranasal sinus but maxillary sinus is the most commonly affected. Treatment of infective rhinosinusitis with appropriate antibiotics can prevent complications and result in a satisfactory management outcome (3).

In Nigeria, antibiotics are readily available for procurement in the open market for usage because there is no enforcement of the laid down policies that restrict individuals or patients from having direct access to it without doctor's prescription. This injudicious antibiotics usage might induce growth of resistant bacterial strain with microbial dynamism in infective maxillary sinusitis (4, 5). Furthermore, abuse of antibiotics can lead to replacement of microbial organisms by fungal organisms (5).

There is paucity of literature on the current infective agents implicated in maxillary sinusitis and no agreed antibiotic regimen for the empirical treatment of infective rhinosinusitis in Nigeria. These have led to the injudicious antibiotic usage by the patients with resultant microbial dynamism. In addition, the relative lack of anti-bacteriological sensitivity pattern for infective maxillary sinusitis has caused uncertainty on the part of the clinicians in the choice of the most appropriate antibiotics to be administered as first line therapy where medical laboratory facility is unavailable. The increasing rates of antimicrobial resistance following abuse and misuse of antibiotics hamper logical treatment strategies. This makes it impossible to know which cases of maxillary sinusitis will spontaneously resolve or not hence, trial and error antimicrobial prescription on the part of clinicians is routinely practiced.

When patients have signs suggestive of infective rhinosinusitis, most of the time, they would have used antibiotics indiscriminately and only when there is no improvement in their clinical condition that they present to the Clinicians, especially Otolaryngologists where available (6). At this stage, it is only by performing microscopy, culture and sensitivity test on the aspirate obtained directly from the maxillary antrum or middle meatus of such patients that the exact organisms responsible for the infection can be isolated and the antimicrobial sensitivity pattern known (7, 8).

Infective rhinosinusitis could result in serious morbidity and complications if neglected or inappropriately treated. The aims of this study were to isolate the pathogenic aerobic bacterial and fungal organisms that are implicated in maxillary sinusitis among adults in South Western Nigeria as well as to determine their antibiotic sensitivity pattern. This would be borne in mind in the selection of empirical treatment pending the result of microscopy, culture and sensitivity for aerobic bacteria and in environment where there is no easy access to microbiologic laboratory facility.

METHODOLOGY

Study design: This was a prospective hospital-based, cross sectional study of adults with maxillary sinusitis managed at the Department of Otorhinolaryngology, University College Hospital, Ibadan. Ethical approval was obtained from UI/UCH Ethical Review Board to conduct the study. An understood, written and verbal informed consent was obtained from all the participants and sample collection was conducted in accordance with the Helsinki Declaration of 1975 as revised in 1996. Participants were adults, 18 years old and above, with clinical and radiological diagnosis of maxillary sinusitis (9).

Data Collection procedures

Questionnaire: A structured interview assisted questionnaire was administered to collect the participants' demographic and relevant clinical data of acute and chronic rhinosinusitis (10). Clinical diagnosis of rhinosinusitis was made if there were 2

or more major factors or 1 major factor and 2 minor factors (9).

Radiologic evaluation: Plain radiography of the paranasal sinuses (Occipitomental, occipitofrontal and lateral views) was performed on all the participants. The radiological features of maxillary sinusitis included haziness or opacification of maxillary antrum, gross mucosal thickening and/or presence of fluid level in the maxillary antrum (11).

Bacteriology and mycology: The maxillary antral specimen was obtained by aspiration through an inferior meatal antrostome created under good illumination using standard sterile and anesthetic procedures. Whenever there was a negative aspiration, 3-5mls of normal saline at body temperature was injected into the maxillary antrum and subsequently aspirated again (12). The maxillary sinus aspirates from the more affected antrum in a participant was sent immediately for microscopy, culture and sensitivity for aerobic bacterial and fungal studies in the diagnostic laboratory of the Department of Medical Microbiology, University College Hospital, Ibadan.

The antral aspirate of each patient was inoculated on Sheep blood and MacConkey agar for the culture of the aerobic bacterial organisms. Inoculated plates were then incubated aerobically at 37^{o}C for 18-24 hrs. Bacterial isolates from these specimens were identified using standard bacteriological methods (13), and were then subjected to antibiotics susceptibility testing following the Clinical and Laboratory Standard Institute (CLSI) for the disc diffusion test (14). Pathogenicity of the isolated organism was determined using established pathogenic properties such as production of toxins and/or other virulence factors, and dominance of the organism in the infecting flora (10^{3}cfu/ml). Part of the same specimen was also cultured for fungal organisms on Sabouraud Dextrose Agar at room temperature for 3 weeks and thereafter stained with lactophenol cotton blue for fungi identification if present. We performed disc susceptibility testings' on cefuroxime (30ug), augumentin (10ug), amoxicillin (10ug), cloxacillin (10ug) erythromycin (30ug), ceftriaxone (30ug), ceftazidime (30ug), ciprofloxacin (5ug), ofloxacin (5ug), gentamycin (10ug) and Sparfloxacin (5ug). These antibiotics are readily available for use in our environment. The susceptibility patterns of the drugs were interpreted according to standard methods (14). Part of the antral aspirate of each patient was inoculated on Sabouraud Dextrose Agar and incubated at 37^{o}C for 48hrs and room temperature for up to 3 weeks. The diagnosis of fungal infection was made on the basis of the recognisable and characteristic appearance of fungal hyphae fruiting bodies after staining with lacto phenol cotton blue under microscopy.

Data analysis: Data collected were collated and analyzed using Statistical Package for the Social Sciences (SPSS) version 18. The results were then presented in descriptive format, tables, diagrams and graphs where appropriate. P value of < 0.05 was considered as statistically significant.

RESULTS

Seventy-nine patients (49.4% males and 50.6% females) with acute maxillary sinusitis and chronic maxillary sinusitis were recruited into the study. The mean age of the patients was 32.94 years (SD=12.78; Range: 19-59). Fourteen (17.70%) patients had acute rhinosinusitis and 65 (82.30%) had chronic rhinosinusitis. Fifty-eight (73.40%) patients had history of antibiotic usage before presentation. The clinical presentation of patients with acute rhinosinusitis and chronic rhinosinusitis are shown in tables 1 and 2 respectively.

TABLE 1: CLINICAL PRESENTATIONS OF THE PATIENTS WITH ACUTE RHINOSINUSITIS

Symptoms	Frequency (N)	Percentage (%)
Nasal discharge	14	100.00
Alternating nasal blockage	13	92.86
Facial pressure/ headache	12	85.71
Fatigue	8	57.14
Stuffy nose	8	57.14
Fever	7	50.00
Hyposmia/anosmia	2	14.29
Ear pain	2	14.29
Halitosis	1	7.14

Note: All patients had more than one symptom

TABLE 2: CLINICAL PRESENTATIONS OF PATIENTS WITH CHRONIC RHINOSINUSITIS

Symptoms	Frequency (N)	Percentage (%)
Nasal discharge	57	100.00
Alternating nasal blockage	49	85.96
Itching of eye or ear or nose or throat	44	89.80
Frequent throat hawking & clearing	43	75.44
Excessive sneezing	37	64.91
Hyposmia/anosmia	9	15.79
Facial pain/pressure or headache	7	12.28
Fatigue	5	8.77
Ear pain	5	8.77
Tooth ache	4	7.02
Cheek pain	4	7.02
Hoarseness	4	7.02
Halitosis	3	5.26

Note: All patients had more than one symptom

The diagnosis of maxillary sinusitis was further confirmed with plain radiographs of the paranasal sinuses. Mucosal thickening was found in 47 (59.49%) patients, opacification of the maxillary antrum in 29 (36.71%) patients and fluid level in 3 (3.80%) patients. Fluid level was found only on the Water's view of patients with acute maxillary sinusitis. Only one patient with acute maxillary sinusitis has radiologic evidence of bilateral maxillary antral opacity while four patients with chronic maxillary sinusitis had bilateral maxillary antral opacity.

Out of the 14 specimens from the maxillary antrum of the patients with acute maxillary sinusitis, 8 (57.14%) yielded bacterial growth (Table 3). None of the specimen yielded fungal growth.

However, of the 65 specimens from the maxillary antrum of patients with chronic maxillary sinusitis, only 40 (61.54%) yielded significant aerobic bacterial isolates (Table 4) while 7 (14.58%) yielded fungal isolates (Table 5). Two (3.51%) specimens yielded mixed bacteria growth. Twenty five (38.46%) specimens did not grow any bacteria.

TABLE 3: BACTERIA ISOLATES FROM ANTRAL SPECIMENS OF PATIENTS WITH ACUTE MAXILLARY SINUSITIS

	Bacteria isolated	Frequency(N)	Percentage (%)	Total
Gram Positive	*Streptococcus pneumonia*	**4**	**50.00**	**N = 5 (62.50%)**
	Staphylococcus aureus	**1**	**12.50**	
Gram Negative	*Haemophilus influenza*	**3**	**37.50**	**N = 3 (37.50%)**
Total		**8**	**100.00**	

TABLE 4: BACTERIA ISOLATES FROM ANTRAL SPECIMENS OF PATIENTS WITH CHRONIC MAXILLARY SINUSITIS

	Bacteria isolated	Frequency (N)	Percentage (%)	Total
Gram Positive	*Staphylococcus aureus*	**9**	**21.43**	
	Streptococcus pneumoniae	**6**	**14.29**	**N = 19**
	Streptococcus pyogenes	**2**	**4.76**	**(45.24%)**
	Staphylococcus epidermidis	**1**	**2.38**	
	a-Hemolytic streptococcus	**1**	**2.38**	
Gram Negative	*Pseudomonas aeruginosa*	**8**	**19.05**	
	Haemophilus influenza	**7**	**16.66**	**N = 23**
	Klebsiella spp	**6**	**14.29**	**(54.76%)**
	Escherichia coli	**2**	**4.76**	
Total		**42**	**100.00**	**41(100%)**

TABLE 5: FUNGI ISOLATES FROM ANTRAL SPECIMENS OF PATIENTS WITH CHRONIC MAXILLARY SINUSITIS

Fungal isolates	Frequency	Percentage (%)
Aspergillus flavus	**3**	**42.86**
Aspergillus fumigatus	**2**	**28.57**
Candida albicans	**2**	**28.57**
Total	**7**	**100.00**

The antibiotic sensitivity patterns of the cultured aerobic bacterial organisms are presented in Tables 6 and 7.

TABLE 6: ANTIBIOTIC SENSITIVITY PATTERN OF AEROBIC BACTERIA CULTURED FROM THE ANTRAL ASPIRATES OF PATIENTS WITH ACUTE MAXILLARY SINUSITIS

Bacteria isolates from acute maxillary antral specimen	In vitro antibiotic sensitivity [n (%)]											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Streptococcus pneumoniae	**4 (100)**	**4 (100)**	**3 (75)**		**4 (100)**	**4 (100)**	**4 (100)**	**3 (75)**	**3 (75)**	**2 (50)**		**4 (100)**
Staphylococcus aureus		**1 (100)**			**1 (100)**	**1 (100)**	**1 (100)**	**1 (100)**	**1 (100)**	**1 (100)**		**1 (100)**
Haemophilus influenza	**3 (100)**	**3 (100)**		**3 (100)**	**2 (66.7)**	**3 (100)**		**3 (100)**	**3 (100)**		**1 (33.7)**	

1 = Pefloxacin, 2 = Ciprofloxacin, 3 = Ofloxacin, 4 = Gentamycin, 5 = Augumentin, 6 = Amoxicillin, 7 = Cloxacillin, 8 = Ceftazidime, 9 = Ceftriaxone, 10 = Cefuroxime, 11 = Erythromycin, 12 = Sparfloxacin

TABLE 7: ANTIBIOTIC SENSITIVITY PATTERN OF AEROBIC BACTERIA CULTURED FROM THE ANTRAL ASPIRATES OF PATIENTS WITH CHRONIC MAXILLARY SINUSITIS

Bacteria isolates from chronic maxillary antral specimen	In vitro antibiotic sensitivity [n (%)]										
	1	2	3	4	5	6	7	8	9	10	12
Staphylococcus aureus	9 (100)	8 (88.9)	7 (77.8)	3 (33.3)	8 (88.9)	9 (100)	9 (100)	8 (88.9)	6 (66.9)		9 (100)
Streptococcus pneumoniae	6 (100)	6 (100)		6 (100)	6 (100)	6 (100)	6 (100)	5 (83.3)	5 (83.3)		6 (100)
Staphylococcus epidermidis	1 (100)	1 (100)			1 (100)	1 (100)		1 (100)	1 (100)	1 (100)	
Streptococcus pyogenes	2 (100)	1 (50)		1 (50)	2 (100)	2 (100)	2 (100)		1 (50)	2 (100)	1 (50)
Heamophilus influenza	7 (100)			7 (100)		7 (100)	6 (100)	7(100)	7 (100)	4 (66.7)	6 (100)
Pseudomonas aeruginosa	6 (75)	6 (75)	8 (100)	8 (100)	8 (100)	4 (50)		8 (100)	8 (100)	7 (87.5)	8 (100)
Klebsiella spp	6 (100)		5 (83.6)	6 (100)	6 (100)	4 (66.7)			6 (100)		
Escherichia coli		2 (100)		2 (100)		1 (50)		2 (100)	2 (100)	1 (50)	
a-Haemolytic streptococcus	1 (100)		1 (100)	1 (100)	1 (100)	1 (100)	1 (100)				1 (100)

Erythromycin was excluded from Table 7 above as it was *staphylococcus epidermidis* and *streptococcus pneumoniae* from two specimens that were sensitive to it.
1 = Pefloxacin, 2 = Ciprofloxacin, 3 = Ofloxacin, 4 = Gentamycin, 5 = Augumentin, 6 = Amoxicillin, 7 = Cloxacillin, 8 = Ceftazidime, 9 = Ceftriaxone, 10 = Cefuroxime, 11 = Erythromycin, 12 = Sparfloxacin

DISCUSSION

Rhinosinusitis is the fifth most common diagnosis for which an antibiotic is prescribed and accounted for 21% of all adult antibiotic prescriptions (15). However, the sensitivity and/or the resistance patterns of the predominant pathogens vary considerably from region to region (16, 17). Therefore, the initial antimicrobial treatment of acute rhinosinusitis should be with the most narrow-spectrum agent that is active against the likely pathogens. In selecting an appropriate antibiotic for patients with rhinosinusitis, physicians must bear in mind the incidence of antibiotic-resistant bacteria in their community and consider the patient's overall health status. Special attention should be given to diseases that could impede normal recovery from infection and/or predispose to complications such as diabetes mellitus, chronic pulmonary disease, asthma, cystic fibrosis and immune deficiencies.

In this study, acute maxillary sinusitis constituted about 18% of the cases. None of these patients have co-morbid medical conditions. Studies have shown that most cases of maxillary sinusitis will present during the chronic phase and only few cases will present at the acute phase to physicians (8, 18). The relatively low percentage of those with acute maxillary sinusitis may be because of the practice of self-medication with antibiotics in our environment which could have resulted in a complete resolution of most of these patients' symptoms or cure without a need for presentation to the hospital.

This is supported by the evidence that 73.4% participants had history of antibiotic usage before presentation. In addition, some of the patients may not have severe disease hence would have been successfully managed by the General Practitioners or Family Physicians who are usually the first contact for these patients in hospitals. The persistence of the disease beyond 12 weeks will result in its chronicity (9, 19-22) as observed in about 82% of the participants who presented with features of chronic maxillary sinusitis. These may be the products of failed initial self-medication with a resultant severe form of the disease that has a negative impact on the quality of life and performance status of these patients. It could also be that the disease started initially as non-infectious rhinosinusitis which later became infected. The chronic infective maxillary sinusitis may either be caused by bacteria or fungal organisms.

Only 57.14% of the cultured maxillary antral aspirates from patients with acute maxillary sinusitis in this study yielded pathogenic organisms. It is possible that anaerobic organism, which was not included in this study because of non-availability of funds, was responsible for infection in the remaining 42.86% of maxillary antral aspirates which did not grow any organism. Anaerobic organisms have been reported as causes of acute maxillary sinusitis. (19, 21, 23) Similar studies have also reported that bacterial cultures were negative in certain proportion of suspected

cases of acute community acquired sinusitis (24, 25). This is similar to the finding in this study.

The spectrum of aerobic bacterial isolates from antral specimens of patients with acute maxillary sinusitis in this study is similar to what had been previously reported in the literature (12, 22, 25-30). However, variability exists in the frequencies at which these pathogenic organisms occurred. The frequency of *Streptococcus pneumoniae* or *Haemophilus influenza* as a leading cause of acute maxillary sinusitis varies from study to study (12, 22, 25-30). *Streptococcus pneumoniae* accounted for 50% of the isolated pathogen in this study. This was followed by *Haemophilus influenza* in 37.50% and the least was *Staphylococcus aureus* in 12.50%. The low frequency of *Staphylococcus aureus* in this study is also similar to what had been reported from a similar previous study (31). *Staphylococcus aureus* could be a normal nasal flora in 28 – 35% of healthy individuals (32) and if precaution was not taking during samples collection, it could contaminate maxillary antral aspirates. *Staphylococcus aureus* isolated in this study is likely to be a pathogen rather than a contaminant as the specimen was aspirated with a canula directly from the maxillary antrum into a sterile syringe before being cultured.

Out of the 57 specimens from the maxillary antrum of patients with chronic maxillary sinusitis, only 39 (68.42%) yielded pathogenic aerobic bacterial organisms. No growth was found in the culture from 18 (31.58%) specimens. Similar studies have also reported varied proportion of maxillary antral specimens which yielded pathogenic growth as observed by Aneke et al (57.41%), and Mantovani et al (53.2%) (8, 33). Anaerobic bacteria appear to play an important role in patients with chronic paranasal sinusitis (12). It is a possibility that anaerobic bacteria and other higher organisms, which were not included in this study for lack of funds, could have been responsible for the infection in these patients (42.86%) whose maxillary antral aspirates did not grow any aerobic organism. Hence, a similar study that will include isolation of anaerobic organisms from maxillary antral aspirate is desired. Some of these patients' maxillary antra had an initial negative tap or aspirate as at the time of the study but this was washed and the aspirate from it cultured. The antibiotic abuse among other medications by most of our patients could have rendered the antrum sterile as at the time of the study. Pathogenic anaerobic organisms have been isolated with varied frequencies from similar studies that included anaerobic isolation from maxillary antral specimens of patients with chronic maxillary sinusitis (19, 33-35).

The commonest aerobic bacterial isolate from chronic maxillary sinusitis in this study was *Staphylococcus aureus*, which constituted 21.43% of all isolated bacteria. This has been described as a pathogenic cause of chronic infection of the paranasal sinuses. (35) Hence, its isolation as a pathogen in this study should not be regarded as a mere contaminant from a normal nasal flora (8). In a similar study by Aneke et al, *Staphylococcus aureus* topped the list of their total isolated pathogenic organisms with a frequency of 32.3% respectively (8).

Gram negative bacteria constituted the majority (54.76%) of the aerobic organisms isolated from the maxillary antral specimens of patients with chronic maxillary sinusitis in this study and also, *Pseudomonas aeruginosa* constituted 19.05% of all the aerobic isolates and 34.78% of the gram negative organisms. The predominance of gram negative organisms among the aerobic pathogenic agents in chronic maxillary sinusitis was also reported in similar studies (8, 20, 24, 25). This has been attributed to nonhygienic care and misuse of antibiotics, a problem in developing countries, which generally leads to persistence of resistance strains and chronicity. The *Haemophilus influenza* isolated from the maxillary antral aspirates in this study had also been reported by other workers (8, 23). This may be the cause of an acute exacerbation of chronic maxillary sinusitis because it has been more frequently implicated in acute maxillary sinusitis. *Streptococcus pyogenes* accounted for 4.76% of the isolates from this study. No single isolates of this organism was demonstrated from the similar study in this environment. (8, 25) *Staphylococcus epidermidis* accounted for 2.38% of isolates in this study. This has been demonstrated as one of the most frequent isolates (normal flora) from the nasal cavities of healthy individuals. (36) *Alpha-Hemolytic Streptococcus* was also cultured in one (2.38%) of our specimen.

Normal individuals have on the average more than two different fungal forms that are present in their nasal cavities (37). These could be normal body flora or contaminants even though could be pathogenic in some immunocompetent patients. Thus, over-colonization of the sinuses by fungi can also occur in immunocompromised individual with resultant opportunistic infections even though it was not sought for in this study. The low pH and decreased mucociliary clearance will trap the fungal spores and mycelia and lead to their growth and spread (38). Many authors have reported varied prevalence of fungal infection in chronic rhinosinusitis (39-42). In this study, only seven maxillary antral specimens yielded fungal growth (Table 5). The main fungal organisms isolated were *Aspergillus* and *Candida* species. *Aspergillus* spp have been isolated more frequently than other fungal agents in the maxillary aspirates (41, 42). The abuse of antibiotic usage seen in some of our patients might have contributed to the opportunistic fungal infection in them. None of the maxillary antral

specimen that grew fungus was positive for bacteria growth.

Amoxicillin and trimethoprim-sulfamethoxazole [Bactrim, Septrim]) have been recommended for use in the management of uncomplicated, acute bacterial rhinosinusitis (43, 44). Trimethoprim-sulfamethoxazole was not included in our antibiotic sensitivity pattern as it was observed from our institution that most organisms have developed resistance to it. This might be because of the abuse of the drug which can be easily procured from the counter in our environment. All the aerobic organisms cultured from the maxillary antral aspirate from acute maxillary sinusitis showed 100% in vitro sensitivity to Amoxicillin and Ciprofloxacin (Table 6).

Chronic maxillary sinusitis usually results primarily from a non-infective etiology but may have secondary superimpose bacteria infections.[12] Both Gram positive and Gram negative aerobic and anaerobic organisms have been reportedly cultured from the maxillary antral aspirates of some of these patients (25-27). The types of aerobic bacterial organisms isolated from this study is similar to what had been reported (5,8,12,25). The in vitro sensitivity activities of antibiotics against the isolated organisms from the maxillary antral specimen of patients with chronic maxillary sinusitis are shown in Table 7.

Quinolones (Ciprofloxacin, Pefloxacin and Sparfloxacin) and Penicillin based drugs (Amoxillin, Augumentin, Ceftriaxone) appear to have good sensitivity pattern against most of the aerobic bacterial isolates. Gentamycin has 100% sensitivity pattern against most of the cultured organisms especially gram negative organism. However, *Staphylococcus aureus* and *Streptococcus pyogenes* displayed poor sensitivity to gentamycin. Nevertheless, Gentamycin should be used with caution as it has some ototoxic and nephrotoxic side effects.

Conclusion and Recommendation

The aerobic bacteria isolated from the acute and chronic maxillary sinusitis did not differ much from what had been known. However, *Streptococcus pneumoniae* and *Staphylococcus aureus* were the commonest bacterial isolates from the maxillary antrum of patients with acute maxillary sinusitis and chronic maxillary sinusitis respectively. *Aspergillus flavus* is the commonest fungal pathogen. The in vitro antibiotic sensitivity pattern varies hence the need for microscopy, culture and sensitivity of the antral aspirate in selecting appropriate antibiotics for the patients with rhinosinusitis. Nevertheless, where microbiologic laboratory facilities are unavailable, empirical Amoxicillin or Ciprofloxacin can be administered as a first line antibiotic therapy in the management of bacterial rhinosinusitis.

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