Antibiotic Susceptibility patterns in Adenotonsillar bacterial Isolates in a tertiary hospital in Sub-Saharan Africa

Abstract

Background

The adenoids and tonsils are parts of Waldeyer's ring and are essentially the first line of immunological defense of the upper respiratory tract. These lymphoid tissues can frequently become infected, resulting in hypertrophy and recurrent tonsillitis. Bacterial infections are the main causative agents in chronic adenotonsillitis. Frequently implicated organisms seen ln the adenoids and tonsils include Streptococcus pyogenes, Staphylococcus aureus, Haemophilus influenzae, Moraxella catarrhalis and sometimes anaerobic bacteria. The rise of antimicrobial resistance has greatly diminished the effectiveness of widely used antibiotics.

Objective

The aim of this study is to examine the microbiological characteristics and antibiotic susceptibility patterns of bacterial isolates obtained from adenotonsillar tissues of children undergoing tonsillectomy in a tertiary hospital in Nigeria.

Method

A hospital based cross-sectional study among patients undergoing adenotonsillectomy. Swab was taken from adenoid and tonsillar tissues and sent for sent for microbiology culture and sensitivity. Data entry and analysis was done using the Statistical Product and Service Solutions(SPSS) version 20. Tables and charts were used as appropriate to represent data.

Numerical variables were summarized as means and standard deviation for age while categorical variables were expressed as frequencies and percentages.

Results

A total of 50 patients aged 3 years to 7 years were included in the study. A median age of 4.0 years and mean age of 4.4± 1.5 years was gotten. Most (62% of the patients were under five male/female ratio of 1.3: 1. Most of the adenoid (40%) and tonsillar (32%) tissues did not yield growth. Viridan group of Streptococcus seen 20% of tonsils was the commonest organism isolated from the tonsils. Staphylococcus aureus as seen in 22% of cases was commonest bacterial isolate from the adenoid. Regarding antibiotic susceptibility, aerobic bacteria was resistant to most of the antibiotics. The sensitivity pattern of *Staphylococcus aureus* was as follows; erythromycin(59.5%), cefuroxime(54.1%), ciprofloxacin(51.2%) and amoxicillin/clavulanic acid(51.2%).

The antibiogram of organisms showed a high rate of resistance of aerobic bacteria to antibiotics which was statistically significant. However, the predominant organisms were most sensitive to erythromycin, cefuroxime and amoxicillin/clavulanic acid

Key words: Atibiotic susceptibility, bacterial isolates, adenotonsillar tissue, *Staphylococcus aureus*

Introduction

The adenoids and tonsils are parts of Waldeyer's ring and are essentially the first line of immunological defense of the upper respiratory tract [1,2]. Although these lymphoid tissues subserve important function, these lymphoid tissues can frequently become infected, resulting in enlargement and ongoing inflammation [3]. Chronic adenoiditis and tonsillitis are widespread reasons for performing adenotonsillectomy, especially in children, as these conditions can cause significant health issues such as obstructive sleep apnea, recurrent tonsillitis and middle ear infections[4].

Bacterial infections are the main causative agents in chronic adenotonsillitis. Frequently implicated organisms seen ln the adenoids and tonsils include Streptococcus pyogenes, Staphylococcus aureus, Haemophilus influenzae, Moraxella catarrhalis and sometimes anaerobic bacteria[5]. In our environment empirical antibiotic therapy is the mainstay of treatment[5]. The rise of antimicrobial resistance (AMR) has greatly diminished the effectiveness of widely used antibiotics, hindering treatment outcomes and adding to the global challenge of AMR[6].

The World Health Organization (WHO) identifies AMR as a significant public health crisis [7]. In 2019, 4.9million people died of antimicrobial resistance with 64,500 of the deaths occurring in Nigeria [7]. In areas with limited healthcare resources, such as many regions in sub-Saharan Africa, the issue of antibiotic-resistant infections is worsened by insufficient diagnostic capabilities, self-treatment, and lax regulations surrounding antibiotic sales[7]. This highlights the necessity for localized research to inform antibiotic stewardship and enhance clinical decision-making.

Although many studies have investigated bacterial isolates and resistance patterns in developed nations, there is a lack of data from resource poor settings, like ours. With the rising incidence of resistant pathogens, there is an urgent need for data specific to the region to inform clinical practices and policy development. Additionally, adenoid and tonsillar tissues can harbour bacteria that form biofilms, which are naturally more resistant to antibiotics, making treatment outcomes even more challenging.

This research examines the microbiological characteristics and antibiotic susceptibility patterns of bacterial isolates obtained from adenotonsillar tissues within a resource-limited tertiary healthcare environment. By identifying the main bacterial pathogens and their resistance traits, our goal is to offer evidence-based guidance for empirical antibiotic treatment and underscore the necessity for effective antimicrobial stewardship initiatives. The aim of this study is to identify the bacterial profile of isolates from adenotonsillar tissues and evaluate their antibiotic resistance patterns.

Materials and Method

This is a hospital based cross-sectional study involving 50 children undergoing adenotonsillectomy. Surface swab each was taken from the adenoid, right tonsil and left tonsil. Three samples from each participant which gave a total of 150 samples analyzed for this study.In theatre, after general anaesthesia and endotracheal intubation with sterile endotracheal tube. The mouth was then opened and oropharynx exposed with mouth gag after positioning the patient. A surface swab was taken from right and left tonsil by rotating a sterile cotton wool swab stick on each of the tonsils while avoiding contact with other parts of the oropharynx. The same procedure was done on the surface of the adenoid after retracting the soft palate backward with pillar retractor. Specimens were labeled appropriately and transported immediately to microbiology laboratory of UPTH for further processing. Inoculation of the samples on chocolate, Mac-Conkey, gentamycin blood and crystal violet blood agars. The plates were incubated aerobically at 35-37ºC for 24-48 hours. After 24-48 hours of incubation, plates were examined for evidence of growth of organisms. Thereafter, Gram staining of the colonies was done to ascertain the morphological features and further biochemical characteristics were determined using the following tests: oxidase, coagulase, citrate utilization, lactose fermentation, catalase, urease and indole production. Bacterial isolates were identified by comparing their characteristics with those of known taxonomy [8,9]. Lancefield grouping, bacitracin and optochin sensitivity testing were done for Streptococci spp. Susceptibility was done by disk diffusion method. Oxoid antibiotics susceptibility test discs used includes: 5mcg ciprofloxacin(CIP), 10mcg gentamycin(GN), 30mcg ceftazidime(CAZ), ceftriaxone(CRO), 10mcg penicillin(P), 30mcg cefuroxime(CXM), 10mcg amoxicillin/clavulanic acid(AMC) and 15mcg erythromycin(E). The diffusion zone diameters were calculated and compared with standard reference using Clinical and Laboratory Standards Institute method(CLSI)[10]. Acidometric filter paper test for beta-lactamase activity was done for the isolated organisms. A change in colour of the bromocresol purple indicator from purple to yellow was taken as positive for beta-lactamase production. Data entry and analysis was done using the Statistical Product and Service Solutions(SPSS) version 20. Tables and charts were used as appropriate to represent data. Numerical variables were summarized as means and standard deviation for age while categorical variables were expressed as frequencies and percentages. Pearson's chi-square statistics was used to determine the difference in the bacteriology between the surface and core of the adenoid and tonsils. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1. Demographic characteristics of study group(n=50)

	N	%
Age group		
<5 years	31	62.0
≥5 years	19	38.0
Gender		
Female	14	28.0
Male	36	72.0
Total	50	100.0

Table 2. Aerobic surface of adenoid

	Adenoid	
Organisms	N	%
No growth	20	40.0
Viridans group of Streptococcus	2	4.0
Streptococcus pyogenes	2	4.0
Citrobacter spp	1	2.0
Haemophilus spp	3	6.0
Escherichia coli	4	8.0
Klebsiella spp	2	4.0

Pseudomonas aeruginosa	5	10.0
Staphyloccoccus aureus	11	22.0
Total	50	100.0

Table3. Aerobic surface bacteria of tonsils

	Surface			
	Right tonsil		Left tonsil	
Organisms	N	%	N	%
No growth	16	32.0	15	30.0
Viridan group of Streptococcus	9	18.0	10	20.0
Streptococcus pyogenes	3	6.0	3	6.0
Haemophilus spp	4	8.0	3	6.0
Escherichia coli	4	8.0	5	10.0
Klebsiella spp	5	10.0	3	6.0
Pseudomonas aeruginosa	3	6.0	3	6.0
Staphyloccoccus aureus	6	12.0	8	16.0
Total	50	100.0	50	100.0

Chi-square = 1.12, Fishers exact p-value = 0.992

Table 4 Antibiogram of aerobic organisms

Antibiotics	Percentage of bacteria isolates sensitive to antibiotics					
	VG S	Pseudo	Strep p	E coli	S. aureus	Kleb spp
Ciprofloxacin	66.7	26.3	61.5	58.5	51.2	76.9
Cefuroxime	12.5	0.0	61.5	17.6	54.1	7.7
Amox-clav	8.3	5.3	15.4	52.9	51.2	7.7
Erythromycin	50.0	5.3	61.5	17.5	59.5	23.1
Ceftazidime	0.0	76.9	15.4	0.0	13.5	61.5

Chi square = 538.14, p-value = 0.0001

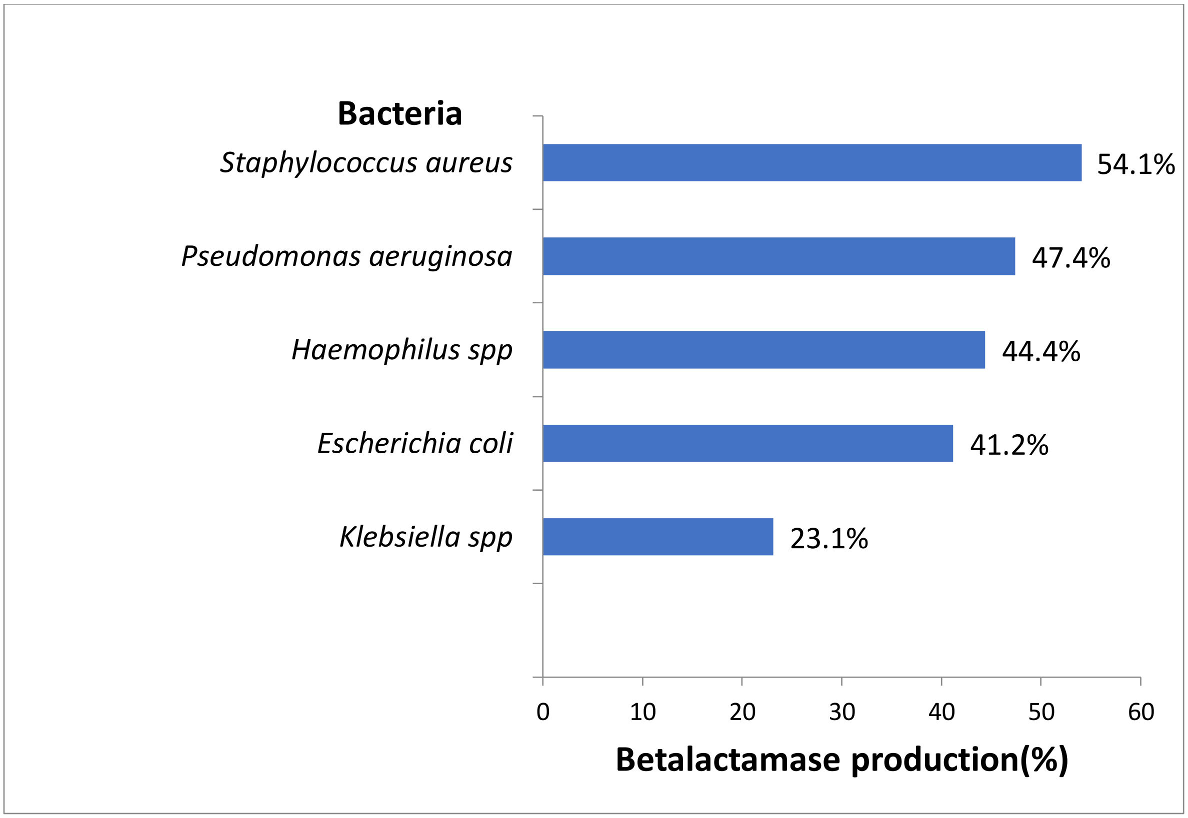
Key

VG S Viridans group of Streptococcus, Pseudo Pseudomonas aeruginosa,

Strep p Streptococcus pyogenes, E.coli Escherichia coli, S. aureus Staphylococcus aureus

Kleb spp Klebsiella spp, Amox-clav Amoxicillin clavulanic acid

Fig 1: Betalactamase Production of Bacterial Isolates



BETA-LACTAMASE PRODUCTION AMONG AEROBIC BACTERIA ISOLATES

The aerobic isolates were tested for beta-lactamase production and five organisms were found to be positive. Amongst these pathogens, Staphylococcus aureus had the greatest beta-lactamase activity (54.1%) and the lowest was Klebsiella spp (23.1%). Pseudomonas aeruginosa was 47.4% and Escherichia coli had 41.2% as in fig.1

DISCUSSION

In the demographic analysis of participants that had adenotonsillectomy in this study, age less than 5 years had the highest number of adenotonsillectomy. This is similar to the findings by Onotai and daLilly-Tariah in Port-Harcourt[11]. This is attributed to frequency of upper respiratory tract infection resulting to maximum enlargement of adenotonsillar tissue during this age period[12]. Similarly, Mbam et al in Ibadan, southwestern Nigeria reported adenotonsillectomy to be commonest among 2-5 years[12].

In this study, more males than females had adenotonsillectomies. This is in agreement with the findings by Mbam et al[12], Adegbiji et al[13], Samdi et al[14], Onotai and daLilly-Tariah[11]. This is probably due to male children exploring their environment more than the female counterparts, putting objects into the mouth which could increase the risk of upper respiratory tract infection among them. Contrarily, a study done in Iraq on bacteriology in adenoid disease reported female preponderance[15].

In this study, Staphylococcus aureus was the most prevalent aerobe isolated from the adenoid surface. This agrees with Rasha et al[16] in Iraq on aerobic bacterial profile associated with chronic tonsillitis and adenoid hypertrophy in children who reported Staphylococcus aureus as one of the predominant organisms on the surface of the adenoid.This is probably because Staphylococcus aureus persists within mucosal biofilms in the adenotonsillar tissues3 and thus resistant to routine antibiotics.. There were no bacteria isolated in 40% of surface samples and 20% of core samples of adenoid and this could be attributed to fastidious organisms.

Regarding aerobic organisms on the tonsillar surface, viridans group of Streptococcus was most prevalent in this study. In contrast, Staphylococcus aureus accounted for the most predominant isolates of surface throat swab in a study on microbiological profile of pharyngotonsillitis in National Hospital, Abuja, Nigeria[17]. Viridans group of Streptococcus is part of the normal flora of the oropharynx and there is usually contamination of tonsillar surface with oropharyngeal secretions[18]. This may be linked to its prevalence on the surface of the tonsils. The isolation of gram negative coliforms such Pseudomonas aeruginosa and Klebsiella spp may be attributed to poor hygiene among the children. This is different from the findings of Okoye et al[19] in Awka and Garbe et al in Gusau who reported Streptococcus pyogenes as the most prevalent pathogen implicated in pharyngotonsillitis. Pathogenic organisms may vary from one geographical location to another.

Regarding antibiotic susceptibility, aerobic bacteria was resistant to most of the antibiotics and was statistically significant(p-value=0.0001). The sensitivity pattern of Staphylococcus aureus was as follows; erythromycin(59.5%), cefuroxime(54.1%), ciprofloxacin(51.2%) and amoxicillin/clavulanic acid(51.2%). Abdulahi and Iregbu documented similar level of sensitivity of Staphylococcus aureus to erythromycin, ciprofloxacin and amoxicillin/clavulanic acid in Abuja[20]. Contrarily, Sadoh et al[21] in Benin city reported 100% sensitivity of Staphylococcus aureus to cefuroxime. The antibiotic resistance seen in this study may be due to the abuse and overuse of these antibiotics among the paediatric population.

In this study, Staphylococcus aureus had the greatest beta-lactamase activity which accounted for 54.1%. Similarly, Taylan et al[22] found Staphylococcus aureus as the most beta-lactamase producing aerobe with activity of 100% and exceeded other isolates in adenotonsillar disease. This excellent beta-lactamase production of Staphylococcus aureus which accounted for resistance to beta-lactam antibiotics may be responsible to its dominance in the adenotonsillar sites.

CONCLUSION

The aerobic surface bacterial pattern of the adenoid was predominated by Staphylococcus aureus while that of tonsils was predominated by viridans group of Streptococcus.

The antibiogram of organisms showed a high rate of resistance of aerobic bacteria to antibiotics which was statistically significant. However, the predominant organisms were most sensitive to erythromycin, cefuroxime and amoxicillin/clavulanic acid

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