https://dx.doi.org/10.4314/jpb.v14i1.5
Vol. 14 no. 1, pp. 38-44 (March 2017)
http://ajol.info/index.php/jpb

Journal of
PHARMACY AND BIORESOURCES

Epidemiology of odontogenic infections in a secondary healthcare centre in Southern Nigeria

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Received 19th January 2017; Accepted 2nd March 2017

Abstract
Association of odontogenic infections with several systemic diseases is of public health importance in Nigeria. This study aimed at determining the epidemiological and microbiological profiles of odontogenic infections and it aetiologic agents in dental patients in Benin City metropolis. Surface and deep socket swabs were collected from each patient before and after tooth extraction and processed for aerobic bacteria. Antimicrobial susceptibility test was carried out on each isolate using standard microbiological methods. Demographics of patients were collected with standard data recording format. Patients aged 20-29 years were more predisposed to odontogenic infections, predominantly peridontitis (51.5%) followed by caries (18.6%) and irreversible pulpitis (9.3%). Teeth in the right lower quadrant of the mouth were most frequently excised in both sexes. Predominant isolates were: β-haemolytic *Streptococci* (34%), *Enterococci* (20.6%), *Corynebacteria* (11.9%), *Staphylococci* (9.3%), γ-haemolytic *Streptococci* (5.2%), *Neisseria* (1.5%), *Bacillus* (1%), and α-haemolytic *Streptococci* (0.5%). There was low level of susceptibility of isolates to amoxicillin 30% and high level of susceptibility to perfloxacin (80%). A total of 19.1% of isolates were resistant to the five classes of antibiotics, indicative of multiple drug resistance (MDR) phenomenon. Our study has shown that, treatment of odontogenic infection in the study centre must change and be guided by antimicrobial susceptibility test result to ensure rational use of available antimicrobials.

Keywords: Odontogenic infections; Antimicrobial activity; Epidemiological profile; Isolates

INTRODUCTION

Odontogenic infections occur in the oral cavity, several of which involve the teeth and its surrounding structures. Grooves and fissures on the surface of the tooth as well as the sides of the teeth that contact one another are shelters for food debris and poor oral hygiene makes these sites susceptible to colonization by adherent bacteria. About 1000 bacterial species are reported to be present in the mouth, many of which are implicated in a wide array of oral infections [1].

These infections could arise from dental plaques on the enamel of the tooth. Acute dental abscess usually occurs secondary to dental caries, trauma, or failed root canal treatment. Release of toxic products by aetiologic bacteria into the periapical tissues may result in acute inflammation and pus formation [2]. An infected pulp chamber results in the colonization of the root canal by a mixture of anaerobic bacteria [3]. Inflammation of surrounding gingival tissues may be associated with a necrotic dental pulp. Periodontitis occurs when inflammatory

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ISSN 0189-8442 © 2017 Faculty of Pharmaceutical Sciences, University of Jos, Jos. Nigeria.

reactions to gingival pathogens extend into the epithelial attachment between the tooth, and into the alveolar bones. The infection may remain localized on the affected tooth or quickly spread through translocation of bacteria, metastatic injury related to bacterial toxins and metastatic inflammation due to immune system injuries. Most systems of the human body have been identified as a potential site for microbial metastasis of oral origin [4].

Previous research has reported bacteremia immediately after incision of an abscess, tonsilectomy and tooth extraction [5]. Odontogenic bacteria have been implicated in infectious endocarditis, brain and liver abscesses [6-8]. These aetiologic agents have been detected in the lungs of patients with cystic fibrosis [9] and have caused a variety of soft tissue infections of the skin following bites and clenched fist injuries [1]. A case of meningitis caused by *Streptococcus oralis* has been associated with dental extraction just as chronic meningitis has occurred with dental caries .Bacteria found in these sites could contaminate the cerebrospinal fluid and infect the central nervous system [4]. It is the overwhelming increase of microorganisms in the oral cavity which has contributed to the initiation and progression of oral infections particularly in patients with poor oral hygiene.

In Nigeria most surveys on the epidemiology of oral infections have been sporadic and Dentists in this area prescribe drugs (amoxicillin) without the guidance of culture and sensitivity test due to limited availability of microbiology laboratory setup. This practice could lead to emergence of antimicrobial drug resistance. Additionally, the extraction of infected tooth, seen as a more permanent treatment option has been on the increase in Southern Nigeria [10]. Thus an up to date information on the antimicrobial susceptibility pattern of odontogenic pathogens need to be available at local, National and global levels both as indicatives of inappropriate treatment and implication for public health. The broad aim of this study was to carry out epidemiological survey on the distribution of odontogenic infections, and to determine the antimicrobial susceptibility pattern of it aetiologic agents among patient who visited the Dental Clinic of Central hospital Benin City, Nigeria.

EXPERIMENTAL

Study design. A prospective study of 97 consecutive patients who visited the dental clinics at Central Hospital Benin City, Nigeria was carried out, following ethical approval from Hospital's Institutional Review Board and informed consent from all participants enrolled in the study.

Sample collection. All Patients who attended dental clinic from May 9 – May 31, 2016 for tooth extraction were included in this study. Socio-demographic information collected from patients included: age, gender, socioeconomic status, ethnicity, medical and medication history. Questions on habits, such as alcohol intake, smoking, preferred side of chewing during mastication were assessed with standard data recording format.

Exclusion criteria. All patients who attended dental clinic within this time frame for other dental interventions and those who were on antibiotics within two weeks prior to the commencement of the study were excluded.

Specimen collection. Specimens were collected from each patient after the induction of anesthesia before tooth extraction, using a sterile swab stick to swab the surface of the infected tooth. The second specimen was collected after extraction with the aid of a sterile swab stick rubbed in the deep socket of the excised tooth to obtain the deep culture. A total of 194 swabs from 97 patients were collected into swab stick tubes containing 5ml of freshly prepared sodium thioglycolate broth and transported to the laboratory for further microbiological evaluative tests.

Isolation and identification of bacteria. Each specimen in sodium thioglycolate broth was streaked onto the surface of separate plates containing 10% blood agar. Inoculated plates were incubated at 37^0C for 24hours and observed for growth. Bacterial colonies were identified based on colonial characteristics, biochemical test [11] and Gram staining reaction [12].

Antibiotic susceptibility test. Antibiotic susceptibility test was carried out using the disk diffusion standard method [13], with some modifications. Standardized (1mL) inoculum adjusted to 0.5 McFarland standard of each isolate was spread evenly on the surface of already dried Mueller-Hinton agar plate. A multi disc containing 10µg each of amoxicillin, cotrimoxazole, streptomycin, chloramphenicol and perfloxacin (Oxoid, England) was impinged onto the surface of each inoculated plate and incubated at 37^O C for 24 hours. Inhibition zone diameters were measured to the nearest millimeter and interpreted with published guidelines for antimicrobial susceptibility testing for commonly occurring pathogens obtained from clinical isolate [13].

Data analysis. One-way analysis of variance using SPSS statistical software version... was adopted in the comparison of the number of patients affected by the odontogenic infections among the different age groups and sex; P values <0.05 was considered statistically significant. Discrete variables such as position of most frequently excised tooth, prevalence of aetiologic agents and antimicrobial susceptibility pattern of isolates were expressed as percentages.

RESULTS

A total 97 patients were enrolled in this study and these include 35.05% males and 63.95% females; mean age of 37.59 and age range was 9-109 years. Exactly 194 specimens were obtained in this study. Epidemiological studies showed *periodontitis* as the most prevalent oral infection, while *gingivitis* was the least. Female patients had a higher prevalence of oral infections irrespective of the type of oral infection (figure 2). The most frequently excised tooth type was located in the right lower quadrant of the mouth irrespective of sex (Table 1). Patients between the ages of 20-29 were more predisposed to oral infections, majorly periodontitis 50 (51.5%), dental caries 18 (18.56%) and irreversible pulpitis 9 (9.2%), while other oral conditions accounted for 20 (20.6%). The most frequently encountered odontogenic bacterial isolate were β-haemolytic *Streptococcus* species 66 (34 %), *Enterococcus* spp. 40 (20.6%), *Corynebacterium* spp. 23 (11.9%), *Staphylococcus* spp 18 (9.3%), γ-haemolytic *Streptococcus* spp. 10 (5.2%), *Neisseria* spp. 3 (1.5%), *Bacillus* spp. 2 (1.0%) and *α*-haemolytic *Streptococcus* spp. 1 (0.5%). Thirty-one (16%) cultured specimen did not show any growth (Figure 1). Bacterial isolates were more susceptible to perfloxacin compared to amoxicillin which was least active (Table 2). This study demonstrated a marked difference between surface and deep socket bacterial flora within the same individual 38.14%, and 46.4% of patients showed no significant difference. A total of 15.46% of patients had no growth in their cultured specimen.

DISCUSSION

High predisposition rate of patients aged 20-29 years to odontogenic infections, as observed in this study could due to their eating habits. Previous research has shown that young adults take in larger quantities of carbohydrate and sugars. These substrates are readily fermented by oral bacteria to produce acids that could erode the dental hard tissues [14]. Studies have reported peridontitis with a prevalence rate of 15-58% for Nigerians age 15years [15]. This is at variance with the (51.5%), observed in our study. The observed

difference may be due to variation in sampling techniques and in age specific grouping of data. Gingivitis with a prevalence rate (1%) in this study is at variance with available literature; which reported 15% among children age 2-5yrs [16]. This disparity may be due to the age range of patients (9-109years) enrolled in our study as research has shown gingivitis to be a childhood disease most prevalent in children between the ages of 2-5 years [16].

Table 1: Anatomical Positions of the Excised Tooth

EXO POSITION	MALE (%)	FEMALE (%)	TOTAL
RU set of teeth	8 (57.14)	6 (42.86)	14
RL set of teeth	10 (31.25)	22 (68.75)	32
LU set of teeth	8 (33.33)	16 (66.67)	24
LL set of teeth	8 (29.63)	19 (70.37)	27
Total	34 (35.10)	63 (64.90)	97

Excision position (EXO) Right upper quadrant (RU), Right lower quadrant (RL), Left upper quadrant (LU) and Left lower quadrant (LL).

Table 2: Susceptibility pattern of isolates to antimicrobial agents

Isolates	Perfloxacin	Cotrimoxazole	Amoxicillin	Streptomycin	Chloramphenicol
β *Strep* (n=66)	59(80.3%)	44(66.6%)	20(30.3%)	51(77.3%)	39(59%)
Enterococcus (n=40)	34(85%)	20(50%)	3(7.5%)	29(72.5%)	13(32.5%)
Corynebacterium (23)	19(82.61%)	9(39.9%)	6(26.1%)	19(82.6%)	12(52.2%)
Staph (n=18)	12(66.6%)	7(38.9%)	2(11.1%)	12(66.7%)	5(27.9%)
γ *Strep* (n=10)	8(80%)	6(60%)	3(30%)	7(70%)	4(40%)
Neisseria (n=3)	3(100%)	2(66.6%)	0(0%)	2(66.7%)	1(33.3%)
Bacillus (n=2)	2(100%)	0(0%)	0(0%)	1(50%)	0(0%)
α Strep (n=1)	1(100%)	0(100%)	0(0%)	0(0%)	0(0%)
No growth (31)	-	-	-	-	-

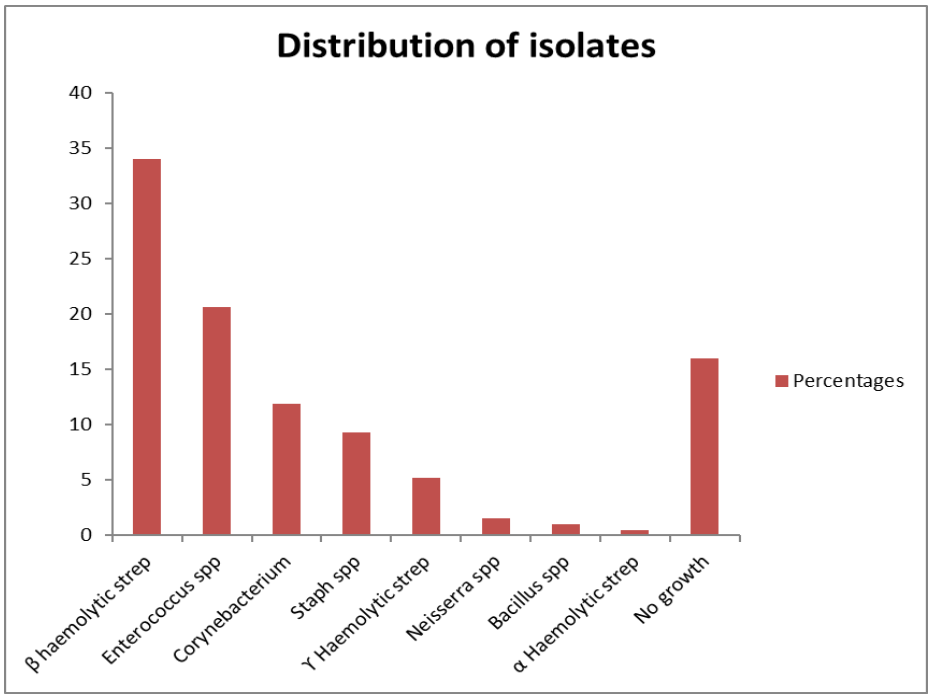

Figure 1: Distribution of isolates

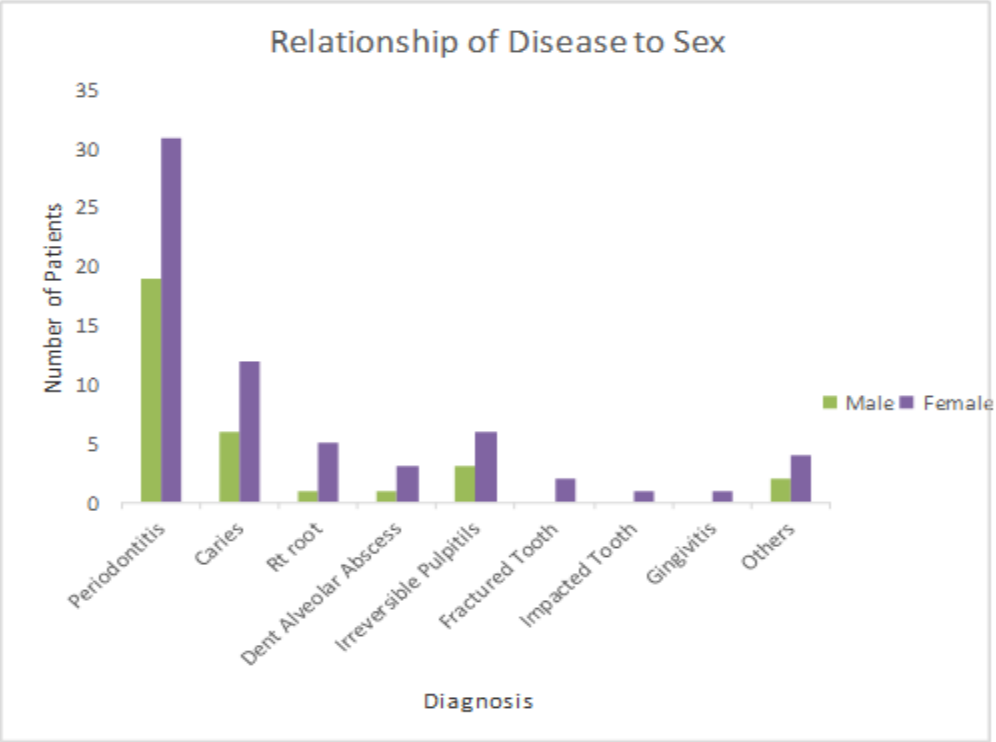

Figure 2: Distribution of odontogenic infections with respect to sex.

The most frequently excised tooth was observed to be located in the right lower quadrant of the mouth in both sexes. This may be due to the fact that most of the patients agreed to having the right side of their mouth as their preferred chewing side during mastication of food. Earlier report has shown posterior mandibular teeth to be more involved in mastication and thus more predisposed to wear and cracks resulting from tooth and food contact [17]. Consequently, patients with the right side of their mouth as their preferred chewing side during mastication have this side preferentially more predisposed to wear and cracks. Cracked tooth shelter food debris and are breeding grounds for oral bacteria.

Published results have confirmed that odontogenic infections are usually a result of synergistic interaction among several bacterial species predominant among which are species of oral *Streptococci* and a wide array of anaerobic Gram negatives. *Streptococci* group is believed to be the primary invaders of soft tissue; its growth prepares an environment that is conducive for the growth of obligate anaerobes [18].

In this study, β-haemolytic *Streptococci* (34%) were the most prevalent facultative anaerobes isolated from the 194 specimen collection. There appears to be an association of β-haemolytic *Streptococci* with periodontitis as 59.1% of the total β-haemolytic *Streptococci* were isolated from patient diagnosed with periodontitis. Our result is similar to the work, where β-haemolytic *Streptococci* was identified as the most commonly found facultative anaerobes in odontogenic infections [19]. The observed association of β-haemolytic *Streptococci* with periodontitis has been reported [20]. High degree of isolation rate of Streptococci in this study could be related to its ability to ferment dietary carbohydrates in the mouth to produce acid. Frequent and sustained production of acid erodes the buffering capacity of saliva and favours aciduric bacterial like *Streptococci* which exacerbate the damage to

dental hard tissues. Additionally, its facultative nature enables survival inside deep periodontal pockets. This study has shown that 51% of *Corynebacteria species* were associated with cases *of periodontitis*. This is at variance with previous works where less than 2% of the genus *Corynebacterim* was associated with cases of *periodontitis* [17]. Out of the total number of *Enterococci* isolates, 50% were found to be associated with *periodontitis. Corynebacteria* and *Staphylococci* accounted for 10 % and 5% of the total isolates identified in this study with a distribution pattern of 51%, 30%, 4.3% as well as 66.7%, 22.2% and 11.1% association with periodontitis, caries and dental alveolar abscess respectively. Both bacteria are normal flora of the human body, commonly colonizing the skin, upper respiratory, urogenital and gastrointestinal tracts of man. However, a few species of these genera have been associated with oral infections. *C. diphtheria* and *staphylococcus aureus* have been implicated occasionally in dental alveolar abscess and other odontogenic infections. In 37 patients, there was marked difference in the bacterial isolates obtained from the surface swabs compared with the deep socket swabs within the same subject. This is in line with literature reports [21] and our findings further buttressed the fact that odontogenic pathogens are polymicrobial. Surface and deep socket isolates were however, similar within the same subject in 45 patients. The antimicrobial susceptibility tests showed that 82% of all isolates were susceptible to perfloxacin, while above 66.6% were susceptible to the streptomycin. This may be due to the broad spectrum activity of these classes of drugs and the ability for perfloxacin to diffuse sufficiently into the mucosal of the oral cavity to kill both dormant and rapidly dividing cell. Seventy percent (70%) of the four principal odontogenic bacterial isolated in this study were resistant to the amoxicillin. This class of drug was the preferred choice in the management of oral infection in the study area. High level resistance to amoxicillin by these isolates may result from misuse of antibiotics, self-medication and negligence on the part of the patients. It could also be due to lack of up to-date knowledge on antimicrobial resistance among the Dentists and the Nurses; an extension of in availability of local antibiogram data. Variability in the susceptibility pattern of the four principal odontogenic isolates to antifoliates and chloramphenicol may be due to the intrinsic genetic properties of individual isolates.

This study has shown the imperative of continuous surveillance studies on the antimicrobial susceptibility pattern of odontogenic pathogens for early detection of emerging resistance trends and adjustment in the usage of therapeutic interventions. Efforts would be made to evaluate possible role of obligate anaerobes in oral infections in future studies. The role of fungi and viruses in odontogenic infections was not within the purview of this study.

Conclusion. Odontogenic infections are of public health importance in Nigeria. Our study has demonstrated age and gender dependence in it distribution. Patients aged 20-29years were more predisposed to these infections; predominantly peridontitis 51.5%, followed by caries 18.6%, and irreversible pulpitis 9.3%. Most frequently excised tooth/teeth were located in the right lower quadrant of the mouth in both sexes. This study has shown *Streptococci, Enterococci, Corynebacteria* and *Staphylococci* as the predominant odontogenic pathogen in the study centre. These aetiologic agents were resistant to amoxicillin but were highly and moderately susceptible to perfloxacin and Streptomycin respectively. In line with findings from this study, perfloxacin and streptomycin are recommended as drugs of choice in the management of oral infections in Central hospital, Benin City as long as the

benefit outweighs the risk. Cotrimoxazole can also be used in patients who can tolerate it.

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