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Preoperative administration of 0.2% chlorhexidine mouthrinse reduces the risk of bacteraemia associated with intra-alveolar tooth extraction

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ABSTRACT

The aim of the study was to investigate the effect of preoperative 0.2% chlorhexidine mouthwash on the risk of bacteraemia following routine intra-alveolar tooth extraction.

The study was a randomized controlled clinical study of 101 subjects who underwent intra-alveolar dental extractions under local anaesthesia. Subjects were randomly assigned to either chlorhexidine or a control group. The chlorhexidine group had 0.2% chlorhexidine mouthwash administered for 1 min before any dental manipulation, and the control group had a mouthrinse of sterile water. Blood samples were collected at baseline, 1 min and 15 min after the dental extractions. Subculture and further identification of the isolated bacteria were performed by conventional microbiological techniques.

There was a statistically significant difference in the incidence of bacteraemia between the control group (52.4%) and chlorhexidine group (27.1%) ($P = 0.012$). Bacteraemia was most frequently detected at 1 min after extraction (33.3%). Of the 30 subjects who had positive blood culture at 1 min, bacteraemia persisted in 8 (26.7%) of the subjects after 15 min. Bacteria isolated included *Staphylococcus aureus*, *Actinomycetes naesulendi*, *Prevotella* species, *Streptococcus* spp., and *Acinetobacter iwoffii*.

Routine use of 0.20% chlorhexidine mouthwash before dental extraction is recommended to reduce the risk of bacteraemia following tooth extraction.

1. Introduction

Tooth extractions almost always cause a breach in the oral mucosa leading to dissemination of bacteria into the blood stream (Macfarlane et al., 1984). This causes bacteraemia due to the heavy presence of bacteria in the oral cavity (Hays, 2006). Therefore, there is need to reduce the bacteria load in the oral cavity so as to minimize bacteraemia. This can be achieved by the use of antiseptic or antibiotic prophylaxis (Macfarlane et al., 1984). The main objective of antiseptic prophylaxis is to reduce the bacteria load in the oral cavity at the time the dental manipulation begins with the aim of minimizing the risk of developing bacteraemia (Bender et al., 1984; Segreti, 1999). Studies have shown that a single use of a 0.20% chlorhexidine mouthwash has a strong antimicrobial effect on saliva microflora (Addy et al., 1991; Jenkins et al., 1994), and on the supragingival plaque (Netuschil et al., 1989). Chlorhexidine has been the most widely investigated antiseptic for the prevention of bacteraemia after dental manipulations, although contradictory results have been reported in the literature (Erverdi et al., 2001; Tomas et al., 2007a, b). However it is difficult to compare results obtained in these studies due to different methodologies such as type of dental intervention, technique for applying chlorhexidine and the formulation and concentration of chlorhexidine used (Okell and Elliott, 1935; Durack, 1995). To prevent infective endocarditis due to bacteraemia from dental treatment, the American Heart Association recommended the use of antiseptic mouthwash

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containing chlorhexidine or povidone-iodine before certain dental manipulations (Dajani et al., 1997). The British Society for Antimicrobial Chemotherapy guidelines also suggested that a preoperative mouthwash with 0.2% chlorhexidine gluconate should be administered and held in the mouth for 1 min to prevent bacteraemia following tooth extraction (Gould et al., 2006).

However, the European Society of Cardiology and the British Society of Cardiology in their recent protocols on prevention of bacterial endocarditis due to bacteraemia from dental manipulations made no mention of the use of antiseptics (Horstkotte et al., 2004; Korada, 2006) This lack of consensus on the need for antiseptic prophylaxis probably occurs because the efficacy of chlorhexidine mouthwash in prevention of bacteraemia after dental procedures has not been established (Tomas et al., 2007a, b). As for measures to eradicate bacteraemia following dental extraction, no single method (either topical or systemic antimicrobials or antiseptic agents) has been very effective, despite the fact that some measures may reduce the prevalence significantly relative to others (Parahitiyawa et al., 2009).

The purpose of this study was to investigate the effect of preoperative 0.2% chlorhexidine mouthwash on the risk of bacteraemia following routine intra-alveolar tooth extraction.

2. Material and methods

This study was conducted at the Departments of Oral and Maxillofacial Surgery and Medical Microbiology and Parasitology, Lagos University Teaching hospital, Idi-Araba, Lagos, Nigeria between November 2012 and June 2013. All consecutive healthy adult subjects aged 18 years and above who presented at the dental clinic for extraction of one or more molar teeth under local anaesthesia were included in the study. The following exclusion criteria were used: subjects currently on antibiotics or have been on antibiotics in the last 7 days prior to the study, subjects on routine use of oral antiseptics or with any type of congenital or acquired immunodeficiency, those having any known risk factor for bacterial endocarditis or with any disease that could predispose them to infections or bleeding, subjects who were hypersensitive to chlorhexidine gluconate, those who refused consent and patients who had positive baseline bacteraemia. Eligible subjects were randomized into 2 groups using computer generated groups placed in white opaque envelopes. The test group consisted of subjects who received preoperative 0.2% chlorhexidine (Corsodyl GSK pharmaceuticals, Nottingham, NG80 2PR. United Kingdom) mouthwash, while the control group received sterile water mouthwash. Written informed consent was obtained from all the subjects before enrolment into the study. Ethics approval for this study was obtained from the Health Research and Ethics Committee (HREC) of the Lagos University Teaching Hospital, Idi-Araba, Lagos, Nigeria.

2.1. Surgical technique

Intra-alveolar extractions of molar teeth were done using extraction forceps (lower or upper molar forceps) and/or an elevator. Before extracting the tooth, local anaesthesia was achieved with 1.8 ml of 2% xylocaine with adrenaline (1:80,000) given approximately 10 min before the extraction. The injection (Inferior alveolar nerve, lingual nerve and long buccal nerve block for the lower teeth and infiltration for the upper teeth) was given using an aspirating syringe. If blood was aspirated into the cartridge or if blood was seen at the mucosa where the needle punctured the pterygomandibular fossa, the subject was disqualified from participating in the study. After extraction of teeth, haemostasis was achieved by the subject biting hard on a gauze pack placed on the socket for about 10–15 min. Post-operative instructions were then given to the subjects. The duration of extraction procedure was recorded. This was the time interval between the placement of elevator or forceps in the tooth socket and when the tooth was delivered.

2.2. Collection of blood samples for blood culture

Three peripheral venous blood samples were collected from each subject: a baseline blood sample taken before the administration of local anaesthesia; second sample was taken at 1 min after tooth extraction. In cases of multiple tooth extractions, the second blood sample was taken 1 min after extraction of the last tooth. The third blood sample was taken 15 min post-extraction. About 5 ml of venous blood was taken each time. For the blood sample collection, a large bore (18–22) gauge needle was placed in the dorsum of the hand or antecubital fossa after cleaning the site with alcohol and hibitane. Each blood sample was inoculated into an oxoid signal culture bottle and immediately taken to the laboratory. The baseline blood sample was to ascertain the presence or absence of bacteraemia before tooth extraction while the 2nd and 3rd samples were to evaluate the bacteraemia associated with tooth extraction. Each subject was given 1000 mg of paracetamol 2 h after extraction, then 1000 mg three times daily for 3 days. The following steps were taken to minimize the possibility of contamination (Adeyemo et al., 2013):

1. Sterile gloves were used in obtaining blood samples and performing the extractions and 0.5% chlorhexidine alcoholic solution was used as skin disinfectant before sample collection. Alcoholic chlorhexidine solutions has been shown by several studies and a recent meta-analysis to significantly reduce blood culture contamination when compares with povidone-iodine solution (Suwanpimolkula et al., 2008; Benjamin et al., 2011; Caldeira et al., 2011).
2. After each failed attempt at taking blood sample, a new sterile needle was used for the next attempt and also new sterile needle was used to inoculate the sample into the oxoid signal culture bottle and not the one with which the blood sample was obtained.
3. The rubber stopper on each bottle was cleaned with 0.5% alcoholic chlorhexidine solution before inoculation.
4. Cleaning of the rubber stopper with 0.5% alcoholic chlorhexidine was also done in the laboratory before insertion of the signal device.

2.3. Blood culture

All bottles were incubated at 37 °C, and checked for evidence of growth twice daily for 14 days before discarding. A sub-culture was done on all the bottles at 24 h, 48 h, and at any time there was evidence of growth. A terminal culture was done at the 14th day on all negative blood cultures. The primary sub-culture was done on aerobic agar (blood agar base (oxoid) + 5% sheep blood), chocolate agar in CO_2 and Anaerobic blood sugar (Fastidious anaerobe agar + 5% sheep blood). A metronidazole disc was placed in the first quadrant of all anaerobic plates. All isolates on the aerobic blood agar and chocolate agar was gram stained after 24 h of growth in air and CO_2 respectively while isolates from the anaerobic blood agar was gram stained after 48 h. All negative gram lactose-fermenting bacilli were identified using the API20E. All gram positive cocci were tested for catalase production.

The haemolytic reactions of all catalase-negative organisms were determined and they were further tested for their reactions to PVR and their ability to grow in the presence of 6.5% NaCl. Catalase

positive organisms were tested for coagulase production and resistance to Novobiocin as well as their ability to grow on mannitol salt agar. Characterization of the anaerobes was by API20A according to manufacturer's instructions. For anaerobic culture, an anaerobic jar (oxoid) with a gas processing kit that provided an atmosphere of 80% N_2, 10% H_2 and 10% CO_2 was used.

2.4. Statistical analysis

Data collected was analysed by using SPSS (statistical package for social sciences) for Windows (version 16, Chicago, IL) statistical software package. The critical level of significance was set at $P < 0.05$. A descriptive statistics was generated.

3. Results

101 subjects participated in the study. There were 56 (55.4%) males and 45 (44.6%) females with a male to female ratio of 1.2:1. The control group had 28 (59.6%) males and 19 (40.4%) females while the test group (chlorhexidine group) had 28 (51.9%) males and 26 (48.1%) females. Table 1 shows the sex distribution of subjects. The age of the subjects ranged between 18 and 76 years (Mean ± SD = 32.5 ± 11.7 years). The most common teeth extracted were the lower right first molar (12.3%). A single tooth was extracted in 88 subjects (87.1%) while 13 subjects (12.9%) had two or more teeth extracted. The most common reason for tooth extraction was caries and it's sequelae in 88 subjects (87.1%) followed by periodontitis which accounted for extractions in 7 subjects (6.9%).

3.1. Prevalence of bacteraemia associated with intra-alveolar extraction

Eleven subjects (10.9%) out of a total 101 subjects had positive baseline blood cultures and were therefore excluded from the analysis of prevalence of bacteraemia. Five (10.6%) of the excluded samples were in group A and 6 (11.1%) were in group B ($P > 0.6$). Therefore only 90 subjects were included in the analysis of positive blood culture following extraction.

Of the 90 subjects, there were 51 (56.7%) males and 39 (43.3%) females with a male to female ratio of 1.2:1. The age of these subjects ranged from 18 to 69 years with a mean ± SD of 32.2 ± 11.1 years. Forty-eight subjects (53.3%) were in the test (chlorhexidine) group while 42 (46.7%) were in the control group. In the chlorhexidine group, there were 26 (54.2%) males and 22 (45.8%) females while in the control group, there were 25 (59.5%) males and 17 (40.5%) females. Overall, bacteria were isolated in blood cultures of 35 of the 90 subjects with a prevalence of 38.9%.

Out of the 48 subjects in the chlorhexidine group, 13 (27.1%) had positive blood cultures while 35 (72.9%) had no positive blood culture. Twenty-two (52.4%) of the control group had positive blood cultures while 20 (47.6%) had negative cultures. Therefore the prevalence of bacteraemia in the chlorhexidine group and the control group after intra-alveolar extractions were 27.1% and 52.4% respectively (Table 2). There was statistically significant difference in the prevalence of bacteraemia between the 2 groups ($P = 0.012$). Positive blood culture was detected at 1 min in 30 subjects, at 15 min in 13 subjects and at both 1 min and 15 min in 8 subjects (Table 3). Bacteraemia was most frequently detected at 1 min and this occurred in 30 (33.3%) subjects after extraction. Positive blood culture was detected more in control group than chlorhexidine group at both 1 min and 15 min ($P = 0.131$; $P = 0.072$ respectively). Out of the 30 subjects that had bacteraemia at 1 min after extraction, bacteraemia persisted in 8 (26.7%) of them after 15 min.

Table 1
Sex distribution of subjects.

Sex of subjects	Group		
	A (%)	B (%)	Total
Male	28 (59.6)	28 (51.9)	56 (55.4)
Female	19 (40.4)	26 (48.1)	45 (44.6)
Total	47 (46.5)	54 (53.5)	101 (100)

A. (Control group).
B. (Chlorhexidine group).

Table 2
Prevalence of bacteremia in groups A (Control) and B (Chlorhexidine).

Groups	Positive (%)	Negative (%)	Total
A	22 (52.4)	20 (47.6)	42
B	13 (27.1)	35 (72.9)	48
Total	35 (38.9)	55 (61.1)	90

3.2. Bacteria isolates from the blood samples

A total of 30 bacteria species were isolated from 43 positive blood samples. Seventeen (56.7%) were aerobes while 13 (43.3%) were anaerobes. The most common bacteria isolated was *Staphylococcus aureus* seen in 12 (40%) of the bacteria isolates. This was followed by *Actinomycetes naesulendi* and *Prevotella* species seen in 4 (13.3%) of bacteria isolates in each case. Thirty-five percent of the aerobes isolated were gram positive cocci while 58.8% were gram

Table 3
Positive blood cultures (bacteremia) and time of occurrence.

Time	Number of cases (%)	Number of samples
1 min only	22 (62.9)	22
15 min only	5 (14.3)	5
1 min and 15 min	8 (22.8)	16
Total	35	43

Table 4
Total bacterial isolates from positive samples.

Bacterial species	Frequency (%)	Bacteria spp.	Frequency (%)
Aerobes		Anaerobes	
Gram positive cocci		Gram positive bacilli	
Staphylococcus aureus	12 (40)	*Actinomycetes naesulendi*	4 (13.3)
Staphylococcus epidermidis	2 (6.7)	*Actinomyces isrealii*	1 (3.3)
Staphylococcus lentus	1 (3.3)	*Clostridium difficile*	1 (3.3)
A-haemolytic streptococcus	1 (3.3)	*Propinibacterium propionicus*	1 (3.3)
Staphylococcus schleiferi	1 (3.3)	*Propinibacterium avidum*	1 (3.3)
Staphylococcus haemolyticus	1 (3.3)	Gram negative bacilli	
Gram negative cocci		*Prevotella melaninogenica*	1 (3.3)
Moraxella specie	1 (3.3)	*Prevotella disiens*	1 (3.3)
Gram negative bacilli		*Bacteriodes ureolyticus*	1 (3.3)
Acinetobacter iwoffii	3 (10)	*Prevotella oralis*	1 (3.3)
Actinobacillus specie	1 (3.3)	*Prevotella intermidis*	1 (3.3)
Tatumella ptyseos	1 (3.3)	*Fusobacterium mortiferum*	1 (3.3)
Vibrio hollisae	1 (3.3)	*Fusobacterium varium*	1 (3.3)
Pseudomonas fluorescens-25	1 (3.3)	*Bacteroides distasonis*	1 (3.3)
Vibrio vulnificus	1 (3.3)		
Flavibacterium meningosepticum	1 (3.3)		
Alcaligenes faecalis	1 (3.3)		
Providencia stuartii	1 (3.3)		
Yersinia pseutuberculosis	1 (3.3)		

Table 5
Bacteria identified in blood cultures for control and chlorhexidine groups.

Chlorhexidine group (Frequency)	Control group (Frequency)
Aerobes	Aerobes
S. aureus (8)	*S. aureus* (4)
S. lentus (1)	*S. schleiferi* (1)
S. haemolyticus (1)	*Pseudomonas fluorescens-25* (1)
S. epidermidis (2)	*Acinetobacter iwoffii* (3)
Yersinia pseudotuberculosis (1)	*Vibrio vulnificus* (1)
Providencia stuartii (1)	*Flaviobacterium meningosepticum* (1)
Actinobacillus spp. (1)	*Vibrio hollisae* (1)
A-haemolytic streptococcus (1)	*Tatumella ptyseos* (1)
Alaeligenes faecalis (1)	
Moraxella spp. (1)	Anaerobes
Anaerobes	*P. melaninogenicus* (1)
Actinomycetes naesulendi (2)	*P. oralis* (1)
Clostridium difficile (1)	*P. intermedia* (1)
Propinibacterium propionicus (1)	*P. disiens* (1)
Propinibacterium avidum (1)	*Actinomycetes naesulendi* (2)
Bacteroides distasonis (1)	*Bacteroides ureolyticus* (1)
	Actinomyces isrealii (1)
	Fusobacterium varicum (1)
	Fusobacterium mortiferum (1)

negative bacilli. Among the anaerobes, 61.5% were gram negative bacilli while 38.5% of isolates were gram positive bacilli (Table 4).

In both control and chlorhexidine groups, *Staphylococcus aureus* were the most common aerobes isolated. *Acinetobacter iwoffii* was also commonly isolated in the control group. More anaerobes were isolated in the control group than the chlorhexidine group. The commonest anaerobe in the chlorhexidine group was *Actinomycetes naesulendi* while *Prevotella* species were the commonest in the control group (Table 5).

3.3. Factors influencing bacteraemia associated with intra-alveolar extraction

3.3.1Gender of subjects

Bacteraemia was observed in 19 (54.3%) females and 16 (45.7%) males. There was no significant association between the subject's gender and development of bacteraemia ($P < 0.073$).

3.3.2. Age of subjects

The mean age ± SD of subjects with bacteraemia was 29.9 ± 8.7 years which was lower than that of the subjects without bacteraemia (33.7 ± 12.3). However, the difference was not significant ($P < 0.182$). Logistic regression analysis of the effect of age on the presence of positive blood culture showed that age does not have any significant effect on bacteraemia following tooth extraction ($P < 0.158$).

3.3.3. Duration of extraction

The duration of extraction of the 90 subjects ranged between 1 min and 53 min with a mean ± SD of 17.9 ± 13.6 min. The duration of extraction in the control group ranged between 1 min and 45 min with a mean ± SD of 16.7 ± 11.8 min which was not significantly lower than duration of extraction in the chlorhexidine group with a mean ± SD of 18.9 ± 14.8 min ($P < 0.276$). The mean duration of extraction in subjects' with bacteraemia was 17.6 ± 12.6 min while that of subjects without bacteraemia was 18.2 ± 14.3 min. The difference in the mean duration of extraction between the 2 groups was not significant ($P = 0.6$). Overall, logistic regression analysis of the effect of duration of extraction on bacteraemia after intra-alveolar tooth extraction showed that duration of extraction had no significant effect on post-extraction bacteraemia ($P = 0.79$).

3.3.4. Preoperative oral hygiene and periodontal status

Fifty-one (56.7%) of the subjects had oral hygiene that was rated fair while 23 (25.6%) and 16 (17.8%) were rated good and poor respectively. Ten (37.3%) of subjects with good oral hygiene had positive blood culture while 19 (37.3%) of the subjects with fair oral hygiene also had positive blood culture after extraction. Bacteraemia in 6 subjects rated poor was 37.5%. There was no statistically significant association between the oral hygiene status of these subjects and post-extraction bacteraemia ($P = 0.570$).

Out of 10 subjects with gingival bleeding, 6 had positive blood samples. Twenty-two of 58 subjects with supra and subgingival calculus also had bacteraemia while 4 (100%) of those with no sign of periodontitis had positive cultures. Periodontal status of subjects had no significant influence on the development of bacteraemia ($P = 0.261$).

3.3.5. Number of teeth extracted

Single tooth extraction was carried out in 79 (87.7%) subjects. Twenty-six (32.9%) of these had positive blood culture after extraction. Of the 11 subjects who had more than one tooth removed, 4 (36.4%) had positive blood culture. No significant association was found between number of teeth extracted and prevalence of positive blood culture ($P = 0.138$).

Multivariate analysis of the effects of these independent factors on bacteraemia following intra-alveolar tooth extraction (Table 6) shows that none of the variables studied have any statistical significant association with occurrence of bacteraemia following intra-alveolar extraction. There was no significant difference in the prevalence of positive blood culture associated with the use of dental forceps, elevators or dental forceps and elevators for the extraction among the subjects.

4. Discussion

The prevalence of bacteraemia associated with various oral surgical procedures varies widely from as low as 7%–100% depending on the type of procedure (Heimdahl et al., 1990; Debelian et al., 1998; Rajasuo et al., 2004; Takai et al., 2005). Prevalence of bacteraemia following tooth extraction varies with some authors reporting prevalence of bacteraemia between 35% and 100% (Wahlmann et al., 1999; Rajasuo et al., 2004). In this study, the overall prevalence of bacteraemia associated with intra-alveolar tooth extraction was 38.9%. This is similar to prevalence of 32% reported by Enabulele et al. (2008) and prevalence of 38% reported by Roberts and Radford (1987) but is lower than those reported by some other authors (Dios et al., 2006; Maestre-Vera and Gomez-Lus Cantelles, 2007). Dios et al. (2006) found a prevalence of 96.22% within 30 s after completion of dental extraction. This variation in prevalence may reflect different microbiological

Table 6
Multivariate analysis of the effects of independent variables (factors) on bacteremia.

Variables	Unstandardized coefficients		Standardized coefficients	*t*	Sig.
	B	Std. error	Beta		
Bacteremia	.901	.321	–	2.807	.000
Periodontal status of patients	.078	.107	.128	.730	.467
Age of patients	.003	.004	.078	.726	.470
Sex of patients	.173	.097	.180	1.770	.080
Number of teeth extracted	.094	.081	.122	1.151	.253
Oral hygiene of patients	–.029	.129	–.038	–.222	.825
Duration of extractions	.000	.004	.012	.105	.917
Forceps and elevators used for extraction	.141	.112	.138	1.250	.214

a. Dependent variable: bacteremia.

techniques and differences in methodology. Takai et al. (2005) in a study on bacteraemia associated with some oral surgical procedures reported that surgery for osteomyelitis resulted in the highest prevalence of bacteraemia (58.3%), followed by tooth extraction (57.9%) and orthognathic surgery (30.3%). Heimdahl et al., (1990) using lysis filtration and BACTEC aerobic and anaerobic culture for intra-alveolar tooth extraction and third molar extraction respectively reported prevalence of 100% for intra-alveolar tooth extractions and 60% for third molar extraction. Tomas et al. (2008) also reported that the prevalence of bacteraemia following third molar surgery was 62% at 30 s after completing the first extraction of a mandibular molar and 67% at 15 min after finishing the final extraction.

Out of the 30 subjects who had bacteraemia at 1 min after extraction, bacteraemia persisted in 8 (26.7%) of them after 15 min. This may imply that post-operative bacteraemia following dental extraction may not be transient. Although it has been previously thought that bacteraemia associated with oral surgical procedures in healthy individuals was transit in nature (Peterson and Peacock, 1976; Poveda-Roda et al., 2008). Tomas et al. (2007a, b) however questioned this assertion after they observed persistent bacteraemia for at least 15 min after three to four dental extractions. They also reported bacteraemia in 20% of subjects 1 h after completion of tooth extraction under general anaesthesia. Lockhart et al., (2004) observed that bacteraemia persisted in 14% of his subjects after 45 min Goker and Guvener (1992) also reported persistence of bacteraemia after 1 h and 24 h after a surgical procedure. In a recent study on bacteraemia associated with cleft lip and palate surgery, Adeyemo et al. (2013) also reported that bacteraemia associated with cleft surgical procedures is not transient in nature.

The importance of these findings is that dental extraction can be harmful to patients at risk especially those with cardiac anomalies and those that are immune-compromised. Bacteraemia may lead to a number of focal infections like infective endocarditis, brain abscess, cavernous sinus thrombosis, lung and liver abscesses and prosthetic joint infection (Hall et al., 1996a; Hall et al., 1996b). Bacteraemia following invasive oral procedures has been traditionally associated with bacterial endocarditis (Poveda-Roda et al., 2008). The ability of various microbial species to adhere to specific sites determines the anatomical localization of infections caused by these microorganisms (Korada, 2006). *Viridans Streptococcus* and *Staphylococcus aureus* have numerous bacterial surface components and have been shown in animal models of experimental endocarditis to function as critical adhesions to the endocardium (Heimdahl et al., 1990; Poveda-Roda et al., 2008). They are the most commonly isolated bacteria in the blood stream of patients with bacterial endocarditis (Bayliss et al., 1983; Valente et al., 2005). Because the number of immune-compromised patients is increasing (Okabe et al., 1995), utmost care must be taken in such patients to prevent the complications that can arise as a result of bacteraemia associated with tooth extraction.

In the present study, *Staphylococcus aureus* was the most commonly isolated bacteria. *Viridans streptococcus* and *Staphylococcus aureus* are also the two most common isolates in positive blood cultures after dental extractions (Tomas et al., 2007a, b; Guntheroth, 1984). In a study on *Staphylococcus aureus* in the oral cavity, Smith et al. (2003) reported that out of 5005 specimens examined, *Staphylococcus aureus* was isolated from 1017 of these specimens, giving credence to the fact that *Staphylococcus aureus* may be a more frequent isolate from the oral cavity than previously reported. In another study to investigate the occurrence of Staphylococci in the oral cavity using saliva and supragingival plaque specimens, Ohara-Nemoto et al. (2008) isolated nine *Staphylococcus* species and identified 334 isolates. In the study, *Staphylococcus aureus* was the most frequent species, followed by *Staphylococcus epidermidis* (Ohara-Nemoto et al., 2008).

Although, *Staph aureus* is considered rare in the oral cavity, previous studies have also isolated Staph aureus in the blood stream following oral surgical procedures (Okabe et al., 1995; Enabulele et al., 2008). Enabulele et al. (2008) reported *Staphylococcus* spp as one of the mostly commonly isolated aerobes in the blood stream following tooth extraction. Okabe et al. (1995) isolated Staphylococcus 12 times and *Streptococcus* 13 times in the blood stream following tooth extraction. Tomas et al. (2008) also isolated few Staph aureus in the blood stream following third molar surgery. It must however be acknowledged that other studies on bacteraemia during other dental procedures have reported the viridans group of *Streptococcus* as the most common isolate (Takai et al., 2005; Tomas et al., 2008).

In the present study, the overall prevalence of bacteraemia after tooth extraction was significantly lower in the chlorhexidine group than the control. In addition, positive blood culture was higher in the control group than chlorhexidine group at both 1 min and 15 min after extraction; although the difference did not reach a significant level. This may be due to the smaller sample size at 1 min and 15 min as compared to the overall prevalence. A single use of 0.20% chlorhexidine mouthwash reduced the prevalence of post-extraction bacteraemia in this study. This implies that 0.2% chlorhexidine if used as a single mouthwash pre-operatively may be beneficial in reducing the prevalence of bacteraemia following dental extractions This could go a long way in protecting the at risk patients especially those that are immune-compromised.

There has been contradictory evidence with regard to the effect of preoperative mouthrinse with antiseptics on the prevalence of bacteraemia associated with dental procedures, with some even suggesting that there may be no clear benefit (Segreti, 1999). The main objective of antiseptic prophylaxis is to reduce the bacterial load in the oral cavity at the time of dental manipulation with the aim of reducing the risk of developing bacteraemia (Segreti, 1999). Wilson et al. (2007) in their report stated that topical antiseptic rinses do not penetrate beyond 3 mm into the periodontal pocket and therefore do not reach areas of ulcerated tissue where bacteria most often gain entrance into circulation. On the basis of this, topical antiseptics may not be very effective in reducing the frequency, magnitude and duration of bacteraemia associated with dental procedures. However, it has been demonstrated that a single use of a mouthwash with 0.20% chlorhexidine has a strong antimicrobial effect on the salivary flora (Segreti, 1999) and on supragingival bacterial plaque (Netuschil et al., 1989; Barros et al., 1998).

In this study rinsing the mouth with 0.20% chlorhexidine before dental manipulation significantly reduced the prevalence of bacteraemia after dental extraction. Tomas et al. (2007a, b) reported similar findings that washing the mouth with 0.20% chlorhexidine significantly reduced the prevalence of bacteraemia after dental extraction. In this study, age, duration of extraction, oral hygiene status, type of instrument used, and number of teeth extracted were not significantly associated with prevalence of bacteraemia following intra-alveolar dental extraction. In addition, sex and periodontal status were not associated with prevalence of bacteraemia following intra-alveolar dental extraction.

5. Conclusion

In this study, the prevalence of bacteraemia associated with dental extraction was 38.9%. Of the 30 subjects who had positive blood culture at 1 min, bacteraemia persisted in 26.7% of them after 15 min which implies that bacteraemia following dental extraction is not transient. The prevalence of bacteraemia associated with dental extraction after a preoperative mouthrinse with 0.2%

chlorhexidine was significantly lower than when subjects had a preoperative mouthrinse without chlorhexidine. Based on the findings of this study, the routine use of 0.2% chlorhexidine mouthwash before dental extraction is recommended to reduce the risk of bacteraemia following dental extraction.

Conflict of interest statement

Authors declare no conflict of interest.

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