Prevalence and Bacteriology of Bacteremia Associated With Cleft Lip and Palate Surgery

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Abstract: The aim of the study was to determine the prevalence and bacteriology of bacteremia associated with cleft lip and palate (CLP) surgery. Three venous blood samples were obtained from 90 eligible subjects who presented for CLP surgery: before surgical incision, 1 minute after placement of the last suture, and 15 minutes thereafter. The samples were injected into an Oxoid Signal blood culture and transported to the laboratory for gram-positive/negative and aerobic/anaerobic bacteria analysis. Prevalence of bacteremia associated with cleft surgery was 38.1%. Prevalence rates of bacteremia in cleft lip surgery, cleft palate surgery, and alveoloplasty were 40.9%, 33.3%, and 50%, respectively. There was no significant difference in prevalence rate of positive blood culture in cleft lip surgery, cleft palate surgery, and alveoloplasty ($P = 0.69$). Positive blood culture was detected most frequently (47%) 1 minute after placement of the last suture. Of the 23 subjects who had positive blood culture at 1 minute, bacteremia persisted in 8 (35%) of them after 15 minutes. The most common bacteria isolated were coagulase-negative staphylococcus, *Acinetobacter lwoffii*, and coagulase-positive *Staphylococcus aureus*. Sex and age of the subjects, duration of surgery, blood loss, and type of cleft surgery were not significantly associated with positive blood culture. Bacteremia associated with CLP surgery is polymicrobial and persisted for at least 15 minutes after surgery in 35% of cases. This may reinforce the need for prophylactic antibiotics to protect at-risk patients from developing focal infection of the heart by oral flora.

Key Words: Bacteremia, cleft deformities, surgery

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It is well known that several intraoral/extraoral procedures result in bacteremia.[1] Over the years, a lot of published studies have focused on dental procedures as a cause of infective endocarditis. Bacteremia also constitutes an essential step in the pathogenesis of other focal infections of oral origin such as prosthetic joint infections and brain abscess. In these instances, the infection can be life-threatening.[2,3] As a result of these, it is therefore recommended that at-risk patients receiving procedures that could induce bacteremia should receive prophylactic treatment.[4,5] Although the guidelines for prophylactic treatment in oral and maxillofacial surgery should contribute to the prevention of infective endocarditis, scientific data are not available, and subsequently the prophylaxis for the surgery is empirically performed.[5]

To date, data on the incidence and bacteriology of bacteremia associated with cleft lip and palate (CLP) surgery are scarce in the literature. It is reported that up to 11% of patients with cleft lip/palate defects present with congenital heart defects, thereby predisposing them to bacterial endocarditis. Data concerning the incidence and nature of bacteremia associated with cleft lip/palate surgery would be important in assessing the need for prophylaxis and choice of antimicrobial regimen. The purpose of this study was to investigate the prevalence and bacteriology of bacteremia associated with CLP surgery.

METHODS

Study Design

The study was carried out at the Department of Oral and Maxillofacial Surgery and Medical Microbiology and Parasitology, Lagos University Teaching Hospital, Idi-Araba, Lagos, Nigeria. Approval for the study was obtained from the Health Research and Ethics Committee of the hospital.

All eligible subjects who presented for CLP surgery were included in the study. The following categories of subjects were excluded from the study: orofacial clefts based on Tessier classification, subjects with known congenital heart defects or any other known risk factor for bacterial endocarditis, and those receiving antibiotics before surgery. Written informed consents were obtained from all subjects or their parent/guardian before enrollment into the study.

Surgical Technique

Unilateral cleft lip (complete or incomplete) was repaired using either Millard rotation advancement technique or Tennison-Randall

TABLE 1. Sex Distribution of Cleft Deformity

Type of Cleft	Male, n (%)	Female, n (%)	Total, n (%)
Unilateral CLP	18 (20)	12 (13.3)	30 (33.3)
Unilateral cleft lip ± alveolus	10 (11.1)	11 (12.2)	21 (23.3)
Bilateral CLP	8 (8.9)	8 (8.9)	16 (17.8)
Cleft palate (hard and soft)	4 (4.4)	5 (5.6)	9 (10)
Isolated cleft of soft palate	4 (4.4)	4 (4.4)	8 (8.9)
Bilateral cleft lip	2 (2.2)	2 (2.2)	4 (4.4)
Microform clefts	2 (2.2)	0 (0)	2 (2.2)
Total	48 (53.3)	42 (46.7)	90 (100)

triangular technique, whereas bilateral cleft of the lip was repaired by Millard forked flap technique. Repair of cleft of the palate was done using von Langenbeck technique. All surgeries were done under general anesthesia. Blood loss during surgery was calculated by weighing gauze, measuring suctioned blood, and adjusting for the volume of irrigation solution used during the operation.

Collection of Blood Samples for Microbiological Analysis

Peripheral venous blood samples were collected from each patient for microbiological analysis for bacteremia. A total of 3 blood samples were collected from each patient. For blood collection, a large-bore (18- to 22-gauge) needle was placed in a vein in either the antecubital fossa, dorsum of the hand, or femoral vein after thorough cleaning of the site with hibitane-in-spirit. A baseline sample (first sample) was collected just before intubation for cases done under general anesthesia or just before local anesthetic injection for cases done under local anesthesia. A second sample was collected 1 minute after placement of the last suture following the surgical repair. A third sample was collected 15 minutes after placement of the last suture. About 3 to 4 mL of blood was taken each time and injected into an Oxoid Signal blood culture and immediately transported to the laboratory. The purpose of the first sample was to ascertain the presence or absence of bacteremia before surgery, whereas the second and third samples evaluated surgery-associated bacteremia. Antibiotic (ceftriaxone) was administered to each patient immediately after the collection of the third blood sample.

The following steps were taken to minimize the possibility of sample contamination:

(1) Sterile gloves were used in obtaining blood sample and 0.5% chlorhexidine alcoholic solution was used as the skin disinfectant agent before sample collection.
(2) After each failed attempt, a fresh sterile needle was used for the next attempt.
(3) A fresh sterile needle, and not the one with which the sample was obtained, was used to inoculate the sample into the Oxoid Signal bottle.
(4) The rubber stopper on each bottle was cleaned with 0.5% chlorhexidine alcoholic solution before inoculation.
(5) Cleaning of rubber stopper with alcoholic chlorhexidine was also done in the laboratory before insertion of the signal devise.

Blood Culture

All bottles were incubated at 37°C and checked for evidence of growth twice daily for 14 days before discarding. A subculture was done on all bottles at 24 hours, 48 hours, and at any time that there was evidence of growth. A terminal culture was done at 14 days on all negative blood cultures.

The primary subculture was done on aerobic blood agar (blood agar base [Oxoid] + 5% sheep blood), chocolate agar in CO_2, and anaerobic blood agar (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 were Gram stained after 24 hours of growth in air and CO_2, respectively, whereas isolates from the anaerobic blood agar were Gram stained after 48 hours. All gram-negative lactose-fermenting bacilli were identified using the API 20E. All gram-positive cocci were tested for catalase production. The hemolytic reactions of all catalase-negative organisms were determined and further tested for their reactions to pyrrolidonyl arylamidase 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 done by AP120A according to manufacturers' instructions.

For anaerobic culture, an anaerobic jar (Oxoid) with the gas processing kit that provided an atmosphere of 80% N_2, 10% H_2, and 10% CO_2 was used.

Statistical Analysis

Data analysis was performed using SPSS for Windows (version 17.0; SPSS Inc., Chicago, IL). For all comparisons $P < 0.05$ was adopted as the criterion for establishing a statistical significance. A descriptive statistics was generated.

RESULTS

A total of 90 subjects participated in the study. There were 48 males (53.3%) and 42 females (46.7%) with a male-to-female ratio of 1.1:1.

Pattern of Sex Distribution of CLP Deformities

Table 1 shows the sex distribution of the different types of cleft deformities. Unilateral CLP (33.3%) was the most common defect, followed by cleft lip with or without alveolus (23.3%). Cleft palate (hard and soft) was seen in 9 subjects (10%). Microform cleft of the lip was seen in 2 subjects (2.2%).

Surgical Procedures

A total of 91 surgeries were performed in 90 subjects (Table 2). Each patient underwent 1 surgical procedure, except 1 patient who had 2 surgical procedures at the same surgery. There were 48 cases of lip repair (primary = 45; secondary = 3), 38 cases of palate repair (primary = 35; secondary = 3), 4 cases of alveoloplasty, and 1 case of velopharyngoplasty. Thirty-seven of the primary lip repairs were done in subjects with unilateral cleft (CLP = 17; cleft lip with or without alveolus = 19; microform cleft = 2), and 8 were done in patients with bilateral cleft. Of the secondary lip repair, 1 was done in a subject with unilateral cleft lip and alveolus and 2 cases in subjects with bilateral CLP.

Primary palate repair was performed in 12 subjects with unilateral CLP, 8 subjects with cleft palate, 6 cases of isolated cleft of soft palate, and 9 cases of bilateral cleft palate. Of the 3 secondary palatal

TABLE 2. Surgical Procedures

Type of Cleft Surgery	Frequency	Percentage
Primary lip repair	45	49.4
Primary palate repair	35	38.5
Secondary lip repair	3	3.3
Secondary palate repair	3	3.3
Secondary alveolar bone graft	4	4.4
Velopharyngoplasty	1	1.1
Total	91	100.0

repairs, 2 were done in subjects with isolated cleft of soft palate and 1 in a subject with bilateral CLP.

Surgical Techniques

Unilateral cleft lips were repaired using either Millard rotation advancement technique (n = 19) or Tennison-Randall triangular technique (n = 19). All bilateral cleft lip deformities (n = 10) were repaired using Millard forked flap technique. Cleft of the palate was repaired using von Langenbeck technique. All the 4 cases of secondary alveolar bone graft were done with autogenous bone graft harvested from the mental region. Velopharyngoplasty was performed using a superiorly based pharyngeal flap.

Age of Subjects at Time of CLP Repair

The age of the subjects at the time repair ranged between 3 months and 35 years. Overall, mean (SD) age at the time of repair was 7.2 (SD, 10.2) years. Of the 45 primary lip repairs done, 20 (44.4%) were done within 3 months of age, whereas 18 (51.3%) of the primary cleft palate repairs (n = 35) were done within 18 months of age (Table 3). Of the total primary cleft repairs (n = 80) done, 12 (15%) presented for primary cleft repair at older than 6 years: 9 (11.3%) with cleft palate and 3 (3.7%) with cleft lip deformities (Table 3).

Prevalence of Bacteremia Associated With CLP Surgery

A total number of 90 subjects had cleft lip and surgery done in this study. Although 1 subject in this study had 2 surgical procedures (minor secondary lip repair and alveoloplasty), both were done at the same surgery. For the analysis of positive blood culture, this subject was included in the alveoloplasty group. A total 6 subjects (6.7%) had positive baseline blood cultures and were therefore excluded from the postoperative blood culture analysis. Therefore, only 84 cases were included in the analysis.

Of these 84 subjects, there were 44 (52.4 %) males and 40 (47.6%) females with an overall 1.1:1 male-to-female ratio. Age of these subjects ranged from 3 months to 35 years, with a mean 7.26 (SD, 10.91) years. Forty-four subjects (52.4%) had cleft lip repair, 36 (42.8%) had cleft palate repair, and the remaining 4 (4.8%) had alveoloplasty. Cleft lip repair was performed in 23 males and 21 females, whereas cleft palate repair was done in 20 males and 16 females. Three females and 1 male had alveoloplasty.

Bacteria were isolated in blood cultures of 32 of 84 cases, with a prevalence of 38.1%. The age of the subjects with positive blood cultures ranged between 3 months and 32 years, with a mean of 4.9 (SD, 9.22) years. There were 19 males (59.4%) and 13 females (40.6%) with a 1.5:1 male-to-female ratio. Positive blood culture was observed in 18 cases (40.9%) of cleft lip repair, 12 cases (33.3%) of cleft palate repair, and in 2 cases (50%) of alveoloplasty. Therefore, the prevalence rates of bacteremia in cleft lip surgery, cleft palate surgery, and alveoloplasty were 40.9%, 33.3%, and 50%, respectively. There was no significant difference in the prevalence rate of bacteremia in cleft lip surgery, cleft palate surgery, and alveoloplasty ($P = 0.69$).

Positive blood culture was detected in a total of 40 blood samples from 32 subjects. Positive blood culture was detected most frequently (47%) 1 minute after the placement of the last suture (Table 4). However, in 8 subjects (25%), positive blood culture was detected both at 1 minute and 15 minutes after placement of the last suture (Table 4). Overall, 23 subjects (27.4%) had positive blood cultures at 1 minute after surgery, and 17 (20.2%) subjects had positive blood cultures at 15 minutes postoperatively. Therefore, prevalence rates of bacteremia after 1 minute were 27.4% and 20.2% after 15 minutes. Of the 23 subjects who had positive blood culture at 1 minute, bacteremia persisted in 8 (35%) of them after 15 minutes.

TABLE 3. Age of Subjects at Time of Repair

Age at primary CLP repair		
0–3 mo	20	44.4
>3 mo to 1 y	12	26.7
>1 y	13	28.9
Total	45	100
Age at primary palate repair		
9–12 mo	10	28.5
>12–18 mo	8	22.9
>18 months	17	48.6
Total	35	100

TABLE 4. Positive Blood Cultures (Bacteremia) and Time of Occurrence

Time	No. Cases (%)	No. Samples
At 1 min only	15 (47)	15
At 15 min only	9 (28)	9
At 1 and 15 min	8 (25)	16
Total	32	40

Bacteria Isolates From the Blood Samples

A total of 15 bacteria species were isolated from all the blood cultures. Thirteen (86.7%) of the isolates were aerobes, whereas the other 2 (13.3%) were anaerobes. The aerobes included 2 gram-positive cocci, and 10 Gram-negative bacilli. The 2 anaerobes cultured were gram-negative bacilli (Table 5).

The most common bacteria isolated were coagulase-negative staphylococcus, seen in 14 (35%) of all the positive blood samples, followed by *Acinetobacter lwoffii* (4 [10%]) and coagulase-positive

TABLE 5. Total Isolates From Blood Sample and Frequency of Isolation

	Frequency (%)
Aerobes	
Gram-positive cocci	
Coagulase-negative staphylococcus	14 (35)
Coagulase positive *S. aureus*	3 (7.5)
Gram-negative bacilli	
Escherichia coli	1 (2.5)
A. lwoffii	4 (10)
Proteus mirabilis	3 (7.5)
Enterobacter agglomerans	3 (7.5)
Enterobacter cloacae	1 (2.5)
Flavobacterium meningosepticum	1 (2.5)
Citrobacter freundii	1 (2.5)
Proteus stuartii	3 (7.5)
Tatumella ptyseos	2 (5)
Proteus vulgaris	1 (2.5)
Yersinia enterocolitica	1 (2.5)
Anaerobes	
Gram-negative bacilli	1 (2.5)
Bacteroides stercoris	1 (2.5)
Prevotella intermedia	
Total	40 (100)

TABLE 6. Bacteria Isolates From Cleft Lip and Cleft Palate Surgeries

Isolates From Cleft Lip Surgery	Isolates From Cleft Palate Surgery
Aerobes	Aerobes
Coagulase-negative staphylococcus	Coagulase-negative staphylococcus
Coagulase-positive *S. aureus*	Coagulase positive *S. aureus*
Y. enterocolitica	*P. vulgaris*
E. agglomerans	*T. ptyseos*
E. cloacae	*C. freundii*
A. lwoffii	*F. meningosepticum*
	A. lwoffii
Anaerobes	*P. mirabilis*
B. stercoris	*E. coli*
P. intermedia	

Staphylococcus aureus (3 [7.5%]). Only 2 anaerobes species (5%) were isolated from 2 positive blood cultures. Table 5 shows the classification of the bacteria isolates and the frequency of isolation.

Table 6 shows bacteria isolates from blood cultures of subjects who had cleft lip surgery and cleft palate surgery. Coagulate-negative staphylococcus, coagulase-positive *S. aureus*, and *A. lwoffii* were common isolates in both cleft lip and cleft palate repairs (Table 6). Anaerobic bacteria were isolated in blood cultures related only to cleft lip surgery (Table 6).

Factors Associated With the Development of Bacteremia in Cleft Surgery

Sex of Subjects

Positive blood culture was observed in 19 males (59.4%) and 13 females (40.6%). There was no statistically significant association between the subjects' sex and the occurrence of positive blood culture ($P = 0.313$).

Age of Subjects

The mean age of the 84 subjects was 84.4 (SD, 124.9) months. The mean age of subjects with positive blood culture (62.3 [SD, 113.7] months) was lower than those without positive blood culture (98.1 [SD, 130.5] months). However, the difference was not statistically significant ($P = 0.054$).

Duration of Surgery

Estimated duration of surgery ranged between 25 and 210 minutes (mean, 75.6 [SD, 35.5] minutes). The duration of surgery in cleft lip repair (58.65 [SD, 24.6] minutes) was significantly lower than those of cleft palate repair (mean, 94 34 [SD, 34.4] minutes) ($P = 0.011$). The mean duration of surgery in subjects with bacteremia was 77.3 (SD, 33.2) minutes, whereas that without bacteremia was 74.5 (SD, 37.1) minutes. There was no significant difference in the mean duration of surgery between those with and those without positive blood culture ($P = 0.59$).

Volume of Blood Loss During Surgery

The mean estimated blood loss was 77.9 (SD, 126.2) mL (range, 5–750 mL). The mean estimated blood loss in cleft lip surgery (123.02 [SD, 158.8] mL) was statistically lower than that for cleft palate surgery (36.45 [SD, 76.40] mL) ($P = 0.004$). Simple regression analysis showed significant positive correlation between duration of surgery and volume of blood loss ($P = 0.000$).

Type of Cleft Surgery

The prevalence of bacteremia varied with the type of surgery. The prevalence of bacteremia in cleft lip surgery was 40.9%, whereas the incidence in cleft palate surgery was 33.3%. A prevalence of 50% was recorded for alveoloplasty (Table 7). No significant difference was observed between the type of cleft surgery and the occurrence of bacteremia ($P = 0.83$).

Multiple regression analysis was used to determine the effect of independent variables on the outcome variable (positive blood culture). Sex and age of subjects, duration of surgery, volume of intraoperative blood loss, and type of cleft surgery were not significantly associated with bacteremia following cleft surgery (Table 8).

DISCUSSION

The overall prevalence of bacteremia associated with CLP surgery observed in this study was 38.1%. Whereas the prevalence of 38.1% in this study is slightly higher than those for oral procedures such as root scaling and orthodontic treatment, it is lower than those generally reported for routine dental extractions and third-molar surgery.[2,6–8] Although prevalence of bacteremia in cleft-related surgery in the present study differs depending on type of surgery, no statistical difference was observed.

The implication of bacteremia persistence 15 minutes after surgery in 53% of subjects is that bacteremia following CLP surgery is not transient, although it has previously been speculated that bacteremia associated with oral surgical procedures in healthy individuals is transient in nature.[9,10] Tomas et al[2] questioned this assertion after they observed persistent positive blood cultures for at least 15 minutes after 3 to 4 dental extractions. The implication of our findings is that cleft-related surgery could be harmful in patients at risk, especially those with associated cardiac anomalies.

The relatively low number of bacteria isolates in the present study may be due to the fact that a large proportion of subjects in this study were infants and small children with no teeth. Takai et al[8] reported no incidence of bacteremia in edentulous subjects in their study. This is due to the fact that the highest number of bacteria is found in the dental plaque and in the gingival crevices.[11–14] It is possible that composition of bacterial flora in edentulous patients is different from that in dentate patients because of the absence of periodontal pockets, which contain high amount of *Streptococcus* species.[8,13]

The study also shows that bacteremia following CLP surgery is polymicrobial in nature. Several studies have previously reported that bacteremia following dental procedures is polymicrobial.[1,7,8,15] This is due to the fact that the oral cavity has a polymicrobial flora, all of which can gain access into the bloodstream during these procedures.[5,16,17] The predominance of aerobes in this study is in agreement with findings of previous studies.[8,17]

The most commonly isolated aerobes in the present study were gram-positive cocci (coagulase-negative staphylococcus and coagulase-positive *S. aureus)*. Previous reports have shown that CLP patients

TABLE 7. Type of Cleft Surgery and the Occurrence of Bacteremia

Type of Cleft Surgery	Bacteremia		Total
	Positive	Negative	
Cleft lip surgery	18	26	44
Cleft palate surgery	12	24	36
Others (alveoloplasty)	2	2	4
Total	32	52	84

$P = 0.83$.

TABLE 8. Multivariate Analysis of the Effects of Independent Variables (Factors) on Bacteremia

	Unstandardized Coefficients		Standardized Coefficients		
	B	SE	β	*t*	*P*
Bacteremia*	1.531	0.199		7.683	0.000
Patient's age	0.001	0.001	0.195	1.451	0.151
Amount of blood loss	0.000	0.001	0.062	0.417	0.678
Operation time in minutes	0.000	0.002	−0.028	−0.194	0.847
Patient's sex	0.042	0.061	0.084	0.682	0.498
Type of cleft surgery	−0.036	0.110	−0.043	−0.328	0.744

*Dependent variable: bacteremia.

had more *Staphylococcus* species load when compared with normal children.[18,19] *Staphylococcus* species is a skin and nasal commensal,[20] and cleft surgery involves both transoral and intraoral incisions that often lead to communication with the skin and nasal mucous membrane. Therefore, contamination of CLP surgical wound and subsequent entry of *Staphylococcus* species into the bloodstream may explain the high prevalence of *Staphylococcus* species observed in this study.

In the present study, only 2 anaerobe species were isolated from 2 positive cultures. Although these 2 bacteria species have also been isolated in other studies,[8,11,12] the total number of anaerobes was much fewer than those widely reported in literature, especially following dental procedures. The fact that gingival sulcus incisions are not common in cleft surgery may be responsible for the fewer number of anaerobes isolated in blood culture following CLP surgery, as intraoral anaerobes are found mostly within gingival crevices and pockets.[21]

The findings of this study show that age and sex have no influence on the occurrence of bacteremia. The findings are in agreement with previous reports following third-molar surgery and intra-alveolar tooth extraction.[2,11] In addition, no significant difference was observed in the mean duration of surgery between those with bacteremia and those without bacteremia, in agreement with the observation of Okabe et al[13] following tooth extraction.

Although blood loss was observed to increase with an increase in the duration of surgery, an observation that has been reported by other workers,[22,23] the prevalence of bacteremia did not correlate with blood loss, in agreement with the findings of Takai et al.[8] Although no significant relationship was established between the type of cleft surgery and the occurrence of bacteremia, 50% of those who underwent alveoloplasty had positive blood cultures, unlike 40.9% and 33.3% for cleft lip surgery and cleft palate surgery, respectively. The relatively high prevalence in alveoloplasty may be due to the extent and magnitude of surgery, as alveoloplasty involved an additional procedure of harvesting of autogenous bone from the mental region.

One of the most widely reported underlying disease that may predispose an individual to possible focal heart infections is the presence of congenital heart defects.[5,16,24,25] Congenital heart defects are commonly associated with CLP, and an incidence of up to 51% has been reported, with atrial septal defects and ventricular septal defects being the most common.[26–29] Hence, the American Heart Association recommends prophylactic antibiotics for this group of patients whenever any invasive dental procedure is to be performed.[5]

Bacteremia following invasive oral procedures has traditionally been associated with bacterial endocarditis.[16,30] The ability of various microbial species to adhere to specific sites determines the anatomical localization of infections caused by these microorganisms.[5] Numerous bacteria surface components present in *Streptococcus viridans* and *S. aureus* have been shown in animal models of experimental endocarditis to function as critical adhesions to the endocardium.[5,14] *Streptococcus viridans* and *S. aureus* are the most commonly isolated bacteria in bloodstream of patients with bacterial endocarditis.[7,25] *Staphylococcus aureus* was also the most commonly isolated bacteria in the present study. Therefore, prophylactic antibiotics should be incorporated as part of the clinical practice guideline in the surgical management of patients undergoing CLP surgery and other cleft-related surgery. This will go a long way in protecting at-risk patients, especially those with associated congenital cardiac defects, from developing infection of the heart by oral flora. In addition, broad-spectrum antibiotics should be preferred because of the fact that bacteremia associated with cleft surgery is polymicrobial in nature.

CONCLUSIONS

Cleft lip and palate surgeries produced bacteremia in about 38% of cases. Bacteremia associated with CLP surgery persisted for at least 15 minutes after surgery in about 53% of the cases. This reinforces the need for prophylactic antibiotic especially for CLP surgery because of the fact that some of the patients with these defects have congenital heart defects that predispose them to bacterial endocarditis. Bacteremia associated with CLP surgery seems to be sporadic as no association was found between positive blood culture and age of patients, length of surgery, and type of surgery.

REFERENCES

1. Otten JE Pelz K, Christmann G. Anaerobic bacteremia following tooth extraction and removal of osteosynthesis plates. *J Oral Maxillofac Surg* 1987;45:477–480
2. Tomas I, Pereira F, Llucian R, et al. Prevalence of bacteremia following third molar surgery. *Oral Dis* 2008;14:89–94
3. Gendron R, Grenier D, Maheu-Robert L. The oral cavity as a reservoir of bacterial pathogens for focal infections. *Microbes Infect* 2000;2:897–906
4. Roberts GJ. Dentists are innocent! "Everyday" bacteremia is the real culprit: a review and assessment of the evidence that dental surgical procedures are a principal cause of bacterial endocarditis in children. *Pediatr Cardiol* 1999;20:317–325
5. Wilson W, Taubert KA, Gewitz M, et al. Prevention of infective endocarditis: guidelines from the American Heart Association. *J Am Dent Assoc* 2007;138:739–745
6. Kitagawa T, Kohara H, Sohmura T, et al. Dentoalveolar growth of patients with complete unilateral cleft lip and palate by early two-stage Furlow and push-back method: preliminary results. *Cleft Palate Craniofac J* 2004;41:519–525
7. Olsen I. Update on bacteraemia related to dental procedures. *Transfus Apher Sci* 2008;39:173–178
8. Takai S, Kuriyama T, Yanagisawa M, et al. Incidence and bacteriology of bacteremia associated with various oral and maxillofacial surgical procedures. *Oral Surg Oral Med Oral Pathol Radiol Endod* 2005;99:292–298
9. Peterson LJ, Peacock R. The incidence of bacteremia in pediatric patients following tooth extraction. *Circulation* 1976;53:676–679

10. Pejcic A, Pesevska S, Grigorov I, et al. Periodontitis as a risk factor for general disorders. *Acta Fac Med Naiss* 2006;23:59–63
11. Rajasuo A, Nyfors S, Kanervo A, et al. Bacteremia after plate removal and tooth extraction. *Int J Oral Maxillofac Surg* 2004;33:356–360
12. Rajasuo A, Perkki K, Nyfors S, et al. Bacteremia following surgical dental extraction with an emphasis on anaerobic strains. *J Dent Res* 2004;83:170–174
13. Okabe K, Nakagawa K, Yamamoto E. Factors affecting the occurrence of bacteremia associated with tooth extraction. *Int J Oral Maxillofac Surg* 2004;24:239–242
14. Roda RP, Jimenez Y, Carbonell E, et al. Bacteremia originating in the oral cavity. A review. *Med Oral Patol Oral Cir Bucal* 2008; 13:E355–E362
15. Heimdahl A, Hall G, Hedberg M, et al. Detection and quantitation by lysis-filtration of bacteremia after different oral surgical procedures. *J Clin Microbiol* 1990;28:2205–2209
16. Chagadasan V. Oral sepsis and focal oral infections. *Singapore Med J* 1980;21:763–765
17. Enabulele OI, Aluyi HAS, Omokao O. Incidence of bacteraemia following teeth extraction at the Dental Clinic of University of Benin Teaching Hospital, Benin City, Nigeria. *Afr J Biotech* 2008;7:1390–1393
18. Rennin A, Treharne LJ, Richard B. Throat swabs taken on the operating table prior to cleft palate repair and their relevance to outcome: a prospective study. *Cleft Palate Craniofac J* 2009;46:275–279
19. Arief EM, Mohamed Z, Idris FM. Study of viridans streptococci and *Staphylococcus* species in cleft lip and palate patients before and after surgery. *Cleft Palate Craniofac J* 2005;42:277–279
20. Yemman MR, Bayer AS. *Staphylococcus aureus*, platelets and the heart. *Curr Infect Dis Rep* 2000;2:281–298
21. Kroes I, Lepp W, Relman DA. Bacteria diversity within the human gingival crevice. *Proc Natl Acad Sci U S A* 1999;96:14547–14552
22. Onah IL, Opara KO, Olaitan PA, et al. Cleft lip and palate repair: the experience of two West African sub-regional centers. *J Plast Reconstr Aesthetics Surg* 2008;61:878–882.
23. Adeyemo WL, Ogunlewe MO, Desalu I, et al. Frequency of homologous blood transfusion in patients undergoing cleft lip and palate surgery. *Indian J Plast Surg* 2010;43:54–59
24. Maestre-Vera JR, Gomez-Lus Centelles ML. Antimicrobial prophylaxis in oral surgery and dental procedures. *Med Oral Pathol Oral Cir Bucal* 2007;12:E44–E52
25. Valente AM, Scheurer M, Corey GR, et al. Frequency of infective endocarditis among infants and children with *Staphylococcus aureus* bacteremia. *Paediatrics* 2005;115:e15–e19
26. Liang CD, Huang SC, Lai SP. A survey of congenital heart disease in patients with oral clefts. *Acta Paediatr Taiwan* 1999;40:414–417
27. Agrabawi HE. Facial cleft and associated anomalies: incidence among infants at a Jordanian medical center. *East Mediterr Health J* 2008;14:356–359
28. Oyati AI, Danbauchi SS, Ameh EA, et al. Echocardiographic findings in children with surgically correctible non-cardiac congenital anomalies. *Ann Trop Paediatr* 2009;29:41–44
29. Gurel HG, Basciftci FA, Arslan U. Transient bacteremia after removal of a bonded maxillary appliance. *Am J Orthod Dentofacial Orthop* 2009;135:190–193
30. Johnson DH, Rosenthal A, Nadas AS. A forty-year review of bacterial endocarditis in infancy and childhood. *Circulation*. 1975;51:581–588

