Bacteremia Associated With Toothbrushing and Dental Extraction

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Background—Antibiotic prophylaxis recommendations for the prevention of infective endocarditis are based in part on studies of bacteremia from dental procedures, but toothbrushing may pose a greater threat. The purpose of this study was to compare the incidence, duration, nature, and magnitude of endocarditis-related bacteremia from single-tooth extraction and toothbrushing and to determine the impact of amoxicillin prophylaxis on single-tooth extraction.

Methods and Results—In this double-blind, placebo-controlled study, 290 subjects were randomized to (1) toothbrushing, (2) single-tooth extraction with amoxicillin prophylaxis, or (3) single-tooth extraction with identical placebo. Blood was drawn for bacterial culturing and identification at 6 time points before, during, and after these interventions. The focus of our analysis was on bacterial species reported to cause infective endocarditis. We identified 98 bacterial species, 32 of which are reported to cause endocarditis. Cumulative incidence of endocarditis-related bacteria from all 6 blood draws was 23%, 33%, and 60% for the toothbrushing, extraction-amoxicillin, and extraction-placebo groups, respectively ($P<0.0001$). Significant differences were identified among the 3 groups at draws 2, 3, 4, and 5 (all $P<0.05$). Amoxicillin resulted in a significant decrease in positive cultures ($P<0.0001$).

Conclusions—Although amoxicillin has a significant impact on bacteremia resulting from a single-tooth extraction, given the greater frequency for oral hygiene, toothbrushing may be a greater threat for individuals at risk for infective endocarditis. **(*Circulation*. 2008;117:3118-3125.)**

Key Words: bacteremia ■ bacteria ■ infective endocarditis ■ valves ■ risk factors

Historically, much of the emphasis on prevention of infective endocarditis (IE) has focused on the risk from dental and other nondental procedures.[1] The American Heart Association (AHA) recommendations for antimicrobial prophylaxis for IE are controversial owing to the lack of definitive evidence for efficacy and because they are based largely on studies that used surrogate measures for risk.[2–12] Studies of incidence, duration, nature (species), and magnitude of bacteremia from dental procedures are often in conflict because of variability in study design. Although there are many reports that address bacteremia from dental extractions, considered the most invasive of dental office procedures, there are few such data on routine daily activities such as toothbrushing. We identified 7 studies that used bacteremia from toothbrushing alone as an outcome, 5 of which were published between 1954 and 1977.[13–17] The other 2 reports were published after patient enrollment for the present study.[18,19] These 7 reports had a range in the number of subjects from 20 to 30, and they had a wide range of bacteremia incidence. Only 1 of these reports measured bacteremia >20 minutes after brushing.[19] All of these studies used nonmolecular microbiology methods, with their inherent limitations. Incidence figures for bacteremia in adults range from 0% to 100% for single-tooth extractions[5,7,20–22] and from 0% to 57% for toothbrushing.[13–15,17,19] There is no large, prospective comparison study of the incidence, duration, nature, and magnitude of bacteremia from procedures with these perceived extremes of invasiveness. The literature suggests that the detection of bacteria after a tooth extraction drops off sharply after 10 minutes, and isolated reports indicate that positive blood cultures can be detected for as long as 30 minutes after a dental procedure.[8,12,20,23] Finally, the extent to which systemic antibiotics reduce the incidence, duration, nature, and magnitude of bacteremia from dental procedures is controversial as well.[5,24]

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Our review of the literature identified 170 species of bacteria that have been isolated from blood after dental procedures and 275 species of bacteria that have been reported to cause IE; however, there are no studies that focus on the subset of bacteria that are common to both of these groups. The purpose of the present study was to compare the incidence, duration, nature, and magnitude of bacteremia from endocarditis-related bacteria during and after brushing or a single-tooth extraction and to determine the impact of

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Table 1. Main Characteristics of the 3 Study Groups

Characteristics*	Brushing Group (n=98)	Extraction-Amoxicillin Group (n=96)	Extraction-Placebo Group (n=96)	All Subjects (n=290)
Age, y	39.7 (11.7)	39.7 (10.5)	40.5 (10.9)	40.0 (11)
Male sex, n (%)	55 (56)	61 (64)	51 (53)	167 (58)
Ethnicity, n (%)				
White	27 (28)	18 (19)	23 (24)	68 (23)
Black	68 (69)	73 (76)	73 (76)	213 (73)
Hispanic	2 (2)	3 (3)	1 (1)	6 (2)
Other	1 (1)	2 (2)	0 (0)	3 (1)
Body mass index, kg/m^2	29.0 (7.95)	29.5 (7.60)	28.1 (7.95)	28.9 (7.83)
Range	18.5–59.97	18.5–60.14	16.6–59.05	16.6–60.14
Diabetes, n (%)†	5 (5)	9 (9)	8 (8)	22 (8)
Surgery type, n (%)				
Simple		83 (87)	70 (73)	153 (53)
Complex		9 (9)	18 (19)	27 (9)
Missing		4 (4)	8 (8)	12 (4)
Extraction time, min		6.52 (10.76)	7.93 (10.48)	
Range		0.75–58	0.5–51	
Mean pocket depth‡				
Mean (SD)	3.54 (1.17)	3.63 (1.12)	3.38 (1.07)	3.51 (1.13)
Range	1.83–8.57	1.85–7.89	1.83–6.92	1.83–8.57
Calculus index§				
Mean (SD)	1.32 (0.86)	1.31 (0.74)	1.20 (0.78)	1.28 (0.80)
Range	0–3	0–3	0–2.84	0–3
Gingival index‖				
Mean (SD)	1.97 (0.68)	2.00 (0.66)	1.82 (0.76)	1.93 (0.71)
Range	0.22–3	0.34–3	0.15–3	0.15–3
Plaque index¶				
Mean (SD)	1.68 (0.75)	1.61 (0.70)	1.50 (0.73)	1.60 (0.73)
Range	0–3	0–3	0.07–3	0–3

*Continuous values are mean (SD).

†One subject each in the amoxicillin and placebo groups had well-controlled type 1 diabetes mellitus; the remaining 20 subjects had type 2 diabetes mellitus.

‡Mean pocket depth=mean periodontal pocket depth for all remaining teeth.

§Calculus index: 0=no calculus; 1=supragingival calculus extending slightly below the free gingival margin (not more than 1 mm); 2=moderate amount of supragingival and subgingival calculus or subgingival calculus alone; and 3=abundance of supragingival and subgingival calculus. Each tooth was measured from the mesial and mesiobuccal sites, with the average representing the tooth score. The mean of all tooth scores represents the calculus index.

‖Gingival index: 0=normal gingiva; 1=mild inflammation, a slight change in color and edema, and no bleeding on probing; 2=moderate inflammation, redness, edema, and bleeding on probing; and 3=severe inflammation, marked redness and edema, ulcerations, and a tendency toward spontaneous bleeding. The gingival tissue of each tooth was examined at the distofacial papilla, mesiofacial papilla, facial margin, and lingual margin. A mean score for these 4 areas was obtained for each tooth. The mean value of all tooth scores represents the gingival index.

¶Plaque index: 0=no plaque in the gingival area; 1=no plaque visible to the unaided eye, but plaque is visible on the probe after being moved across the gingival crevice; 2=gingival area covered with a thin to moderately thick layer of plaque visible to the naked eye; and 3=heavy plaque accumulation and soft debris in the interdental area. Four surfaces (mesial, distal, facial, and lingual) were recorded, with the average value calculated for each tooth. The mean of tooth scores represents the plaque index.

AHA-recommended amoxicillin prophylaxis on the incidence, duration, nature, and magnitude of bacteremia after a single-tooth extraction.

Methods

Patients

Patients presented to our urgent care service with the need for extraction of at least 1 erupted tooth. Exclusion criteria included the following: fewer than 10 teeth; use of systemic antibiotics within the previous 2 weeks; need for antibiotic prophylaxis based on current practice guidelines; active viral disease; immunocompromise; poorly controlled systemic disease; history of penicillin allergy; temperature >100.5°F; facial cellulitis; and manipulation of the gingival tissues (eg, chewing, toothbrushing) within 1 hour before the study. Patients who met the inclusion/exclusion criteria were informed of the study, and institutional review board–approved consent was obtained.

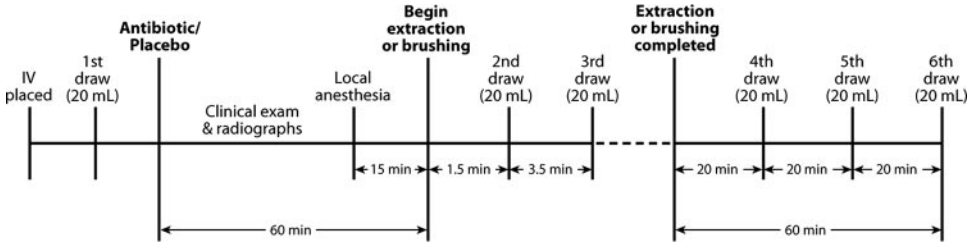

Figure 1. Study protocol time line. The timing for the steps in the brushing and extraction procedures was strictly controlled. The extraction began with 5 to 7 seconds of tissue reflection followed by 8 to 10 seconds of tooth elevation, followed by removal in the usual manner.

Procedures

Patients were randomly assigned by a computer-generated list, with a block size of 12, to 1 of 3 interventions: (1) toothbrushing, (2) single-tooth extraction with amoxicillin prophylaxis according to AHA recommendations (extraction-amoxicillin), or (3) single-tooth extraction with an identical placebo (extraction-placebo). Study drug and identical placebo capsules were placed in sealed, opaque envelopes identified only by study identification number. When a patient was enrolled, the next envelope in sequence was opened and the treatment assignment implemented. Baseline data included demographics, medical history, and a thorough clinical and radiographic examination of the teeth and periodontium. Dental and periodontal disease parameters included mean periodontal pocket depths for all remaining teeth, calculus scores (range 0 to 3), gingival erythema scores (range 0 to 3), and plaque scores (range 0 to 3; Table 1). For all 3 arms of the study, a specific protocol was followed (Figure 1). The puncture site was scrubbed, and a large-bore (18 to 22 g) BD Insyte Autoguard Shielded IV Catheter (Becton Dickinson Medical Systems, Sparks, Md) was placed in the usual manner and attached to a bag of normal saline. The baseline blood sample (20 mL) was then drawn, and 7 to 8 mL was inoculated directly into both aerobic and anaerobic BACTEC bottles (BD Diagnostics, Sparks, Md) for bacterial culturing. Patients in the extraction arms of the study were anesthetized with 1.8 mL of 2% lidocaine with 1:100 000 epinephrine ≈15 minutes before surgery. Mepivacaine 3% without vasoconstrictor was used if further local anesthesia was necessary. In accordance with AHA recommendations, the extraction began 1 hour after ingestion of the amoxicillin or placebo. For the brushing arm of the study, subjects brushed all surfaces of the teeth adjacent to the gingiva with a new toothbrush (without toothpaste) for 2 minutes, timed as 30 seconds for each of the maxillary and mandibular quadrants of teeth. Subsequent blood draws of 20 mL were taken at 1.5 minutes and at 5 minutes after the initiation of surgery or brushing. Additional blood samples (20 mL) were drawn 20, 40, and 60 minutes after the end of the procedure. Two milliliters of blood was drawn into a new syringe and discarded before each of the 6 blood draws, and the catheter was flushed with 2 mL of saline from a new syringe after each blood draw. Patients randomized to the brushing group had their dental extraction accomplished at the end of the study period, after the last blood draw, or on a subsequent visit.

Bacterial Isolation and Identification

Blood samples were cultured in BACTEC Plus Aerobic/F and LYT-IC/10 Anaerobic/F (BD Diagnostics). Bacterial colonies were isolated on both selective and nonselective media such as blood agar, chocolate agar, and MacConkey II agar (BD Diagnostics) for aerobes and on anaerobic blood agar, Columbia CNA agar, and blood agar plates supplemented with phenylethyl alcohol and kanamycin/vancomycin for anaerobes. All false-positive bottles (ie, bottles that were signaled positive but for which the subculture was negative) were further incubated for a total of 2 weeks. Bottles with positive cultures were also kept for 2 weeks and subcultured periodically to ensure recovery of additional species. The 16S ribosomal RNA (rRNA) sequencing method was used for bacterial identification. Bacterial lysates were used as templates in polymerase chain reaction with 16S rRNA universal primers according to standard protocols.[25] Polymerase chain reaction products were sequenced with an ABI 3100 DNA sequencer according to the manufacturer's instructions (PE Applied Biosystems, Foster City, Calif). Identification of strains was based on comparisons of the first 500 bases with Database Project (RDP [Ribosomal Database Project]; http://wdcm.nig.ac.jp/RDP/htlm/index.htlm) and GenBank by BLAST http://ncbi.nlm.nih.gov/BLAST.cgi). For those strains that were potentially new species (ie, <98% similarity to their closest relatives), full 1500–base pair sequences were obtained.[25,26] Investigators involved in bacterial culturing and identification were blinded as to subject randomization.

Quantification of Bacteria in Blood

Sensitive, real-time, quantitative polymerase chain reaction was used to quantify bacteria. Bacterial DNA was isolated from patient blood draws and from blood seeded with known quantities of several common oral pathogens. Patients were selected who had positive cultures after toothbrushing (n=16), single-tooth extraction with amoxicillin (n=20), or single-tooth extraction with placebo (n=23). Additional patient samples were drawn from a prior pilot study of multiple-tooth extractions (n=5). A modification of the QIAGEN DNA Blood Mini Kit (QIAGEN, Valencia, Calif) procedure was used for optimal recovery of bacterial DNA from blood. For real-time quantitative polymerase chain reaction, TaqMan technology and probes (Biosearch Technologies, Novaro, Calif) and universal 16S rRNA primers (Integrated DNA Technologies, Coralville, Iowa) conserved among oral pathogens were used with the SmartCycler system (Cepheid, Sunnyvale, Calif). We established standard curves for the seeded pathogens and calculated the levels of bacteria in subject blood cultures. The sensitivity of the method was 25 colony-forming units (CFU) per polymerase chain reaction, which corresponds to 10^3 to 10^4 CFU per milliliter of blood.

IE-Related Species of Bacteria

Our comprehensive search of the literature provided a list of 275 species of bacteria reported to cause IE, which we compared with the list of bacterial species identified in the present study. The bacterial species common to both lists were used in the present analysis.

Statistical Analysis

Demographic and baseline clinical characteristics of participants are reported as means and SDs or frequencies and percentages. For the analysis of incidence, each patient was assessed at each blood draw and coded as positive for any bacterium that was common to the list of 275 bacterial species reported to cause IE. Comparisons by study arm at each blood draw and a summary comparison by study arm that combined all draws were made with χ^2 tests. Duration of bacteremia was defined as the number of blood draws at which any target organism was cultured. Intercurrent negative findings were rare (n=2), were judged to be spurious, and were considered positive for analysis. Duration to specific intervals by study arm was compared with χ^2 tests. Statistical significance (α) of 0.05 was used in all cases.

Calculation of the required sample size was based on comparison of the rates of incidence in the hygiene and extraction-placebo study arms. Our prior work suggested that the incidence of bacteremia from single-tooth extraction would be between 70% and 100%.[7] There was no consensus opinion available on the incidence of bacteremia after toothbrushing in adults; estimates ranged from 30%

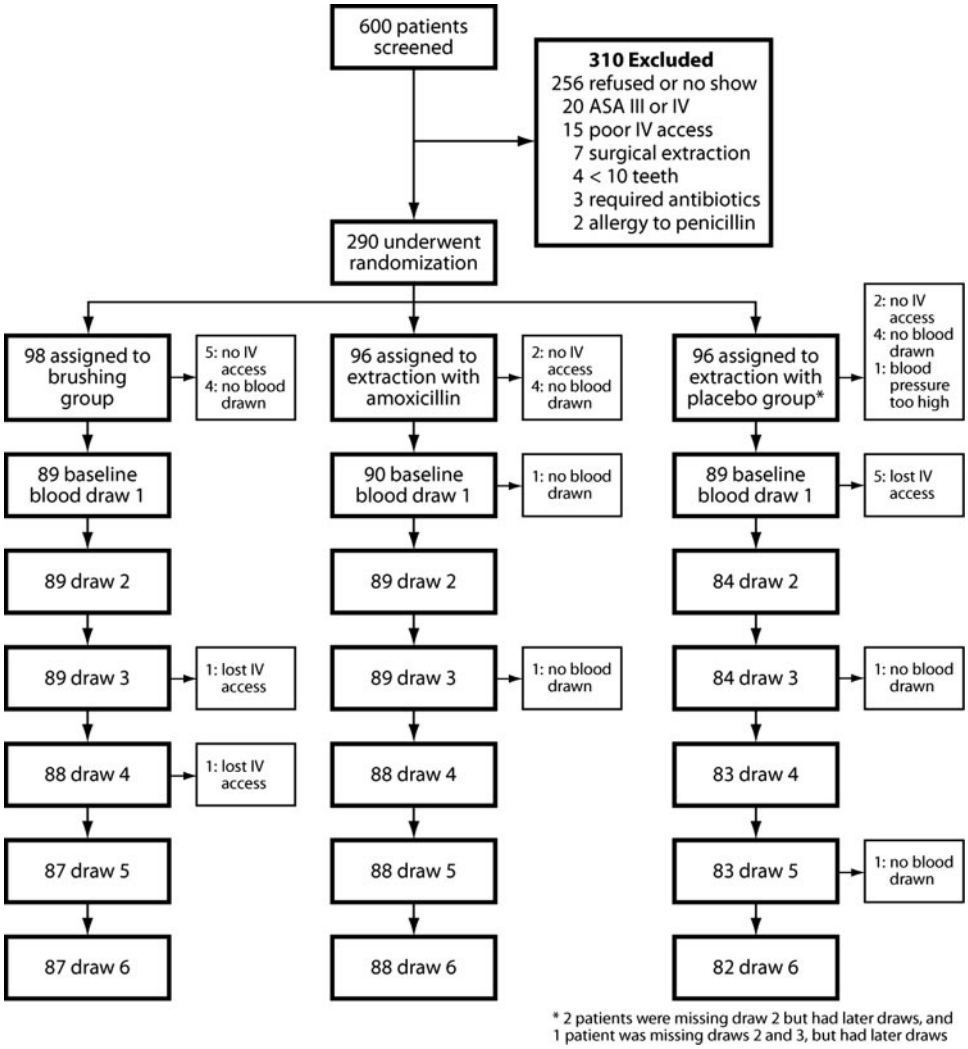

Figure 2. Study groups and reasons for exclusion.

to >60%. Assuming a significance level of 0.05, we estimated that 80 participants per study arm would yield nominal power of 90% to detect a difference in cumulative incidences of at least 20%.

The authors had full access to the data and take full responsibility for its integrity. All authors have read and agree to the manuscript as written.

Results

During the 3-year study period, we screened 600 patients and subsequently randomized 290 patients to 1 of 3 groups (Figure 2). The mean age was 40 years, 58% were men, and 73% were black. Baseline characteristics were well balanced between the study groups with the exception of a higher percentage of complex extractions in the extraction-placebo group than in the extraction-amoxicillin group (Table 1). However, no meaningful differences were found in extraction times or in the incidence of bacteremia between those with simple and complex extractions in the relevant study arms.

Overall Incidence, Duration, Nature, and Magnitude of Bacteremia

Incidence

The overall incidence of bacteremia at any of the 6 draws was 32%, 56%, and 80% for the brushing, amoxicillin, and placebo groups, respectively (χ^2 $P<0.0001$). The highest incidence occurred at the time of the procedures in the placebo group (79%), followed by the extraction-amoxicillin (56%) and brushing (28%) groups. All baseline blood cultures were negative, with the exception of 3 instances, likely from skin contamination (eg, *Staphylococcus epidermidis*).[27,28]

Duration

Two percent of the placebo group (n=2) and 9% of subjects in the brushing group (n=9) were still bacteremic at 60 minutes after the procedure. Two subjects (2%) in the extraction-amoxicillin group were positive at 40 minutes.

Nature

We identified 98 different bacterial species, the most common of which belonged to the genera *Streptococcus* (49%), *Prevotella* (9%), *Actinomyces* (5%), and *Fusobacterium* (5%).

Magnitude

All analyzed samples were below the detection threshold of 10^4 CFU per milliliter of blood.

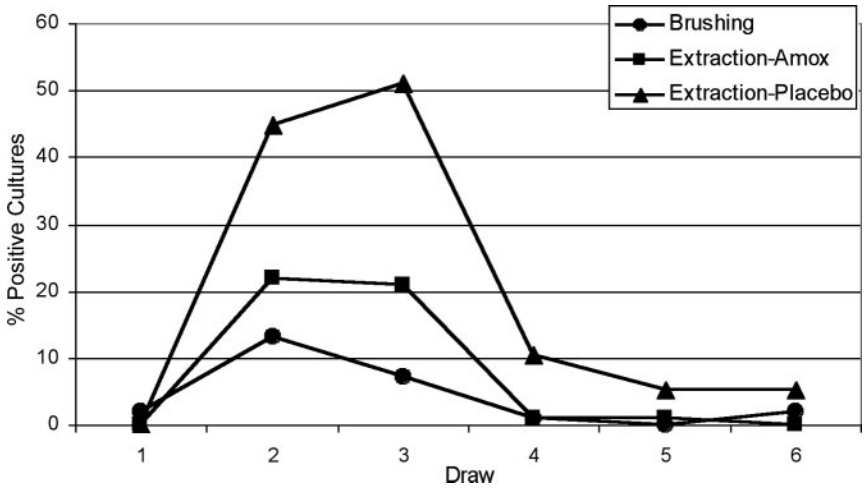

Figure 3. Incidence and duration of bacteremia at 6 time points from IE-related bacterial species. Numbers at the baseline represent the time points for the 6 blood draws: (1) baseline and (2) 1.5 minutes and (3) 5 minutes after initiation of brushing or extraction; and (4) 20 minutes, (5) 40 minutes, and (6) 60 minutes after completion of the brushing or extraction.

Incidence, Duration, Nature, and Magnitude of Bacteremia From Endocarditis-Related Bacterial Species

Of the 98 bacterial species identified, 32 species overlapped with our list of 275 species reported to cause IE, and the following results focus on these 32 oral bacterial species.

Incidence

All baseline blood cultures were negative, with the exception of 1 patient (with 2 species) in the brushing group (Figure 3; Table 2). The cumulative incidence of bacteremia from all 6 blood draws was 23%, 33%, and 60% for the brushing, extraction-amoxicillin, and extraction-placebo groups, respectively ($P<0.0001$). There was a significant difference in the incidence of positive cultures among the 3 groups at draws 2, 3, 4, and 5 (all $P<0.05$). The highest incidence of positive cultures occurred in the first 5 minutes of the procedures (combining draws 2 and 3), with incidence figures of 19%, 33%, and 58% for the brushing, extraction-amoxicillin, and extraction-placebo groups, respectively. The extraction-placebo group had a significantly greater number of positive cultures at 20 minutes (10%) than the extraction-amoxicillin (1%) and toothbrushing (1%) groups ($P=0.001$). This pattern persisted to 40 minutes.

Duration

The vast majority of bacteremic subjects (93%) had a brief duration of bacteremia (<20 minutes; Figure 3). There was a significant drop in the incidence of positive cultures at 20 minutes in all 3 groups (all $P<0.0001$), and this continued at 40 and 60 minutes, with little difference between the brushing and extraction-amoxicillin groups at draws 4 to 6. Five percent of subjects in the extraction-placebo group and 2% of the brushing group were still bacteremic at 60 minutes.

Nature

Ten (31%) of the 32 IE-associated oral bacterial species were (viridans) streptococci (Table 2). Thirteen (48%) of 27 positive cultures in the brushing group were (viridans) streptococci compared with 23 (49%) of 47 in the extraction-amoxicillin group and 106 (70%) of 151 in the extraction-placebo group. The majority of the nonstreptococcal species occurred in the extraction groups. With the exception of 1 subject in the placebo group, polymicrobial blood cultures occurred only within the first 5 minutes of the procedure, albeit at a low rate in the brushing (2%) and extraction-amoxicillin (6%) groups compared with the extraction-placebo group (29%).

Magnitude

As noted above, all analyzed samples were below the detection threshold of 10^4 CFU per milliliter of blood.

Impact of Amoxicillin

Amoxicillin resulted in a significant reduction in the incidence of positive cultures at draws 2, 3, and 4 ($P<0.0001$), and it reduced the incidence of positive cultures by 69% (from 151 to 47) for all species and by 78% (106 to 23) for (viridans) streptococci (Table 2).

Discussion

Although there is a strong emphasis on prevention of bacteremia in the dental office setting, the relative risk for IE from dental procedures versus routine daily events such as toothbrushing is unknown. Bacteria commonly gain entrance to the circulation through ulcerated gingival crevicular tissue that surrounds the teeth.[23] Although dental extractions are among the most likely of dental procedures to cause bacteremia, toothbrushing may disrupt a far larger surface area of gingival crevicular tissue. Although brushing does not appear to have the same incidence and nature of bacteremia as a dental extraction, we found a substantial incidence (23%) of bacteremia of IE-causing species from this common daily oral hygiene activity. In addition, the brushing group had a larger percentage of positive cultures at 60 minutes (9% versus 2%, respectively). This suggests that brushing poses a risk for bacteremia similar to that of a dental extraction, given professional guidelines that recommend toothbrushing at least twice per day. Therefore, there is the potential for bacteremia from toothbrushing alone to occur >200 times per year, compared with an average of fewer than 2 dental office visits per year per person in the United States.[29] Although amoxicillin has a significant impact on bacteremia from a dental extraction, a notable number of the extraction patients who received prophylaxis in the present study nonetheless showed evidence of bacteremia, includ-

Table 2. IE-Related Bacterial Species Identified in the Present Study

	Blood Draw																	
	Brushing						Extraction With Amoxicillin						Extraction With Placebo					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Acinetobacter lwofii/calcoaceticus	1																	
Actinobacillus actinomycetemcomitans		1							1									
Actinomyces meyeri/odontolyticus										1					2			
Capnocytophaga sp														1				
Eikenella corrodens								1	1					1	1			
Fusobacterium nucleatum								1						4	4	2	1	
Granulicatella adiacens																1		
Haemophilus aphrophilus														1				
Lactobacillus rhamnosus/casei									3									
Lactobacillus salivarius														1				
Neisseria elongata								1							1			
N flavescens														1	1	1		
N mucosa/sicca								1	1						1			
N pharyngis								1										
Peptostreptococcus micros		2	1											3	3	2		1
Prevotella denticola								2	1									
Prevotella melaninogenica									2					1				
Prevotella oralis															1			
Propionibacterium acnes		1												1	1		1	1
Staphylococcus epidermidis	1	1	1					1										1
Staphylococcus warneri		1				1		1										
Stenotrophomonas maltophilia		1	1															
Streptococcus anginosus		3						7	1					12	10			1
Streptococcus constellatus								4	3					6	8		1	
Streptococcus cristatus		1							2					2	3			
Streptococcus gordonii			1											3	1			
Streptococcus intermedius		2	1					1	1					4	6	1		1
Streptococcus mitis								1	2					8	11	3	1	
Streptococcus mutans		1	2											5	6		1	
Streptococcus oralis															2			
Streptococcus salivarius															4			
Streptococcus sanguinis				1		1			1					2	3	1		
Veillonella parvula			1					2	3					2	4			

IE-related bacterial species identified in the present study blood draws occurred at: (1) baseline; (2) 1.5 minutes and (3) 5 minutes after initiation of brushing or extraction; and (4) 20 minutes, (5) 40 minutes, and (6) 60 minutes after completion of the brushing or extraction. Numbered boxes represent the number of positive cultures for that species at that time point. Our literature search revealed 275 species of bacteria reported to cause IE. We identified 98 species in the present study, of which these 32 species are among the list of 275.

ing IE-related species. This lack of 100% efficacy alters the per-dose risk-benefit ratio, increasing the number needed to treat to avert a distant site infection.

The duration of bacteremia likely reflects the nature and number of bacteria that enter the circulation, as well as multiple other host factors such as immune responses. Although it is not clear what role duration has on the risk for bacterial seeding of cardiac valves, the present data demonstrate that bacteria are cleared rapidly, particularly in the presence of amoxicillin. However, some pathogenic species persisted for at least 60 minutes after brushing and extraction without antibiotic prophylaxis.

The human oral cavity is colonized by a larger variety of bacterial flora than any other anatomic area. More than 700 species of bacteria have already been identified, 400 of which were found in the periodontal pocket adjacent to teeth.[30] Streptococci represent a significant proportion of the flora around the teeth, especially in the supragingival plaque, and they are frequently associated with IE. An extensive search of the literature yields a common list of 126 individual bacteria reported in blood cultures after extractions (n=131) or toothbrushing (n=26), all identified by conventional clinical laboratory methods. However, data on the incidence, duration, nature, and magnitude of bacteremia from non–IE-associated species

and bacteria identified by nonmolecular means are of little or no help to clinicians or policy makers.[31] We focused on the 32 bacterial species identified in the present study that were also on our list of 275 bacteria reported to cause IE, 11 (34%) of which have not been reported previously in studies of brushing or extractions. Finally, we identified 71 species and subspecies of bacteria not previously reported in blood cultures after extractions or toothbrushing, 30 of which are novel.

It is difficult to quantify the magnitude of bacteria that initially gain entrance to the circulation after dental procedures owing to factors such as heart rate, blood volume, proximity of the blood collection site to the source of the bacteremia, and the rapid bacterial clearance by the reticuloendothelial system. Although animal model data have established that the rate of infection of damaged heart valves is dependent on the inoculum size of the bacterial challenge, with larger inocula yielding higher infection rates, there are no data indicating the range of inocula that results in endocarditis in vulnerable patients. Although we were able to reliably detect and therefore quantify a bacterium in blood at or above a concentration between 10^3 and 10^4 CFU/mL, the magnitude from extractions and toothbrushing was below this level in all samples examined. Therefore, all we can say is that the magnitude of bacteria in the blood cultures was $<10^4$ CFU/mL.

There were more than twice as many complex extractions in the extraction-placebo group (19 versus 9) as in the extraction-amoxicillin group, which, although not statistically significant, suggests that 20% of the placebo group versus 9% of the amoxicillin group had a more invasive procedure. This might contribute to the increased incidence and duration of bacteremia in the placebo group, and this would likely explain the (nonsignificant) increased extraction time for the placebo group. If this is the case, there is less of an impact from amoxicillin than Figure 3 suggests.

There are potential limitations to the present study. First, because all subjects were seen at a hospital-based clinic, and all needed an extraction, they may have been demographically distinct from and had a greater burden of dental disease than the general population. The present study population was similar to the US population in gender distribution (58% male in the study versus 49% male nationally) but differed in racial/ethnic breakdown (73% black in the present study versus 12% nationally and 28% locally; US Census Bureau, American Community Survey, 2006[32]). We are not aware of any differences between racial groups in terms of oral bacterial flora in disease or health, and we therefore believe that these data are easily extrapolated to other racial and ethnic groups. Second, although the number of bacterial CFU per milliliter of blood was always below 10 000, this does not exclude the possibility of significant differences in bacterial CFU per milliliter of blood below this threshold between the 3 groups, which might be important in terms of risk of heart valve colonization. The present data suggest that brushing and single-tooth extraction, generally thought to be at different ends of the spectrum of invasiveness, are similar from the standpoint of magnitude.

There is ongoing debate concerning the health risks, cost-effectiveness, and practicality of the routine use of prophylactic antibiotics.[3,4,33–35] The lack of efficacy data for this practice must be weighed against risk factors (eg, drug reactions), potential for resistant strains, and various economic costs to society from the routine use of antibiotics for common dental procedures. Although the 2007 AHA recommendations call for far fewer people to receive antibiotic prophylaxis than in earlier guidelines, these recommendations have been adopted for more than 20 groups of noncardiac patients as well.[36] The incidence, duration, nature, magnitude, and daily occurrence of bacteremia from toothbrushing and other routine daily events (eg, chewing food) calls into question the appropriateness and emphasis on prophylaxis for periodic dental procedures. Given the unfeasible concept of advocating antibiotic coverage for toothbrushing, we suggest that a controlled clinical trial is indicated to resolve this longstanding issue. In the meantime, there should be a greater focus on avoidance of dental disease in patients at risk for distant site infection in general and for IE in particular.

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Disclosures

None.

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CLINICAL PERSPECTIVE

There is ongoing debate concerning the health risks, cost-effectiveness, and practicality of the routine use of prophylactic antibiotics in the dental office setting. The relative risk for infective endocarditis from bacteremia during invasive office procedures such as dental extractions versus routine daily events such as toothbrushing is unknown. Although toothbrushing does not have the same incidence, duration, nature, or likely magnitude of bacteremia as a dental extraction, we found a substantial incidence of bacteremia (23%) of infective endocarditis–causing species of bacteria from brushing. Therefore, given the far greater frequency for oral hygiene than for dental office procedures, toothbrushing appears to be a greater threat for individuals at risk for infective endocarditis. Although amoxicillin has a significant impact on bacteremia resulting from a dental extraction, 33% of patients undergoing extraction after prophylaxis showed evidence of bacteremia, including infective endocarditis–related species. The duration of bacteremia for some pathogenic species persisted for at least 60 minutes after brushing and extraction without antibiotic prophylaxis. The magnitude of bacteremia for all 3 study groups was $<10^4$ colony-forming units per milliliter of blood, which suggests that brushing and single-tooth extraction are similar from the standpoint of magnitude. Given the daily occurrence of bacteremia from toothbrushing and other routine daily events and the lack of efficacy data for antibiotic prophylaxis, the present study calls into question the appropriateness of this practice and suggests that there should be a greater focus on avoidance of dental disease in patients at risk for endocarditis.