Evaluation of Post-surgical Bacteremia with Use of Povidone-Iodine and Chlorhexidine During Mandibular Third Molar Surgery

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Abstract

Background Microorganisms may invade the blood stream by oral routes through surgical procedures like extractions, fractured teeth and periodontal pockets. The incidence of bacteremia is 70–80 % following tooth extraction, sub gingival scaling and intra ligament injection.

Aims and Objectives Aim of study was to evaluate and compare the efficacy of two topical antimicrobial agents for the prevention of post-surgical bacteremia during mandibular third molar surgery. And objectives were to suggest need of proper topical antimicrobial agents and select proper antibiotics before oral surgical procedures in high risk cardiac patients.

Materials and Methods Thirty patients with Class 1, Position B mesioangular impacted mandibular third molar were randomly included in study and divided into 3 groups, each group containing 10 patients. Group I; sterile water group, Group II: povidone-iodine (5 %) group, Group III: chlorhexidine (Q, 2 %) group, pre and post-surgical blood samples were collected and Microbiological analyses of the blood samples were done. The organisms were identified by standard method on grams staining and identification of bacterial species by biochemical tests.

Results The clinical parameters like oral hygiene index simplified and periodontal index of Russel showed that all patients in three groups had fair oral hygiene with simple gingivitis on mean. In some individuals with slightly higher OHIS and PI scores, bacteremia was noted. All the pre surgical blood samples were negative for the growth of bacteria after 7 days of culture. In total 30 patients, 12 subjects had postoperative bacteremia. Out of those 12 patients 6 cases (60 %) of group I showed positive bacterial growth in the post surgical blood sample, while 4 cases in group III and 2 cases (20 %) in group II showed the same.

Conclusion Use of povidone-iodine and chlorhexidine prior to the oral surgical procedures decreases the incidence of bacteremia as compared to sterile water irrigation. Povidone-iodine significantly reduces the incidence bacteremia and number of organisms compared to chlorhexidine and sterile water.

Keywords Bacteremia · Chlorhexidine · Oral surgery · Povidone iodine · Third molar surgery

Introduction

The development, implementation and routine use of effective infection control strategies has required a major commitment by health professionals and industry. There have been many advances in equipment, instrument, barrier and chemical technologies in the past few years. Yet, the willingness of health care providers to respond to well documented information on infectious disease risks and recommendations for prevention has been crucial in this recent evaluation of infection control.

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Microorganisms may invade the blood stream by oral routes through surgical procedures like extractions, fractured teeth and periodontal pockets. Bacteremia could also be associated with gingival massage, mastication, mobile teeth, oral prophylaxis and other oral manipulations. Thus occurred bacteremia depends on the quality of oral hygiene, periodontal condition and type of treatment rendered. The incidence of bacteremia is 70–80 % following tooth extraction, subgingival scaling and intra ligamental injection [1].

The occurrence of transient bacteremia does not lead to any complications in healthy individuals but in certain individuals with congenital/acquired heart diseases or those fitted with valvular prosthesis; Circulating bacteria may reach defective endocardium and can cause a bacterial endocarditis, as first suggested by Horder in 1909 and later by Lewis Grant in 1923 [2].

As a consequence, many health professionals responded by incorporating better microbial disease prevention measures into their professional activities.

The American Heart Association recommends prophylactic antibiotics for patients who are undergoing oral surgical procedures and are most likely to cause transient bacteremia [3, 4]. Although prophylactic antibiotics may decrease the risk of bacterial endocarditis, it cannot prevent transient bacteremia. So in adjunct with these, topical antiseptics have been used [5, 6]. The various topical antiseptics used are chlorhexidine, iodine, phenols, and quaternary ammonium compounds, Iodophores.

In this study an effort is made to evaluate the potent topical antimicrobial agent that minimizes the incidence of postoperative transient bacteremia following lower third molar surgery and to suggest prophylactic use of effective antibiotic for commonly isolated bacteria.

Materials and Methods

Thirty patients with Class 1, Position B mesioangular impacted mandibular third molars were randomly selected for the study. The first patient to be included in study was assigned in group 1. Second in group 2 and third in group 3 and likewise. Inclusion criteria's were both male and female patients with impacted teeth, the patients who did not have any systemic diseases, and the exclusion criteria were the patients with history of bacterial endocarditis, rheumatic fever, congenital heart diseases, prosthetic heart valves, the patients with symptoms of any infections (severe periodontitis, space infections, residual pericoronitis) and the patients who were taking antimicrobial agents (antibiotics) and immunosuppressive medications.

The selected patients were divided into three groups, each group containing 10 patients, Group I; sterile water

group, Group II: povidone-iodine (5 %) group and Group III: chlorhexidine (0.2 %) group, the standard kit and surgical technique for the removal of third molar was used. The patient was asked to rinse the mouth with 15 ml of mouth rinsing solution for 1 min. The solution was selected according to the groups to which patients belonged. Inferior alveolar nerve block along with lingual and long buccal nerve block was administered using 2 % lignocaine hydrochloride (1:80,000 adrenaline). Standard Wards incision was used. After tooth removal the wound was irrigated with saline and checked for any bone particle etc. and the irregular tissues were trimmed with scissors and interrupted sutures were given with 3-0 silk. Pressure pack was given. Pre and immediate (within minute after suture placement) post surgical 5 ml of blood was collected by the same surgeon. The patients were recalled for follow up on the 1st, 2nd and 7th post operative day for swelling and trismus, wound dehiscence and any other oral infection etc.

Microbiological Study

Microbiological analyses of the blood samples were done in the Department of Microbiology. The presurgical and post-surgical samples were sent in transporting medium bottle, containing thioglycollate medium enriched with brain heart infusion (BHI) broth. These samples were incubated at 37 °C for 48 h. Then the samples were checked for the growth (turbidity) of bacteria. The colony was counted using colony counter under magnifying lens and expressed as CFU $\times 10^3$. The organisms were identified by standard method on grams staining and identification of bacterial species by biochemical tests.

Results and Observations

Thirty patients with mean age of 28 years participated in the study and were treated for surgical removal of the mandibular third molars, after using assigned mouth rinse. The clinical parameters like oral hygiene index simplified and periodontal index of Russel showed that all patients in three groups had fair oral hygiene with simple gingivitis on mean. In some individuals with slightly higher OHIS and PI scores, bacteriemia was noted. Statistical evaluation showed that there were no significant difference was present in the oral hygiene index simplified and periodontal condition in intergroup comparison (Table 1; Fig. 1).

All the pre surgical blood samples were negative for the growth of bacteria after 7 days of culture. Out of 30 patients 6 cases (60 %) of group I showed positive bacterial growth in the post surgical blood sample, while 4 cases in group III and 2 cases (20 %) in group II (Table 2; Fig. 2).

Table 1 Mean clinical parameter for OHI-S And PI

	OHI-S	PI	OHI-S	PI	OHI-S	PI
Mean	2.26	0.35	2.08	0.22	2.4	0.4
SD	0.7027	0.2915	0.6477	0.2440	1.0934	0.3197
t value	0.5956	1.0812	0.7962	1.4152	0.3406	0.365
	(I–II) NS	NS	(II–III) NS	NS	(III–I) NS	NS

Fig. 1 Clinical parameters (Mean OHI-S and PI Indices)**Table 2** Incidence of post surgical bacteremia

Group	Postsurgical	Total cases	% of growth
Group I	6	10	60
Group II	2	10	20
Group III	4	10	40

Fig. 2 Incidence of Postsurgical bacteremia

In patients showing bacteremia, total 37 organisms were isolated out of which 17 were aerobes and 20 were facultative anaerobes. The number of organisms isolated in these individuals were either 1 or 2 and they were, A.H.S = alpha hemolytic streptocci, B.H.H = beta hemolytic streptocci, and STAPH = Staphylococci

In group I 7 aerobic and 10 facultative anaerobes were isolated. Mostly commonly isolated organisms were alfa-haemolytic streptococci (7 organisms). In group II one species of methicillin resistant *Staph. Aureus* was isolated

and two enterococci were isolated. Totally this group had four organisms, two aerobes and two anaerobes. In group III 7 aerobes and 8 anaerobes were found. In 2 cases *pepstreptococci* and *diphtheroides* were also isolated. The most commonly found organisms were alpha haemolytic streptococci, beta haemolytic streptococci and *staphylococci aureus* organism. The total CFU (colony forming units) are shown in the Table 3 and Fig. 3. The isolated organisms were evaluated for antibiotic sensitivity; most sensitive antibiotics were amoxicillin, penicillin and amikacin followed by intermediate sensitive antibiotics gentamycin and cefuroxime. The least sensitive antibiotic was erythromycin (Table 4; Fig. 4).

Discussion

Importance of administration of traditional systemic antibiotic prophylactically as a supplement to local antiseptic is an unanswered question in dental and medical literature. Great stress is placed on selecting specific antibiotic preparation and method of administration to affect or kill the microorganisms, after they enter the circulation. Very fewer studies are done to know the methods and advantages of affecting or killing the bacteria at the source, namely the oral cavity, before intravascular entry. Bacteremia does not occur without provocation. Any technique that reduces the number of microorganisms in the oral cavity may reduce the degree of bacteremia.

The new guidelines recommend prophylaxis for any procedure that may alter the gingival tissue, the periapical region or induce perforation of oral mucosa (i.e. biopsies, suture removal, placement of orthodontic bands, tooth extractions and periodontal procedures). Conversely, the following procedures and events do not need prophylaxis: routine local anaesthetic injections through non-infected tissue, taking dental radiographs, placement of removable prosthodontic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, shedding of deciduous teeth and bleeding from trauma to the lips or oral mucosa [23].

Degerming of the oral cavity could offer a high degree of protection against bacteremia of dental origin, not only by reducing the size of the inoculum entering the blood

Table 3 Statistical analysis of number of colony forming units in all groups

	Group I		Group II		Group III	
	Aerobic	Anaerobic	Aerobic	Anaerobic	Aerobic	Anaerobic
Mean	1288.00	1841.00	540.00	775.00	981.00	791.50
SD	561.09	516.16	592.96	106.07	289.76	266.25
T value	1.0012	2.7609	2.6384	4.0873	1.6186	0.8079
	S	S	NS	NS	NS	S

S significant, NS not significant

Fig. 3 Total number of CFU isolated

stream but also by reducing the number of different species of microorganisms [1]. American Heart Association (AHA) recommends use of topical antiseptic solution 3–5 min

before the oral surgical procedures to decrease the incidence of bacteremia.

With the above details in mind, we evaluated and compared the effect of povidone-iodine and chlorhexidine antiseptic mouth rinses on bacteremia following mandibular third molar surgery, we also investigated the antibiotic sensitivity to suggest most suitable antibiotic for prophylactic use to prevent untoward effects of bacteremia in high-risk patients.

In our study we selected 30 out patients with Class 1, Position B mesioangular impacted third molars to study clinical parameters like, oral hygiene index simplified [7], for the assessment of oral hygiene and periodontal index (Russell index) [7], to assess the status of periodontium. In our study all most all the patients had fair oral hygiene with

Table 4 Organisms isolated and their antibiotic sensitivity

Organisms isolated	Antibiotics used	Sensitivity GRADE	Number of cases
STAPH, STREPTOCOCCI	Penicillin	S.I.R	6, 3, 3
	Amoxicillin	S.I.R	8, 2, 2
	Gentamycin	S.I.R	5, 3, 4
	Erythromycin	S.I.R	3, 7, 2
	Amikacin	S.I.R	6, 3, 3
	Cefuroxime	S.I.R	4, 4, 4

S sensitivity, I intermediate sensitivity, R resistant

Fig. 4 Antibiotic sensitive test

simple gingival inflammation. Statically it was revealed that none of the preoperatively recorded parameters in either control or experimental groups were significantly correlated to the occurrence of bacteremia. The results of our study are in concurrent with the results of Witzemberger et al. [8]. However in his study, the plaque index in control group and gingival index in experimental group were relatively close to having significant correlation with the occurrence of bacteremia. In contrary Lofthus et al. [9] demonstrated the increased incidence of bacteremias in individuals with inflamed periodontium.

The blood as a tissue has the ability, within limits, to sterilize, itself. Transient bacteremia does not have any deleterious effects in healthy subjects, and are usually cleared within 10–20 min

Bacteremia may persist as long as the manipulation of tissue is continued. Therefore blood sample was collected immediately (within minute) after the procedure and sent for culture and sensitivity [6, 8].

The occurrence of bacteremia is related to many factors including disease level, surgical technique, and time of blood sampling, culture and isolation methods, and identification of microorganisms, incidence of bacteremia was from 6.9 to 83.8 % [10, 11]. Otten et al. and Brown et al., were also of the opinion that with existing periodontitis, periapical infections and gingival inflammation with poor oral hygiene the incidence of transient bacteremia is high [3, 12–14].

In our study all presurgical blood samples were negative for bacterial growth. Only 12 out of 30 samples showed bacterial growth post surgically attributing to 40 %. This can be because of fair oral hygiene and simple gingival inflammation.

We second the opinion of Horderand Levis Grant [2], that oral surgical procedures in high-risk cardiac patients can cause bacterial endocarditis.

In our study we noticed that 60 % of patients in control group had bacteremia while 40 % in chlorhexidine group and 20 % of povidone-iodine group showed bacteremia, indicating drop in the incidence. Our results suggest that the reduction of the incidence of bacteremia is due to povidone-Iodine solutions antiseptic action rather than irrigation and mechanical washing of the sulcus or oral cavity. Our findings are in accordance with the results of following authors, Rahn et al. [15], Bender et al. [6], Scopp and Orvieto [16]. But Witzemberger et al. [8] states that local degerming by mouth rinsing and sulcus irrigation with povidone-iodine prior to oral surgical procedures seems neither to increase prior decrease the incidence of bacteremia. As in our study, chlorhexidine has lower antibacterial activity than povidone-iodine and these results are consistent with the findings of Rahn et al [15], Rechamnn et al. [12], Veksler et al. [17] and Yamalika et al. [18].

In our study total 37 organisms were isolated out of which 17 were aerobes and 20 were facultative anaerobes. The number of organisms isolated in these individuals were either one or two. The most commonly isolated organism was an alpha-haemolytic streptococcus followed by staphylococcus. These two organisms are associated with acute and subacute bacterial endocarditis. Our findings are in accordance with the results of Morrison Rogosa et al. [10] who also found diphtheroids 33 %. Otten et al. [19] found aerobic and anaerobic bacteria with two to nine different species per patient, which are more than what we found.

In our study we found one species of diphtheroids, peptostreptococci and enterobacteria. Enterobacteria may also cause bacterial endocarditis. This finding is in correlation with the findings of Franklin et al. [14] except that he found *Coxiella burnetii* (3 %) and wide variety of other organisms (8 %). In our study streptococci and staphylococci organisms were commonly found. Our findings are in consistent with Rahn et al. [15] who identified streptococci viridians, which may cause bacterial endocarditis. In contrary Brown et al. [3] found streptococci, provetalla and peptostreptococcus and Winslow et al. [11] also found staphylococcus aureus, streptococcus, *Neisseria flava*, pseudomonas and diphtheroids. These type of organisms may be the because of the presence of periodontitis and gingival inflammation in their cases. Thus we conclude that streptococci and staphylococci are the most commonly isolated organisms followed by enterococci, diphtheroids and peptostreptococci.

Amongst the number of colony forming units isolated, control and chlorhexidine groups showed no significant difference in aerobic and anaerobic colony forming units. But anaerobic organisms were found significantly low in povidone-iodine group than control group.

All isolated organisms were tested for antibiotic sensitivity by use of six antibiotic discs, namely Penicillin, Amoxicillin, Amikacin Erythromycin, Gentamycin and Cefuraxime. The amoxicillin was most sensitive followed by Penicillin and Amikacin. These findings are consistent with findings of Roberts et al. [20]. Dajani et al. [21, 22] also suggests use of amoxicillin as prophylaxis against bacterial endocarditis.

Conclusion

The most commonly isolated organism was streptococci and was most sensitive to the amoxicillin. So, it can be concluded that bacteremia is caused by a result of any oral surgical procedures. The inflammation of periodontium increases the incidence of bacteremia, use of povidone-iodine and chlorhexidine prior to the oral surgical procedures decreases the incidence of bacteremia as compared to sterile water

irrigation. Povidone-iodine significantly reduces the incidence bacteremia and number of organisms compared to chlorhexidine and sterile water. Pre-procedural use of mouth rinse and subgingival irrigation with an antiseptic mouth rinse resulted in reduction of blood born aerobic and anaerobic bacteria. This provides experimental evidence that supports the American Heart Association's (AHA) recommendations for reducing bacteremia caused by invasive dental procedures. Povidone-iodine use without systemic prophylaxis of antibiotics in low risk patients may be appropriate. Pre-procedural use of povidone-iodine with amoxicillin prophylaxis for bacterial endocarditis must be used when indicated.

These findings have significant clinical implications and strongly suggest the need for further research with attention to various other antimicrobial solutions. Additional laboratory investigations of the less prevalent oral microorganisms with larger sample size should be undertaken to elucidate normal ecology of mouth prior to alterations by antimicrobial agents for better results.

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