Detection of Infective Endocarditis Causative Bacteria Following Root Canal Treatment in High and Low Risk Cardiac Patients.

(An in-vivo study)

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Dedicated to

This work is gratefully dedicated to my great ***Mother*** who has been a great help to me. She was always there when I needed her and went through many difficulties in order to support and assist me in performing such work. She spent several hours, days and nights till I finished this thesis.

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Key words

*** Infective Endocarditis**

***Bacteraemia**

***AHA (American Heart Association)**

***High risk and low risk cardiac patients.**

***Guidelines differences**

***Antibiotic prophylaxis**

Abstract

Infective endocarditis (IE) is a fatal disease in cardiac patients. It was correlated with many dental procedures due to transient bactremia. Thus the aim of this study was to detect the incidence of transient bacteramia associated with root canal therapy that can cause IE in high and low risk cardiac patients, then to correlate the type of bacteria isolated from the root canal with that present in the blood stream. The third aim was to detect if there is a relation between *bateraemia* occurring and incidence of IE. Thirty cardiac patients were selected needing endodontic treatment for their teeth. The patients were divided into high and low risk groups according to their heart condition taken from the patient's cardiac report and from the preoperative echocardiogram. Preoperative blood sample was taken before any procedures, a preoperative root canal sample was taken after access cavity, while a postoperative root canal sample and postoperative blood sample were taken after complete mechanical preparation of the root canal. All samples were then cultured and microorganisms identified using gram stain, to detect the bacteria present in the root canal and compare them with those present in the blood stream. Endodontic procedures were then completed. Patients were followed up after 15 days for any signs or symptoms of infective endocardiris and postoperative echocardigram was done to explore the existence of any vegetation. Results showed transient *bacteraemia* occurred in few cases following radicular preparation of necrotic teeth. It was also found that the bacteria present in the preoperative root canal sample was also detected in the postoperative blood sample. No cases developed infective endocarditis.

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INTRODUCTION

Endocarditis is a life-threatening disease, although it is relatively uncommon. Substantial morbidity and mortality result from this infection, despite improvements in outcome due to advances in antimicrobial therapy and enhanced ability to diagnose and treat complications. Primary prevention of endocarditis whenever possible is therefore very important.

Endocarditis usually develops in individuals with underlying structural cardiac defects who develop *bacteraemia* with organisms likely to cause endocarditis. *Bacteraemia* may occur spontaneously or may complicate a focal infection (eg, urinary tract infection, pneumonia or cellulitis).

Some surgical and dental procedures cause transient *bacteraemia* that rarely persists for more than 15 minutes. Blood-borne bacteria may lodge on damaged or abnormal heart valves or on the endocardium or the endothelium near anatomic defects, resulting in bacterial endocarditis.

The recent American heart association **(AHA)**[1] recommendation reflects analyses of relevant literature, inculuding in vitro susceptibility data of pathogens causing endocarditis, results of prophylactic studies in experimental animal models of endocarditis, and retrospective analyses of human endocarditis cases in terms of antibiotic prophylaxis usage patterns.

There are currently no randomized and carefully controlled human trials in patients with underlying structural heart disease to definitively establish that antibiotic prophylaxis provides protection against development of endocarditis during *bacteraemia*-inducing procedures **(Dajani et al 1997)**[28].

REVIEW

1. *Bacteraemia* and dental procedures:

Roberts et al (1992)[2] showed that oral hygiene practices and chewing are responsible for random cases of *bacteraemia*. Such *bacteraemia* either from dental treatment or oral hygiene practices are of low-grade intensity and of short duration. Peak of *bacteraemia* was detectable 30 seconds after dental procedures and normally the microorganisms were removed by reticuloendothelial system over a period of a few minutes. The critical step in bacterial infection was the adherence to the host tissues, which led to colonization.

Messini et al (1999)[3] investigated the onset time and duration of *bacteraemia* in handicapped people who did not have general illnesses or received antibiotic protection. From each patient several blood samples were drawn aseptically during different dental treatment, cultured and detected the type of aerobic or anaerobic microorganisms circulating in the blood. The first sample was taken after completion of all fillings, the second after tooth extraction by 5 min and third blood sample after 30 min of the second blood sample. If dental procedure was not complete by 60 min a fourth blood sample was taken. The majority of aerobic bacteria recovered belonged to Streptococcus species and *Gemella* species. On the other hand, the anaerobic bacteria mainly belonged to *Porphyromonas gingivalis* and *Peptostreptococcus* species. *Bacteraemia* could be showed from 15 min to 60 min after dental treatment.

In a review by **Murray and Saunders (2000)**[4] about the relation between root canal treatment and general health. They showed there is currently many of dental practitioners who refuse to perform root canal treatment for systemic illnesses patients. From their reviewing of current literature, they found many publications to suggest that root canal treatment cause *bacteraemia* based on recent culturing techniques that confirmed that bacteria recovered from the peripheral blood during root canal treatment originated from the root canal. Yet that the root canal treatment might cause potential systemic complication is a mere

suggestion. They recommended further research to ascertain whether root canal treatment is indeed exacerbating or causing ill health. They concluded that, there is neither recent scientific evidence nor studies to support this view.

Robert et al (2000)[5] studied the intensity of *bacteraemia* associated with conservative dental procedures in children receiving dental treatment under general anesthesia. Blood cultures were processed to give the percentage prevalence of *bacteraemia*. They showed that dento-gingival manipulative procedures comprising a simple dental restoration due to rubber dam and matrix band with wedge placement can lead to *bacteraemia* comparable to that from dental extraction. It was suggested that these data might indicate the need for antibiotic prophylaxis for some aspects of conservative dentistry, scaling, extraction and surgical procedures. The organisms isolated were typical of those associated with *bacteraemia* of dental Origin as *Streptococcus* species, *Staphylococcus*, *gram positive* and *negative Bacilli*, *Veillonelle*, *Neisseria* and *Diphtheroid*, *Bacteroids* and *Micrococcus* species. They suggested that AHA guidelines not recommending antibiotic prophylaxis for rubber dam placement might need to be re-examined.

In a study by **Seymour et al (2000)**[6] they provided a critical review of the current evidence that links dental treatment with infective endocarditis (IE) and evaluated the risks of antibiotic chemoprophylaxis, in retrospective analysis in hospital based patients. They found that there was an increasing evidence that spontaneous *bacteraemia* were more likely to cause IE at high risk patients than specific episodes of dental treatment. Also the evidence suggested that procedures confined in the root canal are of low risk to *bacteraemia*. But manipulation of gingival or periapical area might cause *bacteraemia*. Antibiotic chemoprophylaxis might not necessarily reduce dental induced *bacteraemia*. The protective effect, if any, from antibiotic cover may arise from an inhibitory action upon bacterial colonization on the compromised cardiac valves. Thus they recommended a randomized controlled study targeting a specific cardiac condition and an

operative dental procedure with low risk as endodontics to investigate the need for antibiotic prophylaxis in such cases and to evaluate risk and benefits of the antibiotic prophylaxis.

Ingle (2002)[7] found that practitioners should be aware of the relationship between *bacteraemia* caused by dental procedures especially dental extraction and IE. Non-surgical endodontic procedures produced a lower incidence of *bacteraemia* compared to tooth extraction. Thus, he concluded that endodontic therapy should be the treatment of choice instead of tooth extraction for patients believed to be susceptible to IE following *bacteraemia*.

Carmona et el (2002)[8] defined bacterial endocarditis as an infection that affects the endocardium in valvular, mural and septal defects , as well as in arteriovenous and arterioarterial short circuits. They evaluated the evidence implicating dental procedures in bacterial endocarditis development and the basis for antimicrobial prophylaxis. They found that the nature of dental procedures that cause *bacteraemia*, patients at risk for bacterial endocarditis and the effectiveness of antibiotic prophylaxis guide lines, continue to be points of controversy. There is more evidence to support the important role of oral health status in the prevention of bacterial endocarditis of dental origin. They concluded that the dental practitioner should promote oral health care to decrease risk of caries or periodontal diseases in such cases. They found no hard data on which to scientifically base the need for antibiotic prophylaxis in patients at risk for IE. However, they recommended it, at least from the medico legal prespective, especially to persons with previous bacterial endocarditis or prosthetic valves and to those undergoing oral surgery, periodontal treatment or implant placement.

Savarrio et al (2004)[9] investigated whether a detectable *bacteraemia* was produced during non-surgical root canal therapy. Thirty patients receiving non-surgical root canal therapy were studied. Three blood samples were taken per patient: preoperatively, perioperatively and postoperatively. In addition, a paper point sample was collected from the root canal. The blood samples were cultured

by pour plate and blood bottle methods. The isolated organisms were identified by standard techniques. Blood samples were analysed for the presence of bacterial DNA by the polymerase chain reaction (PCR). In two cases where the same species of organism was identified in the root canal and the bloodstream, the isolates were typed by pulsed field gel electrophoresis (PFGE). By conventional culturing, they found that a detectable *bacteraemia* was present in 9 of the 30 patients (30%) who had no positive preoperative control blood sample. In 7 (23.3%) patients, the same species of organism was identified in both the blood stream and in the paper point sample from the root canal system. Overall, PCR gave lower detection rates compared with conventional culture, with 10 of 90 (11%) of the blood samples displaying bacterial DNA. PFGE typing was undertaken for two pairs of culture isolates from blood and paper points; these were found to be genetically identical. Blood bottle method was more sensitive than pour plate method in detecting organisms in this study. They concluded that non-surgical root canal treatment may invoke a detectable *bacteraemia*.

2. Microbiology and root canal therapy:

Baumgartner et al (1992)[10] developed a mouse model to study the abscessogenic potential of pure and mixed oral anaerobes associated infections of endodontic origin. Maximum subcutaneous lesions were seen on their backs between 3 and 14 days after inoculation. They found that in pure cultures strains of *Fusobacterium nucleatum*, *Peptostreptoccocus anaerobius*, and *Veillonella parvula* were pathogenic. A mixed culture of *F. nucleatum* with either *Porphyromonas gingivalis* or *Prevotella intermedia* was significantly more pathogenic than *F. nucleatum* in pure culture.

Noda et al (2000)[11] investigated the antibiotic susceptibility of the bacteria detected from persistent apical periodontitis cases. Intracanal exudates from 15 patients were sampled for detecting bacteria and antibiotic susceptibility of the bacteria identified was examined. The species most commonly detected were *Streptococcus* and *Enterococcus*. Other species of obligate anaerobes detected