Enterococcus Faecalis- An Endodontic Enigma

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Abstract: Human microflora is a unique niche for a variety of microorganisms. In the past few years, Enterococcus faecalis has been the focus of interest in dentistry. A recognized pathogen in post-treatment endodontic infections, E. faecalis is frequently isolated both in mixed flora and in monocultures and from endodontic infections like obturated root canals with chronic apical periodontitis. E. faecalis is probably the species that can best adapt to and tolerate the ecologically demanding conditions in the filled root canal. Eradication of E. faecalis from the root canal with chemomechanical preparation and using disinfecting irrigants and antibacterial dressings is difficult. This review article summarizes various aspects of this endodontic enigma.

Key words : Enterococcus faecalis, Periodontitis, Retreatment, Oral Microflora, Antibiotics

INTRODUCTION

In the past few years, Enterococcus faecalis has been a cause of post-treatment disease, where it has also been detected as monocultures. The prominence of E. faecalis in root-filled teeth has made it a focus of attention as an etiological factor of Post Treatment Disease. In order to appreciate fully the complexity of this virulent microorganism, it is essential to know it. Enterococci are part of the normal flora in the oral cavity and gastrointestinal tract. They are recognized as potential human pathogens causing 12% of the nosocomial infections. Development of multiple resistances to various antibiotics in enterococci poses serious therapeutic problems. E. faecalis accounts for around 80% of all infections caused by enterococci. Nosocomial and community-acquired infections caused by the genus Enterococcus include urinary tract infections, bacteremia, intra-abdominal infections and endocarditis. Enterococci are also frequently isolated from intubated patients. Enterococci pose increasing problems in medicine, in food engineering and environmental control and in dentistry especially in endodontics. Therefore, there is a need to integrate knowledge from medical and dental studies on these organisms. This article summarizes the contemporary knowledge about E. faecalis and offers a brief description of different important aspects in in dentistry.

TAXONOMY, CLASSIFICATION & IDENTIFICATION

The name “enterocoque” was first used by Thiercelin in a paper from France published in 1899; the name was proposed to emphasize the intestinal origin of this organism. Enterococcus faecalis is a nonspore-forming, fermentative, facultatively anaerobic, Gram-positive coccus. Enterococcus faecalis cells are ovoid and 0.5 to 1 μm in diameter. They occur singly, in pairs, or in short chains, and are frequently elongated in the direction of the chain. Most strains are nonhemolytic and nonmotile. Surface colonies on blood agar are circular, smooth, and entire. The G+C content of the DNA ranges from 37 to 40 mol%. In 1930’s Lancefield serologically classified Enterococci as group D Streptococci. In 1937, Sherman proposed a classification scheme, in which he recommended that the term ‘enterococcus’ should be used specifically for streptococci that grow at both 10 & 45°C, at pH 9.6 and in 6.5% NaCl, survive at 60 °C for 30 min and have ability to split esculin. In 1980 based on genetic differences enterococci were removed from the genus Streptococcus and placed in their own genus, Enterococcus. The previously used species designations such as faecalis, faecium, durans, and so forth were retained but were preceded by the genus name Enterococcus in place of Streptococcus. Enterococcus faecalis causes 80-90% of human enterococcal infections, while Enterococcus faecium accounts for a majority of the remainder. Other enterococcal species are infrequent causes of human infection.

VIRULENCE FACTORS

Enterococci possess a number of virulence factors that permit adherence to host cells and extracellular matrix, facilitate tissue invasion, effect immunomodulation and cause toxin-mediated damage. These factors include: (1) Aggregation Substance (AS), (2) Enterococcal Surface Proteins Such As Esp, (3) Gelatinase, (4) A Cytolysin Toxin, (5) Extracellular Superoxide Production, (6) Capsular Polysaccharides and (7) Antibiotic Resistance Determinant.

ENTEROCOCCI-ITS RESISTANCE TO ANTIBIOTICS

Most enterococci are intrinsically or naturally resistant to various antimicrobials including b-lactams. They are naturally sensitive to ampicillin and vancomycin, but can acquire resistance to these antibiotics after exposure. They are able to develop resistance to tetracyclines, macrolides, glycopeptides (vancomycin and teicoplanin), chloramphenicol and to high concentrations of b-lactams as well as aminoglycosides. The acquisition of antibiotic resistance occurs either through the acquisition of resistance genes on plasmids or transposons from other organisms. Enterococci can secrete phenomones, which are stimulating the synthesis of the surface aggregation substance. This facilitates the contact between the cells and the formation of the mating aggregate, which finally will lead to the exchange of plasmids carrying resistance. In the last few years,
Enterococci have received increasing attention because of the development of resistance to multiple antimicrobial drugs. This may be one explanation for its dominance in nosocomial infections. The ability of enterococci to transfer plasmids to streptococci and staphylococci and the implications of a possible spread of penicillin- and vancomycin-resistance to these and other Gram-positive species are also of concern. In Europe as well as in the USA, vancomycin-resistant E. faecium has caused most outbreaks of hospital infections and has also proved to be ampicillin-resistant. In cases of gentamycin-resistance, most of the isolates were VanB E. faecium isolates and they also were resistant to ampicillin and tetracycline.

THE ORAL CAVITY & ENTEROCOCCAL INFECTIONS

Only a few studies have focused on the occurrence of enterococci in the oral cavity. Enterococci have been isolated in small numbers from the oral cavity of a number of people. E. faecalis is the most commonly isolated species of enterococci. According to Jett et al, enterococci are commensal organisms well suited for survival in intestinal and vaginal tracts and the oral cavity. Williams et al found enterococci in the saliva of 21.8% of 206 investigated persons. Sedgley et al investigated the prevalence, phenotype and genotype of oral enterococci. Enterococci were detected in oral rinse samples from 11% of 100 patients receiving endodontic treatment and 1% of 100 dental students with no history of endodontic treatment. All enterococcal isolates were identified as E. faecalis. The dominance of E. faecalis in infected, filled root canals, however, is an indication that its occurrence in the oral cavity may be higher than suggested by most studies.

ROLE OF ENTEROCOCCI IN NON-ORAL INFECTIONS

Enterococcus faecalis is responsible for about 80% of all infections caused by enterococci, with E. faecium responsible for the remaining 20% of the infections. In a survey of 15,000 isolates, only 2% of E. faecalis strains were resistant to ampicillin or vancomycin compared with 83% of E. faecium strains. However, even though E. faecalis is less resistant to antibiotics, it is still responsible for the major part of infections. These observations indicate the existence of additional virulence factors that enhance the virulence of E. faecalis. Enterococci are responsible for 8–15% of infective endocarditis, and have a high affinity for heart valve tissue like streptococci and staphylococci.

EFFECT OF INTERAPPOINTMENT DRESSINGS AND IRRIGANTS ON ENTEROCOCCUS FAECALIS

Ørstavik et al tested a variety of antimicrobial agents like interappointment dressings, such as calcium hydroxide, camphorated monoparachlorophenol, camphorated phenol and mixed antibiotic–steroid combinations, as well as irrigants such as NaOCl, chlorhexidine digluconate, chlorhexidine acetate and iodic compounds have been tested for their efficacy against E. Faecalis. They inferred that E. faecalis is the most resistant bacterium against calcium hydroxide, both in vivo and in vitro. NaOCl is effective against E. faecalis both in buffered and unbuffered solutions. But in a recent study, Gomes et al suggested that a 30-min incubation is required to eradicate E. faecalis completely with 0.5%. MTAD inhibits salivary bacteria after 5 min of incubation, and has a potential to facilitate eradication of E. faecalis from infected dentine when used together with NaOCl. Chlorhexidine is bactericidal in clinically adequate concentrations. It is effective against a wide range of both Gram-negative and Gram-positive bacteria as well as against yeasts. Gomes et al observed that 0.2% chlorhexidine liquid killed E. faecalis in 30 s, chlorhexidine gel with the same concentration required 2 h to achieve the same result. Suka et al compared the effect of pure calcium hydroxide and calcium hydroxide combined with chlorhexidine (0.2%) or camphorated monoparachlorophenol (CMCP) using the human dentine block model and E. faecalis as a test organism. They concluded that calcium hydroxide combined with CMCP effectively killed the test organism in dentine, while no difference was found between pure calcium hydroxide and calcium hydroxide combined with chlorhexidine. The antibacterial effect of 2% and 4% IKI has been shown to be better than that of calcium hydroxide, NaOCl and chlorhexidine.

SUSCEPTIBILITY OF ENTEROCOCCI TO THERAPEUTIC ANTIBIOTICS

Antibiotics are not considered to be a routine part of endodontic treatment. In addition, the effect of systemic antibiotics against bacteria residing in the root canal system is supposed to be poor. E. faecalis has not been reported in severe spreading infections from the root canal. Hence in endodontics, from a clinical point of view, the antibiotic susceptibility of E. faecalis may not be of major importance. There are no clinical studies showing the effectiveness of systemic antibiotics in endodontic enterococcal infections. Nevertheless, as enterococci are a common cause of bacterial endocarditis, the antibiotic susceptibility of endodontic enterococci is of interest. Enterococci are naturally resistant to nitroimidazoles, which are active only against obligately anaerobic bacteria. The effect of clindamycin against enterococci is also known to be poor.

CONCLUSION

E. faecalis is part of the human normal flora and an important pathogen in opportunistic infections in humans. It is ecologically tolerant and has the ability to survive harsh conditions. In endodontics, E. faecalis is rarely present in primary apical periodontitis, but it is the dominant microorganism in root-filled teeth presenting with post-treatment apical periodontitis. The present article has dealt with the taxonomy, identifying characters, pathogenesis, virulence factors and antimicrobial resistance pattern of Enterococcus faecalis. Eradication of E. faecalis from the root canal remains a challenge, while chlorhexidine and combinations of disinfectants show some promise. Accurate knowledge about the pathogen and its role in the pathogenesis of endodontic infections helps to develop effective strategies in treating the infections. Further studies are required to unfold many mysteries of this endodontic enigma.

REFERENCES


