ORIGINAL RESEARCH PAPER

Dental Science

ANTIBIOTICS IN ENDODONTICS: AN OVERVIEW ON INTEGRAL AND CONTEMPORARY ASPECTS

KEY WORDS: Antibiotics, Endodontics, Intracanal Medicament, Antibiotic resistance, Triple antibiotic paste.

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ABSTRACT

Background: An antibiotic drug is defined as a substance produced by the microorganism, or a synthetic derivative of naturally occurring substances, that inhibit the growth or cause the death of other micro-organisms. For management of dental infection, dental practitioners usually prescribe antibiotics. However, inappropriate prescribing patterns of antibiotic has led to the development of antibiotic-resistant strain raising issue globally. Hence ,this narrative review aims to address the knowledge about the role of antibiotic in endodontics, when used systemically, prophylactically and as an intracanal medicament.
Methodology: A web-based research on Pubmed, using Mesh term was performed and the data was synthesized using short listed relevant articles. Important cross-reference articles were also reviewed.
Conclusion: This article presents a rational approach to the use of systemic and topical antibiotics in the endodontic practice.

INTRODUCTION:

Endodontic infection is a polymicrobial infection mainly involving anaerobes. The severity of infections depends upon the pathogenicity of the microorganisms involved and the resistance of the host. The response continues until the source of infection is not removed, resulting in clinical signs and symptoms of an infection and the inflammatory response produced by the host[2]. Hence, the primary objective of endodontic treatment is to remove microbes and their by-products from the infected root canal system.

Antibiotics are not an alternative; but adjunct to the endodontic treatment [3,4]. They are indicated for treating immunoco mpromised patients, clinical situations with evident signs of systemic infection, severe infection and the cases, which are likely to cause bleeding in the oral cavity [5, 6].

METHOD:

A web-based research on Pubmed, using Mesh term antibiotics, endodontics, intracanal medicament, antibiotic resistance, triple antibiotic paste was performed and the data was synthesized using short listed relevant articles. Important cross-reference articles were also reviewed.

DISCUSSION:

ANTIBIOTIC IN ENDODONTICS:

When to prescribe antibiotics is a big question? The indications where antibiotics are prescribed like fever (>100°F), malaise, cellulitis, unexplained trismus and progressive swelling which are the signs and symptoms of systemic involvement and spread of infection. Some conditions like healthy patients with symptomatic pulpitis, symptomatic apical periodontitis, draining sinus tract, and localized swelling of endodontic origin do not require antibiotic coverage for drainage. The systemically administered drug attains the only minimum inhibitory concentration in the involved anatomic space, which is filled with exudate due to poor circulation and diffusion gradient.

Incision and drainage allow pus to drain and prevent the spread of infection, which is followed by adjunctive antibiotic therapy. A proper loading dose of antibiotics is important to achieve an adequate therapeutic blood level of antibiotics. A proper regime for 7 days is adequate and the improvement in health status should be monitored for first 24 – 48 hours after antibiotics are prescribed.

Penicillin is the drug of choice, for both aerobic and anaerobic microorganisms like Staphylococcus, Streptococci, and Pneumococci [7]. Patients if allergic to penicillin are treated with clindamycin 300 mg (65%) a preferred drug of choice, followed by azithromycin (15%) and metronidazole (13%) [8]. The first generation cephalosporin are prescribed when gram-positive organisms are suspected to be the primary causative factor of the infection [9].

Tetracycline's are bacteriostatic antibiotics that specifically inhibit the binding of aminoacyl-t-RNA synthetases to the ribosomal acceptor site [10]. In 2002 Swift JQ et al reported azithromycin to be effective against the anaerobes involved in endodontic infection. The oral loading dosage of azithromycin is 500 mg followed by 250 mg once a day for five to seven days [11]. Ciprofloxacin has an effective action against, gram-positive aerobic organisms,hence prescribed for endodontic infections [12]. Metronidazole is a synthetic antimicrobial agent, bactericidal and most effective against anaerobes.[13]. The recommended loading dosage is 1000 mg followed by 500 mg every six hours for five to seven days[11]. In 2006 Baumgartnar JC et al reported clindamycin to be the second drug of choice next to penicillin in treating endodontic infections. [14]. However, amongst the dental health professionals B lactam antibiotics remains the drug of choice for the treatment of endodontic infections [15,16].

Prophylactic antibiotic for medically compromised patients:

The principles of antibiotic prophylaxis include the following: (1) satisfactory **risk and cost-benefit ratios** should exist in which patient is benefitted significantly (2) the antibiotic must be in high concentrations at the **target site** (blood or tissue) before the onset of the bacteremia or surgery, (3) an antibiotic **loading dose** must be higher than maintenance dose, (4) the antibiotic was chosen should be **active** against the most likely microorganism that cause the infection and (5) the antibiotic is continued only as long as microbial contamination of or from an operative site continues.[17]. It has been reported that in patients undergoing endodontic treatment with immunocompromised health status are at high risk for developing infective endocarditis owing to bacteremia, hence requires antibiotic prophylaxis. The American Heart Association has supported that antibiotic prophylaxis is required for root canal instrumentation or surgery beyond the root apex and for intraligamentary local anesthetic injections [18, 19].

Only high risk immunocompromised patient require antibiotic prophylaxis prior to endodontic treatment. It is mandatory that every dental clinician should consult physician for prescribing antibiotic prophylactically in clinical situation like avulsion, re-implantation and while treating above condition.

Antibiotic used as intracanal medicament:
It is reported that to achieve successful endodontic treatment removal of causative factor is of prime importance. However, complete eradication of bacteria is difficult owing to its anatomic complexity. Hence, the local application of antibiotic has been tried out as an effective mode for disinfection as systemic route fail to achieve antibiotic due to lack of blood supply. Intracanal medicaments are indicated for various reasons including the elimination or reduction of microorganisms, prevention of post-treatment pain or continuing exudate, and to enhance anesthesia [20].

Grossman in 1951 was the first to report local use of antibiotic. He proposed PBSC a polyantibiotic paste combination of penicillin, bacitracin, streptomycin and caprylate sodium with silicone as a vehicle.[21] Though a potent therapeutic it proved to be ineffectiveness against anaerobic species and reported to evoke allergic reactions. Hence in 1975, the Food and Drug Administration (FDA) prohibited PBSC for endodontic use. Later, an antifungal version PBSN, in which Nystatin substituted caprylate sodium, was released.[22]

LEDERMIX :
In 1962 Schroeder and Triadan introduced Ledermix (Lederle Pharmaceuticals).[23] This medicament contains a corticosteroid, triamcinolone acetonide (1%) to control pain and inflammation related to pulp and periapical diseases and an antibiotic demeclocycline—HCl (3.2%) to compensate for the perceived corticoid-induced reduction in the host immune response , in a polyethylene glycol base.[24]. The medicament has an advantage of diffusion through dentinal tubules and cementum to reach the periradicular and periapical tissues. In 1990 Abbott et al.in reported that the dentinal tubules to be route for passage of active components to the periradicular tissues. [15]

Heling I et al, Ehrmann EH et al, Abbott PV et al in their studies investigated and confirmed the effectiveness of Ledermix as an intracanal medicament.[15]. In 1981 Schroeder advocated the combination of Ledermix paste with calcium hydroxide in 50:50 mixture which had advantage of slower release and diffusion of the active components of paste making the action of medicament last longer. It is indicated for the treatment of necrotic teeth with incomplete root formation, as intracanal dressing between appointments, perforation repair, inflammatory root resorption, inflammatory periapical bone resorption and for the treatment of large periapical radiolucent lesions [15,25,26].

Septomixine Forte:
Septomixine Forte (Septodont, Saint-Maur, France) contains two antibiotics: —first neomycin which has bactericidal action against gram-negative bacilli but it is ineffective against bacteroides and fungi and second polymixin B sulphate which is ineffective against gram-positive bacteria. Tang et al reported it to be ineffective in inhibiting residual intracanal bacterial growth between appointments [15].

Triple antibiotic paste:
The intricacy of root canal infections, it is questionable that any single antibiotic could result in effective and predictable disinfection of all canals. More likely, a combination would be needed for controlling microbial growth. Complementary to it, a combination of antibiotics would also decrease the likelihood of the development of resistant bacterial strains. Hoshino et al in 1996 determined that a combination of ciprofloxacin, metronidazole, and minocycline, each at a concentration of 25µg per ml (0.0025 percent) of paste, was able to disinfect infected root dentine in vitro.[27] In 1996 Sato et al found that this combination at 50µg of each antibiotic per mL (0.005 percent) was sufficient to disinfect infected root dentine in situ, commercially available as 3-MIX MP [28]. Windley et al in 2005 used metronidazole, ciprofloxacin, and minocycline in a thick paste at a concentration of 20mg of each drug per mL (i.e., 2 percent) to counteract these potential effects [29]. Metronidazole is a nitroimidazole compound. It is selectively toxic to anaerobic microbes. The presence of certain redox proteins reduces the nitro group of this compound and generates free radicals that enter the cell and induce DNA damage. This results in rapid cell death [30].

Tetracyclines, which includes doxycycline and minocycline are primarily bacteriostatic, inhibiting protein synthesis by binding to 30S ribosomes in susceptible organisms, it inhibits collagenases and matrix metalloproteinases and increases the level of interleukin-10, an anti-inflammatory cytokine [31,32]. However, Trope M, Kim JH et al, Petrino JA et al, Nagata JY et al reported crown discoloration associated with Triple Antibiotic Paste and suggested substituting minocycline with another antibiotic or the minocycline is left out thus using a bi-antibiotic paste. [33-37]. A modified triple antibiotic paste (MTAP) composed of metronidazole, ciprofloxacin, and clindamycin was successfully used as an intracanal medicament to disinfect necrotic immature teeth during an endodontic regeneration procedure. [33]. Lin et al. compared the antibacterial effect of clindamycin and tetracycline in bovine dentinal tubule model, as well as using the agar diffusion test and reported that clindamycin significantly reduced the amount of viable bacteria in each dentin layer compared with the tetracycline.[38,39].

CONCLUSION:
Based upon the review of the available literature, the primary treatment for acute and chronic infections of endodontic origin is operative intervention. The therapeutic use of antibiotics is an adjunct to treatment. Prophylactic antibiotics, is advocated pre-operatively for endodontic treatment, in high risk systemic conditions. The use of topical/ intracanal antibiotics/ antimicrobial agent is also a good option but requires further research and evaluation.

Conflict of interest: no conflict of interest.

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