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Triple Antibiotic Paste (TAP) - A Review

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Abstract

The elimination of microorganisms from the root canal and periapical area is essential for the endodontic procedure to be successful. A sterile state cannot be achieved with only endodontic instrumentation. Local administration of antibiotics has been studied in light of the development of non-instrumentation endodontic treatment, lesion sterilisation, and tissue healing.

A beneficial regimen for managing non-vital young permanent teeth and primary teeth has been described as triple antibiotic paste (TAP), which contains metronidazole, ciprofloxacin, and minocycline.

Keywords: Non-Vital, Triple Antibiotic Paste, Young permanent tooth, Primary Teeth, TAP

Introduction

In both animal models and human investigations, the part played by microorganisms in the emergence and maintenance of pulp and periapical disorders has been amply documented.[1,2] The presence of microorganisms in the root canal system is unmistakably linked to the

onset and evolution of an endodontically generated periapical lesion.[3] Bacteria can invade and live deeply within dentin and in cementum surrounding the periapex when they are present in diseased root canals and peri radicular tissues. Endodontic treatment is to get rid of the bacteria in the affected root canal and stop infection.[4] The root canal infection is regarded as a polymicrobial infection that includes both aerobic and anaerobic microorganisms. It is doubtful that a single antibiotic could effectively sterilise the canal due to the complexity of the root canal infection. To deal with the varied flora encountered, a mix would probably be required.[5]

For the first time in endodontics in 1951, Grossman used a poly – anti biotic formula known as PBSC, a com bination of "penicillin, bacitracin, streptomycin, and caprylate sodium" in a silicon medium in a paste form.[6] Gram-positive bacteria were treated with penicillin, penicillin-resistant bacteria were treated with bacitracin, gram-negative bacteria were treated with streptomycin, and yeasts were treated with sodium caprylate. Despite the fact that PBSC's clinical examination demonstrated positive therapeutic effects, anaerobic bacteria, which are crucial to endodontic problems, were unaffected by the formula. As a result, the US Food and Drug Administration outlawed the use of PBSC for endodontic procedures in 1975, noting the possibility of sensitization and penicillin allergy. An article on the use of antibiotics to manage root canal bacteria, which are thought to play a role in the aetiology and progression of pulpitis, was published by the American Association of Endodontics in 2006. TAP is an anti-biotic combination that was created specifically to aid in the process of rejuvenation. After doing studies on its efficiency in clearing out the bacteria from the root canal, Hoshino and colleagues introduced it. As a powerful anti-microbial agent, this mixture is utilised to treat necrotic pulp in open apex teeth and has numerous other uses in the field of endodontics.[7,8] This review aims to discuss pro perties of TAP, its composition, its various appli cations and indications.

TAP

TAP is a "intra-canal medicament" that includes the three anti-biotics metronidazole, ciprofloxacin, and minocyc line in a precise ratio of 1:1:1 to provide effective outcomes. TAP is used in order to get the greatest outcomes and effectively clean the area because one anti-biotic is insufficiently powerful to eradicate all poly microbial flora. TAP offers potent antibacterial effects in endodontic regeneration procedures since it is a mixture of three antibiotics. The canal prepares the way for the cells with the potential to renew through the cleansing and sterilising activity it performs. Since there is a large decrease in the likelihood of microbial resistance, the combined action of the three drugs in one mixture is very beneficial.[8,9]

Composition and preparation

According to Hoshino et al[8] Mixing ciprofloxacin, metronidazole, and minocycline in a proportion of 1:1:1, that is ciprofloxacin 33%, metronidazole 33%, and Minocycline 34%, with macrogol and propylene glycol paste concentrated at 0.1-1.0 mg/ml; or Mixing ciprofloxacin, metronidazole, and minocycline in a proportion of 1:3:3.[10-12]

Application of TAP

Intra-canal Medicament

The root canal microbiome is multi-microbial and contains actinomyces, aerobic and anaerobic bacteria, as well as other bacteria that are antibiotic-resistant. Due to the prevalence of anti-biotic resistance, various anti-biotics were needed to treat the poly microbes and overcome the resistance.[13] TAP is now the most

successful pharmacological combination for overcoming bacterial strain resistance.

$Ca(OH)_2$ and TAP's effects were investigated by Pai et al. (2014).[14] They discovered that 3 of 20 patients with 15% $Ca(OH)_2$ experienced flare-ups between appointments. However, none of them experienced flare-ups between appointments in relation to the TAP.

In a different investigation, it was discovered that TAP demonstrated superior disinfection abilities in com parison to $Ca(OH)_2$.[15,16]

In a different trial, the effectiveness of TAP in com bination with other anti-biotics was assessed, including amoxicillin and metronidazole, amoxicillin and clavulanic acid and metronidazole, amoxicillin and clavulanic acid and metronodazole, and amoxicillin and cloxacillin and metronodazole. In comparison to other formulations, they discovered that the TAP displayed the largest bacterial inhibitory zone. [17] Researchers looked at the antibacterial effectiveness of TAP and $Ca(OH)_2$ in conjunction with 2% chlorhexidine against E. faecalis. They discovered that $Ca(OH)_2$ combined with 2% chlorhexidine is more effective against E. faecalis than TAP. TAP could remove germs from the dentin up to a depth of 400 µm, but $Ca(OH)_2$ could only do so up to a depth of 200 µm.[18]

Regenerative Endodontics

A growing specialty called regenerative endodontics focuses on restoring the traumatised and unhealthy pulp tissue in these teeth. Utilising stem cells to replace missing tissues could restore such tissues to their pre-loss condition. Dentin, pulp, cementum, and periodontal tissues that are damaged can be healed with regenerative endodontics.[19] Vital pulp cells still present at the apical end of the root canal, multipotent dental pulp stem cells, periodontal ligament stem cells, and stem cells from the apical papilla or bone marrow can all contribute to regeneration.[20,21] Growth factors are abundant in the blood clot itself. It has long been believed that revascularization of the pulp space in a tooth with necrotic infected pulp tissue and apical periodontitis is not conceivable.[1]

Nygaard-Ost by and Hjortdal successfully regenerated pulps after vital pulp removal in immature teeth, but were unsuccessful when the pulp space was infected. Thus, if the canal is effectively disinfected, revascularization should occur similar to that in an avulsed immature tooth.[22] After the infection in the canal is under control, it looks like an avulsed tooth with a necrotic but sterile pulp area. The blood clot is then put in position to replicate the scaffold that the ischemic necrotic pulp in the avulsed tooth has built up over time. Here, the necrotic, uninfected pulp serves as a framework to allow new tissue from the periapical region to grow. For revascularization to be successful, there must be no bacteria present since the new tissue will cease growing where it encounters bacteria in the canal space.[1] The clinical effectiveness of the TAP in the disinfection of immature teeth with apical periodontitis has been reported. TAP, calcium hydroxide, and form cresol were evaluated by Raison Bose as intracanal medications in young, non-vital permanent teeth. Comparing the three antibiotic groups, the dentin wall thickness increased by the largest percentage in the triple antibiotic group.[23]

Treatment of Root Fracture

According to several clinical studies and case reports on teeth with horizontal root fractures and their cor responding treatment with TAP as the intracanal medication and MTA as the coronal obturating material, the fractured root has been repaired radiographically, and tooth symptoms have disappeared after a 12-month period [80]. It is thought that the cleaning and microbe

removal by the TAP, which results in acceptable healing between the shattered fragments, is what gives rise to the success of such nonsurgical endodontic care.[24, 25]

TAP in Operative Dentistry

TAP is used outside of endodontics as an antibacterial paste. Studies have shown that Streptococcus mutans and Lactobacillus casei respond well to glass ionomer cement (GIC) that contains TAP. Yesilyurt et al. showed that the physical and bonding characteristics, com pressive strength, and bonding strength to dentine are not altered and remain ideal when 1.5% TAP is added to GIC.[26]

Lesion Sterilisation and Tissue Repair

A deciduous tooth with dental caries affecting the pulp tissue and peri radicular pathosis might occasionally be a challenge for traditional endodontic operations for a number of different reasons. In this case, the only method by which dentists could prolong the life of a young child's deciduous teeth was lesion sterilisation and tissue repair (LSTR). By sterilising the lesion and encouraging tissue repair and regeneration through the host's natural tissue responses, this treatment tries to get rid of bacteria from the root canals.[27]

A new approach that is less invasive and time-consuming treatment could be a ray of hope for the patient and the practitioner in the modern era. In these therapeutic situations, the LSTR-claims its significance. The LSTR therapy concept was created by Hoshino at the Niigata University School of Dentistry in 1990, and Takushige popularised it. The LSTR is an endodontic method that includes no or little instrumentation, followed by the administration of an antibiotic solution in a propylene glycol vehicle to clean the peri-apical lesions and root canal systems. LSTR's fundamental tenet is "do not remove or touch and leave it." Caries, pulpitis, and root canal infections are all treated and medicated by it.

The idea behind LSTR is that the host's natural defence mechanisms can restore the damage. Bacterial burden can be reduced by using medications to sterilise the canals and pulp chamber.

Medication-induced sterilisation will result in 20–40% cleaning activity and debride ment. Three mix MP pastes are another name for this type of substance, which is most frequently a combination of three antibiotics, the solvent macrogol, and propylene glycol. If the procedure is successful tissue repair can be expected.[28]

Discussion

Systematic anti-biotic treatment necessitates bio ab sorption and bio modulation in the liver, followed by circulation in a circular system that transports the bio modulated medication to the affected location in the root canal system. Local drug application is more effective because the blood supply to the necrotic pulp and infected root canal system is impeded, and the bio Modulated drug also experiences this impediment at the infected site, rendering the drug ineffective in the enclosed canals. This is dependent on the type of drug and the method of local drug delivery system.[28]

In 1990, Hoshino et al. combined antibiotics in a 1:1:1 ratio, including metronidazole 500 mg, ciprofloxacin 200 mg, and minocycline 100 mg.[8] In 1998, Takushige et al. utilised a 1:3:3 ratio of the aforementioned anti-biotics.[29] The nitroimidazole group compound met ronidazole binds to DNA and inhibits the growth of both gramme positive and gramme negative anaerobes. The fluoroquinolone group of drugs includes ciprofloxacin, which inhibits DNA gyrase and aids in the eradication of gram-negative bacteria. The broad range antibiotic Minocycline works by preventing the production of new proteins, collagenases, and matrix metalloproteinases. It

eliminates both gram-positive and gram - negative bacteria, as well as Spirochetes.[28]

Additionally, calcium hydroxide pastes, chlorhexi-dine paste, neomycin, polymyxin, and nystatin were employed, as well as Leder mix paste (Triamcinolone and Demeclocycline) and Gross man's poly anti-biotic paste (Penicillin, Bacitracin, and Streptomycin).[30]

The usage of TAP leads to the development of crown discoloration, bacterial resistance, and hypersensitivity reactions. Kotha SK et al. (2022), in order to overcome the above-mentioned systemic and local side effects of components of TAP, tested various natural products and their combinations as an alternative to TAP. They concluded that the combinations of herbal medicaments, I, e. (neem, turmeric, and bitter gourd), (bitter gourd, Triphala, and neem), and (bitter gourd, neem, and ginger) have shown similar diameters of zones of inhibition when compared with TAP group as control. Author also concluded that combinations of herbal medicaments have shown significant antibacterial efficacy when tested for common endodontic pathogens, that is, E. faecalis, C. albicans, and S. mutans. Herbal Medicaments are cost-effective, easy to handle, easily available, and renewable in nature.[31]

Conclusion

The cautious and thorough removal of pathogenic bacteria from the diseased root canal space is absolutely necessary for the effectiveness of the endodontic treatment. Despite the fact that mechanical preparation is the initial stage, it is insufficient to completely cleanse the area.

It is important to consider non-instrumentation app roaches like tooth repair and ways to maintain a condition that is conducive to pulp regeneration and revascularization, especially when local drug administration, particularly antibiotic local administration, has been demonstrated to be unsuccessful.

TAP has been found to be the most successful of all. TAP, a combination of three distinct antibiotics, has excellent outcomes and works well against many microbes. Additionally, the combined effects of three distinct antibiotics help lessen the likelihood of germ resistance. The finest antimicrobial agent must be chosen because there are numerous benefits and drawbacks related to the different antimicrobial agents that are accessible. TAP has unquestionably shown to deliver positive outcomes.

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