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Pharmacology in Endodontics: A Review Article.

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ABSTRACT

Pain and Periapical infections are most common complaints with which patients approach a dental surgeon and Endodontic therapy is one of the most common dental procedures. Pain control and infection management is the foremost aim while performing the endodontic therapy. Therefore, use of analgesics and antibiotics becomes an integral part of dental procedures for treating dental infections and providing pain free procedures. Nowadays researches aim on finding medicaments with maximum efficacy and minimal side-effects.

Keywords: Analgesics, Antibiotics, Pain, Root Canal Therapy

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INTRODUCTION

Goal of endodontic therapy is elimination of microorganisms by thorough mechanical debridement, cleaning and shaping of the canal and three dimensional obturation.¹ But endodontic therapy is incomplete without pharmacologic management.² Since microorganisms are the major cause for pulpal injury,³ many cases require the need of antibiotics .Certain cases require antibiotic prophylaxis and often pain and anxiety is also associated with endodontic therapy .^{4,5} So , as an endodontist it is essential to know the mechanism of action of drug, side effects ,dosage of these drugs. In the light of these findings, the present article describes various antibiotics, analgesics used in endodontics, infection control and antibiotic prophylaxis.

Infection Control

The microbial etiology of pulpal infections is established as early as 1965³. The rationale of endodontic therapy is to eliminate the occurring infection, prevent the microorganisms from infecting or reinfected the root canal and periradicular tissues.¹ Hence Infection control plays a key role in endodontic practice. Endodontists have to take some of the precautions in the dental office to prevent transmission of infection from patient to dentist , dentist to patient and patient to patient. Proper hand washing before and after the patient examination and procedure , use of protective clothing like aprons ,face masks, protective eye wear to prevent contact with the splatter, high volume evacuation, rubber dam isolation ,surgical scrub techniques helps to minimise the cross contamination.^{6,7}

Adhering to a proper sterilization protocol is necessary. According to a study, endodontic files due to a complex design makes sterilization difficult and sterility of files for reuse has shown to be less than 100%. Single use Pre-sterilized (gamma sterilized) endodontic files and burs, laser sterilization are introduced recently in the dental practice to minimize cross contamination.⁸

Antibiotics

Antibiotics are antibacterial agents used to kill bacteria. These are important adjuvants in endodontic therapy. It can be given singly or in combination. Can be bacteriocidal or bacteriostatic. Antibiotics are indicated in an endodontic therapy when the infection is either or systemic or is persistent.² It should be prescribed with caution and when there is a defined need .Proper dosage and selection of antibiotic is very important.

Classification:

	Drug	Mechanism of action
1.	Penicillin	Bactericidal
2.	Cephalosporins	Bactericidal
3.	Metronidazole	Bactericidal
4.	Flouroquinolones	Bactericidal
5.	Macrolides	Bacteriostatic
6.	Clindamycin	Bacteriostatic
7.	Tetracyclin	Bacteriostatic

Penicillins

Penicillin and its derivatives are the mainstay of antibiotic regimen in endodontic practice .^{2, 5, 11} Oral preparations include penicillin v, amoxicillin, ampicillin. Amoxicillin is the most commonly used drug. Due to its extended spectrum of action it is effective against gram positive cocci like streptococci, staphylococci and

pneumococci, gram positive rods like Bacillus, Corynebacterium, clostridium and oral anaerobes like Peptostreptococci, Actinomyces, Eubacterium. It has a short half-life ($t_{1/2}=1$ hour), better oral absorption relatively less toxic, and excreted unchanged in urine.^{9,10} Though its toxic effects are less, a study shows 3 -6 % of patients experience an allergic reaction to penicillin. This can be as minor as a rash or as significant as life-threatening anaphylaxis. Patients may also develop adverse side effects such as gastrointestinal problems and secondary infections. Adverse side effects like allergy and anaphylactoid reactions are seen in some cases which include cold hands and feet, bronchospasm, wheezing, circulatory collapse and unconsciousness .In patients with renal disease, reduction in dosage is advised.

Cephalosporins

Cephalosporins comprise a group of β -lactam antibiotics that are structurally similar to penicillin and are used alternatives to penicillin if broader spectrum antibiotics are necessary for treatment.¹¹ First-generation cephalosporins are most commonly used in dentistry since they kill most oral pathogens and should be considered for use in most infections. Second- and third generation cephalosporins are used for refractory infections, probably after laboratory results of a culture. Of orally active cephalosporins, cefaclor, cefuroxime and cefprozil have significant activity against anaerobes. It is noteworthy that most cephalosporins reach therapeutic concentration in osseous tissues like alveolar bone after administration of usual doses and thus are used to treat periapical infections.¹² However they exhibit cross allergic reactions with penicillins.

Metronidazole

Metronidazole is bactericidal drug attacks the bacteria's DNA. It is active against obligate anaerobic bacteria but not against facultative bacteria or aerobes. ¹¹

Since it is active against periodontal pathogens like Pervotella ,porphyromonas, eubacterium, fusobacterium, veillonella, camphylobacter, Camphylobacter Clostridium, treponema ,peptostreptococcus it is effective in endoperio lesions . Patients taking metronidazole should be cautioned about not using alcohol .The half-life of metronidazole is in the 8- to 10-hour range. Side effects include an unpleasant, metallic taste and brown discoloration of the urine, effects are dose related.

Fluoroquinolones

Fluoroquinolones are bactericidal drugs which interfere with DNA replication. However, they are not effective against microbes commonly seen in endodontic infections. Their use in dentistry should probably be limited to cases in which culture and sensitivity results prove their indication. Ofloxacin has a broader spectrum of action against oral anaerobes ¹²

Macrolides

Erythromycins kill bacteria by inhibiting bacterial protein synthesis. They are the drug of choice for patients allergic to penicillins. Effective against gram positive bacteria but have a limited spectrum of action for gram negative bacteria. Newer macrolides like azithromycin and clarithromycin show wide spectrum of action and develop higher tissue concentrations.

Side effects include increased gut motility and allergy. The estolate ester form of Erythromycin can cause cholestatic hepatitis. The illness starts after 10-20 days of treatment and manifestations of this side effects occur few days after the drug is discontinued.¹¹

Tetracyclines

It exhibits broad spectrum of action against oral pathogens , has long half life. It binds reversibly to the 30 s subunits of bacterial ribosomes and interfere with bacterial protein synthesis.¹¹ In spite of development of resistance against them, they are widely used in dentistry due to its broad spectrum of action. Its Side effects include staining of teeth , photosensitivity. Since they are concentrated in the gingival fluids, they are useful in periodontal infections.

Antibiotic prophylaxis in endodontics

Antibiotic prophylaxis is a matter of continuing discussion and debate and recommendations and guidelines are reviewed regularly. Previous studies have shown that the incidence of bacteremia is low with root canal procedures. Some authors claim that in endodontic therapy, the need of prescribing prophylactic antibiotics can be eliminated by simple pre-operative mouth rinsing with chlorhexidine which reduces the magnitude of a bacteremia.¹⁴ but intracanal instrumentation can cause bacteremia and may need prophylactic antibiotics in certain cases.¹⁵

A study shows that there is no role of antibiotic prophylaxis, in a healthy patient undergoing endodontic treatment. However, when the maxillary antrum or floor of the nose has been perforated, antibiotic prophylaxis may be given to prevent development of infection. Antibiotic prophylaxis is recommended following the re-implantation of avulsed teeth to prevent bacterial invasion of the pulp and also inhibit root resorption.¹⁶

Prescribing antibiotics for prophylaxis in endodontics should be based on rational approach. The authors have recommended the use of a broad-spectrum antibiotic, which has activity against both facultative and anaerobic oral organisms. Short term, high dosage regimens are most effective single oral or intravenous dose of antibiotic prophylaxis rather than a 3–5 day course can be given on completion of the procedure¹⁶

According to the American Heart Association, antibiotics must be administered one hour (in case of oral route) or 30 minutes (by intravenous route) before the procedure. The antibiotics of choice are amoxicillin 2 grams. Patients allergic to penicillin should receive clindamycin 600 mg.¹⁵

Pain control

Pain management is one of the most important aspect in endodontics.^{18, 19} Analgesics or anti-inflammatory drugs are usually prescribed during root canal therapy; most of the cases can be managed by using non-narcotic analgesics such as NSAIDs. A study claimed that non-opioid drugs were more used compared to opioid analgesics for most of the clinical situations in endodontics, however opioid analgesics are prescribed when additional pain relief is required.¹⁸ Some of the important analgesics used in endodontics are explained below.

Codeine

It is a methyl- morphine which is a naturally acting opium alkaloid.¹¹ Though it is less efficacious than morphine, due to its low abuse potential, it is prescribed by the endodontists in moderate to severe pain. Its analgesic action is mainly due to generation of morphine by demethylation. It has good activity by oral route. A single oral dose acts for 4-6 hours. Degree of analgesia is comparable to aspirin (60 mg codeine ~ 600 mg aspirin) Constipation is the major side effect when it is used as an analgesic.

Tramadol

It is centrally acting synthetic opium alkaloid used to treat medium intensity short lasting pain. Its affinity for μ opioid is modest and that of κ and δ receptors are weak.¹¹ It acts by inhibiting reuptake of Noradrenaline and 5-HT and thus activates mono aminergic spinal inhibition of pain. It has a good oral bioavailability, $t_{1/2}$ is 3-5 hours and effect lasts for 4-6 hours. It causes less respiratory depression, sedation, constipation, urinary retention than morphine. It is well tolerated, safer in patients with cardiovascular diseases. Common side effects include dizziness, nausea, dry mouth, sweating.

Propoxyphene

Chemically related to methadone but exerts a similar action to codeine. It is metabolized in liver, $t_{1/2}$ =4-12 hours. Overdose causes delirium and convulsion. Demethylated metabolite of propoxyphene is cardiotoxic. It has been used as a mild oral analgesic (dose 60-120 mg) as a substitute of codeine in combination with aspirin and paracetamol¹¹

Aspirin and other NSAIDs

Aspirin is the most commonly used drug. It irreversibly binds the enzyme cyclooxygenase, and blocks the arachidonic acid pathway and thus inhibits prostaglandins, which are the mediators of inflammation.²¹ For patients receiving low dose aspirin prophylaxis against stroke or heart attack, consultation with their physician is required.

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