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The endodontic dilemma - Rationale behind antibiotic usage

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ABSTRACT

Antibiotics are life saving therapeutic agents of inestimable value. Many dental surgeons prescribe antibiotics to prevent the possible development of pain and swelling during endodontic therapy. This is being done more out of tradition rather than with any sound scientific knowledge. This sorry state of affairs has contributed to an alarming increase in the rate of microbial resistance to antibiotics.

The objective of this paper is to enlighten the dental fraternity about the true rationale behind advocating antibiotics during endodontic therapy. It is imperative that dental surgeons appreciate the fact that antibiotics are useful *adjuncts* during endodontic therapy, and are not *indispensable*. In this article, we have delineated the true indications for antibiotic prophylaxis in Endodontics as well as given an overview of the conditions, which warrant such coverage.

Key words — Antibiotics usage, antibiotics in endodontics, root-canal infection, periapical pathosis.

Introduction

In the last two centuries, the average human life span has more than doubled. The major reason for this phenomenal achievement has been the control of infectious diseases with the help of antibiotics. Thus the advent of *Antibiotics* constitutes the single greatest advance in human health care. Although, Paul Ehrlich formulated the concept of Chemotherapy in 1906, the use of agents effective specifically in the treatment of infectious diseases is credited to ancient Chinese physicians who about 2500 years back, used materials such as moldy soybean curd incorporated *Soil and mud packs* in the

treatment of infections¹. Yet, it was only in 1942 that the term *Antibiotic* (literally meaning "Against Life"; Greek: *Anti* – Against, *Biosis* – Life) was coined by *Waksman*. It is essentially defined as a substance produced by microorganisms, or a synthetic derivative of a naturally occurring substance, that inhibits the growth or causes death of other microorganisms.

In spite of all its myriad advantages, the irony remains that antibiotics constitute the single most abused group of drugs in health care today. This has led to an alarming increase in the rate of microbial resistance to antibiotics. This is validated by the fact that at least 60,000 to 100,000 deaths occur annually in United States hospitals due to Nosocomial (Hospital acquired) infections caused by antibiotic resistant micro-organisms². This spurt in nosocomial & community acquired

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infections along with the problems of drug toxicity; hypersensitivity reactions & drug interactions have been attributed to indiscriminate use of antibiotics. The misconceptions regarding antibiotics which is resulting in their abuse and untoward sequelae are

- ❖ The belief that antibiotics are 'safe' and do no harm.
- ❖ The belief that antibiotic prophylaxis is commonly successful.
- ❖ An absolute ignorance of the type of microbial flora in the pulp space.
- ❖ The "I don't know what else to do." syndrome (When all diagnostic and therapeutic procedures fail, we assume the condition to be an infection!)

Rationale Behind Antibiotic Usage

To serve in the best interests of our patients and profession, it is imperative that we not only know which antibiotic has to be employed; but more importantly we should be judicious enough to realize whether there is any need for one at all? Thus the rationale behind the use of antibiotics in Endodontics should be based upon the following three core criteria –

- ❖ Whether antibiotics is indicated in a given endodontic infection?
- ❖ When to advocate prophylactic antibiotic coverage?
- ❖ Which antibiotic is most effective in resolving endodontic infections?

Is antibiotics necessary?

"The desire to take Medicine is perhaps the greatest feature,

Which distinguishes Man from Animals!"

—Sir William Osler

The cardinal rule one should remember is that antibiotics are designed primarily to control

active microbial infections, not for preventing the possibility of infections, unless the patient is medically compromised. Prophylactic use of antibiotics in a healthy patient in whom there is no evidence of active microbial infection is not supported by sound scientific knowledge. The common notion behind prescribing antibiotics during an endodontic infection is to quell the infection present in the pulp space and/or the periapical area. Many of us fail to understand that for antibiotics to kill the susceptible bacteria, the systemic antibiotic has to be carried by the blood circulation into the pulp space to come in direct contact with the bacteria. In an infected or necrosed pulp this does not happen as the blood supply in such cases is highly constrained & restricted. Thus the role of antibiotics in infections restricted to the pulp space is minimal, if any.

In case of periapical pathoses, it is very important to appreciate that most chronic endodontic periapical lesions are not infected lesions but are inflammatory lesions³⁻⁵. In periapical inflammation, bacteria may or may not be present in the periapical tissues, as it is not an infectious process. The inflammation is mostly caused by the bacterial toxins, their harmful metabolic by-products or disintegrating pulp tissue from the root canal⁶. The periapical tissues are also endowed with powerful natural (phagocytes, complement components, macrophage-derived cytokines) and specific (T and B lymphocytes, plasma cells, immunoglobulins, lymphocyte derived cytokines) defense mechanisms. Hence elimination of irritants, especially pathogenic bacteria in the root canal by careful chemo-mechanical debridement is far more effective than antibiotics in preventing flare-ups and treating chronic endodontic periapical lesions⁷. Moreover, the incidence of bacteremia associated with nonsurgical root canal treatment is essentially negligible as long as the endodontic instruments are confined within the root canal system^{8,9}.

When are antibiotics indicated?

The only indications for the usage of antibiotics in Endodontics are –

- ❖ Active microbial infections with manifestations of local and systemic signs & symptoms such as diffuse swelling with sinus discharge, fever, malaise, lymphadenopathy and elevated white cell count.
- ❖ Preventing the possibility of any infection following bacteremia in high-risk patients.

The rationale behind advocating prophylactic antibiotic coverage in Endodontics is to prevent the inadvertent bacteremia following the chemo mechanical debridement of the pulp space in high-risk patients. Although nonsurgical endodontics produces one of the lowest incidences of transient bacteremias of all dental procedures, prophylactic antibiotic regimens are indicated for medically compromised patients. The list of conditions, which warrant the need of such coverage, is not an exhaustive one (Table I). Hence, it is advisable to put a patient under prophylactic antibiotic coverage if one of these two

Table I
Conditions Warranting Prophylactic antibiotic Coverage

- ❖ Uncontrolled Diabetes Mellitus
- ❖ Prosthetic Cardiac Valves
- ❖ Previous Bacterial Endocarditis
- ❖ Complex, cyanotic congenital heart disease
- ❖ Surgically constructed systemic pulmonary shunts
- ❖ Rheumatic Heart disease
- ❖ Addisons disease
- ❖ Mitral valve prolapse and valvular regurgitation
- ❖ Total joint replacements
- ❖ Chronic Alcoholism
- ❖ AIDS

conditions are satisfied, namely -

1. Any condition, which causes immunosuppression in a patient.
2. Any condition which creates an ideal breeding ground for infections in a patient.

Choosing the right antibiotic

The dental surgeon's motto when it comes to prescribing antibiotics should always be "caution", and this duty cannot be more succinctly expressed than by this couplet—

"Be not the First by whom the New are tried;

Nor yet the Last to lay the Old aside."

—Pope Alexander

If an antibiotic is to be used to control periapical infection such as an acute abscess or diffuse swelling, it is important to be familiar with the microbiology of the pulp space infection. More than 90% of bacteria in the infected pulp space are anaerobes. *Bacteroides*, *Fusobacterium*, *Peptostreptococcus*, *Peptococcus*, *Eubacterium*, *Propionibacterium* & *Actinomyces* appear to be the most important pathogens¹⁰. If antibacterial spectrum were the only criterion, Clindamycin would be the drug of choice for treating endodontic infections. It is especially effective against *Bacteroides* species and periapical lesions but also upsets the normal bacterial flora of the gut, occasionally producing a severe colitis. Fortunately, this reaction is very rare, and Clindamycin can be used in patients who are allergic to Penicillin or its derivatives.

Penicillin and its derivatives namely Amoxicillin and Ampicillin are nearly as effective as Clindamycin against oral strains of *Bacteroides* species, and are more effective against the Gram-positive organisms. In addition they are the least toxic group of antibiotics in non-allergic patients. Although the choice of Penicillin as a prophylactic antibiotic

is still rational, currently Amoxicillin is more favoured, as it is better absorbed by the GIT & provides a higher and more sustained serum levels than does Penicillin. The recommended prophylactic regimens is given in Table II¹¹.

For the 15% of patients who are allergic to Penicillin, the selection of an appropriate antibiotic is more difficult (Table II). Cephalosporins can produce hypersensitivity reactions in patients allergic to Penicillin. Tetracyclines only have bacteriostatic activity against oral microbes and are inactive against a number of Gram-positive cocci. Erythromycin is the most popular Penicillin substitute, but the estolate ester form of erythromycin can cause cholestatic hepatitis. The illness starts after 10 to 20 days of treatment and all manifestations of this side effect usually disappear in a few days when the drug is discontinued. This

reaction is believed to be an allergic response to the estolate ester and can be avoided by not using the estolate form of erythromycin. Oral administration of large doses of erythromycin or its derivatives like Azithromycin or Clarithromycin frequently causes epigastric distress, which may be quite severe. Their spectra of antibacterial activity are similar to Penicillin. However, their activity against bacterial strains commonly found in endodontic lesions is considerably less than Penicillin. Bacterial resistance to these also develops relatively early. Hence, if a patient were allergic to Amoxicillin and Ampicillin, the drug of choice would be Clindamycin, despite its toxicity. Clindamycin therapy should not exceed 7 days. The reported incidence of diarrhoea is about 8 per cent whereas the incidence of bacterial colitis is very rare.

Table II Antibiotic Prophylactic Regimen

SITUATION	ANTIBIOTIC	REGIMEN
Standard Prophylaxis	AMOXICILLIN	Adults, 2 gm ; Children 50 mg/kg orally one hour before procedure
Cannot use Oral Medications	AMPICILLIN	Adults, 2 gm IM or IV; Children, 50 mg/kg IM or IV within 30 minutes before procedure
	CLINDAMYCIN	Adults, 600 mg ; Children, 20 mg/kg orally one hour before procedure
Allergic to Penicillin	CEPHALEXIN OR CEFADROXIL	Adults, 2 gm ; Children, 50 mg/kg orally One hour before procedure
	AZITHROMYCIN OR CLARITHROMYCIN	Adults, 500 mg ; Children, 15 mg/kg orally One hour before procedure
Allergic to Penicillin and unable to take Oral medications	CLINDAMYCIN	Adults, 600 mg ; Children, 15 mg/kg IV one hour before procedure

Metronidazole is a highly effective antibiotic in the management of obligate anaerobic infections, particularly those caused by *Bacteroides* species, for which it may be the last defense against these highly resistant organisms. Yet, it is not the drug of choice or an alternate agent against gram positive anaerobic cocci, gram negative cocci, Enterobacteriaceae (except *Bacteroides*), or gram negative bacilli¹². Considering its importance in selective infections and its adverse drug reactions and DNA altering potential, Metronidazole should be reserved for important and approved uses.

Most infections are usually controlled with appropriate antibiotics in 7 to 10 days. If a diffuse periapical swelling caused by an endodontic infection does not show any remission in 3 to 5 days during treatment with antibiotics, bacterial culture of root canal and antibiotic sensitivity test are highly recommended.

Conclusion

Antibiotics are life saving therapeutic agents of inestimable value. Many dentists routinely prescribe antibiotics to prevent the possible development of pain and swelling during endodontic therapy. This is being done more out of tradition rather than with any sound scientific knowledge. The future value of antibiotics in treating life threatening infectious diseases maybe diminished or eliminated if they are used indiscriminately. The objective of this paper is to enlighten the dental fraternity about the true rationale behind advocating antibiotics during endodontic therapy. In this article, we have delineated some of the indications for antibiotic prophylaxis in Endodontics. Any perceived potential benefit of antibiotic therapy must be weighed against the known risks of antibiotic toxicity; allergy; and development, selection and transmission of microbial resistance. In the battle for survival, the versatile microbes are fighting a guerrilla

war with superior numbers and resistance will eventually prevail unless antibiotic agents are used with circumspection and common sense. These recommendations can serve as guidelines for the practicing dentist, with the caveat, however, that guidelines are no substitute for sound clinical judgment.

Recommendations of American heart Association.

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