The Use and Abuse of Antimicrobial Agents in Dental Practice

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Authors' contributions

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ABSTRACT

It’s been over 60 years since the widespread use of penicillin saved millions of lives from infection. Today there is a rapid emergence of antimicrobial resistance and it’s on the increase with each passing day. The dentists are responsible for a large number of antimicrobials prescribed and thus have a part to play in the antimicrobial resistance also. The present article discusses how are the dental professionals prescribing habits differ from other medical professionals, how are they contributing towards antimicrobial resistance and what are the steps which can be taken to curb the overuse of antimicrobials by dentists.

Keywords: Antimicrobials; antibiotics; antimicrobial resistance; dentists.
1. HISTORY

Alexander Fleming is generally credited with the discovery of the first antibiotic but contrary to common belief, evidence of traces of antibiotics (tetracycline) dates back to the 350-550 CE where they were found in the human skeletal remains from ancient Sudanese Nubia [1]. Paul Ehrlich and Alexander Fleming are more conventionally considered the pioneers of the antibiotic era. Ehrlich’s idea of a compound that selectively targeted the microbes and not the host based on the selective staining of microbes by aniline and other dyes ultimately led to the production and marketing of a drug named “Salvarsan” and “Neosalvarsan” for the treatment of syphilis in 1909 [2]. They were the most popular antibiotics till penicillin replaced them in the 1940’s [3]. Alexander Fleming discovered penicillin on the 3rd of September 1928 [4], though its mass production didn’t start till 1945. Ironically, Fleming was also the first one to caution against antibiotic resistance, warning against using them for too short period or too weak of a dose.

It is a well-known fact that no new classes of antibiotics have been discovered after the 1970’s and the development in the field since then has been the modification of the existing classes of antimicrobial.

2. WHY SHOULD ANTIMICROBIAL RESISTANCE BE TAKEN SERIOUSLY?

There is no denying the fact that antimicrobial agents have been one of the favored tools of modern medicine against infections, especially in critical emergency and life threatening situations. In an article by Suda KJ et al. [5], the annual spending in the United States of America on antibiotics in 2009 was approximately 10.7 billion dollars. But the hard fact remains that antimicrobial agents have been grossly overused in all fields of medicine for the last 60 years, for conditions which do not warrant an antimicrobial therapy or given in too short a course or in too weak a dose. All of this has resulted in microbes becoming resistant to antimicrobial agents which they were sensitive to previously [6]. According to various newspapers, on the 27th January 2015, the White House proposed to spend more than $1.2 billion to develop new antibiotics and preserve existing ones as the widespread overuse of disease-fighting drugs threatens their effectiveness in humans. It further said that, “antibiotic resistance is one of the most pressing public health issues the world is facing today” [7].

A statement made by Dr Keiji Fukuda, WHO’s Assistant Director-General for Health Security in 2014 can very well indicate the seriousness of antimicrobial resistance “Without urgent, coordinated action by many stakeholders, the world is headed for a post-antibiotic era, in which common infections and minor injuries which have been treatable for decades can once again kill,” [8]. This startling revelation is because the infection causing microbes are becoming increasingly resistant to presently used antimicrobial agents and more cases of multi-drug resistant infections are surfacing throughout the world. The classic example being methicillin-resistant Staphylococcus aureus (MRSA) which is not only resistant to all common antibiotics but also to combinations of antimicrobials [9,10]. Antimicrobial resistance not only makes infections difficult to treat but also prolongs the infectious period of the disease thus helping in its spread. This causes an immense burden on the family members and the society at large as the treatment becomes more expensive and more time is spent in the hospital which lead to loss of productivity.

3. HOW IS ANTIMICROBIAL PRESCRIPTION BY DENTISTS DIFFERENT FROM A PHYSICIAN’S PRESCRIPTION?

The use of antimicrobials by the dentists has some peculiarities which make them different from other medical professionals. The first peculiarity is the basic anatomy of the tooth where the pulp is surrounded by rigid walls and the fact that the blood supply to the tooth is limited and it enters the pulpal space through a very narrow opening apical foramen. Limited vascularity of the tooth by itself makes the use of most systemic antimicrobials relatively ineffective as the penetration of antibiotics in the pulp space is a slow process [11]. To add to the complexity of the situation, most of the oral and dental infections are polymicrobial in nature [12] so a narrow spectrum antimicrobial will not be as effective as broad spectrum antimicrobials [13].

Antimicrobial agents prescribed by the dentists almost invariably are accompanied by analgesics mostly of the nonsteroidal antiinflammatory drugs (NSAID) category. The two classes of drugs have potential interactions and most of the NSAID’s reduce the bioavailability of the antibiotics [14,15] (though there are particular combinations which increase the bioavailability of the antibiotics) and as is known a sub optimal
dose of antimicrobial agents cause antimicrobial resistance.

Last but not least is the fact that antimicrobial prescription by dentists is empirical at best as no antibiotic sensitivity tests are done to determine the best suited antimicrobial agent. The knowledge of the infection causing microbes comes from the microbial, clinical and epidemiological studies published in the literature and antibiotics prescribed are on a presumptive basis of the causative organisms [16].

4. HOW ARE THE DENTAL HEALTH CARE PROFESSIONALS CONTRIBUTING TO ANTIMICROBIAL RESISTANCE?

Dental health care professionals prescribe antimicrobial agents for conditions both therapeutically and prophylactically [17]. In a study by center for disease control (CDC), dental healthcare professionals account for 7 to 11 % of the total antimicrobial prescriptions [18]. These antimicrobials are given prophylactically before dental procedures, during treatments, after treatment or as the only form of treatment. Unfortunately the last type of prescription is very common in developing countries where a large fraction of population cannot afford dental treatment in private dental setups and the government facilities for the same are limited and overburdened. Many patients suffering from dental pain visit the dentist to just get a prescription for medicine which very often includes an antimicrobial agent without getting any kind of operative treatment done. In developing countries where legislation regarding the prescription of antimicrobials is not very strong or is not strongly implemented, people just go to a neighborhood pharmacy to buy medicines over the counter for dental pain, which again include antimicrobial agents. This cycle is repeated many times before the person finally decides to get any kind of definitive dental treatment done.

Though the patient’s expectations are a contributing factor in the overuse of antimicrobials by dentists, it is by no means the only contributing factor. The dental health care professionals are equally, if not more responsible for the abuse of antimicrobial agents. The use of prophylactic antimicrobials taken before various dental procedures for the prevention of local post-operative complications like dry socket and infections or to prevent systemic complications like infective endocarditis is extremely common [19]. There are numerous studies in place to prove that the prophylactic prescription of antibiotics doesn’t decrease the risk of post-operative infections or dry socket, and they are of little use if any in dentoalveolar surgical procedures including third molar surgical extractions in a non-medically compromised patient [20-22]. Even in patients who are at risk of developing infective endocarditis, the use of antibiotics is recommended only for those who are in the highest risk category. The American Heart Association modified its recommendations in 2007 in keeping with the current research. It now supports the prophylactic use of antibiotics only in patients with a prosthetic heart valve, patients with a history of endocarditis, patients with a heart transplant, patients with abnormal heart valve function, and those with certain congenital heart diseases only [23].

It is not uncommon in developing countries to find dentists prescribing antimicrobials to cover defects in asepsis and improperly sterilized instruments which increases the risk of post-operative infections [24,25].

The most common cause for a dental visit is pain and the most common cause of dental pain is odontogenic infections. Localized odontogenic infections when restricted to the pulp or spreading into the perialpical area do not warrant the use of antimicrobial agents [26]. Two of the most painful conditions in dentistry, namely acute pulpitis and acute apical abscess, do not require antimicrobials for their treatment. The treatment for these conditions is the removal of the pulp and establishment of drainage either through the root canal or surgically respectively [27].

The use of inter appointment antimicrobials is widespread especially in endodontic treatment procedures [28,29]. Time and again studies have proven that the use of antimicrobials before, during or after endodontic treatment, including flare ups and endodontic surgeries is of little consequence in altering the prognosis of the treatment in anyway [26,30-33].

There are very few conditions where antimicrobial therapy is indicated. Only when systemic signs of infections like pyrexia, malaise and lymphadenopathy are noticed, the use of antimicrobial agents is recommended to prevent the spread of infections to other vital organs [34,35]. There are also some localized conditions which require antimicrobial therapy like acute necrotizing ulcerative gingivitis, and pericoronitis [36].
Another distressing aspect of antibiotic prescription by dentists that it is sometimes not warranted at all. For example in viral infections like herpes simplex [37].

5. WHAT CAN BE DONE ABOUT IT?

As the famous motivational speaker and author Zig Ziglar said “The first step in solving a problem is to recognize that it does exist.” This is true when it comes to the contribution of dentists towards antimicrobial resistance. The dental fraternity needs to recognize that they have a sizable contribution towards antimicrobial resistance and if immediate steps are not taken to curb unnecessary prescriptions, it can become a global threat.

The first step to curb the incorrect use of antimicrobials is to identify the causes which promote its overuse. The casuases can be broadly classified as inadequate knowledge both on the dentist and the patient’s part, and also patient’s incorrect expectations. Many dentists have inaccurate knowledge about which conditions warrant the use of antimicrobial agents. This leads them to prescribe antimicrobials for almost all conditions the patient presents with [38]. Another factor which promotes the overuse of antimicrobials is the inability of the dentist to diagnose the condition the patient is suffering from and prescribing antimicrobials in a hope that it will cure the problem. Patients also lack knowledge that the conditions they are suffering from can be resolved only by operative intervention and not by antibiotics. Their expectations of antimicrobial prescriptions from the dentist are based on their incorrect perception that antimicrobials can cure dental problems, and also bad advice from other people. But in dentistry, there are usually interventions that can be used as first-line treatments rather than the prescription of antibiotics [39].

The second step is to formulate strategies which will help to curb the antimicrobial over use. This can be done by sensitizing, educating and reinforcing the dental healthcare professionals about the seriousness of antimicrobial resistance. These strategies will be ineffective if the general public is not made aware of the consequences of the over use of antimicrobial agents. Government should take initiative to create public awareness campaigns through media and social outreach programs to increase the knowledge of people about antimicrobial overuse. The government should bring in legislations banning the over the counter (OTC) sales of antimicrobial drugs. The Indian government has banned the OTC sale of 24 antimicrobial drugs with effect from 1st march 2015. This ban was one of the main recommendations of the “Chennai declaration” which aimed at finding a solution to the antibiotic resistance in developing countries [44].

6. CONCLUSION

Antimicrobial resistance is a serious problem staring into the face of all health care professionals including dentists and positive steps should be taken by all involved before it’s too late and we reach a “post antibiotic era”.

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CONSENT
It is not applicable.

ETHICAL APPROVAL
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COMPETING INTERESTS
Authors have declared that no competing interests exist.

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