Knowledge, Awareness and Practice towards New Generation Cephalosporin among Dental Students

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Authors’ contributions

This work was carried out in collaboration among all authors. Author KAHS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author DG managed the analyses of the study. Author RS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Dentists all over the world prescribe antibiotics therapeutically and prophylactically to manage oral and dental infections more commonly orofacial infections. The prescribing of antibiotics by dental practitioners has become an important aspect of dental practice as most human orofacial infections originate from odontogenic infections. The cephalosporins are a large family of broad-spectrum β-lactam antimicrobial drugs. Cephalosporins are now used as first-line agents in the treatment of many infections, including pneumonia, meningitis, and gonorrhea. The aim of this study was to assess knowledge awareness and Practice towards New Generation Cephalosporin among dental students. A questionnaire consisting of 10 questions were prepared and distributed to 100 dental students, the questionnaire was prepared online and the link was distributed to the dental students. The results were tabulated and statistical analysis was done using SPSS software. From this survey, it is seen that most of the students were not well aware of the new

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generation cephalosporins. 63% of the dental students were aware that cephalosporins are broad-spectrum antibiotics. 74% of the students were aware of cephalosporin drugs, 88% of the respondents do not use cephalosporins in their practice, among the entire population only 32% were aware regarding the new generation cephalosporin and only 33% of the students were aware regarding its action against MRSA. 17% of the dental students were aware that 5 generations of cephalosporins are available. Most of the dental students who attempted this questionnaire did not have complete knowledge regarding the new generations of cephalosporins rather they were aware of the 3rd and 4th generation cephalosporins. Furthermore, knowledge regarding the pharmacological aspects of new generation cephalosporins is necessary so that they can apply it to their practice.

Keywords: Awareness; cephalosporin; cefotaxime; Ceftaroline; dental students.

1. INTRODUCTION

Dentists all over the world prescribe antibiotics therapeutically and prophylactically to manage oral and dental infections more commonly orofacial infections. The prescribing of antibiotics by dental practitioners has become an important aspect of dental practice as most human orofacial infections originate from odontogenic infections. Dentists prescribe between 7% and 11% of all common antibiotics (beta-lactams, macrolides, tetracyclines, clindamycin, metronidazole) [1]. More common dental infections present in the form of pulpitis and periapical periodontitis, which require only operative measures like fillings, root canal therapy, or extraction if the tooth is not restorable. Unfortunately, dentists still prescribe antibiotics for this condition [2].

The cephalosporins are a large family of broad-spectrum β-lactam antimicrobial drugs. In comparison with many older agents, the cephalosporins demonstrate low rates of drug-associated toxicity and favorable pharmacokinetic profiles. Cephalosporins are now used as first-line agents in the treatment of many infections, including pneumonia, meningitis, and gonorrhea [3]. New cephalosporins are introduced frequently. Many of these new agents offer a unique spectrum of activity or pharmacologic advantages over previously available drugs. Even though they are widely accepted as broad-spectrum antibiotics, cephalosporins are not active against all the bacteria commonly isolated in a hospital microbiology lab. Organisms that do not get inhibited by cephalosporins overgrow with the potential to cause infection. Some of these are easily recognizable as pathogens [4]. The cephalosporins, similar in action to ampicillin-like penicillin derivatives, may be used with caution in patients who have exhibited delayed-type allergic reactions to penicillin and when erythromycin cannot be used [5].

Clinical situations that require antibiotic therapy on an empirical basis are limited, and they include oral infection accompanied by elevated body temperature and evidence of systemic spread like lymphadenopathy and trismus [6]. Facial cellulitis that may or may not be associated with dysphagia, [7] is a serious disease that should be treated by antibiotics promptly because of the possibility of infection spread via lymph and blood circulation, with the development of septicemia. There are also a limited number of localized oral lesions that are indicated for antibiotic use and these include periodontal abscess, acute necrotizing ulcerative gingivitis, and pericoronitis [7].

Previously our department has conducted extensive research on various aspects of prosthetic dentistry, like in vitro studies, surveys, clinical trials and review [8–22]. New generation cephalosporins play a very vital role in the treatment of acute oral infections and hence it is essential for dental students to be aware of these medications.

2. AIM

The aim of this study was to assess knowledge awareness and Practice towards New Generation Cephalosporin among dental students.

3. MATERIALS AND METHODS

A questionnaire consisting of 10 questions was prepared and distributed to 100 clinical dental undergraduate students to assess their knowledge, awareness, and practice towards New Generation Cephalosporin among dental students. The questionnaire was prepared online using a survey planet and the link was distributed
to the dental students to fill the survey. The questionnaire contained questions about basic knowledge of cephalosporins and their newer generation. The data was collected and tabulated using Microsoft Excel and imported into SPSS software for statistical analysis.

3.1 Questionnaire

1. Cephalosporins are?
2. Are you aware that Cephalosporins are used in dentistry?
3. Do you use cephalosporins in your practice?
4. Are you aware that cephalosporins are similar to penicillin drugs?
5. Cephalosporins should be avoided when a narrower spectrum antibiotic would be effective?
6. Are you aware of the New Generation Cephalosporins?
7. Ceftaroline is active against methicillin-resistant *Staphylococcus aureus* (MRSA) and gram-positive bacteria?
8. How many generations of cephalosporins are available?
9. Which is the new-gen cephalosporin?
10. Commonly used antibiotics in dentistry?

4. RESULTS AND DISCUSSION

Completed questionnaires were returned by all the participants giving a response rate of 100%. From this survey, it is seen that most of the students were not well aware of the new generation cephalosporins. Fig. 1 shows that 63% of the dental students were aware that cephalosporins are broad-spectrum antibiotics. From Fig. 2 it is seen that 74% of the students were aware of cephalosporin drug, 88% of the respondents do not use cephalosporins in their practice, 65% of the students were aware that cephalosporins are similar to penicillin and 35% were not aware, there was a moderate awareness regarding cephalosporins 51% of the respondents knew that cephalosporins must be avoided when the narrow-spectrum antibiotic is effective, among the entire population only 32% were aware regarding the new generation cephalosporin and only 33% of the students were aware regarding its action against MRSA. Fig. 3 and Fig. 4 shows that only 17% of the dental students were aware that 5 generations of cephalosporins are available and only 15% of the students were able to identify the new generation cephalosporin i.e., Ceftaroline. From Fig. 5 it can be seen that the students were well aware that penicillin and amoxicillin were common drugs used in dentistry.

![Fig. 1. Bar graph showing the awareness among the dental students regarding the spectrum of cephalosporins. X represents The spectrum and Y represents the No. of dental students. From this graph, we can infer that most of the students had good knowledge regarding the spectrum as 63% of the students opted for Broad-spectrum antibiotics](image-url)
Fig. 2. Bar graph showing the various close-ended questions regarding the basic knowledge about cephalosporins. The X-axis represents the close-ended questions and Y-axis represents the number of dental students. Blue denotes Yes and Red denotes No. From this graph, we can see that students had moderate knowledge regarding the cephalosporins.

How many generations of cephalosporins are available?

Fig. 3. Bar graph showing the knowledge regarding generations of cephalosporins. The X-axis represents the generations of cephalosporins and the Y-axis represents the number of dental students. From this study, it was seen that only 17% of the students had the knowledge of generations of cephalosporins which being 5 generations of cephalosporins (green).
Fig. 4. Bar graph showing the various new generation cephalosporins. The X-axis represents the new-gen cephalosporins and Y-axis represents the number of dental students. From this graph, we can infer that the students had very poor knowledge (15%) regarding the recent new generation cephalosporin which is Ceftaroline (Blue).

Fig. 5. Bar graph showing awareness of commonly used antibiotics in dentistry. The X-axis represents the Various Drugs and Y-axis represents the number of dental students. From this graph, we can infer that 75% of the students were aware that penicillin and amoxicillin (Blue) is the most commonly used antibiotics in dentistry.

The cephalosporins, which have the action that is ampicillin-like penicillin derivatives, may be used in dentistry with caution in patients who have exhibited delayed-type allergic reactions to penicillin and when erythromycin cannot be used. Their lack of advantage over other agents, and their cost, preclude routine use for usual dental infections [5,23]. As from this survey, Fig. 2...
shows that the dental students are not fully aware of the use of cephalosporins and only 43% of students are aware of its use in dentistry and among the entire population only 12% of the students mentioned that they have used cephalosporins in their practice.

As mentioned earlier cephalosporins are broad-spectrum beta-lactam antibiotics and most of the dental students (63%) were aware of the same as seen in Fig. 1. Being a broad-spectrum antibiotic it has its flaws in creating few antibiotic-resistant infections which was seen in its older generations [4]. Narrow-spectrum antibiotics allow killing only those bacteria species that are causing the disease. As such, it leaves the beneficial bacteria unaffected, hence minimizing the collateral damage. Like amoxicillin-clavulanate, cephalosporins should be avoided when a narrower spectrum antibiotic would be effective because they increase the risk of Clostridium difficile, MRSA, and other resistant infections. In this survey, from Fig. 2 it is seen that the dental students have a moderate (51%) knowledge in this regard.

Cephalosporins and penicillins are small molecular-weight compounds with a beta-lactam ring that have various side chains [24]. The two groups vary in regard to the constituents and structure of the side chains as well as their degradation pathways [24–26]. However, similarities in the side chains do correlate with risk for cross-reactivity [27,28]. Drugs like aminopenicillins, amoxicillin, and ampicillin, have the same R-group side chains as several first- and second-generation cephalosporins. The highest observed cross-reactivity rate (27%) is with cefadroxil, which has the same R-group side chain as amoxicillin. This statement is based on two studies that documented a total of 10 adverse events in 40 patients [29,30]. Based on these data, patients confirmed to be selectively allergic to amoxicillin or ampicillin, but who tolerate penicillin, should not be given cephalosporins with similar R1 side chains. The knowledge regarding the similarity between cephalosporin and penicillin was about 65% among dental students and this can be seen in Fig. 2.

This survey shows that the dental students had very low (33%) awareness regarding the new generation cephalosporins as seen in Fig. 2 and only 17% of the dental students were aware of the fact that there are 5 generations of cephalosporins as seen in Fig. 3. Since their discovery, cephalosporins have a major group of antibiotics. They have been divided into generations based on their chemical properties. These cephalosporins are divided into 5 Generations and each generation has its differences; the first generation is very effective against gram-positive bacteria, second-generation targets both Gram-positive and Gram-negative bacteria but its less effective towards gram-positive bacteria compared to the first generation. Third-generation cephalosporins are effective against many Gram-negative bacteria and bacteria that haven’t responded to first- or second-generation cephalosporins. Fourth-generation cephalosporins work against both Gram-positive and Gram-negative bacteria, commonly used for more severe infections or for immunodeficient patients. Ceftaroline, ceftolozane are fifth-generation cephalosporin, often used to treat infections, including MRSA infections, which are resistant to other antibiotics. They are mostly referred to as “advanced generation cephalosporins” [31,32]. From this survey, it’s seen that only 15% of the dental students who attempted the survey were able to identify the fifth-generation cephalosporin which was ceftaroline as seen in Fig. 4.

In regard to Ceftaroline and its actions against MRSA, from Fig. 2 we can see that the dental students had a poor knowledge with a percentage of 32%. Ceftaroline is often used to treat patients with MRSA infection and they are known as advanced generation cephalosporins, its action is mediated by binding to penicillin-binding proteins in bacteria, consistent with other beta-lactam antibiotics and also is distinct as it has antimicrobial activity against multidrug-resistant Staphylococcus aureus [33]. Ceftaroline’s mechanism of action is similar to that of other beta-lactams in that it binds to PBPs and as a result inhibits their ability to act as transpeptidases in cell wall synthesis. It binds to PBPs in both gram-positive and gram-negative bacteria [34].

Even though cephalosporins are widely used to treat infections, its use in dentistry is not as much. In dentistry antibiotics are used commonly in the field of endodontics [35,36]. The inflammatory process results in endodontic pain, which is most commonly due to microbial irritation, but they can also be related to mechanical or chemical factors [37]. The use of antibiotics along with surgical therapy is the best way to treat odontogenic pain. The most commonly used drug in dentistry is penicillin and
amoxicillin and most of the dental students attempting this survey were aware of this fact. The narrow spectrum of antibiotics is considered the first choice as it does not affect the gastrointestinal tract as much as broad-spectrum antibiotics. Penicillin is the drug of choice in treating odontogenic infections as it is prone to gram-positive aerobes and anaerobes, organisms found in alveolar abscess, periodontal abscess, and necrotic pulps. Both aerobic and anaerobic microorganisms are susceptible to penicillin [38]. Cephalosporin is indicated in endodontic practice as they exhibit good bone penetration [39]. Antibiotic therapy is essential in dentistry; patients at high risk include those with infective endocarditis, immunocompromised conditions, and dental procedures which may produce bacteremias. Invasive dental procedures if performed in such patients should be preceded with an antibiotic prophylaxis [23].

5. CONCLUSION

Most of the dental students who attempted this questionnaire did not have complete knowledge regarding the new generations of cephalosporins rather they were aware of the 3rd and 4th generation cephalosporins. Furthermore, knowledge regarding the pharmacological aspects of new generation cephalosporins is necessary so that they can apply it to their practice. Further knowledge and awareness would enhance the efficacy of usage and overcome the difficulties that are encountered in dentistry.

CONSENT AND ETHICAL APPROVAL

As per university standard guideline, participant consent and ethical approval have been collected and preserved by the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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