

AWARENESS TOWARDS NEW GENERATION CEPHALOSPORIN AMONG DENTAL STUDENTS

Type of manuscript: Research article

Ahmed Hilal Sheriff¹, Dhanraj Ganapathy², Subhashree Rohinikumar³, Dhanraj Ganapathy⁴,

¹Undergraduate student, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India.

²Professor & Head of Department, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India

³Senior Lecturer, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India, Corresponding Author

⁴Professor & Head of Department, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India, [Email: ghanrajmaganapathy@yahoo.co.in](mailto:ghanrajmaganapathy@yahoo.co.in), Ph:9841504523

Article Info

Volume 81

Page Number: 6674 - 6679

Publication Issue:

November-December 2019

Article History

Article Received: 5 March 2019

Revised: 18 May 2019

Accepted: 24 September 2019

Publication: 31 December 2019

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 aim of the 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 practitioners to assess their knowledge, awareness and practice towards New Generation Cephalosporin among dental students. The questionnaire was prepared online using survey planet and the link was distributed to the dental practitioners to fill the survey. The questionnaire contained questions about basic knowledge on cephalosporins and their newer generation. The responses were recorded and analysed. 12% use cephalosporins in practice, 43% were aware of cephalosporins, 33% were aware of new generation cephalosporins. 58% of the respondents said cephalosporins have four generations, 75% said penicillin and amoxicillin were the common antibiotics used in dentistry, 64% said cefixime is a new generation cephalosporin and 63% said cephalosporins are broad spectrum antibiotics. 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 the dentists can apply it in their practice.

Keywords: Awareness, cephalosporins, dental students

I. 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 (betalactams, macrolides, tetracyclines, clindamycin, metronidazole). 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.(Mende et al., 2020)

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.(Menéndez et al., 2019) New cephalosporins are introduced frequently. Many of these new agents offer a unique spectrum of activity or pharmacologic advantage over previously available drug. Even though they widely accepted as broad-spectrum antibiotics, cephalosporins are not active against all the bacteria commonly isolated in a hospital microbiology lab. Organisms that don't get inhibited by cephalosporins overgrow with a potential to cause infection. Some of these are easily recognizable as pathogen. 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.(Smith et al., 2020)

Clinical situations that require antibiotic therapy on empirical basis are limited, and they include oral infection accompanied by elevated body temperature and evidence of systemic spread like lymphadenopathy and trismus.(Thornhill et al., 2019)Facial cellulitis that may or may not be associated with dysphagia, is a serious disease that should be treated by antibiotics promptly because of

the possibility of infection spread via lymph and blood circulation, with 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.(Santosh & Ogle, 2017)

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

II. MATERIALS & METHODS:

A questionnaire consisting of 10 questions were prepared and distributed to 100 dental practitioners to assess their knowledge, awareness and practice towards New Generation Cephalosporin among dental students. The questionnaire was prepared online using survey planet and the link was distributed to the dental practitioners to fill the survey. The questionnaire contained questions about basic knowledge on cephalosporins and their newer generation. [Table 1]

| | | |
|---|----------------------------------------------------------------------------------------------------------|--------------------------|
| 1 | Are you aware that Cephalosporins are used in dentistry? | a) Yes b) No |
| 2 | Do you use cephalosporins in your practice? | a) Yes b) No |
| 3 | Are you aware that cephalosporins are similar to penicillin drugs? | a) Yes b) No |
| 4 | cephalosporins should be avoided when a narrower spectrum antibiotic would be effective | a) Yes b) No |
| 5 | Are you aware of New Generation Cephalosporins? | a) Yes b) No |
| 6 | Ceftaroline active against methicillin-resistant Staphylococcus aureus (MRSA) and gram-positive bacteria | a) Yes b) No |
| 7 | How many generations of cephalosporins are available? | a) 2 b) 4 c) 5 |

| | | |
|----|-----------------------------------------|-------------------------------------------------------------------|
| 8 | Commonly used antibiotics in dentistry? | a) penicillin & amoxicillin b) Clindamycin c) Cephalosporin |
| 9 | Which is the new gen cephalosporin? | a) cefotaxime b) ceftaroline c) cefepime |
| 10 | Cephalosporins are? | a) Broad spectrum b) Narrow spectrum |

Table 1: Questionnaire used in the study

III. RESULTS

12% use cephalosporins in practice, 43% were aware of cephalosporins, 33% were aware of new generation cephalosporins (Fig 1) 58% of the respondents said cephalosporins have four generations (Fig 2), 75% said penicillin and amoxicillin were the common antibiotics used in dentistry (Fig 3) 64% said cefipime is a new generation cephalosporin (Fig 4) and 63% said cephalosporins are broad spectrum antibiotics (Fig 5).

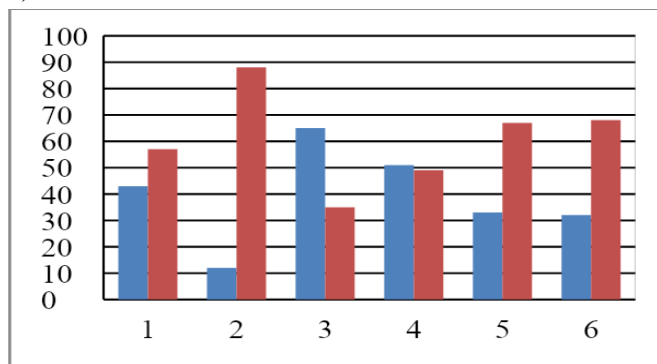


Figure 1

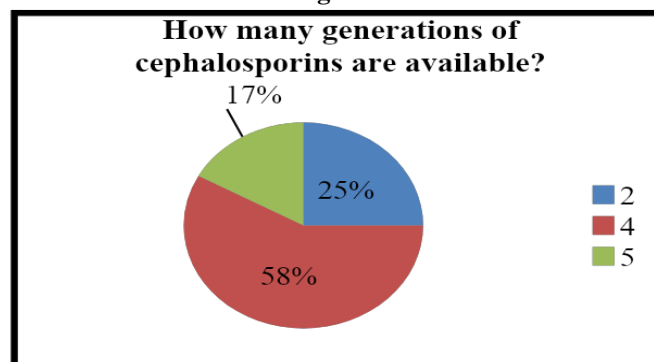


Figure 2

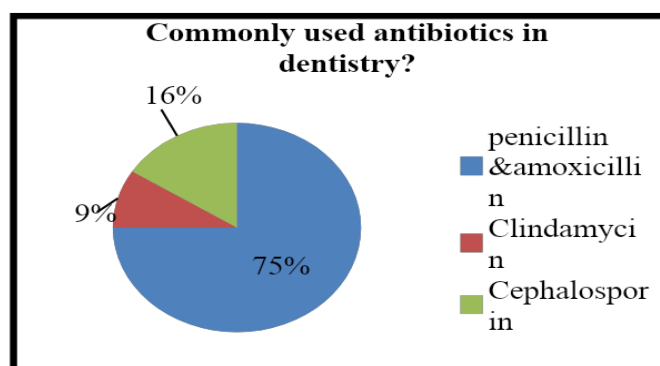


Figure 3

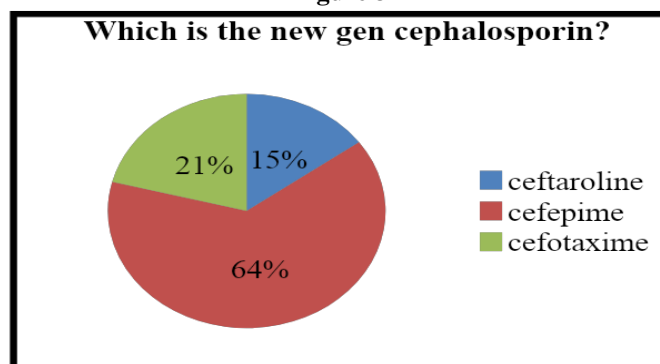


Figure 4

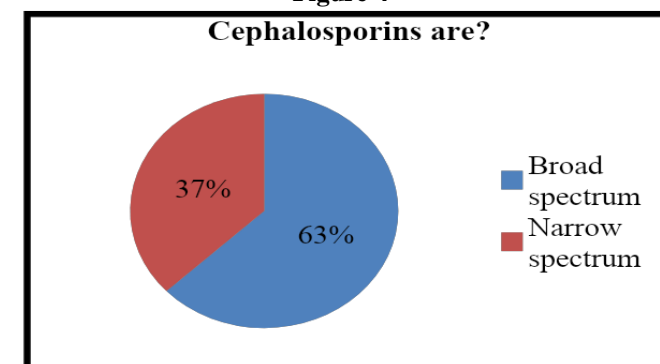


Figure 5

IV. DISCUSSION:

The cephalosporins, which have 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, precludes routine use for usual dental infections. As from this survey it shows that the dental students are not fully aware about the use of cephalosporins and only 43%

of students are aware about its use in dentistry. (Ramu & Padmanabhan, 2012)

Cephalosporins and penicillins are small molecular-weight compounds with a beta-lactam ring that has various side chains. The two groups vary in regard to the constituents and structure of the side chains as well as their degradation pathways. However, similarities in the side chains does correlate with risk for cross reactivity. (Iravani et al., 1985) 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. 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. This survey shows that use of cephalosporins in their practice is very less which is around only 12% and where as the knowledge regarding the similarity between cephalosporin and penicillin was about 65%. (M. E. Pichichero, 2005)

This survey shows that the dental students had very low (33%) awareness regarding the new generation cephalosporins and only 17% of the dental students were aware regarding the 5th generation cephalosporins. 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 their drugs are as shown in table 2. Each generation has their differences; 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 bacterias compared to 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. Ceftriaxone, ceftazidime are fifth-generation cephalosporin, often used to treat infections, including MRSA infections, which are resistant to other antibiotics. They are most commonly referred to as "advanced generation cephalosporins". (Gern, 2006; Michael E. Pichichero, 2005) 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 ceftriaxone. (Gern, 2006; Lounsbury et al., 2019; Michael E. Pichichero, 2005)

In regard to Ceftriaxone and its actions against MRSA the dental students had poor knowledge Ceftriaxone 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*. Ceftriaxone'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. (Berlango et al., 2015)

As mentioned earlier cephalosporins are broad spectrum beta lactam antibiotics and most of the dental students were aware of the same. Being a broad-spectrum antibiotic, it has its flaws in creating few antibiotic resistant infections which was seen in its older generations. Narrow-spectrum antibiotic 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 it is seen that the dental students have a moderate (51%) knowledge in this regard.(Palavecino, 2007)

Even though cephalosporins are widely used to treat infections, its use in dentistry is not as much. In dentistry antibiotics is used commonly in the field of endodontics, 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. The use of antibiotic 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. Narrow spectrum of antibiotics is considered 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 intraoral anaerobes, organisms found in alveolar abscess, periodontal abscess and necrotic pulps. Both aerobic and anaerobic microorganisms are susceptible to penicillin. Cephalosporin is indicated in endodontic practice as they exhibit good bone penetration. 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.(Lovering et al., 2012; Villegas-Estrada et al., 2008)

V. 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 the dentists can apply it their practice. Further knowledge and awareness would enhance the efficacy of usage and overcome the difficulties that are encountered in dentistry.

VI. REFERENCES:

- [1]. Berlanga, G., Howell, A., Koshy, J., Brust, K., Midturi, J., & Cahuayme-Zuniga, L. (2015). Ceftaroline (CF) for Methicillin Resistant *Staphylococcus aureus* (MRSA) Bacteremia, Endocarditis and Other Deep Seated Infections. In *Open Forum Infectious Diseases* (Vol. 2, Issue suppl_1). <https://doi.org/10.1093/ofid/ofv133.1390>
- [2]. Gern, J. E. (2006). A Review of Evidence Supporting the American Academy of Pediatrics Recommendation for Prescribing Cephalosporin Antibiotics for Penicillin-Allergic Patients. In *PEDIATRICS* (Vol. 118, Issue Supplement_1, pp. S21–S21). <https://doi.org/10.1542/peds.2006-0900jj>
- [3]. Iravani, A., Welty, G. S., Newton, B. R., & Richard, G. A. (1985). Effects of changes in pH, medium, and inoculum size on the in vitro activity of amifloxacin against urinary isolates of *Staphylococcus saprophyticus* and *Escherichia coli*. In *Antimicrobial Agents and Chemotherapy* (Vol. 27, Issue 4, pp. 449–451). <https://doi.org/10.1128/aac.27.4.449>
- [4]. Lounsbury, N., Reeber, M., Mina, G., & Chbib, C. (2019). A Mini-Review on Ceftaroline in Bacteremia Patients with Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infections. In *Antibiotics* (Vol. 8, Issue 1, p. 30).

- <https://doi.org/10.3390/antibiotics8010030>
- [5]. Lovering, A. L., Gretes, M. C., & Strynadka, N. C. J. (2012). *Structural Insights into the Anti- Methicillin-Resistant Staphylococcus aureus (MRSA) Activity of Ceftobiprole*. <https://doi.org/10.2210/pdb4dki/pdb>
- [6]. Mende, A., Venskutonis, T., & Mackeviciute, M. (2020). Trends in Systemic Antibiotic Therapy of Endodontic Infections: a Survey among Dental Practitioners in Lithuania. *Journal of Oral & Maxillofacial Research*, 11(1), e2.
- [7]. Menéndez, R., Cantón, R., García-Caballero, A., & Barberán, J. (2019). [Three keys to the appropriate choice of oral antibiotic treatment in the respiratory tract infections]. *Revista española de quimioterapia: publicacion oficial de la Sociedad Espanola de Quimioterapia*, 32(6), 497–515.
- [8]. Palavecino, E. (2007). Clinical, Epidemiological, and Laboratory Aspects of Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infections. In *Methods in Molecular Biology* (pp. 1–19). https://doi.org/10.1007/978-1-59745-468-1_1
- [9]. Pichichero, M. E. (2005). A Review of Evidence Supporting the American Academy of Pediatrics Recommendation for Prescribing Cephalosporin Antibiotics for Penicillin-Allergic Patients. In *PEDIATRICS* (Vol. 115, Issue 4, pp. 1048–1057). <https://doi.org/10.1542/peds.2004-1276>
- [10]. Pichichero, M. E. (2005). Evidence Supporting the Use of Cephalosporin Antibiotics in Penicillin-Allergic Patients. In *Pediatric Asthma, Allergy & Immunology* (Vol. 18, Issue 4, pp. 230–246). <https://doi.org/10.1089/pai.2005.18.230>
- [11]. Ramu, C., & Padmanabhan, T. V. (2012). Indications of antibiotic prophylaxis in dental practice—Review. In *Asian Pacific Journal of Tropical Biomedicine* (Vol. 2, Issue 9, pp. 749–754). [https://doi.org/10.1016/s2221-1691\(12\)60222-6](https://doi.org/10.1016/s2221-1691(12)60222-6)
- [12]. Santosh, A. B. R., & Ogle, O. E. (2017). *Clinical Microbiology for the General Dentist, An Issue of Dental Clinics of North America E-Book*. Elsevier Health Sciences.
- [13]. Smith, A., Al-Mahdi, R., Malcolm, W., Palmer, N., Dahlen, G., & Al-Haroni, M. (2020). Comparison of antimicrobial prescribing for dental and oral infections in England and Scotland with Norway and Sweden and their relative contribution to national consumption 2010-2016. *BMC Oral Health*, 20(1), 172.
- [14]. Thornhill, M. H., Dayer, M. J., Durkin, M. J., Lockhart, P. B., & Baddour, L. M. (2019). Oral antibiotic prescribing by NHS dentists in England 2010-2017. *British Dental Journal*, 227(12), 1044–1050.
- [15]. Villegas-Estrada, A., Lee, M., Hesek, D., Vakulenko, S. B., & Mobashery, S. (2008). Co-opting the Cell Wall in Fighting Methicillin-Resistant *Staphylococcus aureus*: Potent Inhibition of PBP 2a by Two Anti-MRSA β -Lactam Antibiotics. In *Journal of the American Chemical Society* (Vol. 130, Issue 29, pp. 9212–9213). <https://doi.org/10.1021/ja8029448>