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Antibiotic indication in endodontics by Colombian dentists with different levels of training: a survey

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ABSTRACT

***Aim*:** *This study investigated how Colombian dentists with different academic levels indicate antibiotics with therapeutic purposes in endodontics.* ***Materials and method*:** *A cross-sectional survey was conducted among 559 dentists in the form of an online questionnaire.* ***Results*:** *Three hundred and twenty questionnaires were answered (57.2%). There were significant differences among respondents. For irreversible pulpitis, 140 dentists (43.7%) said they prescribe antibiotics (57.5% of general practitioners, 20.1% of specialists and 38.9% of those with Master's and/or PhD degrees), while for symptomatic apical periodontitis, 183 (57.2%) did so (74.1% of general practitioners, 28.4% of specialists and 50.0% of those with Master's and/or PhD degrees) ($p < 0.05$). Amoxicillin was the most frequently prescribed antibiotic, and its association with clavulanic acid was the most often cited for acute periradicular abscess with systemic involvement.* ***Conclusions*:** *The greatest misunderstandings in prescribing antibiotics occurred among general practitioners. Considering all clinical conditions that do not require antibiotics, 60% of general practitioners and 34% of specialists, on average, indicated antibiotics.*

Keywords: *antimicrobial stewardship - dental pulp disease - bacteria - dental infection control - antibacterial drug resistance*

Indicação dos antibióticos em Endodontia por dentistas colombianos com diferentes níveis de formação: uma pesquisa por questionário

RESUMO

***Objetivo*:** *Este estudo investigou como dentistas colombianos com diferentes níveis acadêmicos indicaram antibióticos com fins terapêuticos em Endodontia.* ***Materiais e método*:** *Realizou-se um levantamento transversal com 559 dentistas. Foi enviado um questionário online.* ***Resultados*:** *Foram respondidos 320 questionários (57,2%). Houve diferenças significativas entre os profissionais com diferentes níveis de formação. Para pulpite irreversível, 140 (43,7%) dentistas afirmaram indicar antibióticos (57,5% clínicos gerais, 20,1% especialistas e 38,9% com mestrado e/ou doutorado), enquanto para periodontite apical sintomática, 183 (57,2%) prescrevem estes medicamentos (74,1% clínicos, 28,4% especialistas e 50,0% com mestrado e doutorado) ($p < 0,05$). A amoxicilina foi a mais indicada entre os profissionais, e sua associação com ácido clavulânico foi a mais referida para abscesso perirradicular agudo com acometimento sistêmico.* ***Conclusões*:** *Os maiores equívocos na prescrição de antibióticos ocorreram com os clínicos gerais. Considerando todas as condições clínicas que não requerem antibióticos, 60% dos clínicos gerais e 34% dos especialistas, em média, indicaram estes medicamentos.*

Palavras-chave: *administração de antimicrobianos - doença da polpa dentária - bactérias - controle de infecção dentária - resistência a medicamentos antibacterianos*

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INTRODUCTION

The discovery and large-scale use of antibiotics since the middle of last century has enormous impact on the treatment of infections, leading to the survival of thousands of people who would otherwise have died, mainly during the second world war[1]. Due to advances in molecular methods in microbiology, especially at the beginning of the current century, "new pathogens" have been detected in different types of infections that affect humans. However, the development, approval, and launch of new antibiotics have not kept pace with this evolution, and several "new microorganisms" already have multiple resistance to traditional antimicrobials[2].

The emergence and spread of antibiotic-resistant pathogens have become important public health problems, requiring global action from the different health areas[3]. It is estimated that infectious diseases will be the main cause of human mortality in the coming decades, mainly due to the growing number of microorganisms that are multi-resistant to antimicrobials[4].

A broad range of bacterial resistance genes has been detected through molecular methods in samples obtained directly from infected root canals[5]. Although the presence of a resistance gene in a sample does not necessarily imply phenotypic resistance, proteomics studies have detected the expression of resistance factors such as TetR and Beta-lactamase in endodontic infections[6,7]. As the unnecessary use of antibiotics can contribute to selecting these resistant microorganisms, antibiotics should be prescribed with great caution.

The American Association of Endodontics (AAE) and the European Society of Endodontology (ESE) frequently revise the guidelines for endodontists regarding proper antibiotic prescription. There is general consensus that in most clinical endodontic situations, it suffices to provide local treatment with removal or reduction of the infection source, without using systemic antibiotics[8-10].

Different studies around the world have shown that dentists still prescribe antibiotics unnecessarily in endodontics[11-14]. There is a clear discrepancy between the recommended protocols for prescribing antimicrobials for patients who really need them and current practices among dentists in different parts of the world[15]. For most Latin American countries, including Colombia, there are few studies on whether antibiotics are prescribed correctly for endodontic purposes. Thus, the aim of this study was to investigate, through an online questionnaire, how professionals with different levels of academic education, who provide endodontic treatment in Colombia, prescribed antibiotics.

MATERIALS AND METHOD

This study was approved by the institutional ethics committee at Universidad Santo Tomas under number 1-18-30082018. A questionnaire (Table 1) was created through Google forms and e-mailed to 559 dentists registered in the Federation of Colombian Dentistry database. The answers were received from February 21 to November 13, 2018. The questionnaire enquired about gender, age, length of professional experience, workplace, region of the country, weekly mean number of patients, monthly mean number of antibiotic prescriptions, clinical situations in which antibiotics are prescribed, duration of antibiotic prescriptions, prescription of loading dose, conduct for patients allergic to penicillins, and management in case of failure of the first-choice antibiotic. The antibiotics listed in the different clinical situations were amoxicillin, amoxicillin with clavulanic acid, azithromycin, cephalexin, clindamycin, erythromycin, penicillin v, and metronidazole.

Sample calculation and statistical analysis

The following parameters were established to estimate the sample size: effect size (w) 0.30 (Cohen's Test scale), power 90%, α error 5%, and degree of freedom equal to 30. Calculation software was G * Power 3.1.9.7 (Universität Kiel, Germany), indicating a total number of 233 individuals. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to test data normality. The chi-square test or Fisher's exact test were used for the comparison among dentists. The level of statistical significance was established as 5% ($p < 0.05$).

RESULTS

A total 320 (57.2%) questionnaires were answered, 193 (60.3%) by general practitioners, 109 (34.1%) by specialists, and 18 (5,6%) by professionals with Master's or PhD degrees. Most dentists who answered the questionnaire were ≥ 25 years old (n = 269; 84.1%), women (61.6%), and had more than 10 years of professional experience in dentistry (48.4%) (Table 2).

Table 1. Questionnaire about the prescription of antibiotics in endodontics by Colombian dentists

1. What is your level of education in dentistry?

( ) General clinician ( ) Specialist in endodontics ( ) Magister (MSc) ( ) Doctor (DSc / PhD)

2. Gender:

( ) Male ( ) Female

3. Age:

( ) Less than 25 years ( ) 25-35 years ( ) 36-45 years ( ) More than 45 years

4. How long have you been a dental professional?

( ) 0-5 years ( ) 6-10 years ( ) More than 10 years

5. If you are an endodontist, how many years' experience do you have in endodontics only?

( ) 0-5 years ( ) 6-10 years ( ) More than 10 years ( ) I am not an endodontist

6. Where do you conduct your dental practice?

( ) Private practice ( ) Hospital ( ) Academic Institution Clinic ( ) Military Institution ( ) Others

7. In which region of the country do you work?

( ) Southeast ( ) South ( ) Center-west ( ) Northeast ( ) North

8. What is the average number of patients you see per week?

( ) 5-10 ( ) 11-20 ( ) More than 20

9. How many times a month do you prescribe antibiotics, on average?

( ) 1-3 ( ) 4-6 ( ) More than 7 ( ) 0

10. Situations in which you prescribe an antibiotic as an adjunct to treatment for adult patients

	Amoxicillin	Amoxicillin + clavulanic acid	Azithromycin	Cephalexin	Clindamycin	Erythromycin	Penicillin V	Metronidazole	None
Irreversible pulpitis									
Irreversible pulpitis with symptomatic apical periodontitis									
Pulp necrosis									
Symptomatic acute apical periodontitis									
Chronic apical abscess									
Acute apical abscess with localized intraoral edema/ pain									
Acute apical abscess with diffuse intraoral and extraoral edema, fever, and trismus									
Avulsion									
Postoperative pain (after instrumentation/ filling)									
Root perforation									

Table 2. Demographics, academic education levels, and profile of the service provided

Variable	%
Age	
< 25 years	15.9
25-35 years	33.8
36-45 years	22.2
>45 years	28.1
Gender	
Female	61.6
Male	38.4
Academic education level	
General Practitioner	60.3
Specialist in Endodontics	34.1
Master/PhD	5.6
Years' experience	
0-5 years	36.6
6-10 years	15.0
>10 years	48.4
Setting	
Private office	56.9
University	20.3
Hospital	5.3
Military Institution	1.6
Other	15.9
Region of the country	
North	7.2
South	8.1
Northeast	39.1
Midwest	42.5
Southeast	3.1
Mean number of patients per week	
5-10 patients	41.9
11-20 patients	25.6
>20 patients	32.5

Regarding the prescription of antibiotics, 257 professionals (80.3%) prescribe antibiotics for 7 days, and only 6 (1.9%) suspend the prescription after the symptoms disappear. Comparison among the groups for prescription time showed no statistical difference ($p > 0.05$), suggesting that the level of training does not influence this decision (Table 3). More than half of the respondents prescribe antibiotics in up to 3 cases per month, and only 7% do not prescribe them. Regardless of the clinical situation and the professional training, amoxicillin is the most frequently prescribed antibiotic. Only in acute periradicular abscess with systemic involvement, the association of amoxicillin with clavulanic acid was the most frequently reported prescription. Also, 243 professionals (75.9%) responded that they do not prescribe an attack dose. Clindamycin was the most frequently recommended antibiotic in case of allergy to penicillin (n = 120; 37.5%), followed by erythromycin (n = 97; 30.3%) and azithromycin (n = 76; 23.8%).

Comparing the three groups of professionals, only the variable "2nd choice in case of allergy to penicillin" showed a significant difference ($p < 0.01$), with specialists in endodontics presenting the highest frequency of clindamycin prescription (54.1%). In the other groups, Master's or PhD and clinicians, azithromycin (44.4%) and erythromycin (37.8%) were the most frequently prescribed alternatives. When the antibiotic does not have the desired effect, 52.5% of the professionals choose to change the antibiotic, without significant differences among groups.

There were significant differences in antibiotic prescription among groups for irreversible pulpitis with symptomatic apical periodontitis and symptomatic acute apical periodontitis ($p < 0.01$). For irreversible pulpitis with symptomatic apical periodontitis, 140 dentists (43.7%) said they

Table 3. Comparison among the three levels of academic education for general clinical conduct in antibiotic prescription

Variable	Academic Education Level				*p*-value
	General Practitioner (N = 193) N (%)	Specialist in Endodontics (N = 109) N (%)	Master/PhD (N = 18) N (%)	Total (N = 320) N (%)	
Prescription time					0.422
3 days	9 (4.7)	6 (5.5)	0 (0.0)	15 (4.7)	
5 days	19 (9.8)	12 (11.0)	5 (27.8)	36 (11.2)	
7 days	158 (81.9)	87 (79.8)	12 (66.7)	257 (80.3)	
10 days	4 (2.1)	1 (0.9)	0 (0.0)	5 (1.6)	
14 days	1 (0.5)	0 (0.0)	0 (0.0)	1 (0.3)	
Until symptoms disappear	2 (1.0)	3 (2.8)	1 (5.5)	6 (1.9)	

prescribe antibiotics (57.5% general practitioners, 20.1% specialists, and 38.9% with Master's or PhD degrees), while for symptomatic acute apical periodontitis, 183 (57.2%) prescribe antibiotics (74.1% clinical, 28.4% specialists and 50.0% with Master and PhD). In cases of abscesses, clinicians prescribe significantly more antibiotics than specialists and professionals with Master's or PhD degrees, not only for chronic cases (78.2%, 45.9%, and 50%, respectively, $p < 0.001$), but also for acute cases with localized intraoral edema/pain (94.3%, 87.2%, and 66.7%, respectively, $p < 0.05$). In cases of root perforation, 61.1% of clinicians prescribe some antibiotic, against 26.6% of specialists and 50% of professionals with Master's or PhD degrees ($p < 0.01$).

DISCUSSION

Healthcare professionals often use systemic antimicrobials to treat or prevent infections. However, there is still a global threat to the effectiveness of these agents related to their indiscriminate use, resulting in the emergence of resistant microorganisms[16]. This concern also applies to endodontics, since antibiotic resistance by bacteria isolated from infected root canals has been frequently reported[17]. Moreover, the number of deaths related to endodontic infections refractory to antibiotic treatment is significant[18].

Endodontic infections are polymicrobial, which means that multiple species and virulence factors are involved[7]. Sometimes, the immune system cannot suppress this type of infection, and antibiotics are required[18]. However, the prescription of antibiotics in endodontics should be limited to certain clinical conditions, with the aim of preventing the spread of infection and the development of secondary infections in medically compromised patients. As verified in the present study, many professionals lack knowledge about the proper use of antibiotics in endodontics. In this context, the main contribution of this study was to recognize and point out the magnitude of this problem among Colombian dentists.

The present study was based on a questionnaire about antibiotic prescription in different clinical situations, which was answered by 320 dentists with different levels of training. Studies using similar questionnaires have been conducted in different countries[11,12,14,19,20]. However, this was the first study to investigate antibiotic prescription habits among dentists in Colombia. The response rate was acceptable (54.7%), compared to similar studies in Spain (31.1%)[11], Norway (27.2%)[19], United States (22.9%)[20], and Brazil (4.4%)[14].

In this type of study, it is important to record the level of professional training and geographic location in order to design continuing education strategies, if necessary. The current study compared different regions of Colombia, but found no significant difference among them regarding prescription or level of professional training.

The greatest misunderstandings in prescribing antibiotics occurred among general practitioners. Considering all clinical conditions that do not require antibiotics, 60% of general practitioners, on average, prescribed them, while only 34% of endodontics specialists did so. The mean for professionals with Master's or PhD degrees was 45%, which contradicts expectations, considering their higher level of education. Another alarming finding was for avulsion conditions, which do require antibiotic therapy, but for which 44% of general practitioners reported they did not prescribe antibiotics. The same occurred with 25% of specialists and 39% of professionals with Master's and PhD degrees. Specific training in endodontics is the most likely explanation for the fact that specialists prescribe more accurately and better than other professionals.

In the present study, professionals with different levels of education prescribe antibiotics for irreversible pulpitis (21.2%) and irreversible pulpitis with symptomatic apical periodontitis (43.7%), which is a matter of concern. Dentists prescribe antibiotics to reduce the patient's pain, though there is no evidence in the literature justifying it[21]. In irreversible pulpitis with acute apical periodontitis, the pulp remains vital, with no infection or signs and symptoms of systemic involvement. In these cases, there is only an inflammatory process in the pulp, and therefore, antibiotics are not indicated[21]. The level of professional training showed a statistical difference in this case (Table 4). A low percentage was found for this situation in studies in other countries such as Lithuania (19.4%)[12] and Brazil (6.2%)[14], while the percentage was higher in a study in India[22]. The significant difference between the results of the present study and those observed in Lithuania[12] and Brazil[14] may be related to the fact that the present study included general practitioners

Table 4. Frequency of antibiotic prescription in clinical conditions according to different academic education levels

Variable	Academic Education Level				*p*-value
	General Practitioner	Specialist in Endodontics	Master/PhD	Total	
	(N = 193)	(N = 109)	(N = 18)	(N = 320)	
	N (%)	N (%)	N (%)	N (%)	
Irreversible pulpitis					0.052
Prescribed antibiotics	54 (28)	10 (9.1)	4 (22.2)	68 (21.2)	
No	139 (72)	99 (90.9)	14 (77.8)	252 (78.8)	
Irreversible pulpitis with symptomatic apical periodontitis					< 0.001
Prescribed antibiotics	111 (57.5)	22 (20.1)	7 (38.9)	140 (43.7)	
No	82 (42.5)	87 (79.9)	11 (61.1)	180 (56.3)	
Pulp necrosis					0.19
Prescribed antibiotics	86 (44.6)	25 (22.9)	6 (33.4)	117 (36.5)	
No	107 (55.4)	84 (77.1)	12 (66.6)	203 (63.5)	
Symptomatic acute apical periodontitis					< 0.0001
Prescribed antibiotics	143 (74.1)	31 (28.4)	9 (50.0)	183 (57.2)	
No	50 (25.9)	78 (71.6)	9 (50.0)	137 (42.8)	
Chronic apical abscess					0.0001
Prescribed antibiotics	151 (78.2)	50 (45.9)	9 (50.0)	210 (65.6)	
No	42 (21.8)	59 (54.1)	9 (50.0)	110 (34.4)	
Acute apical abscess with localized intraoral edema/pain					0.045
Prescribed antibiotics	182 (94.3)	95 (87.2)	12 (66.7)	289 (90.4)	
No	11 (5.7)	14 (12.8)	6 (33.3)	31 (9.6)	
Acute apical abscess with diffuse intra and extraoral edema, fever, and trismus					0.025
Prescribed antibiotics	186 (96.4)	107 (98.2)	15 (83.4)	308 (96.2)	
No	7 (3.6)	2 (1.8)	3 (16.6)	12 (3.8)	
Avulsion					0.077
Prescribed antibiotics	108 (56)	82 (75.2)	11 (61.1)	201 (62.9)	
No	85 (44.0)	27 (24.8)	7 (38.9)	119 (37.1)	
Postoperative pain (after instrumentation/filling)					0.408
Prescribed antibiotics	78 (43.1)	31 (28.4)	8 (45.5)	117 (36.6)	
No	115 (59.6)	78 (71.6)	10 (55.5)	203 (63.4)	
Root perforation					< 0.0001
Prescribed antibiotics	118 (61.1)	29 (26.6)	9 (50.0)	156 (48.7)	
No	75 (38.9)	80 (73.4)	9 (50.0)	164 (51.3)	

who perform endodontic treatment, while the other studies included only specialists in endodontics.

Due to the short half-life of antibiotics, a minimum serum inhibitory concentration is essential for the success of antibiotic therapy. Therefore, a higher initial dose (attack dose) is usually recommended to ensure antibiotic penetration into bone tissue in a concentration high enough to eliminate the microorganisms in the infection site. The present findings showed that more than 70% of

all interviewed professionals do not prescribe attack doses. Different results were found in other countries[14,20], where most professionals do prescribe the attack dose.

Regarding the second-choice antibiotic in cases of penicillin allergy, most professionals choose clindamycin (37.5%), regardless of training level. A similar rate was found in Brazil (33%)[14]. However, differences were found in intragroup analysis in which professionals with Master's or PhD degrees prescribe more azithromycin; specialists prescribe more clindamycin; and clinicians prescribe more erythromycin. Current recommendations suggest azithromycin instead of clindamycin in these cases[23]. The problem with clindamycin is the risk of infection by *Clostridioides difficile*, and the consequent development of pseudomembranous colitis. It is important to emphasize that not only clindamycin, but also many other broad-spectrum antibiotics have been associated with this type of adverse reaction, and the risk increases with longer treatment periods and greater number of antibiotics administered[24].

Systemic antibiotics are unnecessary in most cases in endodontics, including acute abscesses located without systemic involvement[18,25]. However, antibiotic therapy is a crucial coadjuvant to treat cases of cellulite with signs of systemic effects, such as lymphadenopathy, limited mouth opening (trismus), fever, loss of appetite, and general malaise. These symptoms suggest that the patient's immune system is not controlling the infection, and the microorganisms may spread to other anatomical spaces[23]. In the present study, most respondents prescribe antibiotics for acute periradicular abscesses with systemic involvement, although the prescription frequency was lowest among the professionals with higher qualifications (Table 4). In these most critical situations, respondents' antibiotic of choice was amoxicillin associated with clavulanic acid, as has been recommended[23]. The association of these two drugs provides a greater spectrum of action, including penicillin-resistant strains.

It is clear that clinicians should keep in mind that antibiotics should be indicated as a therapeutic adjunct to local treatment to help prevent the spread of infection in severe cases[9]. Continuing medical and dental education should be encouraged in order to improve the indication of systemic antimicrobials and prevent erroneous prescriptions, reducing the probability of development of bacterial resistance[15]. There is a clear need to improve antibiotic recommendations as well as knowledge of pulpal and periradicular diseases, which are a problem not only locally, but also globally.

A limitation of the present study is that the professionals were not asked about why they did or did not prescribe antibiotics, as was done in a previous study[20]. Such answers could help identify the degree of information or misinformation about the prescription of antibiotics. However, the longer the questionnaire, the less accurate the information provided[26].

CONCLUSIONS

The greatest misunderstandings in prescribing antibiotics occurred among general practitioners. Considering all clinical conditions that do not require antibiotics, 60% of general practitioners, on average, indicated antibiotics, while only 34% of specialists in endodontics did so. This information reinforces the need to create continuing education programs for Colombian dentists, in order to avoid unnecessary prescriptions, thereby reducing the development of microbial resistance to antibiotics.

DECLARATION OF CONFLICTING INTERESTS

The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

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