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Ich bedanke mich bei den unten aufgeführten Kolleginnen und Kollegen für ihre wertvolle Mitarbeit, die sie in den vergangenen zwei Jahren geleistet haben.

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Prescription of Antibiotics in the Dental Practice

A Survey of Dentists in Switzerland

Keywords: antibiotics, resistance, prophylaxis, endocarditis

Summary In dentistry, antibiotics are prescribed both for prophylactic and therapeutic purposes. Their unwarranted use, however, may lead to the selection of resistant microorganisms. The aim of this study was to evaluate the indications and the extent of antibiotic prescription by dentists in Switzerland.
A questionnaire was sent to 800 dentists during the winter of 2008/2009. Responses to the questionnaire were received from 20% of them. Many respondents indicated that they tried to prescribe antibiotics in a selective and cautious manner. Nevertheless, uncertainties existed regarding the indications. For example, the frequency of prescribing an antibiotic when it was not absolutely necessary was related to the respondents' uncertainty regarding the correct diagnosis and therapy. Not surprisingly, two-thirds of the respondents would prefer to have precise guidelines for the use of these drugs.

Introduction

Antibiotics are among the most important medications available and are indispensable in the battle against infectious diseases. Currently, however, many bacterial pathogens are partly resistant to antibiotics (Talbot et al. 2006, ECDC 2011). Many factors facilitate the spread of bacterial strains resistant to antibiotics, including their excessive and sometimes careless administration to humans and animals, the increase of chronic diseases, and the rising number of surgical operations. In addition, the ever-greater mobility of the world's population favors the spread of antibiotic-resistant microorganisms (Macpherson et al. 2009). For instance, the extremely medication-resistant tuberculosis bacteria – which are resistant to all first-line and at least two second-line tuberculostatics – have even made their way into Switzerland (Muggensturm & Brändli 2007, Macpherson et al. 2009). Infections that are caused by antibiotic-resistant microorganisms are not only difficult to treat, but also prolong treatment duration and result in higher mortality rates and greater treatment costs. Furthermore, it is evident that resistant pathogens are no longer confined to hospitals, but have succeeded in establishing themselves in the general population, in which methicillin-resistant *Staphylococcus aureus* (MRSA) for example has also been found in Switzerland (Liassine et al. 2004, Zimmerli et al. 2009). These community-associated MRSA strains are usually more virulent than nosocomial MRSA, and can trigger life-threatening diseases such as folliculitis and necrotizing pneumonia in young, otherwise healthy patients (Deleo et al. 2010).

Antibiotics are also used in dentistry, for instance, as prophylaxis against endocarditis, but also therapeutically in oral surgery and periodontology (Lambrecht 2004, Mombelli & Samaranayake 2004, Flückiger & Jaussi 2008). In oral bacteria as well it is possible to detect isolates which are resistant to antibiotics. However, their prevalence differs regionally (Walker 1996, Van Winkelhoff et al. 2000, Kulik et al. 2008), which is attributed to the differential use and administration of antibiotics in different countries (Van Winkelhoff et al. 2000).

In order to prevent the incorrect use of antibiotics and thus resistance to them, a correct diagnosis by the dentist is imperative. In various studies in Europe, Canada, Jordan, Kuwait and Yemen, the use of antibiotics in dental practices has been examined. It was found that in some countries, many dentists prescribe or administer antibiotics unnecessarily, for too long, and/or at excessive doses (Epstein et al. 2000, Palmer et al. 2000, Palmer et al. 2001, Salako et al. 2004, Al-Haroni & Skaug 2006, Demirbas et al. 2006, Al-Haroni & Skaug 2007, Dar-Odeh et al. 2008, Mainjot et al. 2009, Sancho-Puchades et al. 2009). Compared to the rest of Europe, Swiss doctors are more conservative about prescribing antibiotics (Filippini et al. 2006, Achermann et al. 2010). The purpose of the present study was to survey Swiss dentists about the extent to which and for what reasons they prescribe antibiotics.

Materials and Methods

A structured questionnaire was e-mailed to 750 and mailed to 50 dentists in Switzerland in the winter of 2008/2009. For practical reasons, the only selection criterion was the presence of an e-mail address on one of the following websites: www.sso.ch or www.doktor.ch. The e-mail addresses of the dentists at the University Dental Clinics in Basel, Bern, and Zürich as well as at the Public Dental Clinic (Volkszahnklinik) in Basel were taken from the respective homepages.

The first section of the questionnaire was devoted to personal information such as age, gender, place and country of education, self-employed vs. employed, focus of practical work, and any dental-specialist credentials.

The subsequent questions addressed knowledge of guidelines for antibiotic use, how the participating dentist keeps up-to-date on this topic, whether he/she attends continuing education courses on this topic, and whether such courses would be desired. Further questions on the use of microbiological pathogen detection methods were asked. Then the participants were asked to name their first choice of antibiotic for certain oral clinical entities.

The next group of questions focussed on antibiotic prophylaxis in risk patients with and without a penicillin allergy. The last question asked about prescribing generics. Along with the questionnaire, the participants were given a product list of antibiotic groups (antibiotic class, active agent, commercial brands).

Results

General information

Of the 800 questionnaires distributed, 161 were answered, which corresponds to a response rate of 20.1%. The information given by participating dentists is shown in Table I.

Tab. I General information about dentists participating in the survey (n = 161). n.a. = question not answered.

Age	24–65 years (median: 42.5 years)
Gender	120 male 39 female 2 n.a.
Licensing exams taken	160 in dentistry 126 in Switzerland 32 abroad, of which 3 also in Switzerland 14 additionally in medicine
Employment status	124 Owner of practice (self-employed) 22 Dentist at university clinic 11 Employed in a practice (not self-employed) 9 Employed at a public clinic 2 n.a.
Focus of practical work (multiple answers possible)	119 General dentistry 59 Restorative/reconstructive dentistry 55 Oral surgery 46 Cariology 43 Periodontology 42 Endodontology 32 Pediatric dentistry 15 Orthodontics
Certified dental specialization	23 Persons, of which: 8 Oral surgery 7 Restorative/reconstructive dentistry 4 Periodontology 2 Orthodontics 2 n.a.

Education and knowledge regarding antibiotic use

With n = 76 (47.2%), about half of the responding dentists were familiar with guidelines for the use of antibiotics. They named the guidelines of the American Heart Association (AHA, mentioned 37 times), the World Health Organization (WHO, mentioned 33 times) and the American Dental Association (ADA, mentioned 21 times). Eight dentists followed the guidelines that they had learned as students and 7 followed those of their professional society, their employer, or the SSO (Swiss Dental Association).

62.7% of participating dentists were interested in concrete guidelines for the implementation of antibiotics. When asked how they kept up on the latest information about antibiotic use, the participants answered as follows (multiple answers possible): continuing education courses (n = 115), study of the literature (n = 107), informal contact with colleagues (n = 89), internet (n = 61), or study club (n = 45). In recent years, 50 (31.1%) of those surveyed had attended a continuing education course on "Antibiotic use in the dental practice". The majority of the participants (133 individuals, 82.5%) considered such a continuing education course desirable.

Detection of microbial pathogens

One hundred four (64.6%) of the dentists surveyed possessed or had access to the necessary sampling and shipping materials in their practice or place of work. Eighty dentists (49.7%) had once already had a pathogen detection test conducted (including antibiogram) before prescribing/administering antibiotics. The most frequently named reasons for this were the choice of medication (n = 49), failure of conventional treatment (n = 23), or diagnostics associated with periodontal disease (n = 21). In addition, 20 dentists (12.4%) had once already had such an identification of pathogens done, including an antibiogram, due to antibiotic treatment failure. In six of these tests, resistance was found and a different antibiotic was administered.

Antibiotic prescription for various clinical and non-clinical signs and clinical entities

When asked which clinical signs of an odontogenic infection prompted them to prescribe antibiotics (Tab. II), most participants (93.2%) named a combination of trouble swallowing, increased body temperature, and restricted mouth opening. Less frequently, participants mentioned non-palpable mandibular edge (72.7%) and increased trouble swallowing (65.8%) as sole symptoms.

Tab. II Antibiotics prescribed as adjunctive treatment of odontogenic infections (e.g. trepanation, abscess incision) given certain clinical signs. Data in percent (n = 161). n.a. = question not anwered.

Clinical signs	no	yes	n.a.
Temperature increase (above 38°C)	34.8%	55.9%	9.3%
Localized, fluctuating swelling	73.3%	8.7%	18.0%
Diffuse, non-delimited swelling	29.8%	56.5%	13.7%
Increasing trouble swallowing	23.6%	65.8%	10.6%
Non-palpable mandibular edge	14.9%	72.7%	12.4%
Combination: increasing trouble swallowing, temperature increase (over 38 °C) and restricted mouth opening	5.0%	93.2%	1.8%

The most frequent answer to the question on antibiotic prescription for non-clinical reasons was postponement of treatment (Tab. III).

In terms of antibiotic use in addition to conventional therapy of various clinical entities, an encouraging range of answers was found: while antibiotics were only prescribed in a few cases of acute pulpitis and chronic apical periodontitis, they were often prescribed for ulcerating diseases and aggressive forms of marginal periodontitis. The first-choice antibiotic (no penicillin allergy, otherwise healthy patient) was amoxicillin, with the exception of ulcerating and/or aggressive forms of marginal periodontitis (metronidazole) or severe, trauma-related tooth dislocation (tetracycline) (Tab. IV). Patients who were allergic to penicillin were most frequently given clindamycin (72%) or erythromycin (20.5%).

Antibiotics were seldom prescribed prophylactically in patients at general medical risk (Tab. V), for instance, in patients taking anticoagulants or patients with well-managed Diabetes mellitus. However, oral surgery patients who were immunosuppressed or at risk of endocarditis, were generally given antibiotics prophylactically.

The great majority of participants consulted with risk patients' medical doctors prior to performing dental treatment: depending on the case, 50.3%; always, 49.1%; one participant (0.6%) did not answer this question.

Generics

The dentists often prescribed generics. Only 8.7% reported that they did not prescribe generics, where 44.1% reported doing so occasionally, 42.9% always did, and 43% did so if requested by the patient (multiple answers were possible).

Tab. III Antibiotics prescribed for non-clinical factors. Data in percent (n=161). n.a. = question not anwered.

Non-clinical factor	never	occasionally	usually	always	n.a.
Patient demands antibiotics	82.6%	14.9%	1.2%	0.6%	0.6%
Uncertain diagnosis	59.0%	39.1%	0.0%	0.6%	1.2%
Necessary to postpone treatment	42.9%	48.4%	5.6%	0.6%	2.5%

Tab. IV Antibiotics prescribed for various clinical entities in addition to conventional treatments. The patient is not allergic to penicillin and is healthy. Data in percent (n=161). For each antibiotic (Amo = Amoxicillin, Pen = Penicillin V, Met = Metronidazole, Tet = Tetracycline) the number of times mentioned is given. n.a. = question not answered, NUG = necrotizing ulcerative gingivitis, NUP = necrotizing ulcerative periodontitis.

Clinical entity	no	yes	n.a.	Amo	Pen	Met	Tet
Acute pulpitis	97.5%	0.0%	2.5%	0	0	0	0
Acute periodontal abscess	88.8%	10.0%	1.2%	7	0	2	1
Chronic apical infection	93.8%	4.3%	1.9%	4	0	0	1
NUG	50.3%	43.5%	6.2%	33	5	44	1
NUP	32.3%	59.6%	8.1%	45	9	66	6
Aggressive marginal periodontitis	26.1%	65.8%	8.1%	64	6	79	10
Sinusitis maxillaris (odontogenic)	27.3%	67.1%	5.6%	76	12	7	6
Removal of wisdom tooth due to pericoronitis:							
a) simple extraction	92.5%	3.7%	3.7%	5	0	0	1
b) surgical removal	72.7%	24.8%	2.5%	28	4	0	3
Maxillary sinus opening after tooth extraction:							
a) infected maxillary sinus	13.7%	83.9%	2.5%	91	18	7	12
b) non-infected maxillary sinus	63.4%	32.3%	4.3%	34	7	3	3
After implantation:							
a) with bone augmentation	29.2%	57.1%	13.7%	51	8	2	6
b) without bone augmentation	69.6%	17.4%	13.0%	9	1	1	3
Suspected osteomyelitis	14.9%	68.3%	16.8%	42	10	4	10
Dental Traumatology:							
a) avulsion	37.9%	59.6%	2.5%	37	6	4	45
b) intrusion	77.6%	18.6%	3.7%	4	1	1	23
c) concussion	90.7%	5.0%	4.3%	3	0	1	5
d) root fracture	86.3%	9.3%	4.3%	3	2	1	7
e) contaminated wound	65.8%	28.0%	6.2%	27	8	3	8
Abscesses:							
a) submucosal abscess	73.3%	16.8%	9.9%	13	3	0	5
b) cheek abscess	36.6%	49.1%	14.3%	44	10	4	7
c) fossa canina abscess	18.0%	67.7%	14.3%	68	12	5	7
d) retromaxillary abscess	11.2%	72.0%	16.8%	75	13	4	6
e) submandibular abscess	19.9%	64.0%	16.1%	64	12	5	7
f) perimandibular abscess	14.9%	69.6%	15.5%	71	14	5	7
g) paramandibular abscess	16.8%	65.8%	17.4%	62	12	5	8

Tab. V Percentage of dentists who prescribe prophylactic antibiotics to risk patients (n=161).

Medical history	Tooth cleaning and polishing	Subgingival fillings	Endodontic treatment	Oral Surgery, including extractions	Impression taking
Immunosuppression	43.5%	34.8%	41.6%	77.0%	8.1%
Autoimmune disease	10.6%	13.0%	12.4%	29.2%	1.9%
Hemodialysis	8.7%	8.1%	9.9%	16.8%	1.9%
Patient taking anticoagulants	1.9%	1.2%	1.2%	5.0%	0.0%
After chemotherapy	11.2%	11.8%	13.7%	34.8%	0.6%
After radiation therapy (maxillofacial area)	18.0%	20.5%	24.8%	52.2%	1.9%
Diabetes mellitus:					
a) well managed	0.0%	0.6%	0.0%	6.8%	0.0%
b) poorly managed	8.1%	6.8%	13.0%	46.0%	2.5%
Endocarditis risk	74.5%	64.6%	64.0%	87.6%	23.6%
Bisphosphonate therapy:					
a) osteoporosis prophylaxis	3.7%	5.6%	8.1%	27.3%	1.2%
b) chemotherapy	16.8%	16.1%	21.7%	44.7%	5.0%

Discussion

Compared to the rest of Europe, the consumption of antibiotics by Swiss outpatients is relatively low. The European average number of defined daily doses per 1,000 inhabitants and day (DID) for outpatients was 18.8. France has a DID of 32, i.e., the highest antibiotic consumption in Europe, and the Netherlands the lowest in the EU (9.8 DID). In Switzerland, the DID is even lower (9 DID), but there are substantial differences between cantons (Filippini et al. 2006). These differences can be explained by the density of doctors' offices in the respective canton, socioeconomic factors such as the age, education, nationality, and income of the patients, as well as cultural differences in the readiness to write antibiotic prescriptions (Filippini et al. 2006, Achermann et al. 2010). However, as these studies calculated the extent of prescribing antibiotics based on sales of antibiotics in the individual cantons (Filippini et al. 2006) or on the reimbursements paid by a large Swiss health-insurance company (Achermann et al. 2010), it is not possible to estimate the extent to which Swiss dentists contribute to antibiotic consumption.

The responsible use of antibiotics seems important to Swiss dentists; in the margins of the questionnaire, several participating dentists remarked that they were aware of the problems associated with the use of these medications and thus attempted to avoid prescribing them unless the patient did not respond to the initial conventional therapy. They also reported consulting with or referring the patient to the patient's general practitioner in cases of certain oral diseases.

Dentists interested in this topic may have been more likely to participate in the survey, which would explain the remarks mentioned above. However, it may also have distorted the results. A further drawback of this study is that it was limited to German-speaking dentists and those with an e-mail address. After 3 or 4 weeks, the dentists were again e-mailed the invitation to participate in the survey. Nevertheless, the response rate was only 20%, which is comparable to a similar study by Kolesaric et al. (2007).

Although the participating dentists reported exercising caution in prescribing antibiotics, a large proportion of unanswered questions may point to uncertainty associated with prescribing them. This would agree with the wish of many participants for periodic continuing education courses on this topic. It is problematic that antibiotics were prescribed in 15% of cases because the patient requested it (Tab. III). Uncertainty and problems with antibiotic administration by dentists have been reported in other studies from Europe, Canada, and the Near East (Epstein et al. 2000, Palmer et al. 2000, Palmer et al. 2001, Salako et al. 2004, Al-Haroni & Skaug 2006, Demirbas et al. 2006, Al-Haroni & Skaug 2007, Dar-Odeh et al. 2008, Mainjot et al. 2009, Sancho-Puchades et al. 2009).

Thus, approximately two-thirds of the participants desired concrete guidelines on the implementation of these medications to facilitate choosing an adequate and appropriate antibiotic. However, such concrete guidelines exist only for endocarditis prophylaxis. The most recent revision of the American Heart Association's (AHA) guidelines on endocarditis prophylaxis was in 2007 (Wilson et al. 2007a). Consequently, the American Dental Association's guidelines (Wilson et al. 2007b) and those of Switzerland (Flückiger & Jaussi 2008) were also updated. In addition, instead of the original three endocarditis ID cards, Switzerland now has two, in which the text has also been changed (orange card for adults, dark yellow for children and adolescents who need prophylaxis due to high risk). Prophylactic antibiotics are recommended before dental treatment in patients with heart valve replacement, patients who have suffered through an endocarditis episode, those with a reconstructed heart valve, patients with congenital heart disease, or after a heart transplant with newly occurring valvulopathy (Flückiger & Jaussi 2008). However, in the present study, only between 64% and 87.6% of the participants administered prophylactic antibiotics for tooth cleaning, subgingival fillings and oral surgery in patients with an increased risk of endocarditis (Tab. V), despite the fact that the current guidelines stipulate performing antibiotic prophylaxis for all of these treatments. Prophylactic antibiotics are recommended for taking impressions when the initiation of gingival or periodontal bleeding is predictable.

Adjunctive to the treatment of odontogenic infections, 93.2% of the Swiss dentists would additionally prescribe antibiotics given a combination of clinical symptoms (Tab. II). In the literature, antibiotic administration has been recommended in cases of tachycardia, facial swelling, restricted mouth opening, a rise in body temperature, painful swallowing, and regional lymph node swelling (Al-Haroni 2008). Where an infiltrate exists or concomitant symptoms such as fever, pain-

ful swallowing, and restricted mouth opening occur, antibiotics may be used due to a possible superinfection (Lambrecht 2004).

For non-clinical factors, 14.9% of those surveyed reported occasionally administering antibiotics if the patient requested them; if the diagnosis was uncertain, the rate increased to 38.1%, and if a postponement of treatment was necessary, it rose to 48.4% (Tab. III). Emergency treatment for acute pain and swelling is seldom tolerated in children. Postponing treatment combined with prescribing an antibiotic for secondary pain relief can be indicated in such cases and even be a necessary prerequisite for subsequently performing causal therapy.

In periodontal diseases, primarily metronidazole is used, followed by amoxicillin. The efficacy of antibiotic treatment with amoxicillin combined with metronidazole as an adjunct to scaling and root planing in chronic and aggressive periodontitis has been proven (Van Winkelhoff et al. 2000, Mombelli et al. 2011).

Ninety-two percent of the dentists surveyed would not use antibiotics for a simple wisdom tooth removal. In contrast, for a difficult surgical removal, 24.8% find it appropriate to support surgery with an antibiotic, preferably amoxicillin. Because no guidelines exist in this instance either, antibiotics are not prescribed in cases of difficult surgical removal of wisdom teeth in healthy patients (Lambrecht 2004).

When a non-infected maxillary sinus is opened during an extraction, antibiotics are initially not mandatory if sinusitis is not suspected. In this case, plastic coverage of the opened maxillary sinus is sufficient (Frenkel et al. 1997, Lambrecht 2004). However, 32.3% of those surveyed in this study prescribed antibiotics in such cases.

After implantation with bone augmentation, over half of the participants support the use of antibiotics, but after implantation without bone augmentation, 69.6% do not prescribe antibiotics. In the literature, prophylactic antibiotics are recommended during implantation with, for instance, an autologous bone graft. For implantation without bone augmentation in a healthy patient, prophylactic antibiotics are not required (Lambrecht 2004).

In cases of tooth avulsion, tetracycline seems to be preferred (Tab. IV), as is amoxicillin for soft-tissue injuries. In the literature, these two antibiotics are suggested as complementary therapy to conventional treatment (Hinckfuss & Messer 2009, Andersson et al. 2012, Diangelis et al. 2012).

Invasive treatments such as conventional and surgical tooth removal, endodontic procedures, and root planing present a potential hazard for risk patients such as the immunosuppressed, those suffering from an autoimmune disease or poorly managed Diabetes mellitus, patients recovering from chemo- or radiation therapy, or those infected with HIV. The results of the present study show that the participating dentists were uncertain about antibiotic prophylaxis for these risk patients. Only a few participants reported prescribing prophylactic antibiotics for immunosuppressed patients, or those with an autoimmune disease or undergoing hemodialysis. Because these patients are at higher risk of infection, the use of antibiotics should be discussed with medical specialists.

After radiotherapy of the head and neck, the vascularization status is unfavorable, so that local resistance to microorganisms is weakened. Prophylactic antibiotics are mandatory in this case (Lambrecht 2004). However, only 18% to 52.2% of the participants would prescribe them for such patients.

Diabetic patients are at higher risk of marginal periodontitis. Gingivitis also occurs more frequently in diabetics, as do periodontal abscesses, Cheilitis angularis, and disturbed wound healing after tooth removal. Thus, for an insulin-dependent diabetic with a labile metabolism, it is recommendable to provide antibiotic prophylaxis after consulting with the patient's general practitioner, and also to prescribe therapeutic antibiotics if complications arise (Lambrecht 2004).

Patients taking bisphosphonates either for osteoporosis or metastatic lung, breast or prostate cancer are at increased risk of developing osteonecrosis after oral surgery, and cancer patients who receive intravenous bisphosphonates have an additionally increased risk of doing so (Brock et al. 2011). Prophylactic antibiotics are necessary in these patients. In all such cases, it is advisable to consult with the patient's oncologist. Co-factors such as diabetes, corticosteroid therapy, and smoking can also influence the decision (Dannemann et al. 2008, Hellstein et al. 2011).

The present study did not include questions about patients with prosthetic joints. The efficacy of prophylactic antibiotics in these patients has yet to be proven (Rossi et al. 2005, Rompen et al. 2008).

Over 40% of the participating dentists reported prescribing generics. Compared to other European countries or the USA, generics are relatively infrequently prescribed in Switzerland. With the revision of the Swiss Federal Health Insurance Act (KVG) in 2001, pharmacists are permitted to issue generics as long as the patient agrees and the prescribing doctor does not explicitly forbid it (right of substitution). A 2011 study found that the overall substitution rate in Switzerland was only 31%, but great differences exist between cantons (Decollogny et al. 2011).

The theme of diseases and use of antibiotics is complex. Uncertainties about prophylactic antibiotic use exist, which is why many of the participants in this study wish more concrete guidelines on the correct implementation of these medications.

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Résumé

En médecine dentaire, les antibiotiques sont prescrits pour la prophylaxie et la thérapie. L'administration trop à la légère de ces médicaments peut cependant conduire à la sélection de micro-organismes résistants. L'objectif de cette étude était de déterminer parmi les dentistes suisses les indications pour l'usage d'antibiotiques ainsi que l'étendue de leur prescription.

Pour ceci, un questionnaire a été envoyé à 800 dentistes en hiver 2008/2009. Le taux de participation était de 20%. Un grand nombre des dentistes participants a indiqué ne prescrire des antibiotiques que de manière ciblée ou qu'avec une certaine retenue. Néanmoins, des incertitudes subsistaient concernant les indications. Par exemple, le recours à un antibiotique, bien que pas forcément indiqué, augmentait lors d'incertitudes liées au diagnostique et à la thérapie. Il n'était donc pas surprenant que deux tiers des répondants ont souhaité avoir des recommandations concrètes pour l'utilisation des antibiotiques.

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