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Microbiological profile of acute dental infection and the resistance of causative species to the antibiotics

Oral cavity infections are caused by mixed bacterial flora consisting of aerobic, anaerobic, Gram-positive and Gram-negative bacteria with the prevalence of streptococci, staphylococci and rods. Most bacteria isolated from dental abscesses belong to three groups: facultative anaerobic Gram-positive cocci, obligate anaerobic Gram-positive cocci, obligate anaerobic Gram-negative rods (7, 11). Parodontium diseases are also dominated by anaerobic bacteria (12).

Therapy effectiveness in acute odontogenic inflammatory conditions is high. It consists in the incision of soft tissues in abscesses, extirpation of root pulp or extraction of the causal tooth. If drainage cannot be effective or there is a risk of systemic infection, antibiotic therapy is advisable. Pathogens in inflammatory conditions of the oral cavity are susceptible to various antibacterial preparations, which does not mean that there is one effective medicine in such cases. Bacteria isolated from dental abscesses are generally susceptible to most antibiotics such as penicilline, amoxicilline, erythromycine or clindamycine. It is believed that due to their good pharmacokinetic profile and high concentration in inflammation site, penicilline and, especially, amoxicilline can be considered antibiotics of primary therapy, used in combination with metronidasol, in the case of no clinical effectiveness of monotherapy (7).

However, the problem of resistance of bacterial strains causing acute inflammatory conditions of the oral cavity to these antibiotics appears more and more frequently. The frequency of refractory strains occurrence is varied and depends on microorganism species, kind of antibiotic and, especially, frequency of its administration during therapy.

Since there is a correlation between bacteria resistance development and antibacterial drug administration, drugs with the possibly narrowest spectrum of activity should be chosen. Broad spectrum of activity can contribute to the selection of refractory strains (5). The phenomenon of cross-resistance is observed – it means unsusceptibility to all the antibiotics belonging to the same chemical group.

The side-effects of currently used antibiotics include the reactions typical of most anti-microorganism drugs, namely causing disorders in physiological bacterial flora and reactions characteristic of particular drug groups (toxic activity). Common, especially inadequate use of antibiotics (empirical antibiotic therapy) in inflammations of the oral cavity leads to the formation of microorganisms through selection which are unsusceptible to those drugs. In future this can pose a serious medical problem.

The aim of the study was to evaluate the effectiveness of primary therapy antibiotics in relation to microorganisms isolated from inflammatory lesions of the oral cavity in the course of odontogenic infections.

MATERIAL AND METHODS

For bacteriological examinations samples were collected from 21 patients, aged 20–50 years, who came to the surgical outpatients' clinic with the symptoms of acute odontogenic inflammations.

Samples for bacteriological examinations were taken with these from the lesions. The samples were placed in test-tubes with Schaedler base made by Bio Merieux company and sent to the laboratory. The material was then inoculated on three sets of Columbia base with the addition of 5% of lamb blood and Chapman base. The culture was incubated for 24 hours in the temperature of 37°C in the atmosphere of 5% CO_2, and in anaerobic conditions using gener-bag anaer made by Bio Merieux company. Different morphological colonies were isolated from the cultured material. After the preliminary evaluation made on differentiation-selective base and evaluation of Gram stained preparation, the cultured microorganisms were identified with regard to their type and species using routine identification methods.

Susceptibility of bacterial strains to selected antibiotics was determined by the method of antibiotic diffusion from the disc in agar gel.

RESULTS

From the samples collected from 21 patients 52 bacterial strains and 6 strains of *Candida* anascogenic yeasts were isolated (Table 1). Ten anaerobe strains were isolated, which constitutes 17.2%. The other isolated strains belonged to aerobic bacteria and constituted 82.8% of the isolated microorganisms.

Table 1. Type of cultured microorganisms and quantitative comparison

No	Type of microorganism	Number of strains
1	*Bacteroides* spp.	2
2	*Candida albicans*	6
3	*Corynebacterium* spp.	2
4	*Enterobacter* spp.	1
5	*Haemophilus parainfluenzae*	1
6	*Peptococcus* spp.	7
7	*Peptostreptococcus* spp.	1
8	*Staphylococcus* spp. kg(-)	5
9	*Staphylococcus* kg(-) MRS	4
10	*Staphylococcus aureus*	1
11	*Enterococcus faecalis*	3
12	*Streptococcus* gr. F	2
13	*Streptococcus* gr. G	3
14	*Streptococcus mutans*	1
15	*Streptococcus pyogenes*	2
16	*Streptococcus salivarius*	14
17	*Streptococcus viridans*	3

The group of 21 treated patients presented the most common causes of infections in clinical practice (dental abscesses – 4, inflammatory complications after tooth extraction – 7, complications after other types of surgical treatment – 1, complicated dens sapientiae eruption – 8). The cultured microorganisms from the infection site belonged to both pathogenic microorganisms (*Streptococcus*

pyogenes, Staphylococcus aureus) and to physiological microflora (*Streptococcus salivarius, Streptococcus viridans*). The infections were caused by aerobic and anaerobic, Gram-positive and Gram-negative bacteria, mainly streptococci, staphylococci and rods.

In the group of 21 treated patients with acute inflammatory conditions, in 14 patients resistance of the cultured pathogens to some commonly used antibiotics was revealed (Table 2). Refractory features were demonstrated by Gram-positive aerobic cocci: *Enterococcus faecalis, Streptococcus* spp., *Streptococcus* (-hemolyzing, *Staphylococcus aureus,* anaerobic Gram-negative cocci *Peptococcus* spp., Gram-negative aerobic rods *Enterobacter* spp., anaerobic Gram-negative rods *Bacteroides* spp. Multiple resistance was found in the clinical cases with the participation of Gram-positive anaerobic cocci *Peptostreptococcus* spp., and coagulase-negative staphylococci unsusceptible to meticiline. Multiple refractory strains *Peptostreptococcus* spp. (unsusceptible to erythromycine, lincomycine, clindamycine, colistine) showed susceptibility to penicillines (penicilline G, ampicilline, amoxicilline), also in some cases with the participation of pathogenic *Enterococcus faecalis, Streptococcus* (-hemolyzing and coagulase-negative *Staphylococcus* spp., penicilline G proved effective in clinical therapy (susceptibility, medium susceptibility). Amoxicilline turned out an effective antibiotic in infections with the participation of *Streptococcus* spp. and *Peptococcus* spp. unsusceptible to penicilline G. Meticiline unsusceptible staphylococci were sensitive to vancomycin.

DISCUSSION

Inflammatory processes of bacterial etiology most frequently develop in the oral cavity. Many organisms existing in the oral cavity are potential opportunist pathogens in the situations when host defense mechanisms are suppressed or such organisms reach the areas normally inaccessible for them, e.g. after tooth extraction or other injuries when bacteria get into tissues or blood stream (2).

In patients with complicated *dens sapientiae* eruption the presence of *Candida albicans* yeast was found, which commonly occurs as a commensal on the oral mucosa. Mechanical irritation or damage of the mucosa creates favourable conditions for local pathogenic lesions with the participation of *Candida albicans*, thus that fungus can be a pathogenic factor in the case of local or systemic decrease in host immunity. The oral cavity becomes a vast entrance for mycosis of the stomach and intestines in hospitalized patients with immune system failure (1). Sometimes, commensal bacteria present in the oral cavity also take part in local infections, or even in systemic diseases. Damaged oral mucosa can be an entrance for local infection with the participation of *Streptococcus viridans* (3).

In the examined patients *Enterococcus faecalis* was cultured from infection site, in the case of pre-mucosal abscess and suppurated root cyst, which means in inflammatory processes occurring over a longer period of time. Sometimes the occurrence of Gram-negative rods or *Streptococci fecalis* can be observed, which are translocated from the alimentary tract and, in favourable conditions, can cause pathogenic state. Also *Helicobacter pylori*, aerobic bacteria connected with chronic inflammation of the stomach mucosa, can periodically move to the oral cavity. Its presence in the oral cavity can be helpful in diagnostically difficult cases of gastric ulcer (8). Similarly, as a result of trauma or surgical treatment, bacteria from other parts of the body can move to the oral cavity.

Pathogenic strains of the same type, participating in acute odontogenic inflammations demonstrated varying susceptibility to different antibiotics. Comparing the studies of antibiotic susceptibility of other authors, differences in results can be observed (6). Anaerobic bacteria of *Bacteroides* type demonstrated resistance to most antibiotics, however, in this study they were susceptible to erythromycine, lincomycine, clindamycine and riphampicine. Gram-positive anaerobic bacteria in the quoted study were susceptible to most antibiotics, however, in this study they

demonstrated resistance to lincomycine, erythromycine, canamycine, clindamycine and colistine. For this reason, these are only the isolation of pathogenic strain in bacteriological examination and evaluation of its antibiotic susceptibility that can indicate adequate, effective antibiotic.

Table 2. Effectiveness of selected antibiotics and pathogenic strains resistance

Cultured microorganisms	penicilline G	ampicilline	amoxicilline	erythromycycina	lincomycine	clindamycine	vancomycine	ampicilline+sulbactam	colistine	riphampicine	canamycine	amoxycilline+clavulinic acid	gentamycin
Streptococcus spp.	S	S		S	S	S							
	R	R	S	S	S	S	S						
	S	S	S	S	S	S	S	S					
Streptococcus β-hemoliz.	I	I	S	I	I	I	S						
	S	S	S	R	R	R	S						
Streptococcus pyogenes	S	S		S	S	S							
	S	S	S	I	S	S		S					
Enterococcus faecalis	S	S					S	S				S	S
	S	S	S	S	R	R	S						
	S	S		S	S	S	I						
Staphylococcus aureus	R	R	R	S	S	S	S						
Staphylococcus spp. KG(-)	R	R		S	S	S	S						
	S	S	S	S	R	R	S	S					
	S	S	S	S	R	R	S	S					
Staphylococcus spp. KG(-) MRS	R	R	R	S	R	R	S	R					
	R	R	R	R	R	R	S	R					
	R	R	R	R	R	R	S	R					
	R	R	R	R	R	R	S	R					
Peptococcus spp.	I		S	R		R			S	R	S		
Peptostreptococcus spp.	I	S	S	S	S	S	S	S	R	S	S		
	S	S	S	S	S	S		S			S		
	I	I	S	R	S	S		S	R	S	I		
	S	S	S	I	I	I	S	S	R	S	I		
	S			R	R	R	S		R	R	R		
	S	S	S	S	R			S					
	S	S	S	R	R	R	S	S			I		
	I	S	S	S	S	S	S	S	R	S	S		
Bacteroides spp.	R			S	S	S	R		R	S	R		
	S	S	S	S	S	S	S	S	S	S	S		
Enterobacter spp.		S	R						S				
Haemophilus parainfluenzae	I	I	S	I	S	I	S	S					
Corynebacterium spp.	S	S	S	S	S	S	S				S		

R – resistant, S – susceptible, I – of medium susceptibility

Similarly to other medical specializations, in dentistry patients antibiotic therapy is prescribed relatively frequently, e.g. as many as 52% of dentists in Hungary use antibiotic for disease prevention (most often Dalacin C, Rulid, Augmentin, Semicillin, Maripen, Doxycycline) (4). More and more frequently opinions that the use of antibiotics should be completely changed, are heard (9). The basic principle is to use them only when it is absolutely necessary, and antibiotic therapy should be conducted in co-operation with microbiological laboratory examining the type of pathogenic strain and its drug susceptibility. Glicopeptides (vancomycin and tecoplanin) are the drugs of ultimate therapy in infections caused by bacteria resistant to meticiline. Thus, it is necessary to limit their use in prophylaxis in surgical treatments in patients who are carriers of MRSA and MRSE (meticiline resistant *Staphylococcus aureus* and *Staphylococcus epidermidis*) (10).

The basis for treatment, also in dental surgery, must be constituted by adequate clinical diagnosis, evaluation of patient's general condition, disease progression and proper operative technique. In practice prescribing antibiotic therapy without bacteriological examination frequently replaces basic and appropriate therapeutic procedures.

CONCLUSIONS

1. Microorganisms cultured from inflammatory lesions in odontogenic infections belonged to pathogenic microorganisms as well as proper microflora of the oral cavity.
2. In odontogenic inflammatory conditions the participation of pathogens resistant to antibiotics of primary therapy is observed.
3. Multiple resistance was observed in infections with the participation of *Peptostreptococcus* spp., coagulase-negative *Staphylococcus* spp. and coagulase-negative, meticiline unsusceptible *Staphylococcus* spp.
4. Due to increasing bacteria resistance, antibiotic therapy should be preceded by bacteriological examination determining the type of pathogenic strain and its drug susceptibility.

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SUMMARY

The aim of the study was to identify the bacteriological profile of acute dental infections. Microbiological specimens were obtained from 21 patients and bacterial strains were isolated. In the examined material both commensal members of an oral microflora as well as pathogen species were found. It was shown that flora of acute dental infection was polymicrobial, predominantly involving streptococci, staphylococci and bacteriae. Both anerobes and oxygen dependent microbes were detected. Moreover, both Gram-positive and Gram-negative species were found. The big difference in the sensitivity to the antibiotics in the same species of pathogens was visible. It appeared that pathogen species isolated from acute dental infections were resistant to the antibiotics of first choice. Moreover, resistance to the range of antibiotics was observed when *Peptostreptococcus* spp., *Staphylococcus* spp.-coagulase negative and *Staphylococcus* spp. coagulase negative, metycilline-resistant were the causative microorganisms.

Profil mikrobiologiczny ostrych zapaleń odzębowych i antybiotykooporność patogenów wywołujących te stany

W pracy przedstawiono wyniki badań bakteriologicznych z miejsc zakażeń odzębowych u 21 chorych. Izolowane bakterie należały zarówno do drobnoustrojów chorobotwórczych, jak również do prawidłowej mikroflory jamy ustnej. Udział w zakażeniach miały bakterie tlenowe i beztlenowe, Gram-ujemne i Gram-dodatnie, głównie paciorkowce, gronkowce i pałeczki. Szczepy chorobotwórcze w obrębie tych samych rodzajów wykazywały zmienną wrażliwość na antybiotyki. W zapaleniach odzębowych obserwuje się obecność patogenów opornych na antybiotyki pierwszego rzutu. Wieloooporność obserwowano w zakażeniach z udziałem *Peptostreptococcus* spp., *Staphylococcus* spp. koagulazo-ujemnych, *Staphylococcus* spp. koagulazoujemnych metycylinoopornych.