



Original article

DEMOGRAPHIC DISTRIBUTION, ETIOLOGICAL BACTERIAL SPECTRUM AND ANTIBACTERIAL TREATMENT OF PATIENTS WITH ODONTOGENIC ABSCESES AND PHLEGMONS OF THE HEAD AND NECK

Yanko Yankov^{1,2}, Lyuben Stoev³.

1)Department of General and Operative Surgery, Faculty of Medicine, Medical University, Varna, Bulgaria.

2)Clinic of Maxillofacial Surgery, UMHAT "St. Marina", Varna, Bulgaria..

3) Department of General and Clinical Pathology, Forensic Medicine and Dentology, Faculty of Medicine, Medical University - Varna, Bulgaria.

ABSTRACT

Background: Odontogenic abscesses are the most common pathology in maxillofacial surgery. Their frequency is significantly higher in people with poor social status.

Materials and methods: The study retrospectively included 81 patients with odontogenic abscesses and phlegmons of the head and neck, hospitalized and operated on as an emergency case. Incision wound secretion for microbiological examination and preparation of an antibiogram were taken from each of them as a standard routine procedure.

Results and discussion: The most affected are young patients (till 44 years), followed by patients in middle age (45-59 years). The reason for this is that with age, teeth gradually fall out of the dentition of mature individuals, and with this, the possibility of the occurrence of odontogenic infections decreases. The lower jaw is more affected. A mixed resident microflora comprising more than one bacterial species is isolated in 62% of all patients. Gram-positive bacteria isolated in the samples of the studied patients were coagulase-negative staphylococci (*Staphylococcus coagulase negative*, CNS), *Staphylococcus aureus*, *Streptococcus anginosus* and *Streptococcus viridans*. Gram-negative bacteria were *Escherichia coli*, *Enterobacter cloacae* and *Stenotrophomonas maltophilia*. Obligate anaerobes were found in only one sample. The isolated fungi were *Candida albicans* and *Candida nonalbicans*.

Conclusion: In the studied group of patients with odontogenic abscesses, Gram-positive bacteria In the studied group of patients with odontogenic abscesses, Gram-positive bacteria were 2.5 times more than Gram-negative. Single antibacterial therapy is preferable for patients with small-area odontogenic abscesses, while triple antibacterial therapy is recommended for large-area odontogenic abscesses and their phlegmonous forms.

Keywords: bacteria, etiological bacterial spectrum, head and neck surgery, maxillofacial surgery, odontogenic abscess, phlegmon,

INTRODUCTION

Odontogenic abscesses are the most common pathology in maxillofacial surgery, which is confirmed by a study conducted in Germany and published in 2020 [1]. Compared to the last decades, there is a decrease in their frequency, which is explained by the popularization of the education of individuals about oral hygiene, the creation of more and more preparations for personal oral hygiene and the strengthening of the prevention of diseases with oral pathology [2]. This is the reason why their frequency is significantly higher in people with poor social status. They are caused by microorganisms whose primary source is the teeth and peri-dental tissues [3]. Their complicated course can lead to complications such as mediastinitis, sepsis and septic shock, thrombosis of the jugular vein, septic venous emboli, obstruction of the upper respiratory tract, pseudoaneurysm or carotid artery rupture, pleural empyema, intravascular coagulopathies, etc., to complete lethal exit [4, 5, 6]. The need to specify the type of their pathogenic agent and its sensitivity to antibiotics, given the fact that widespread abscesses (phlegmons) often lead to prolonged treatment, hospitalization, aggravation of the health system and a doubtful prognosis, is of extreme importance for the maxillofacial surgeon [7]. In some cases, it is impossible to isolate a microbial causative agent, i.e. there is no culture, and in these cases, some authors speak of culture-negative purulent-inflammatory diseases [8]. A study of 50 patients at the University Hospital Geisen and Marburg in Geisen, Germany, in 2016-2017 shows that in 96% of cases in patients with odontogenic abscesses, the isolate is from a mixed microflora (more than one bacterial species have been isolated) and only one bacterial species has been isolated in only 4% [9]. According to this and some other studies, odontogenic abscesses and phlegmons are mainly caused by facultative anaerobic agents [9-12]. The most common bacterial causative agents of odontogenic abscesses and phlegmons in the maxillofacial region are *Prevotella*, *Staphylococcus* spp., *Streptococcus* spp., *Porphyromonas*, *Fusobacterium*, *Veillonella*, *Parvimonas*,

Streptococcus, Mogibacterium and Filifactor [9, 13]. The **aim** of this original article is to investigate and analyze, confirm or modify worldwide findings regarding the demographic distribution, etiologic bacterial spectrum, and antibacterial treatment of hospitalized patients with odontogenic abscesses and phlegmons of the head and neck, as well as to introduce novelties into them.

MATERIALS AND METHODS:

The study retrospectively included 81 patients with odontogenic abscesses and phlegmons of the head and neck, hospitalized and operated on as an emergency in the Clinic of Maxillofacial Surgery at the University Multispecialty Hospital for Active Treatment “Sveta Marina” EAD – city of Varna, Bulgaria in the second half of 2021 and the first half in 2022. In all of them, the diagnosis was confirmed during the operative intervention by the evacuation of the purulent exudate. All patients were 18 years of age or older. Incision wound secretion for microbiological examination and preparation of an antibiogram were taken from each of them as a standard routine procedure.

RESULTS

The study group consisted of 37 men (45.68%) and 44 women (54.32%) with an average age of 42 (18-79) years – 38 (18-78) for men and 45 (18-79) for women.

Figure 1 shows the distribution of patients in the study group by number and gender.

Fig. 1. Distribution of patients in the studied group by number and gender

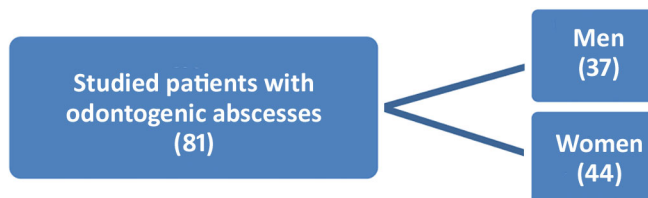
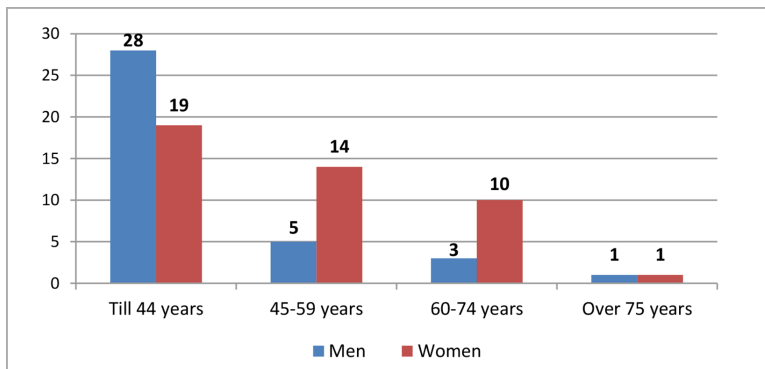


Table 1 and Graph 1 show the age distribution of patients with odontogenic abscesses and phlegmons of the head and neck.

Table 1. Age distribution of patients with odontogenic abscesses and phlegmons of the head and neck

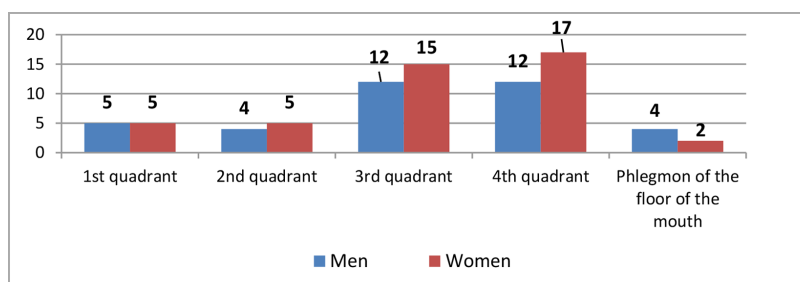
	Number	Arithmetic mean	Median	Standard deviation	Minimum age	Maximum age
Men	37	38	38	16.03	18	78
Women	44	45	46	17.27	18	79
Total	81	42	40	17.15	18	79

Graphic 1. Distribution of patients with odontogenic abscesses by age



Graphic 2 shows the distribution of patients with odontogenic abscesses and phlegmons according to the affected jaw segment.

Graphic 2. Distribution of patients with odontogenic abscesses and phlegmons according to the affected jaw segment



The largest number of patients with an etiological factor for the odontogenic abscess is a tooth from the fourth jaw quadrant (41-48) – a total of 29 (12 men and 17 women).

In second place are the patients with odontogenic abscesses caused by a tooth from the third quadrant (31-38) – 27 people (12 men and 15 women).

Next are the patients with the etiological factor of the purulent inflammation of a tooth from the first quadrant (11-18) - 10 people (5 men and 5 women).

The smallest group is of the patients with an odon-

togenic abscess caused by a tooth from the second quadrant (21-28) – a total of 9 people (4 men and 5 women).

There were 6 patients with diffuse spread of purulent infiltrate (phlegmon) - 4 men and 2 women. In all of them, all three anatomical spaces from the lower floor of the oral cavity were affected – right submandibular space, submental space and left submandibular space.

In 31 of the 81 studied patients, the presence of wound exudate without microbial growth was found. The remaining 50 cases in which the presence of microorganisms was demonstrated are shown in Table 2.

Table 2. Etiological causes of abscesses in patients from the studied subgroup with odontogenic abscesses

Pathogen	Number	Percentage (%)
Mixed resident microflora (more than one bacterial species)	31	62
Staphylococcus coagulase negative (CNS):	5	10
* <i>Staphylococcus epidermidis</i>	(3)	(6)
* <i>Staphylococcus haemolyticus</i>	(1)	(2)
* <i>Staphylococcus capitis</i>	(1)	(2)
<i>Staphylococcus aureus</i>	1	2
<i>Streptococcus anginosus</i>	2	4
<i>Streptococcus viridans</i>	2	4
<i>Escherichia coli</i>	2	4
<i>Enterobacter cloacae</i>	1	2
<i>Stenotrophomonas maltophilia</i>	1	2
Obligate anaerobes	1	2
<i>Candida albicans</i>	3	6
<i>Candida nonalbicans</i>	1	2
Total	50	100

DISCUSSION

The most affected are young patients (till 44 years), followed by patients in middle age (45-59 years). The number of elderly patients (60-74 years old) is smaller, and it is the smallest among old individuals (over 75 years old). There is no data in the world literature indicating a clear reason for this. The most logical explanation for the obtained age-demographic distribution of odontogenic abscesses and phlegmons of the head and neck is that with age, for one reason or another, teeth gradually fall out of the dentition of mature individuals, and with this, the possibility of the occurrence of odontogenic infections decreases.

There is no data in the world of scientific works about the greater frequency of odontogenic exudative diseases of the lower dentition compared to those of the upper. Most likely, this is due to the more damaged lower teeth in the human dentition, the reason for which is the closer and missing anatomical contact between the lower teeth, which is a prerequisite for their more frequent damage, as well as the salivation of the submandibular salivary glands, whose highly viscous saliva is a favorable factor for its retention

on the lower dentition. These features predetermine the retention of more dental plaque and tartar on the lower teeth, which, together with the microorganisms accumulated in them, are the source of the odontogenic infection. Because the oral cavity is rich in a large number and types of bacterial representatives, this explains the results of the present study - the largest share of mixed resident microflora as the cause of odontogenic abscesses and phlegmons of the head and neck.

A mixed resident microflora comprising more than one bacterial species is isolated in 31 of the cultures performed, representing 62%.

Gram-positive bacteria isolated in the samples of the studied 50 patients with odontogenic abscesses, in which the bacterial agent was detected, were 10, i.e. 20%. They are coagulase-negative staphylococci (*Staphylococcus coagulase negative*, CNS), *S. aureus*, *S. anginosus* and *S. viridans*.

Coagulase-negative staphylococci have been found in 5 of the taken wound pus, which makes 10% of the samples – *S. epidermidis* in 3 of the samples, i.e. 6%, *S.*

haemolyticus in 1 of the samples (2%) and *S. capitis* in 1 of the samples (2%). In the head and neck, coagulase-negative staphylococci are the most common cause of infectious diseases of the oral mucosa and skin, being the most common cause of skin infections and abscesses [14]. This confirms the aforementioned research conducted at the University Hospital “Geisen and Marburg” in Geisen, Germany, in 2016-2017, according to which in 96% of cases in patients with odontogenic abscesses the isolate was of a mixed bacterial microflora and only 4% are the isolates with one bacterial species each.

S. aureus was isolated in 1 of all 50 samples with a proven pathogen, which is 2%. It is the most common cause of inflammation of the lips, called cheilitis [15]. In a large part of the population (up to 35%), it is common in high concentration in the nasopharynx, and its asymptomatic existence is one of the most common causes of infection in immunocompromised individuals [16].

S. anginosus is found in 2 of the samples (4%). Although there is evidence of its high oral concentration in patients with squamous cell carcinoma in the oral cavity [17], this does not change the indisputable fact that it is one of the main causes of infections in this area.

S. viridans is also present in 2 of all samples, representing 4%. Being one of the main microorganisms in dental plaque explains why it is also found in patients with abscesses of odontogenic origin [18].

Representatives of Gram-negative bacteria were isolated in 4 of the examined patients, which is 8%. These are *E. coli*, *E. cloacae* and *S. maltophilia*. Although reported to occur in the oral cavity in over 60% of leukemia patients, they mainly cause respiratory infections of the upper respiratory tract [19]. *E. coli* was found in 2 of the samples taken and constituted 4% of the total. It is more often found in patients with immune deficiency. *E. cloacae* was isolated in 1 of all wound secretions and represented 2%. *S. maltophilia* was also observed in only 1 of all cultures (2%).

Obligate anaerobes were found in only one 1 sample (2%). Despite strong evidence that obligate anaerobic bacteria underlie odontogenic diseases of the head and neck [9-12], the present study did not reach this conclusion.

Microorganism fungi were encountered in 4 of the crops (8%). Of these, *C. albicans* in 3 samples (6%) and *C. nonalbicans* in 1 (2%). Candidiasis in the oral cavity occurs most often in patients with weakened immune systems and in healthy people on a high-carbohydrate diet. It often appears as a superimposed infection in patients with inflammatory diseases of the salivary glands and those who used systemic antibiotics for a long time [20].

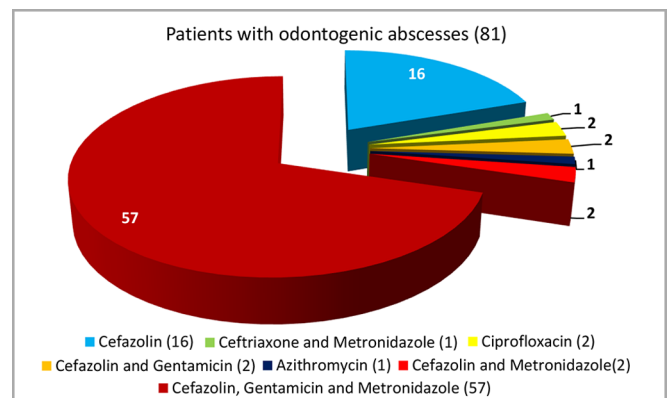
In the group with odontogenic abscesses, Gram-positive bacteria are 2.5 times more than Gram-negative (10 versus 4), and fungi are 4.

The largest number is of the resident microflora as the causative agent of the purulent collection - a total of 36 out of 50 (72%), of which 31 are mixed microflora containing more than one type of bacteria, and 5 are the isolates with one isolated bacterial causative agent (Staphylococcus coagulase negative).

In two out of three men with phlegmon on the floor of the oral cavity, the causative agents are from the group of staphylococci – *S. epidermidis* in one of them and *S. anginosus* in the other one. In the third patient with diffuse spread of the purulent exudate (phlegmon on the floor of the oral cavity), the causative agent is *S. maltophilia*. In the fourth man with phlegmon, a resident microflora is found on the floor of the oral cavity. In the women with phlegmon on the floor of the mouth, *S. haemolyticus* is found in one of them and sterile cultures in the other one. I.e. Gram-positive causative agents of large-area inflammatory tissues are 75% compared to Gram-negative, which are 25%. Taken together for the entire group of patients with phlegmons of odontogenic origin in the maxillofacial area, the ratio of Gram-positive to Gram-negative bacteria to resident microflora to sterile cultures is 3:1:1:1.

Graphic 3 graphically presents the antibacterial preparations used in the treatment of odontogenic abscesses and phlegmons of the head and neck.

Graphic 3. Use of antibacterial agents in the treatment of odontogenic abscesses and phlegmons of the head and neck



Because of the severe clinical presentation in the majority of patients with purulent exudate of odontogenic origin in the head and neck region and the spread of the infection through the bone (upper or lower jaw) in this type of pathology, the use of more than one medical agent in the antibacterial treatment (except for the surgical volume of incision, lavage and drainage) of these patients is recommended. Despite their empiric prescription, none of the patients had a worsening of their general condition in the postoperative period, and no change in their antimicrobial therapy was required. In most cases, the

antibiogram was made 3 to 5 days after taking the material for microbiological examination, and the average hospital stay of patients with this type of disease was an average of 2.78 days.

In order to cover a large biological spectrum, including anaerobic bacteria, the most frequently used antimicrobial therapy was Cefazolin (3x2 g. intravenously), Gentamicin (2x0.8 g. intravenously) and Metronidazole (3x0.5 g. intravenously) - in 57 of the cases. The monetary value of all three medications is not high, which has an important economic significance for the treatment of these patients.

In 19 of the patients, antibacterial therapy consisted of only one agent – monotherapy. In 5 of the cases, it contained two antibacterial agents. The use of only one or two antibiotics in patients with odontogenic abscesses and phlegmons is most often applicable in those with subperiosteal and submucosal abscesses, in which the purulent exudate is in small quantity and has not spread to the adjacent soft tissues, and the clinical manifestations in them are less pronounced.

It can be summarized that in operated patients with odontogenic abscesses with a small amount of purulent exudate, single or double antibiotic therapy is sufficient, and in patients with large-area exudative effusions and those with phlegmons, triple antibacterial therapy is preferable.

CONCLUSION

We prove that the main causative agents of odontogenic purulent infections in the head and neck region are of the Gram-positive spectrum, and in the group studied by us they are 2.5 times more than Gram-negative. The conducted study confirms that in this type of pathology, the largest share of the resident microflora as the cause of the pus collection is 62%. The most likely reason for the high incidence of odontogenic exudative diseases in young patients is tooth loss in older individuals. Based on our clinical practice, we can conclude that single antibacterial therapy is preferable for patients with small-area odontogenic abscesses, while triple antibacterial therapy is recommended for large-area odontogenic abscesses and their phlegmonous forms.

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Address for correspondence:

Yanko Yankov, MD, PhD

University Multispecialty Hospital for Active Treatment “Sveta Marina” EAD - Varna;

1, Hristo Smirnenski Blvd., floor 9, Clinic of Maxillofacial Surgery, Varna, Bulgaria.

E-mail: yanko_1989@abv.bg,