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The Efficacy of Perioperative Antibiotic Therapy in Tonsillectomy Patients

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Abstract

Background. While the results of early research suggested that perioperative antibiotic prophylaxis in tonsillectomy patients is associated with many benefits, these data were not confirmed by further studies and meta-analyses.

Objectives. The aim of this study was to investigate the usefulness and efficacy of antibiotic monotherapy in the healing of surgical wounds of patients undergoing bilateral resection of the palatine tonsils, based on an analysis of selected objective and subjective characteristics of wound healing during the postoperative period.

Material and Methods. The study included 50 men and women who underwent routine resection of the palatine tonsils. The patients were randomized into two groups: Group I, undergoing tonsillectomy with cefuroxime prophylaxis (n = 25), and Group II, who were not given perioperative antibiotic therapy (n = 25). The severity of signs and complaints recorded on postoperative days 1–10 was scored on 3- and 10-item scales.

Results. The only significant intergroup differences pertained to problems with swallowing food and fluids on postoperative days 4–6, 8 and 9 (less prevalent in Group II), postoperative use of analgesics on postoperative day 9 (less frequent in Group II), the degree of mucosal swelling in the operated area on postoperative days 3 and 7 (less severe in Group II), and the amount of fibrin covering the tonsillar niches on the third postoperative day (significantly higher in Group I).

Conclusions. The administration of antibiotics for prevention or control of infection should be preceded by a comprehensive analysis of the potential benefits and risks. Perioperative use of antibiotics is justified only in selected cases, i.e. in individuals with comorbidities (Adv Clin Exp Med 2016, 25, 3, 493–503).

Key words: antibiotics, prophylaxis, tonsillectomy, wound healing.

Bilateral resection of the palatine tonsils is the only efficient treatment of chronic tonsillitis. Nevertheless, constant changes with regard to qualification criteria for this procedure, surgical techniques and protocols of postoperative care are still observed worldwide [1, 2]. These changes are mostly associated with the microbiological profile of pathogenic bacterial flora of the palatine tonsils. Until recently, *Streptococcus pyogenes* was the pathogen responsible for 90% of chronic palatine tonsillitis cases. In the last decade, evidence supporting the predominant role of *Haemophilus influenzae* and *Staphylococcus aureus* in the

etiology of this inflammatory condition has been published; both of these microorganisms synthesize β -lactamases and show resistance to many antibiotics [3, 4]. Recent research has documented the significant role of biofilms in reducing the efficiency of treatment during superinfections within the mucosa-associated lymphoid tissue (MALT) and their involvement in the etiopathogenesis of recurrent palatine tonsillitis. Acute superinfections cause changes in the histopathological structure of the tonsils, typical of chronic tonsillitis [5].

Detailed understanding of the function of the palatine tonsils has led to more efficient treatment

of recurrent acute tonsillitis, reducing the number of surgical resections of the tonsils, i.e. tonsillectomies. However, it should be noted that tonsillectomies are still among the most frequent laryngological surgeries performed worldwide [6]. Moreover, new surgical techniques are being implemented. Some of them, such as laser, argon plasma coagulation or bipolar scissors tonsillectomy, have not met with enthusiastic opinions, as despite the procedures being considerably shorter and virtually bloodless, their implementation did not reduce postoperative pain and markedly prolonged the healing of the tonsillar niches [1]. Nevertheless, many hopes are associated with the use of the harmonic knife and rotary micro-knife, both allowing for precise, virtually bloodless operations and a considerably lower degree of thermal injury [4]. It is noteworthy that the lowest risk of bleeding occurs after cold dissection with ligation. All “hot” techniques involving laser, radiofrequency, coblation or mono- or bipolar forceps are associated with an increased risk of secondary bleeding [7].

The comprehensive process of improving tonsillectomies is not limited to the surgical procedure itself, but also extends to postoperative care. New standards of care have been implemented, including detailed pretreatment and treatment procedures aimed at providing patient comfort and allowing the healing process to be monitored during the postoperative period. However, these procedures also require constant monitoring and verification of their usability. One example is the ongoing discussion in the literature regarding the justification of intravenous antibiotic therapy in patients undergoing tonsillectomy [1, 2, 6, 8].

The results of early studies suggested that perioperative antibiotic prophylaxis in tonsillectomy patients is associated with many benefits [8, 9]. The positive effects of antibiotic therapy noted included decreased levels and duration of pain, a reduced risk of secondary bleeding and improved patient comfort [8–11]. The authors of these studies theorized that bacterial colonization of tonsillar niches was the main cause of postoperative morbidity, suggesting that it is associated with the release of inflammatory mediators and resultant pain. Consequently, the bactericidal and bacteriostatic effects of perioperative antibiotic therapy should be reflected by decreased pain and improved healing. Moreover, the proponents of perioperative pharmacoprophylaxis emphasized another advantage – namely, the anti-inflammatory effect of antibiotics associated with documented *in vitro* inhibition of the release of pro-inflammatory cytokines: interleukin-1, -6 and -8, and tumor necrosis factor- α (TNF- α) from activated macrophages [2, 13–15].

However, such beneficial effects of antibiotic therapy during the healing process were not confirmed by further studies and meta-analyses [3, 6]. Antibiotic therapy was shown not to be associated with any additional benefits in cases of adequately performed surgery following an aseptic regimen [16–20]. Furthermore, several studies revealed negative consequences of antibiotic prophylaxis during tonsillectomy [21, 22]. According to Piltcher and Scarton, patients who received antibiotics during tonsillectomy required higher doses of analgesics, perceived greater discomfort and had increased risk of secondary bleeding [21].

Doubts and controversies regarding the effects of perioperative antibiotic therapy in tonsillectomy patients have stimulated further research in this matter.

The aim of this study was to investigate the usefulness and efficacy of antibiotic monotherapy in the healing of surgical wounds of patients undergoing bilateral resection of the palatine tonsils, based on an analysis of selected objective and subjective characteristics of wound healing during the postoperative period.

Material and Methods

The study included 50 men and women who were hospitalized due to chronic palatine tonsillitis at the Medical University of Silesia's Department of Otorhinolaryngology and Laryngological Oncology in Zabrze, Katowice, Poland. Written informed consent was obtained from all the participants. The patients were randomized into two groups, both of which underwent routine resection of the palatine tonsils under general anesthesia. The randomization of continuous and attribute data was performed using MINITAB 16.0 statistical software (Minitab Inc., State College, USA). The study group comprised of 27 women (54%) and 23 men (46%) with chronic palatine tonsillitis, aged between 18 and 60 years (mean age 30.4 ± 11.8). In order to ensure the homogeneity of the sample, all the patients underwent the same qualification criteria, were operated on using the same technique, and were given the same postoperative care. The correctness of the qualification for surgery was confirmed by pathomorphological examination of surgical tonsillar specimens; microscopic signs of chronic tonsillitis were documented in all cases.

The patients were randomized into two groups. Group I ($n = 25$) included patients in whom the tonsillectomy was performed with cefuroxime prophylaxis (Biofuroxym, Polpharma, Starogard Gdański, Poland). The antibiotic was administered intravenously in doses of 1.5 g every 12 h, from ad-

mission (day 0) to discharge. Subsequently, therapy was continued for another five days with an oral preparation of cefuroxime (Biofuroxym, Glaxo-SmithKline, Brentford, UK) at a dose of 500 mg every 12 h. Group II ($n = 25$) comprised patients who did not receive antibiotic treatment, either during hospitalization or after discharge.

All the patients satisfied the following criteria: a) inclusion criteria: good general status, lack of acute inflammation of the head and neck tissues and other organs, lack of chronic inflammation, established indications for resection of the palatine tonsils; b) exclusion criteria: A history of peritonsillar abscess, liver failure, corticosteroid therapy, gastroesophageal reflux disease (GERD), nicotine dependence, allergy or intolerance to cephalosporins, metamizole (Pyralgina), or midazolam or an active neoplastic process.

Selected demographic and intraoperative characteristics of the patients were documented, along with subjective and objective healing parameters, and were compared between the study groups. The severity of signs and complaints was scored on 3-item and 10-item scales modified and developed by the authors of the study. Similar scales were used previously by Jurkiewicz et al. [2] and Calreavy et al. [8]. The severity of pain from the tonsillar niches on consecutive postoperative days was scored on a 10-item numeric scale where 0 corresponded to a lack of pain and 10 to maximal pain. A 10-item numeric scale (0 – very good status, 10 – very poor status) was used to assess the quality of life and status of patients on consecutive postoperative days. The severity of problems swallowing food and fluids on consecutive postoperative days was scored on a 10-item numeric scale (0 – lack of problems swallowing, 10 – inability to swallow). The degree of oral mucosal hyperemia on consecutive postoperative days was assessed using a 3-item scale: 3 points – hyperemia limited to the tonsillar niches only; 2 points – hyperemia not extending beyond the tonsillar niches, palatoglossal and palatopharyngeal arches; 1 point – hyperemia extending beyond the tonsillar niches, palatoglossal and palatopharyngeal arches, involving the soft palate and uvula, the base of the tongue and the posterior pharyngeal wall. The degree of mucosal swelling in the operated area on consecutive postoperative days was assessed using a 3-item scale: 3 points – swelling limited to the tonsillar niches only; 2 points – swelling not extending beyond the tonsillar niches, palatoglossal and palatopharyngeal arches; 1 point – swelling extending beyond the tonsillar niches, palatoglossal and palatopharyngeal arches, involving the soft palate and uvula, the base of the tongue and the posterior pharyngeal wall. The amount of fibrin covering the tonsil-

lar niches on consecutive postoperative days was quantified using a 3-item scale: 3 points – a layer of fibrin up to 2 mm thick in the area of the tonsillar niches, 2 points – a fibrin thicker than 2 mm layer in the area of the tonsillar niches, 1 point – the presence of fibrin outside the tonsillar niches. The incidence of secondary bleeding from the tonsillar niches on consecutive postoperative days was assessed using a 3 item scale: 3 points – lack of postoperative bleeding, 2 points – light bleeding controlled by compression and parenteral administration of an anti-hemorrhagic agent, 1 point – bleeding requiring surgical intervention.

The statistical analysis was conducted with STATISTICA 10.0 PL package (StatSoft Inc., Tulsa, USA). Normal distribution of the studied variables was checked with the Kolmogorov-Smirnov test. The Student t -test and the Mann-Whitney U test were used for intergroup comparisons of normally and non-normally distributed/ranked variables, respectively. The distributions of qualitative variables within the groups were compared with Pearson's χ^2 test. The characteristics are presented as means and standard deviations for normally-distributed variables, medians and ranges for non-normally distributed parameters, and absolute numbers and percentages. The results are presented as tables and graphs. The threshold of statistical significance was set at $p < 0.05$.

Results

The lack of statistically significant intergroup differences in demographic parameters (age and its distribution, mean body weight and body mass index) and in intraoperative parameters (the severity of bleeding and frequency of electrocoagulation) confirmed the correct selection of the subjects and randomization of the groups and enabled further analyses.

During the subsequent analyses, the subjective and objective parameters of healing outlined above were compared between patients administered antibiotic therapy (Group I) and those operated on without antibiotic prophylaxis (Group II).

Subjective Parameters

The length of time before the patients' return to a normal diet amounted to 8.56 ± 2.47 days in Group I and 9.16 ± 2.07 days in Group II; this difference was not statistically significant. The time before returning to daily life activities equaled 6.24 ± 1.74 days in patients from Group I and 6.72 ± 1.84 in patients from Group II; this difference was not statistically significant either. The du-

Fig. 1. The results of the 10-item scale of swallowing problems on consecutive postoperative days in the patients who were administered antibiotic therapy (Group I, gray bars) and those who did not receive antibiotics (Group II, white bars). Significant intergroup differences are designated with asterisks

ration of bad mouth odor in patients from Groups I and II was 6.68 ± 2.37 and 7.84 ± 1.84 days, respectively; again, this difference was not statistically significant. Similarly, no significant intergroup differences were found in the severity of pain from the tonsillar niches, the quality of life and the status of the patients on consecutive postoperative days.

On the other hand, the two study groups differed significantly in the severity of problems with swallowing. On postoperative days 4, 6, 8 and 9, significantly lower values for this parameter were documented in Group II than in Group I, indicating that patients who did not receive antibiotics experienced fewer problems with swallowing on those days (Fig. 1). The two groups were also compared in terms of the use of analgesics on consecutive postoperative days. No significant intergroup differences were documented except on the 9th postoperative day, when a significantly lower number of patients requiring analgesics was noted in Group II (Table 1).

Objective Parameters

No significant intergroup differences were found in the degree of mucosal hyperemia on consecutive postoperative days (Table 2). On postoperative days 3 and 7, significantly less severe mucosal swelling was documented in patients who did not receive antibiotics (Group II; Table 3). The only significant intergroup difference in the fibrin layer covering the tonsillar niches was revealed on the third postoperative day, when it was significantly thicker in Group I, i.e. in patients who were administered antibiotic prophylaxis. During the remaining postoperative days the two groups did not differ significantly regarding the presence

Table 1. The use of analgesics on consecutive postoperative days in the patients who received antibiotic prophylaxis (Group I) and those who were not given antibiotic therapy (Group II)

Postoperative day	Group I [n]	Group II [n]	p-value
1	25	25	1.000
2	25	25	1.000
3	25	25	1.000
4	25	25	1.000
5	24	24	1.000
6	24	24	1.000
7	22	23	0.637
8	20	19	0.733
9	18	11	0.045
10	15	9	0.089

of fibrin (Table 4). No significant intergroup differences were documented regarding the incidence of secondary postoperative bleeding from the tonsillar niches (Table 5). Similarly, no significant differences were observed with regard to body weight and mean body temperature from three measurements on consecutive postoperative days.

Discussion

Tonsillectomies are performed within a surgical field which is primarily colonized by both saprophytic and pathogenic bacteria. Therefore, the procedure is always associated with a risk of both local and systemic complications. Local complications correspond to less than 1% of postoperative morbidity and most commonly manifest as infection of the surgical wound, with resultant delayed healing, increased pain, the necessity of additional treatment and a longer convalescence period. Systemic complications, i.e. pneumonia, meningitis, or sepsis, represent a trifling fraction – only 0.2% – of postoperative morbidity [2, 22, 23].

In the United States, there are organizations that formulate the standards of management for certain types of surgery. The prevalence of infections in clean-contaminated head and neck oncological surgery was estimated at 0.56% to 5.6%, and pointed to the lack of randomized trials confirming the benefits associated with antibiotic prophylaxis during this type of surgery [24]. The frequency of infections associated with laryngological procedures within a primarily contaminated field ranges from 24% to 87% of cases [24]. According to

Table 2. Mucosal hyperemia scores in the patients who received antibiotic prophylaxis (Group I) and in those who were not given antibiotic therapy (Group II)

Postoperative day	Score	Group I [n]	Group II [n]	p-value
1	0	1	0	0.515
	1	15	19	
	2	7	4	
	3	2	2	
2	0	0	0	0.153
	1	14	11	
	2	4	10	
	3	7	4	
3	0			0.214
	1	15	9	
	2	6	11	
	3	4	5	
4	0	0	1	0.173
	1	13	6	
	2	7	12	
	3	5	6	
5	0	0	1	0.265
	1	12	6	
	2	6	7	
	3	7	11	
6	0	0	1	0.461
	1	8	4	
	2	6	7	
	3	11	13	
7	0	0	1	0.582
	1	4	4	
	2	7	4	
	3	14	16	
8	0	2	1	0.947
	1	3	3	
	2	6	6	
	3	14	15	
9	0	2	2	0.913
	1	2	2	
	2	6	4	
	3	15	17	
10	0	3	3	0.669
	1	2	2	
	2	5	2	
	3	15	18	

Table 3. Mucosal swelling scores in the patients who received antibiotic prophylaxis (Group I) and in those who were not given antibiotic therapy (Group II)

Postoperative day	Score	Group I [n]	Group II [n]	p-value
1	0	1	0	0.724
	1	15	14	
	2	6	8	
	3	3	3	
2	0	1	0	0.116
	1	14	7	
	2	5	11	
	3	5	7	
3	0	1	0	0.030
	1	16	7	
	2	4	6	
	3	4	12	
4	0	0	1	0.067
	1	15	6	
	2	3	6	
	3	7	12	
5	0	0	3	0.051
	1	12	4	
	2	5	7	
	3	8	11	
6	0	1	5	0.350
	1	7	5	
	2	8	6	
	3	9	9	
7	0	3	5	0.036
	1	2	5	
	2	9	1	
	3	11	14	
8	0	4	6	0.834
	1	2	3	
	2	5	4	
	3	14	12	
9	0	4	7	0.781
	1	2	2	
	2	5	4	
	3	14	12	
10	0	4	7	0.770
	1	2	2	
	2	3	3	
	3	16	13	

the guidelines of the American Society of Health-System Pharmacists, prophylactic administration of an antibiotic is recommended in such cases; the agent should show activity against most common pathogens, and should be given in appropriate doses for the shortest possible time [3]. The validity of this recommendation was confirmed by

Johnson et al., who analyzed the process of postoperative healing in 49 tonsillectomy patients, comparing the effects of 3- and 7-day prophylactic administration of amoxicillin [13]. Irrespective of the regimen, the antibiotic prophylaxis proved equally effective in terms of the level of pain and the time before returning to a normal diet and physical ac-

Table 4. Fibrin layer scores in the patients who received antibiotic prophylaxis (Group I) and in those who were not given antibiotic therapy (Group II)

Postoperative day	Score	Group I [n]	Group II [n]	p-value
1	0	3	3	0.948
	1	1	1	
	2	2	1	
	3	19	20	
2	1	1	0	0.491
	2	2	1	
	3	22	24	
3	2	4	0	0.037
	3	21	25	
4	2	4	1	0.157
	3	21	24	
5	2	1	0	0.312
	3	24	25	
6	2	1	0	0.312
	3	24	25	
7	0	1	0	0.353
	2	1	0	
	3	23	25	
8	0	1	0	0.600
	2	1	1	
	3	23	24	
9	0	1	0	0.600
	2	1	1	
	3	23	24	
10	0	2	0	0.352
	2	1	1	
	3	22	24	

tivity. In view of the reduced risk of adverse events, the lower probability of antibiotic resistance and decreased therapeutic costs, this finding justifies a shorter duration of therapy [13].

In 1990 Paterson defined the objectives of perioperative antibacterial prophylaxis, postulating that this treatment should result in the saturation of tissues exposed to surgical trauma with a concentration of antibiotic that would inhibit bacterial replication within the surgical wound [25]. Paterson formulated the five following principles of rational antibiotic prophylaxis: 1) Prophylactic antibiotic therapy can be administered only when surgical intervention is associated with an increased or high risk of postoperative infection; 2) the antibiotic has to be appropriately chosen, i.e. it should be effective against the most frequent pathogens of the given area; 3) the tissue concentration of the antibiotic has to be sufficiently high; 4) the dura-

Table 5. Secondary bleeding scores in the patients who received antibiotic prophylaxis (Group I) and in those who were not given antibiotic therapy (Group II)

Postoperative day	Score	Group I [n]	Group II [n]	p-value
1	1	1	0	0.455
	2	7	5	
	3	17	20	
2	2	2	1	0.551
	3	23	24	
3	2	0	1	0.312
	3	25	24	
4	3	25	25	1.000
5	1	0	1	0.353
	2	0	1	
	3	25	23	
6	1	0	1	0.353
	2	0	1	
	3	25	23	
7	2	0	1	0.312
	3	25	24	
8	2	1	2	0.551
	3	24	23	
9	1	0	1	0.203
	2	0	2	
	3	25	22	
10	2	0	1	0.312
	3	25	24	

tion of the antibiotic administration should be appropriately adjusted; and 5) the antibiotic has to be administered for the shortest possible time that provides antibacterial protection [21, 26, 27].

Recent studies revealed that although American laryngologists routinely implement postoperative antibiotic therapy in 79% of the cases, the analogous percentage of surgeons from United Kingdom amounts to only 12% [10, 11]. This disproportion probably reflects the results of studies and related statistical analyses that were conducted in Europe in order to verify the effect of antibiotic therapy on post-tonsillectomy healing [8–11, 26].

Dhiwakar et al. performed a meta-analysis of data published between 1966 and 2004, showing that researchers are inconclusive in their opinions about whether prophylactic antibiotic therapy should be implemented after tonsillectomy, and if so, which protocol should be used [1, 6]. The authors of the meta-analysis identified a few beneficial effects of antibiotic therapy: a lower risk of fever, a slightly shorter time before the patients return to normal activity, and a shorter duration of mouth odor.

They interpreted these findings as consequences of the bactericidal properties of antibiotics. They also revealed that antibiotic prophylaxis is associated with only a slight reduction in the risk of secondary postoperative bleeding and the time before returning to a normal diet. They did not, however, confirm any significant benefits of prophylactic antibiotic therapy regarding the reduction of postoperative pain, the dosage of analgesics or the duration of their use. Moreover, they identified a small fraction of patients who experienced adverse effects of antibiotic therapy: diarrhea, fungal superinfections, allergies and anaphylaxis; they also emphasized that antibiotic prophylaxis can be associated with an unnecessary increase in therapeutic costs. The development of drug resistance among pathogenic bacterial flora of the oral cavity was postulated as a main negative consequence of the frequent use of antibiotic prophylaxis after tonsillectomies [1, 8]. According to Dhiwakar et al. [1], formulating general conclusions and an objective interpretation of the outcomes of antibiotic therapy and patient responses to treatment is difficult in view of individual variability in oral colonization by pathogenic and commensal bacteria. Therefore, they suggested that decisions about the implementation of antibiotic therapy should be made individually in each patient, as the relationship between the dose and spectrum of action of a given therapeutic agent and the therapeutic response is specific to individuals [6, 8, 16, 17]. Dhiwakar et al. examined a group of 1,035 tonsillectomy patients and found that the implementation of antibiotic prophylaxis is not reflected by lower postoperative pain scores. They also questioned whether the use of antibiotics decreases the risk of post-tonsillectomy fever. Moreover, they did not confirm any beneficial effect of antibiotic prophylaxis on the risk of secondary postoperative bleeding. On the basis of findings reported by Krishna and Lee [28], they suggested that secondary postoperative bleeding is mostly caused by fibrinolytic mechanisms associated with the degradation of fibrin, usually taking place on postoperative days 9–10. This was confirmed by Lowe and van der Meulen [18], who observed that the use of diathermy for tonsillectomy was associated with more severe tissue injury, a larger and thicker fibrin layer on the wound surface and a higher number of postoperative bleeding episodes.

Interesting results were obtained by Milder et al. [29], who analyzed the justifiability of the 2011 clinical practice guidelines from the American Academy of Otolaryngology – Head and Neck Surgery (AAO-HNS), which did not recommend administering antibiotic prophylaxis after tonsillectomies in children and youth. Following the publication of the AAO-HNS guidelines, the use of

perioperative antibiotic prophylaxis after tonsillectomies in the US dropped by 86.5%. In their study Milder et al. found a parallel minor but statistically significant increase in the number of interventions due to postoperative bleeding in patients undergoing tonsillectomies [29].

The current study did not reveal any statistically significant differences in postoperative bleeding. Interestingly, in the case of 19 patients, bleeding of varied intensity from tonsillar niches was observed during the first or subsequent postoperative days. This corresponded to 38% of all the patients in the study, rather than to 1–14% as the statistics in the literature indicate [9, 30]. According to Doshi et al., the statistical data in the literature may be underestimated, which was confirmed by the current findings [31].

Dhiwakar et al. concluded that the lower risk of fever in patients undergoing resection of the palatine tonsils with perioperative antibiotic prophylaxis represents too small a benefit compared to the risk of adverse events associated with this type of intervention [1]. According to Adkinson et al., between 5% and 20% of population are allergic to penicillins [34]. Those authors suggested that the dose and duration of antibiotic therapy should be reduced, e.g. by administering antibiotics in a single perioperative bolus. According to Dhiwakar et al., prophylactic antibiotic therapy is not accompanied by reduced numbers of oral bacteria [1, 6]. Moreover, they hypothesized that it is surgical injury of tissues and nerve endings, with resultant irritation, constriction and pain, that is mostly responsible for the pain of inflamed surgical wounds, rather than bacterial metabolites [6, 8, 18, 28, 32–34]. A similar opinion was presented by Akbas et al. [17]; although they found that the administration of fusafungine reduced pain and improved healing, the pain resolved completely no earlier than 14–20 days post-surgery, i.e. after the epithelialization of surgically exposed muscles and nerve endings.

The reliability of the findings published by Dhiwakar et al. [1] was further confirmed by Thomsen and Gower, who documented similar results in a group of children undergoing tonsillectomy [19]. Obeso et al. analyzed the use of antibiotics during laryngological surgery, and found that the microflora isolated from patients undergoing oral surgery with antibiotic prophylaxis contains predominantly Gram-positive bacteria, with lower participation of Gram-negative and aerobic organisms; in contrast, non-aerobic bacteria predominate within the isolates from patients who do not receive antibiotics, reaching up to 42% of all isolated bacteria [3]. However, the authors postulated that the counts of non-aerobic bacteria may be underestimated as well, since the process of isolating

them is more complex than in the case of aerobes. Furthermore, Obeso et al. [3] used an animal experimental model to study the effects of the route and time of antibiotic administration and the duration of the therapy on postoperative healing. They found that the frequency of infections was considerably lower with preoperative administration of the antibiotic. In contrast, administration of the antibiotic three hours post-surgery was associated with a similar number of infections as in the untreated controls [3]. This was confirmed by Bedwell et al. in their bacteriological examination of resected tonsils, which revealed reduced bacterial counts in the tonsil core from patients who had been treated with clarithromycin prior to surgery [35]. Moreover, Obeso et al. did not find any statistically significant differences in the frequency of infections after various durations of antibiotic therapy or after the administration of clindamycin, cephalosporin, gentamycin, and amoxicillin/clavulanic acid [3]. Consequently, they recommended that the duration of pharmacotherapy should not exceed 24 hours, in order to avoid unnecessary increases in the therapeutic costs, and to reduce the risk of adverse effects, such as diarrhea, allergies or fungal superinfections. On the basis of epidemiological similarities between laryngectomies and gastrointestinal surgeries – both associated with dissection of bacterially contaminated tissues – Obeso et al. suggested that local antibiotic therapy is beneficial during both types of procedures [3]. However, they did not confirm the efficacy of locally administered antiseptics, either alone or combined with antibiotics, or oral antibiotics in the prevention of perioperative superinfections in patients undergoing other types of head and neck surgery. According to some authors, the use of these preventive measures was not associated with reduced bacterial counts in oral lavage [3, 36]. However, Karaman et al. analyzed the effects of local antibiotic prophylaxis in tonsillectomy patients and found a reduction in both aerobic and non-aerobic bacterial counts in tonsillar niches compared with patients who had not received topical antibiotic therapy [20]. Local perioperative antibiotic prophylaxis remains an open issue, as some recent studies have confirmed reduced pain and postoperative bleeding in patients following local perioperative administration of clindamycin [37]. However, there is also research questioning this concept [38].

From the patients' point of view, the level of pain experienced during the healing of tonsillar niches is one of the most important parameters of postoperative care. The severity of pain has a considerable effect on the assessment of other healing parameters, e.g., problems with swallowing, weight loss, discomfort and the return to a normal diet

and activities. Objective evaluation of the severity of pain is an extremely difficult task. Several authors have attempted to examine the level of pain on the basis of the activity of accessory muscles that support swallowing in cases of odynophagia. Their activity was determined by means of superficial electromyography, and the assumption was that electromyographic potentials are proportional to the severity of pain [39].

The results of many published studies support the hypothesis that postoperative pain is caused by metabolites of the bacteria that colonize tonsillar niches. According to this theory, perioperative prophylactic antibiotic therapy should exert a positive effect on postoperative healing parameters. Mann et al. compared the efficacy of oral and parenteral antibiotic therapy with the effects of clindamycin and amoxicillin/clavulanic acid administered locally within the framework of perioperative prophylaxis in tonsillectomy patients [26]. Although all the protocols proved effective, the authors recommended local administration of clindamycin; it was associated with the greatest reduction in the aerobic and non-aerobic bacterial counts in the oral cavity, less severe pain and a shorter duration of mouth odor. Moreover, the considerable reduction in bacterial counts upon local administration of clindamycin persisted for at least 8 h. The authors advocated this form of prophylaxis as opposed to systemic antibiotic therapy; locally administered clindamycin reaches higher tissue concentrations, thus showing stronger bacteriostatic effects with fewer adverse effects [26]. In a similar study conducted by Miura et al., local prophylactic administration of clindamycin during tonsillectomy proved efficient in reducing postoperative pain. However, the only statistically significant reduction of pain was documented on postoperative day 1, with no improvement during consecutive days of treatment with a local antibiotic [40]. Guerra et al. observed that prophylactic administration of an oral antibiotic was accompanied by a significant reduction of pain only on the fourth postoperative day, and did not affect other parameters of healing [16]. Nevertheless, the authors considered this finding beneficial, stating that even transient reduction of pain promotes a return to a normal diet, and thus to resuming the activities of daily living [16, 41]. Zagólski and Kulisiewicz studied 124 children undergoing tonsillectomy and found that those who received antibiotic prophylaxis experienced reduced intensity and duration of postoperative pain, required fewer additional doses of analgesics and returned earlier to normal physical activities [42]. Moreover, the administration of antibiotic therapy was associated with a lower prevalence and shorter duration of mouth odor, and most importantly, with faster

healing and greater satisfaction on the part of the patients' parents. Despite these positive outcomes, the authors highlighted the potential risk of complications related to antibiotic therapy. Therefore, they recommended that patients or their caregivers should be informed of the potential benefits and risks of antibiotic prophylaxis, and should participate in the decision-making process regarding its implementation [42, 43].

The benefits of antibiotic therapy have been identified in many published analyses of postoperative outcomes. However, their authors do not recommend their routine use in patients after resection of the palatine tonsils, as the potential benefits are too small in view of antibiotic therapy-related risks. For example, Grandis et al. [9] observed that the administration of antibiotic prophylaxis shortened the duration of mouth odor and speeded up the patients' return to a normal diet by only one day. Also, a meta-analysis of 23 studies conducted by Iyer et al. revealed that the use of antibiotic prophylaxis only slightly accelerated the return to normal activity [44]. Similar findings were presented by Burkart and Steward, whose meta-analysis and systematic review revealed that oral antibiotic prophylaxis slightly reduces the level of post-tonsillectomy pain, speeding up the return to normal activity and diet by one day [36]. However, the authors postulated that even this much improvement should be considered a positive outcome, since it is associated with economic benefits due to patients' earlier return to work. Moreover, they pointed out flaws in previously published meta-analyses, related to differences in the quality of antibiotics used, the routes of their administration, surgical techniques, anesthesia protocols, measurements and patient characteristics, mostly age and gender [36].

Despite many years of discussion, there is still no definitive answer to the question of whether the use of perioperative antibiotic therapy is associated with any objective benefits for the therapeutic process. In the present study, the patients who received antibiotics did not differ significantly from those who did not in terms of the time before returning to normal activity and diet or the duration of mouth odor. Nevertheless, there were statistically significant intergroup differences in self-assessed problems with swallowing food and fluids. During most of the postoperative period, less severe problems with swallowing were reported by the patients who did not receive antibiotics. However, severity of pain is the most important parameter from the patient's perspective. In this study two criteria were used to verify the level of this parameter in the patients: the use of analgesics, and subjective assessments of the severity of pain, expressed on a 10-item scale. Using the first criteri-

on, it was found that patients operated on without antibiotic prophylaxis experienced a significantly lower level of pain on postoperative day 9. The earlier reduction of the dose of analgesics in this group of patients may reflect faster healing of surgical wounds. However, the study groups did not differ significantly in terms of the subjective assessments of pain severity. As all patients were subjected to the same regimen of analgesia during hospitalization, i.e. metamizole administered parenterally at 2.5 g every 12 h, the first studied criterion (the use of analgesics) could be analyzed only after discharge, and was based on the assumption that the consumption of these agents increases proportionally to the severity of pain. According to the literature, 30% of tonsillectomy patients require higher dose of analgesics than originally prescribed [45]. However, none of the patients in the current study complained that the prescribed dosage was too low.

Most of statistically significant intergroup differences documented in the present study related to objective parameters of healing. The healing process was impaired in patients who received antibiotics, as manifested by a thicker fibrin layer observed on the tonsillar niches on postoperative day 3, and more severe swelling of oral mucosa on postoperative days 3 and 7. These findings constitute a logical explanation for the faster resolution of pain and problems with swallowing documented in patients operated on without antibiotic prophylaxis. No significant intergroup differences were noted in relation to the remaining objective parameters of healing, i.e. the severity of mucosal hyperemia and the incidence of secondary bleeding.

Even considering the potential limitations of this preliminary study, associated with the lack of homogeneity of analyzed groups in terms of age and gender and the subjective assessment of some healing parameters, it did not yield sufficient evidence to support routine use of antibiotic prophylaxis during postoperative care in patients undergoing resection of the palatine tonsils. No significant beneficial effects of antibiotic prophylaxis were observed on the intraoperative parameters analyzed, or on the subjective and objective characteristics of the healing process. Furthermore, the analysis of most objective parameters, i.e. the severity of mucosal swelling and the thickness of the fibrin layer on the tonsillar niches, suggests that the process of healing is better in patients who did not receive antibiotic. These findings are consistent with recent publications and examinations of both children and adult patients. Gil-Ascencio et al. randomized 102 children undergoing tonsillectomy into two groups: those who received antibiotic treatment and those who were not given antibiotic therapy [46]. The authors studied postopera-

tive pain, the time it took to return to normal activity and a normal diet, the duration of bad mouth odor and secondary postoperative bleeding incidents. None of the above parameters displayed statistically significant differences in the groups studied. Similar findings were reported by Baloch et al., who examined a group of 60 adult tonsillectomy patients [47]. Al-Layla et al. [33] and Milder et al. [29] found increased incidence of secondary bleeding in patients subjected to antibiotic therapy.

The findings outlined above substantiate further clinical studies in order to ultimately verify the usefulness of antibiotic prophylaxis during post-tonsillectomy recovery. Until such research is complete, the administration of antibiotics to prevent or control infection should be preceded by a comprehensive analysis of the potential benefits and risks. Routine perioperative use of antibiotics is justified only in selected cases, i.e. in individuals with comorbidities [48].

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