Review Article

MEDICINAL METHODS FOR PREVENTION AND TREATMENT OF ALVEOLAR OSTEITIS

Nikolai V. Muravev[1], Ekaterina Y. Diachkova[1], Elena V. Larionova[1], Svetlana V. Tarasenko[1]*

[1]Department of Oral Surgery, Borovskiy Institute of Dentistry, Sechenov University, Russian Federation. 163789789@mail.ru

https://doi.org/10.51847/W3XENSZyPf

ABSTRACT

The review carried out a retrospective analysis of scientific sources devoted to clinical and experimental studies on the use of various drugs in the treatment of patients with alveolitis to determine the most effective and modern method of therapy for this nosology for the period 2000 to 2020. The selection of scientific literature was done in the electronic medical library eLIBRARY.RU, as well as the database of PubMed medical publications, Google Scholar. According to the literature, various preventive and therapeutic methods based on the multifactorial and complex etiology of dry socket syndrome have been proposed. Alveolitis treatment can be carried out by socket irrigating, revising the socket and performing repeated surgical intervention, as well as through the use of various therapeutic dressings that have antibacterial, local anesthetic properties and prevent oral fluid and food debris from entering the well. However, the most appropriate and effective prevention method has never been identified.

Key words: Alveolitis, Alveolitis treatment, Iodoform, Collagen, Review.

Introduction

Alveolitis is the most common post-extraction complication [1-5]. The main symptoms of alveolitis develop 1-3 days after surgery and represent the pain of varying intensity in the socket area, irradiation of pain to adjacent teeth, ears, temporal region, in some cases - to the neck, eyes, and frontal region, blood clot loss, halitosis, fever to sub-febrile values, reddish gingiva around the socket, exposed alveolar bone, grayish plaque on the walls of the hole, and regional lymphadenitis [1, 4-8].

According to the literature, alveolitis incidence varies from 1 to 4% and also occurs in extractions of the mandibular molar 10 times more than the extractions in the maxilla [1, 3, 9]. Several other studies indicate a value of 0.5 to 5% for the routine tooth extraction [5, 6], alveolitis incidence from 1 to 37.5% for lower third molar extraction [1, 2, 6] and increases up to 45% for removing impact teeth [9].

Alveolitis is one of the most studied complications in dental treatment, while the number of articles devoted to this topic is constantly increasing along with the search for the most effective method for the prevention and treatment of this disease [3]. The main goals of alveolitis treatment are to reduce pain, prevent the growth of bacteria, eliminate inflammation and improve the patient's quality of life [7, 9]. Prevention of alveolitis development is an urgent problem of modern dentistry: the overall morbidity decreases, the patient's rehabilitation period and the number of doctor visits are reduced, and the cost of treatment decreases [9, 10].

According to the literature, various preventive and therapeutic methods have been proposed based on the multifactorial and complex etiology of dry socket syndrome [10]. However, the most appropriate and effective prevention method has not been identified [4, 6, 7, 9].

Materials and Methods

A retrospective analysis of materials from sources of Russian and foreign scientific literature devoted to modern trends in the selection and appointment of pharmacological drugs for the prevention and treatment of alveolar osteitis (e-library, Pubmed, Google Academy) was performed using keywords and their combinations: alveolitis, dry socket, treatment of alveolitis, iodoform, collagen.

Results and Discussion

Methods for alveolitis treatment are quite limited, but there are a large number of drugs for treatment: drugs based on eugenol, chlorhexidine, antibiotics, analgesics, and local anesthetics, enzymes, hemostatic, hormones that are collagen sponges impregnate, pastes, gels, turundas, drugs based on biopolymers such as chitosan, and platelet-rich plasma [3, 5, 7, 9-12]. Alveolitis treatment can be done by irrigating the socket, revising the socket and the second surgical intervention, as well as using a variety of therapeutic dressings that have antibacterial, local anesthetic, and occlusive properties [8].

Zinc-oxide-eugenol paste is widely used as a dressing for alveolitis treatment. This drug was first described by Chisholm in 1873, who mixed clove oil with zinc oxide to

impart plasticity to the mass. Eugenol has a calming and antibacterial effect. At high concentrations, eugenol has a cytotoxic effect, an adverse effect on fibroblasts and osteoblast-like cells, therefore it can reduce the rate of healing [13].

The stability of blood clots in the early postoperative period is the most significant aspect of socket healing and the absence of inflammatory post-extraction complications [7]. Blood clot acts as a framework for angiogenesis and the formation of granulation tissue in the extraction socket. The presence of hemostatic components in drugs for the treatment of alveolitis is the prevention of lysis and atrophy of the blood clot, as well as possible violations in the organization of the clot. As such drugs, various hemostatic sponges containing fibrinogen and thrombin, and as auxiliary substances albumin, collagen, L-arginine hydrochloride, sodium chloride, sodium citrate, riboflavin are used [14].

For the prevention of alveolitis, the use of such antifibrinolytic agents as para hydroxybenzoic acid [15] and tranexamic acid [16] is considered. However, these drugs did not significantly affect the healing of the socket [17, 18].

Infection of the extraction socket plays an important role in the pathogenesis of alveolitis. In this regard, one of the areas to prevent the development and treatment of alveolitis is the appointment of systemic antibiotics, such as penicillin, clindamycin, erythromycin, and metronidazole [4, 6]. However, this prescription for prophylactic purposes is disputed due to the possibility of the development of resistant strains of bacteria and hypersensitivity and disturbance of the patient's microflora [6, 19, 20].

According to some authors, the use of systemic antibiotics to treat alveolitis is also unreasonable, as the inflammatory process only affects the thin, cortical bone lining the tooth socket, so local drugs are sufficient for treatment [4].

Chlorhexidine is the most widely used antiseptic in dental practice [2]. Such properties of chlorhexidine as a wide spectrum of action, the effect on the anaerobic flora, and the lack of microorganisms' resistance make it one of the drugs of choice for preventing the alveolitis development [1, 2, 9]. Chlorhexidine gel can be used directly in the extraction socket: the gel form allows the drug to act on the socket for a long time compared to the chlorhexidine solution [1]. Haraji A. *et al.* (2013) studied the effect of 0.2% chlorhexidine bioadhesive gel on reducing the incidence of alveolitis and reported positive results with a 60-70% reduction in incidence [21].

Shad *et al.* (2018) evaluated the efficacy of 0.2% chlorhexidine bioadhesive gel for the prevention of alveolitis. The study included 180 patients who underwent removal of impacted lower third molars. All patients were divided into two groups: in the study group 0.2% chlorhexidine-based gel was injected into the socket, and in the other group placebo. As a result, the occurrence of alveolitis was recorded in 7.7% of patients in the study group, while in the comparison group, this complication has occurred in 17.7% of patients. The authors concluded that if the chlorhexidine-based gel was used, alveolitis was 2.3 times less likely to develop when the lower third molar teeth were removed [3].

In some studies, the authors noted that the use of 0.12% chlorhexidine solution before and during the intervention reduces the incidence of alveolitis [6, 10].

Topical drugs based on iodoform are widely used in dental practice. Medicines based on this substance are made in the form of solutions, powders, pastes, sponges, flagella, etc., have antiseptic, disinfectant, bactericidal, antifungal, antiprotozoal, and antiviral effects [7, 11]. During the hydrolysis of iodoform, iodine is released, forming iodamine with the proteins of the bacterial cell and coagulating them. This interaction also produces a by-product - formic acid, which irritates the patient's tissues [7].

Kostina *et al.* (2018) conducted an experimental study with the most common drugs on the Russian market for local treatment and prevention of alveolitis, containing iodoform. The concentration of iodoform released from the preparations was assessed by the spectrophotometric method immediately after placing in the model solution, every 15 minutes during the first 2 hours, on the first and second days. Although all preparations differed both in the amount of iodoform and in the desorption of iodine into the aqueous medium, the iodoform content in the preparations did not exceed the maximum permissible concentration (2000 μg per day). Desorption of iodine from turunda after 15 minutes was significantly lower than from the non-woven flagellum; The collagen sponge remains constant during the first day, gradually increasing after 48 hours; reduced from the powder after 45 minutes; from the paste gradually increases, reaching its maximum by the second hour from the introduction and maintaining the concentration for 48 hours. Comparing the iodine desorption from an iodoform turunda - a classic method of treating alveolitis, it was noted that desorption from turunda occurs 1.6 times faster than powder, 3.5 times faster than viscose flagellum, 5.7 times faster than collagen sponge, and 25.2 times faster than paste. The authors of the experiment say that the degree and prolongation of iodoform release from different preparations dosage forms must be taken into account in the practice of alveolitis treatment [7].

Another common drug used to treat alveolitis is "Alvogyl" (Septodont). This is a brown fibrous paste. The preparation contains active ingredients such as butyl paraminobenzoate (25.7 g / 100 g), iodoform (15.8 g / 100 g), and eugenol (13.7 g / 100 g). This product also contains peppermint oil, sodium lauryl sulfate, calcium carbonate, and olive oil [8].

Supe *et al.* (2018) evaluated the clinical efficacy of "Alvogyl" in comparison with the prepared zinc-oxide-eugenol paste. The paste was made independently by mixing powder and liquid. The powder consisted of 80% zinc oxide, 20% polymethyl methacrylate, traces of zinc stearate, zinc acetate, thymol; the liquid contained 85% eugenol and 15% olive oil. This study included 50 patients with alveolitis, who were divided into two groups: in the first group, after antiseptic rinse of the socket with betadine solution and sterile saline, "Alvogyl" was used in the second group, an occlusive dressing soaked in zinc oxide-eugenol paste. Patients were recalled on days 3, 5, 7, and 10, and pain syndrome and healing rate were assessed. Pain intensity decreased faster in the Alvogyl group: the average time required for the complete disappearance of pain was 6.52 days, compared with the other group, where this indicator was 9.06 days. The average time required for the healing of the hole was 7.47 days in the first group and 9 days in the second group. The authors of the study reported that "Alvogyl" is a successful combination drug for the treatment of post-extraction complications [8].

When developing new drugs, especially for the prevention and treatment of alveolar osteitis, researchers pay great attention not only to the active substance itself but also to the direct effect of the carrier on the wound. Collagen is often used as such a fixing material [22].

Materials based on collagen type I have a hemostatic effect, affecting platelet adhesion, protect against plasma loss when closing wound surfaces, play the role of biological drainage of wounds or infected cavities, activate phagocytosis, protects against the development of infections [22]. These materials have therapeutic and prophylactic effects, reduce postoperative pain syndrome, absorb the exudate formed in the socket, prevent its accumulation under the wound covering, are easily placed in the hole and do not require removal, because are capable of resorption, and also promote wound healing by preventing food fragments from entering the extraction socket [7, 22].

Cho *et al.* (2015) evaluated the incidence of post-extraction complications, particularly the development of alveolitis, after removal of the lower third molar in 2697 patients. The sockets of the removed molars are filled with "Ateloplug" (Bioland), which consists of type I collagen. Postoperative complications incidence was 4.52%, and alveolitis developed only in 1.14% of cases. According to the authors of the study, collagen-based drugs can be recommended for the prevention of complications such as alveolitis, postoperative hematoma, and suppuration of the surgical wound [22].

Collagen can also be applied in gel form. Iordanishivili *et al.* (2017) used the wound-healing drug "Agrakol" to prevent the development of alveolitis in patients with type 2 diabetes mellitus. It is a biodegradable hydrogel that forms elastic water and air permeable film on the wound surface. The composition of this drug includes collagen hydrolyzate, a sodium salt of alginic acid, antiseptics (catapol, dioxidin, poviargol), as well as sodium hypochlorite, glycerin. The control group consisted of 25 patients in whom the wound healing took place under a blood clot. In the main group (37 patients), a thin layer of the study drug (up to 1 mm) was applied over the blood clot. In the control group, the incidence of alveolitis was 68.0%, and in the main group - 29.73%. The authors noted that the course of the inflammatory process in the main group was less pronounced [11].

Conclusion

Analysis of the scientific literature showed that one of the most pressing issues in modern surgical dentistry is still to prevent the development and treatment of post-extraction complications, especially alveolar osteitis. Methods and means for alveolitis treatment are relatively limited, however, a significant number of pharmacological agents and options for their use to treat inflammatory complications of tooth extraction. However, the "gold standard" for the management of patients with alveolitis is not determined. Therefore, further study is needed to determine the most effective drug for the prevention and treatment of alveolitis.

Acknowledgments: This paper was supported by the "Russian Academic Excellence Project 5-100".

Conflict of interest: None

Financial support: None

Ethics statement: The protocol for this study was approved by the local ethics committee of Sechenov University. The trail was registered as № 10-20.

References

1. Requena-Calla S, Funes-Rumiche I. Effectiveness of intra-alveolar chlorhexidine gel in reducing dry socket following surgical extraction of lower third molar. A pilot study. J Clin Exp Dent. 2016;8(2):e160-3.
2. Halabi D, Escobar J, Alvarado C, Martinez N, Muñoz C. Chlorhexidine for prevention of alveolar osteitis: a randomized clinical trial. J Appl Oral Sci. 2018;26:e20170245.
3. Shad S, Hussain SM, Tahir MW, Rahat Geelani SR, Khan SM, Abbasi MM. Role of 0,2% Bio-Adhesive Chlorhexidine Gel in Reducing Incidence of Alveolar Osteitis. J Ayub Med Coll Abbottabad. 2018;30(4):524-8.
4. Ansari A, Joshi S, Garad A, Mhatre B, Bagade S, Jain R. A Study to Evaluate the Efficacy of Honey in the Management of Dry Socket. Contemp Clin Dent. 2019;10(1):52-5.
5. Puidokas T, Kubilius M, Nomeika D, Januzis G, Skrodeniene E. Comparative Analysis of Blood Clot,

Plasma Rich in Growth Factors and Platelet-Rich Fibrine Resistance to Bacteria-Induced Fibrinolysis. Microorganisms. 2019;7(9):328.
6. Kolokythas A, Olech E, Miloro M. Alveolar osteitis: a comprehensive review of concepts and controversies. Int J Dent. 2010:249073. doi:10.1155/2010/249073
7. Kostina IN, Molvinskikh VS, Belokonova NA, Ognev MYu. Comparative characteristics of physico-chemical properties of drugs topical application for the prevention of complications of tooth extraction. Probl Dent. 2018;14(4):64-70. (in Russian)
8. Supe NB, Choudhary SH, Yamyar SM, Patil KS, Choudhary AK, Kadam VD. Efficacy of Alvogyl (Combination of Iodoform + Butylparaminobenzoate) and Zinc Oxide Eugenol for Dry Socket. Ann Maxillofac Surg. 2018;8(2):193-9.
9. Teshome A. The efficacy of chlorhexidine gel in the prevention of alveolar osteitis after mandibular third molar extraction: a systematic review and meta-analysis. BMC Oral Health. 2017;17(1):82.
10. Haghighat A, Najafi RB, Bazvand M, Badrian H, Khalighinejad N, Goroohi H. The Effectiveness of GECB Pastille in Reducing Complications of Dry Socket Syndrome. Int J Dent. 2012;2012:587461.
11. Iordanishivili AK, Korovin NV, Lyskov NV, Serikov AA, Muzykin MI, Zhmud' MV, et al. Prophylaxis of the alveolitis at the patients suffering from the diabetes mellitus of second type. Russ Dent. 2017;10(2):25-9. (in Russian)
12. Abdelghany AM, Meikhail MS, El-Bana AA. Microbial activity and swelling behavior of chitosan/polyvinyl alcohol/sodium alginate semi-natural terpolymer interface containing amoxicillin for wound dressing applications. Biointerface Res Appl Chem. 2019;9(5):4368-73.
13. Alemán Navas RM, Martínez Mendoza MG. Case report: late complication of a dry socket treatment. Int J Dent. 2010;2010:479306.
14. Sirak SV, Sletov AA, Chitanava AD. Experience of alveolitis treatment with various antibacterial and hemostatic agents. Far Eastern Med J. 2013;2:56-8. (in Russian)
15. Birn H. Antifibrinolytic effect of Apernyl in “dry socket”. Int J Oral Surg. 1972;1(4):190-4.
16. Anand KP, Patro S, Mohapatra A, Mishra S. The Efficacy of Tranexamic Acid in the Reduction of Incidence of Dry Socket: An Institutional Double-Blind Study. J Clin Diagn Res. 2015;9(9):ZC25-8.
17. Solanki N, Patel Y. Drug Utilization Pattern and Drug Interaction Study of Antibiotics Prescribed to Orthopedic Patients in Private Hospital. Arch Pharm Pract. 2019;10(4):114-7.
18. Sergeevna SM, Efimovna LE, Irina K. Pharmaceutical consulation as a basis for drug care continuity. Pharmacophore. 2020;11(4):76-82.
19. Ali GW, Abd El-Moez SI, Abdel-Fattah WI. Synthesis and characterization of nontoxic silver nano-particles with preferential bactericidal activity. Biointerface Res Appl Chem. 2019;9(6):4617-23.
20. Garipov R, Davtyan A, Diachkova E, Volkova M, Repina S, Tarasenko S. Efficiency and Microbiological Substantiation of the Use of Er: YAG and Nd: YAG Lasers in Patients with Inflammatory Diseases of the Peri-Implant and Periodontal Tissues. Biointerface Res Appl Chem. 2021;11(3):10141-7.
21. Haraji A, Rakhshan V, Khamverdi N, Alishahi HK. Effect of intra-alveolar placement of 0,2% chlorhexidine bioadhesive gel on dry socket incidence and postsurgical pain: a double-blind split-mouth randomized controlled clinical trial. J Orofac Pain. 2013;27(3):256-62.
22. Cho H, Jung HD, Kim BJ, Kim CH, Jung YS. Complication rates in patients using absorbable collagen sponges in third molar extraction sockets: a retrospective study. J Korean Assoc Oral Maxillofac Surg. 2015;41(1):26-9.