CYTOLOGICAL ASSESSMENT OF HEALING ODONTOGENIC INFLAMMATORY PROCESSES WHEN APPLYING HYDROGELS

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ABSTRACT

INTRODUCTION**:** Odontogenic inflammatory processes constitute a significant part among maxillofacial disorders, as well as among all inflammatory processes in organism. The author used hydrogels saturated with silver ions and an antioxidant drug for local treatment of odontogenic abscesses and phlegmons.
AIM OF THE STUDY**.** To conduct cytological assessment when applying hydrogels saturated with silver ions and an antioxidant drug for local treatment of odontogenic abscesses and phlegmons.
STUDY SUBJECT AND STUDY METHODS**.** 50 patients with odontogenic abscesses and phlegmons of maxillofacial area had been examined. To study the dynamics of the inflammatory process, cytology was performed on days 1, 3, 5, 7, 10.
STUDY RESULTS AND THEIR DISCUSSION. No differences were found in both groups of patients on the first day of treatment. On the second or third day, there was a higher number of red blood cells and a significant decrease in the number of neutrophilic granulocytes in the study group than in the comparator group. In the fibrin strands, accumulation of single macrophages, histiocytes, fibrocytes and monocytes were noted. During analysis of cytograms, an increase in the number of erythrocytes, histiocytes, fibroblasts, almost complete absence of neutrophilic granulocytes and single macrophages in the main group were observed on the 4-5 day, indicating the formation of granulation tissue and accelerated onset of proliferation. On the sixth day, patients of the study group had almost no neutrophils and no signs of inflammation, unlike patients in comparator group.
CONCLUSIONS**.** Cytology results has shown that application of hydrogels saturated with silver ions and an antioxidant drug for local treatment of odontogenic abscesses and phlegmons accelerates the healing time of postoperative wounds.

KEY WORDS: wounds healing, cytology, hydrogels, odontogenic abscesses and phlegmons.

INTRODUCTION.

Odontogenic inflammatory processes constitute a significant part among maxillofacial disorders, as well as among all inflammatory processes in organism. Odontogenic abscesses and phlegmons are characterized by severity of the course, complicated postoperative treatment, extension of antibiotic resistance in patients and possible complications [1, 2, 3, 4].

Disadvantages of known local treatment means of odontogenic abscesses and phlegmons after their surgical opening have led to the need to search for and develop more advanced and multifunctional methods of local therapy [5, 6].

Hydrogel dressings for topical use, which are saturated with various medications, deserve special attention. They are known to be used in the treatment of burns, trophic ulcers, diabetic angiopathies, etc. [7, 8, 9, 10]. They are characterized by a number of advantages and positive qualities compared to conventional wound dressings. Hydrogels are completely biocompatible; have a slight anaesthetic effect due to cooling of the wound surface; have sorption properties; are atraumatic when replaced; have a prolonged effect; are transparent, which

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ensures control of the wound surface without removing and replacing the coating and, most importantly, can be saturated with various medicinal substances [11, 12, 13, 14, 15].

The author used hydrogel dressings saturated with silver ions and an antioxidant drug for local treatment of odontogenic abscesses and phlegmons.

The saturation of hydrogels with silver ions provides bactericidal, anti-inflammatory, and reparative functions. Silver can destroy the cell membrane of pathogenic microorganisms and block cyclooxygenase. It has an effect on the DNA of bacterial cells, which leads to disruption of mitosis and reproduction. The use of silver-containing preparations creates optimal conditions for epithelialization and reparative regeneration of wound surfaces. This is due to their effect on the proliferation of keratinocytes, the functional activity of fibroblasts, which contributes to the active formation of granulation tissue. To date, there is no information on the occurrence of resistance of pathogenic microflora to silver ions.

Quercetin is a natural flavonoid having a wide list of positive pharmacological properties and it does not have a pathological effect on tissues. Quercetin is a powerful antioxidant blocking free radicals both of endogenous and exogenous origin by inhibiting free radical lipoperoxidation of membranes, inhibiting 5-lipoxygenase, whose phenolic structure reduces the intensity of lipid peroxidation. Quercetin is characterized by anti-inflammatory, antiviral, anti-allergic and antitumour properties, blocks the release of serotonin and other inflammatory mediators, inhibits the production of pro-inflammatory cytokines, and increases the phagocytic activity of neutrophilic granulocytes [16, 17].

AIM OF THE STUDY.

To conduct cytological assessment when applying hydrogels saturated with silver ions and an antioxidant drug for local treatment of odontogenic abscesses and phlegmons.

STUDY SUBJECT AND STUDY METHODS.

While performing this study ones adhered to generally agreed world and domestic standards in accordance with general provisions of World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects (1964-2008).

The author conducted treatment of 50 patients with odontogenic abscesses and phlegmons of maxillofacial area. Patients were divided into two groups randomly. Comparator group (20 patients) consisted of patients who received standard treatment for odontogenic phlegmon and abscesses, which included opening the inflammatory focus, evacuation of purulent exudate and drainage of the abscess. Ordinary gauze bandages were used as a dressing material. The wounds were scoured with Furacilin solution. At the stage of transition to the second healing phase, dressings with Levomikol ointment were applied before the onset of acentric epithelialization.

Patients of study group (30 patients) in addition to standard surgical treatment, in the postoperative period, hydrogel dressings saturated with silver ions and the antioxidant drug Quercetin were used for dressings (Fig. 1).

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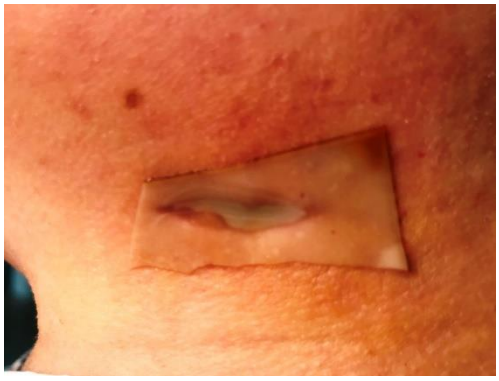

Figure 1. Postoperative wound after incision of odontogenic phlegmon in submandibular space on the left. The wound is covered with sterile hydrogel dressing saturated with silver ions and an antioxidant drug.

In addition to local treatment, the general therapy was conducted in patients, which included antibiotic therapy, antihistamines, detoxification therapy and general restorative therapy. During the surgery or the next day, depending on the specific clinical situation, the odontogenic source of infection (the "causative tooth") was removed.

Surgeries were performed under general or local anaesthesia, depending on the patient's psycho-emotional state.

All patients included in the study have been undergoing treatment on account of abscesses and phlegmons of submandibular tissue space only. Also, patients with a history of diabetes mellitus were not included in the clinical groups. Such sampling conducted to ensure greater reliability of obtained results.

Dressings were changed daily until the start of wound epithelialization and included removal of the previously applied dressing, visual assessment of the wound surface, antiseptic treatment, necrectomy (if necessary), replacement or removal of drains, and application of a new dressing. Hydrogel dressings were fixed on the postoperative wound with a bandage that ensured reliable fixation and fit.

Prints were taken with a sterile, degreased slide in several areas of the wound, then allowed to dry, fixed in an alcohol solution and stained. The course of the wound process was assessed by quantitative counting of cellular elements. Presence and quantitative content of neutrophilic granulocytes and their degenerative forms, lymphocytes, monocytes, macrophages, histiocytes, fibroblasts, and phagocytosis activity were determined. Prints were taken on 1, 2, 3, 4, 5, 6 day. Obtained preparations have been probed microscopically with 40x objective magnification, and simultaneously photographs were taken using a microscope camera [18, 19, 20].

STUDY RESULTS AND THEIR DISCUSSION.

Having analyzed obtained cytograms in patients of both groups on the *first* day of treatment, no significant differences were found between them. In both groups, neutrophilic granulocytes were observed against the background of erythrocytes, which evenly covered almost the entire field of view. Leukocytes with disturbed nuclear contours and in a state of incomplete phagocytosis. Elements of macrophages and single connective tissue cells (histiocytes) were noted. In general, the cytological picture in the main and comparison groups corresponded to an acute inflammatory process (Figs. 2 and 3).

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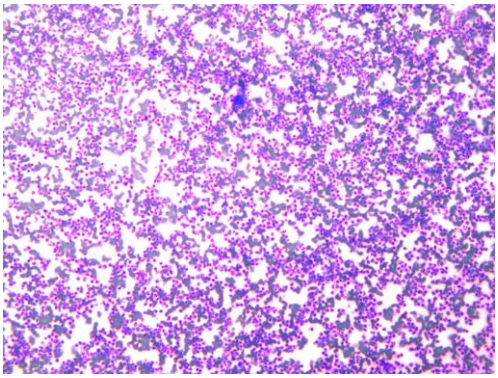

Figure 2. Cytology of wound surface. 1 day, study group.

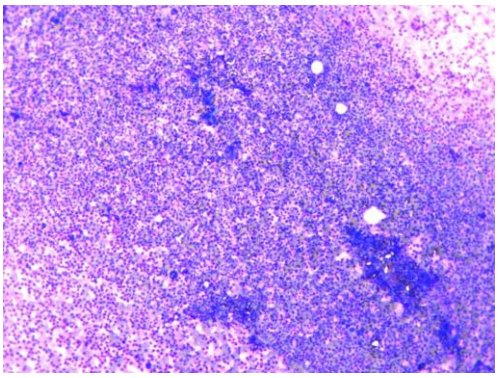

Figure 3. Cytology of wound surface. 1 day, comparator group.

On the *second* day of study, cytological performance already had some noticeable differences between the comparator group and the study group. There was a decrease in the number of neutrophilic leukocytes (up to 100 per high power field), which perform the function of removing germs from the wound, foreign bodies and tissue decay products. A higher number of erythrocytes was observed in the study group than in the comparator group. In the fibrin strands, there was an accumulation of single macrophages, histiocytes, fibrocytes and monocytes. Thus, the state of incomplete phagocytosis was noted in the cytograms of patients from the study group, by contrast of patients from comparator group, in which phenomena of completed phagocytosis prevailed (Figs. 4 and 5).

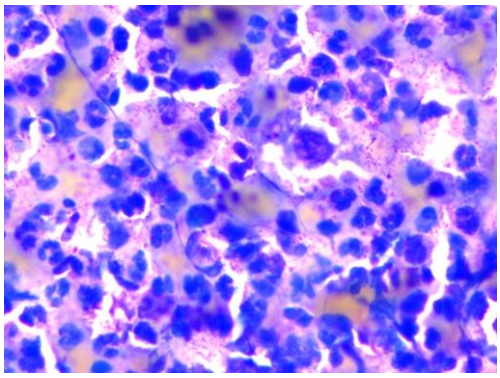

Figure 4. Cytology of wound surface. 2 day, study group.

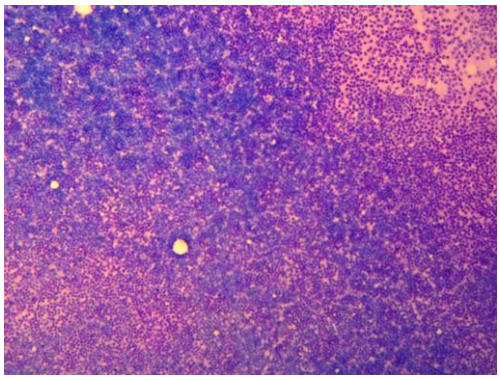

Figure 5. Cytology of wound surface. 2 day, comparator group.

Observations on the *third* day showed that patients treated with hydrogels for topical treatment had a significant decrease in the number of neutrophilic granulocytes (30-50 in the field of view) and macrophages, in contrast to the comparison group (60-80 per high power field) and compared to the previous day. In these patients, leucocytes (neutrophiles) rarely formed dense clusters in the mucous membranes. A small number of connective tissue cells - histiocytes, fibroblasts, fibrocytes were also observed. The cellular picture in patients of comparator group was much poorer in connective tissue elements, which were almost not observed per high

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power field of the cytogram. In these patients, the phenomena of completed phagocytosis and active inflammation continued (Figs. 6 and 7).

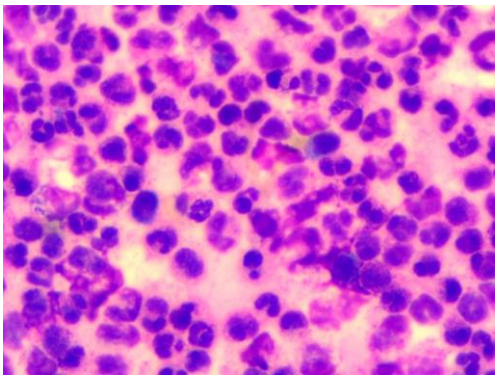

Figure 6. Cytology of wound surface. 3 day, study group.

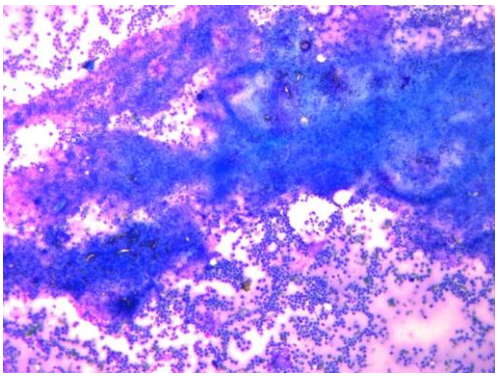

Figure 7. Cytology of wound surface. 3 day, comparator group.

When analyzing cytograms of patients from the study group on the *fourth* day, an increase in the number of erythrocytes, histiocytes, fibroblasts was observed, indicating the beginning of appearance and formation of granulation tissue on the wound surface. Fibrous and mucous-like cords with moderate leukocyte accumulations are commonly observed in the comparator group. Single connective tissue cells (histiocytes, fibroblasts, fibrocytes) have been found locally. As can be seen from the analysis of obtained cytograms, on the 4th day, alternative-exudative reactions in the study group are changing to regenerative ones, which is manifested in the clearing of wound surfaces. In patients of the comparator group, alternative processes continue to prevail (Figs. 8 and 9).

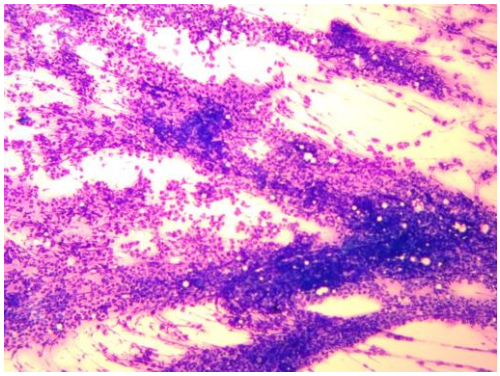

Figure 8. Cytology of wound surface. 4 day, study group.

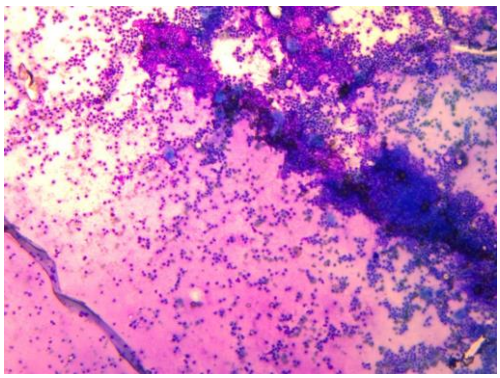

Figure 9. Cytology of wound surface. 4 day, comparator group.

On the *fifth* day, the cytograms showed a significant number of erythrocytes, almost complete absence of neutrophilic granulocytes (5-10 per high power field) in the state of completed phagocytosis and single macrophages. In the comparator group, there was a significantly lower number of erythrocytes and a moderate number of neutrophilic granulocytes (20-30 per high power field) in a state of completed and incomplete phagocytosis. There was observed an

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increase in the number of fibroblasts, indicating an accelerated onset of proliferation in the study group. In these patients, cytological picture meets the course pf inflammatory process (Fig. 10 and 11).

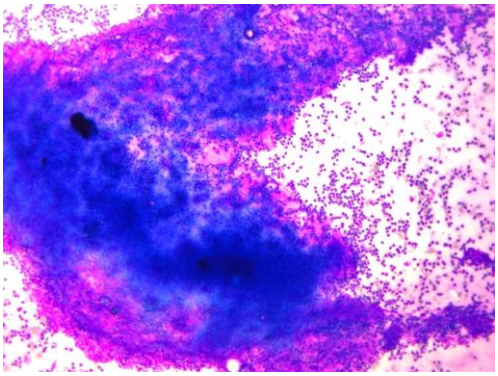

Figure 10. Cytology of wound surface. 5 day, study group.

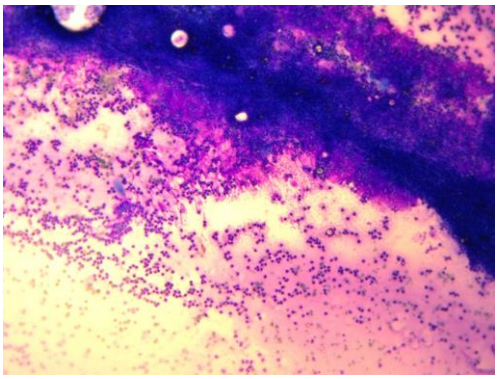

Figure 11. Cytology of wound surface. 5 day, comparator group.

On the sixth day, patients in the study group had almost no leukocytes (neutrophils) per high power field. The number of red blood cells and connective tissue cells increased. Patients in the study group showed almost no signs of inflammation, in contrast to patients in the comparator group, in whom neutrophilic granulocytes (5-10 per high power field) were still observed (Figs. 12 and 13).

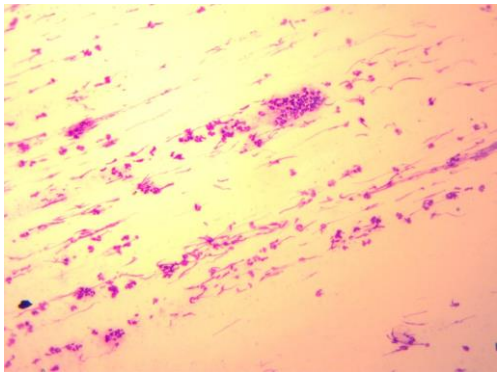

Figure 12. Cytology of wound surface. 7 day, study group.

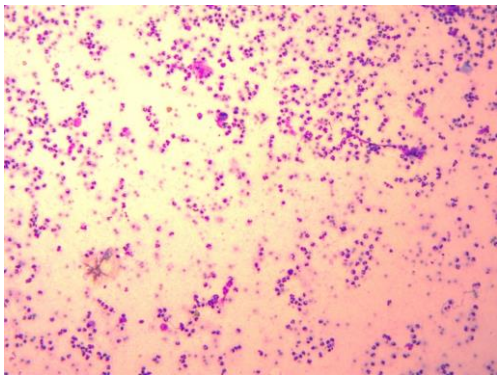

Figure 13. Cytology of wound surface. 7 day, comparator group.

Analysis of cytograms in patients of both clinical groups did not reveal any significant differences on the first day of treatment. Neutrophilic granulocytes, leukocytes in a state of incomplete phagocytosis, a small number of macrophages and histiocytes were observed against the background of erythrocytes. This cytological picture meets the descriptions of the acute inflammatory process by other scientists [21, 22]. On the second or third day of the study, the cytological picture already had noticeable differences between the comparator group and study group. There was observed a higher number of erythrocytes and a significant decrease in the number of neutrophilic granulocytes in the study group than in the comparator group. In the

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fibrin strands, accumulation of single macrophages, histiocytes, fibrocytes and monocytes was noted. That is, the cytograms of patients in the comparator group showed a state of incomplete phagocytosis, in contrast to patients in the study group, where the phenomena of completed phagocytosis prevailed. The results obtained do not contradict the data of scientific medical literature [23].

When analyzing cytograms on the 4-5 day, an increase in the number of erythrocytes, histiocytes, fibroblasts, an almost complete absence of neutrophilic granulocytes and single macrophages in the study group was observed, indicating the formation of granulation tissue and an accelerated onset of proliferation processes, as noted by the authors who studied the cytological picture in the healing of purulent wounds. On the sixth day, patients in the study group had almost no neutrophils and no signs of inflammation, unlike patients in the comparator group. The positive effect of hydrogels on wound healing is confirmed by the data of various scientists, which is confirmed by relevant publications [24, 25, 26, 27, 28].

CONCLUSIONS.

According to the results of cytological studies, it can be established that the use of hydrogel dressings saturated with silver ions and an antioxidant drug for the local treatment of purulent inflammatory wounds of odontogenic etiology can reduce the severity of local inflammatory reactions, accelerate healing time and the onset of reparative processes at the local level. Cytograms data indicates that application of proposed local therapy promotes the growth of nonspecific resistance of organism.

DIRECTIONS FOR FUTURE RESEARCHES.

Study results may be used for the following clinical examination of the effectiveness of application hydrogel dressings saturated with silver ions and an antioxidant drug for the local treatment of odontogenic abscesses and phlegmons.

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