

Heart Rate Variability, Pain Syndrome and Cortisol Concentration in Oral Fluid During Sinus-Lifting And Dental Implantation

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Abstract: Acute pain serves as an important biological function because it warns of the degree of damage or its potential deterioration. This is a rapid response to a harmful stimulus that does not lead to long-term consequences [1]. On the other hand, it can have various psychological and emotional consequences. Attention is therefore focused on aggressive prevention and treatment of acute pain to reduce complications and progression of chronic pain conditions. The study of pain syndrome after dental surgery is still relevant [2, 3], since in clinical [2-11] and experimental studies [12-20] it was shown that surgical interventions in the maxillofacial region entail a cascade of stress reactions [21, 22].

Keywords: sinus-lifting, dental implantation, acute pain, chronic pain, surgical interventions.

1. Introduction

Acute pain serves as an important biological function because it warns of the degree of damage or its potential deterioration. This is a rapid response to a harmful stimulus that does not lead to long-term consequences [1]. On the other hand, it can have various psychological and emotional consequences. Attention is therefore focused on aggressive prevention and treatment of acute pain to reduce complications and progression of chronic pain conditions.

The study of pain syndrome after dental surgery is still relevant [2, 3], since in clinical [2-11] and experimental studies [12-20] it was shown that surgical interventions in the maxillofacial region entail a cascade of stress reactions [21, 22]

2. The purpose of the study.

To determine the most adequate anesthesiological aid regimens in patients with sinus-lifting with simultaneous dental implantation by minimizing stressors.

3. Materials and methods.

Before surgical manipulation, electrodes for ECG recording were applied to the patient, then oral fluid was taken by chewing special tampons by the patient for subsequent evaluation of cortisol therein.



Sinus-lifting was performed with simultaneous dental implantation. Deproteinized porcine spongiform bone, Ovis XENO-P xenogenic porcine bone material (DENTIS, Korea), was used as osteoplastic material. Titanium dental implants (Alpha Bio, Israel) were used as the implant.

After the end of the surgical manipulation, saliva was repeatedly taken by this method and the electrodes were removed.

Patients were randomly assigned to 3 groups who were orally prescribed non-steroidal anti-inflammatory drugs of various classes: etorocoxib, nimesulide, ketorol.

Three-time sampling of oral fluid was carried out. Patients were asked to chew a special swab for 3-4 minutes. A comparison group was formed, which was made up of 25 healthy men and women aged 20 to 37 years. Oral fluid sampling in the comparison group was carried out between 10:00 and 16:00. The taken material was subjected to electrochemiluminescent immunoassay

HRV was assessed based on an analysis of electrocardiogram records. ECG was carried out using the Varikard hardware and software complex. The following ECG intervals were evaluated: before the oral examination, 20 ± 4 minutes; from the moment of anesthesia until the end until the start of surgery, 76 ± 14 minutes; from the end of the surgery until the end of the second intake of oral fluid, $16 \pm 4,5$ min..

A day later, patients were invited for re-examination to assess the implant, assess the intensity of pain syndrome and record an ECG.

4. Study results.

Pain syndrome. One hour and three hours after surgery, patients in Group 3 had the most severe pain syndrome compared to patients in the remaining groups ($p < 0.001$). After 6 hours, patients in Group 2 had significantly lower pain intensity than patients in Group 3 ($p < 0.05$), but higher pain intensity than patients in Group 1 ($p < 0.01$).

A day after the end of the operation, patients of Group 1 had practically no pain syndrome, and pain in patients of Group 2 was lower than in patients of Group 3 ($p < 0.001$). At this time, patients in Group 2 had significantly higher pain intensity than in Group 1 ($p < 0.01$). After 48 hours, patients in Groups 1 and 2 had no pain, and patients in Group 3 had mild pain, which was higher than in the first two groups ($p < 0.01$).

On the facial pain scale, severe pain syndrome was noted only in the third group during the first 3 hours.

Changes in heart rate variability. The dynamics of changes in the ultra-low-frequency component of the HRV. 20 minutes after the end of surgery, ULF significantly decreased in group 3 ($p < 0,001$) and remained the same over the next 24 hours. In the first group, ULF significantly increased compared to the moment of surgery ($p < 0.01$), and no changes occurred after 24 hours. In the second group, this indicator throughout did not have dynamics. At 120 minutes of ECG monitoring, ULF was significantly lower in patients in Group 3 compared to patients in Groups 1 and 2 with no differences at that time point. A day later, ULF was significantly lower in Group 2 than in Group 1 and higher in Group 3 ($p < 0.01$) and lower in Group 3 than in Group 1 ($p < 0,001$).

The dynamics of changes in the very low-frequency component of the HRV. VLF was higher in Group 1 patients compared to Group 2 and Group 3 ($p < 0,001$) patients. Patients in Group 3 had significantly lower very low-frequency component values at the specified time point than patients in Group 2 ($p < 0.05$). Every day after surgery, the values in Group 2 were significantly higher than in Group 3 ($p < 0.001$), but lower than in Group 1 ($p < 0.01$).



The dynamics of changes in the low-frequency component of the HRV. The low-frequency component values had fewer differences than the above-described HRV values. So, before, on time and immediately after the closed sinus-lifting with simultaneous implantation, there were no statistically significant differences either between the estimated periods or between the groups. But it should be noted that after the end of surgical manipulations in the second group, LF was significantly lower than in the 1- group ($p < 0.05$), and higher than in the 3rd group ($p < 0.01$). A day after the operation, LF in all groups increased significantly ($p < 0.01$), but in the 3rd group it was significantly lower, we in the remaining groups ($p < 0.001$).

Dynamics of changes in the vagosympathic index. An inter-group comparison showed that no differences were identified before and during surgery. After surgery, Group 2 had a significantly lower LF/HF ratio than Group 1 ($p < 0.01$) and a significantly lower LF/HF ratio than Group 3 ($p < 0,001$) than Group 1 ($p < 0,001$).

Changes in cortisol concentration in oral fluid. Compared to a group of healthy individuals, patients in all three groups before surgery had no significant difference in cortisol concentration. At 20 minutes after surgery, cortisol was significantly higher in Group 1 than in the comparison group ($p < 0.01$). Patients who took nimesulide and ketorol also had higher cortisol values than healthy individuals ($p < 0.001$). The comparison group and patients from the etoricoxib group did not differ significantly in the day after surgery, but its concentration was significantly higher in the 2nd ($p < 0.05$) and 3rd groups ($p < 0.001$). Cortisol concentration was significantly higher in Group 2 after 20 minutes of surgery than in Group 1, but lower in Group 3 ($p < 0.01$). In the ethericoxib group, its concentration was significantly lower than in the ketorol group ($p < 0.001$). A day after the end of closed sinus-lifting with single-stage implantation, the highest cortisol level was recorded in patients of group 3, compared with patients of other groups ($p < 0.001$). At the same time, the 1st and 2nd groups did not differ significantly from each other.

5. Discussion.

The choice of analgesics is based on previous safety and tolerability studies. Nonsteroidal anti-inflammatory drugs (NSAIDs) cyclooxygenase-2 (COX-2), which selectively blocked the iso-enzyme TsOG-2, were designed to limit the side effects of NSAIDs. Etoricoxib is known to be a selective inhibitor of the TsOG-2 enzyme. It is an effective analgesic that is associated with a reduced risk of bleeding due to platelet dysfunction, gastrointestinal bleeding, and ulcers [23, 24]. No gastrointestinal adverse events were noted in the present study.

Etoricoxib had significant anti-inflammatory efficacy and had beneficial effects on local postoperative trauma than tramadol. The reduction in inflammation caused by etoricoxib and tramadol on day 5 was significantly higher (86.67% and 70%, respectively). On the other hand, only about 13% of patients treated with etoricoxib reported mild inflammation even on Day 5, while 30% of patients treated with tramadol reported mild inflammation on Day 5.

A higher percentage of patients taking etoricoxib (30%) reported both pain reduction and unrestricted mouth opening, compared to those taking tramadol (23%). The results of the unpaired t-test revealed a difference in the efficacy of etoricoxib compared to tramadol. The difference was extremely significant on days 2 and 4, while a significant difference existed on all other days.

There was a long-lasting analgesic effect when treated with etoricoxib. Patient assessment results showed a statistically significant difference in pain reduction for etoricoxib (93.34%



reported no pain) compared to tramadol (60% did not experience pain) at the end of 5 days. In the present study, it was the ethericoxib group that showed the smallest pain syndrome compared to the nimesulide and ketorol group.

The data obtained in the present study are supported by data from other authors. Thus, patients taking LVTD from the group of non-selective COX inhibitors had more pronounced sympathicotension, greater tension of the autonomic nervous system, as a result of their smallest analgesic activity, and more pronounced effects on other organs and systems [25], compared to selective TsOG-2 blockers.

6. Conclusions.

As a result of the analysis of the intensity of postoperative pain syndrome, the assessment of heart rate variability and cortisol concentration in the oral fluid, it has been found that the use of selective blockers TsOG-2 from the coxibes group compared to non-selective cyclooxygenase blockers and blockers is predominantly TsOG-2, reduces intensity of stress reactions, leads to less secretion of cortisol by salivary glands during a day and improves postoperative course of patients during the first three days undergoing sinus-lifting with simultaneous dental implantation.

The use of non-steroidal anti-inflammatory drugs during sinus-lifting with simultaneous dental implantation in patients in the perioperative period from the class of non-selective TsOG-2 blockers and from the class of predominant TsOG-2 blockers leads to greater secretion of cortisol by the salivary glands during the day (20 minutes after surgery - 23,67±1,29 nmol/L and 27,43±1,34 nmol/L, respectively) after surgery, compared to selective TsOG-2 blockers (18,04±1,73 nmol/L).

Diagnosis of pain syndrome after sinus-lifting with simultaneous dental implantation using a digital rating scale and a facial pain scale can be accurate only with pronounced pain intensity (above 31,09±2,82 mm by CRS).

The article is written without the use of artificial intelligence technologies.

Acknowledgments. Scientific article.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

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