

CLINICAL AND INFORMATIONAL ASSESSMENT OF THE EFFECTIVENESS OF TREATMENT OF MAXILLOFACIAL AREA INFLAMMATORY DISEASES: THE RESULTS OF PERIOPERATIVE MONITORING

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КЛІНІКО-ІНФОРМАЦІЙНА ОЦІНКА ЕФЕКТИВНОСТІ ЛІКУВАННЯ ЗАПАЛЬНИХ ЗАХВОРИВАНЬ ЩЕЛЕПНО-ЛИЦЕВОЇ ДІЛЯНКИ: РЕЗУЛЬТАТИ ПЕРИОПЕРАЦІЙНОГО МОНІТОРИНГУ

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КЛИНИКО-ИНФОРМАЦИОННАЯ ОЦЕНКА ЭФФЕКТИВНОСТИ ЛЕЧЕНИЯ ВОСПАЛИТЕЛЬНЫХ ЗАБОЛЕВАНИЙ ЧЕЛЮСТНО-ЛИЦЕВОЙ ОБЛАСТИ: РЕЗУЛЬТАТЫ ПЕРИОПЕРАЦИОННОГО МОНИТОРИНГА

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Abstract. Application of methodology of clinical and informational assessment of comprehensive treatment effectiveness was showed to provide an opportunity to consider multiple-factor effects (both positive and negative) of the chosen rehabilitation approach impact in the system of comprehensive treatment. Increase in specific contribution of psychophysiological components into entropy of clinical and informational system and, consequently, the increase in order of adaptation mechanism were proven. Absolute entropy of clinical and informational system was proven to decrease as a result of comprehensive treatment of patients with maxillofacial area inflammatory diseases. This determined 20.0 % of effectiveness of pathognomonic changes pathogenetic correction.

Keywords: dentistry; inflammatory diseases; maxillofacial area; perioperative monitoring; effectiveness.

Резюме. Продемонстровано, що застосування методології клініко-інформаційної оцінки ефективності комплексного лікування дозволяє урахувати багатofакторні ефекти (як позитивні, так і негативні) впливу обраної реабілітаційної тактики в системі комплексного лікування. Доведено, що на етапах клінічного моніторингу відбувається зростання питомого вкладу психофізіологічної компоненти в ентропію клініко-інформаційної системи та, відповідно, зростання впорядкованості адаптаційних механізмів. Доведено, що в результаті комплексного лікування пацієнтів із запальними захворюваннями щелепно-лицевої ділянки, абсолютна ентропія клініко-інформаційної системи зменшилась, що визначило 20,0% ефективності патогенетичної корекції патогномонічних змін.

Ключові слова: стоматологія, запальні захворювання, щелепно-лицева ділянка, периопераційний моніторинг, ефективність.

Резюме. Продемонстрировано, что использование методологии клинико-информационной оценки эффективности лечения пациентов с воспалительными заболеваниями челюстно-лицевой области позволяет учитывать многофакторные эффекты влияния избранной реабилитационной тактики в системе комплексного лечения. Доказано, что на этапах мониторинга возрастает удельный вес психофизиологической компоненты в энтропии клинико-информационной системы и, соответственно, возрастает упорядоченность адаптационных механизмов. Доказано, что в результате комплексного лечения пациентов с воспалительными заболеваниями челюстно-лицевой области, абсолютная энтропия клинико-информационной системы уменьшилась, что предопределило 20,4% эффективности патогенетической коррекции патогномонических для воспалительных заболеваний челюстно-лицевой области изменений.

Ключевые слова: стоматология, воспалительные заболевания, челюстно-лицевая область, периоперационный мониторинг, эффективность.

Problem statement and analysis of the recent research. Treatment of inflammatory diseases (ID) of maxillofacial area (MFA) is known to be one of the urgent tasks of Maxillofacial Surgery as the incidence of the pathology complications determines the need for further improvement of comprehensive treatment (CT) including rehabilitation measures [1-4]. Both preoperative and postoperative period are unconventionally important in the system of comprehensive treatment of patients with ID of MFA when the state of periodontal tissues and psychophysical recovery of the patient are crucial concerning

the restoration and full functional recovery on the background of morphological substrate recovery [5-7]. Functional approach and early onset of rehabilitation program are able to provide this [12, 13]. Modern trends in comprehensive treatment of patients with ID MFA undergo profound changes which is associated with the introduction of modern surgical technology, methods for adaptive bioenergy reserve assessment, approach to periodontal tissues protection and rehabilitation programs into practice [8, 9]. In addition, methodology for CT effectiveness as a prerequisite for individualized approach choice requires

improvement. One of the assessment methods of dynamic multiple-factor processes, including clinical status of patients is informational entropy analysis (IEA). IEA is especially relevant in case of complex assessment of CT effectiveness [10, 11, 14]. In addition, known clinical and informational models of assessment of CT effectiveness of patients with ID of MFA are not usually characterized by component considering of its constituents.

The objective of the research was to develop and evaluate methodology of informational entropy analysis of effectiveness of patients with inflammatory diseases of maxillofacial area comprehensive treatment.

Materials and methods of the research

Generalized clinical and informational analysis was conducted based on the initial data [7, 10, 11] obtained during clinical monitoring (CM) stages according to specific components indices characterizing patient’s psychophysiological state (psychophysiological component (PPC)), general clinical dental health (clinical and morphological component (CMC)), immune and metabolic (immune and metabolic component (IMC)) and biophysical (biophysical component (CBC)) properties of oral fluid (OF). Initial data of preoperative period were used in order to obtain clinical and informational indices for each of the components. Informational properties of specific clinical manifestations were assessed at the further CM stages in comparison with preoperative period. Such innovative approach was implemented as part of Clinical Informatics principles which fully meets modern requirements of modern clinical research evidence, particularly in the field of Clinical Dentistry.

General clinical dental health (GCDH) of 147 patients with odontogenic ID of MFA was studied at the stages of their perioperative monitoring (CM), namely at the first stage – in the preoperative period, at the second stage – in the early postoperative period (in 3-5 days), at the third stage – in the late postoperative period (in 2-3 weeks), and at the fourth stage – in the remote postoperative period (in 5-6 weeks).

The evaluation of dental health was performed according to papillary-marginal-alveolar (PMA) index, oral hygiene index (OHI-S), hemodynamic parameter of vacuum-pressure area-based resistance (VPABR) of gingival capillaries. The research was performed according to a standardized program of collection, accumulation and analysis of the results. Five-point score was used during PMA assessment (0 points – no inflammatory reaction; 1 point – mild manifestations: mild swelling, no bleeding at palpation, minor gums discoloration; 2 points - moderate inflammation, gingival hyperemia, gingival edema, bleeding in case of contact; 3 points – severe inflammation, significant hyperemia and edema, sores development; 4 points – generalized inflammatory manifestations). OHI-S assessment was performed according to Green-Vermillion methodology “Oral Hygiene Index Simplified, Green-Vermillion, 1964”. At the stage of treatment effectiveness assessment and in different periods before and after the treatment such parameters as saliva flow rate, oral fluid pH, its viscosity, and urease activity were determined in patient’s oral fluid [4, 6, 7, 9, 14] with further calculation of oral fluid buffering capacity (OFBC) and relative urease activity index. The content/activity levels of catalase (CAT),

superoxide dismutase (SOD), reduced glutathione (RG), and secretory immunoglobulin A and dysbiosis severity were determined in the oral fluid [1, 3, 5, 9]. The research was conducted according to a standardized program of collection, storage and analysis of the results. Common and widely used clinical and statistical anamnestic quantitative analysis, variation statistics, probability distribution of clinical signs with study validity assessment was applied. Clinical and statistical data were processed by methods of variation statistics (arithmetical average; its errors; arithmetical average differences were considered reliable according to one-tailed Student’s t-test with $p < 0.05$). Information analysis methodology by specific indices was applied with calculation of h – index informative value according to the formula $h = -p_i \log_2 p_i$, where p_i – is interrelation of the index in the treatment period and its value in the preoperative period. Since all indicated indices were used at CM stages, total entropy of the system and its components was calculated as the sum of informative indicators.

Results of the research and their discussion

Orderliness (entropy) of four-component system of pathognomonic clinical parameters in patients with ID of MFA at CM stages was characterized by dynamic changes, both by

Table 1. Absolute and structural values of clinical informative value indices of general state of patients at the stages of inflammatory diseases of maxillofacial area treatment

Components and indices of clinical monitoring	Clinical informative value of the index (h, bit)			Specific contribution of the index (P, %)			
	CM-II	CM-III	CM-IV	CM-II	CM-III	CM-IV	
Psychophysiological	0.723	0.717	0.610	33.8	33.9	35.6	
Disadaptive type of MBE	0.530	0.520	0.524	3.5	3.5	4.4	
Changes of CVR	0.724	0.662	0.535	4.8	4.5	4.5	
VRD	0.837	0.817	0.699	5.6	5.5	5.8	
Decrease in VRD and VRD	0.818	0.792	0.667	5.5	5.3	5.6	
Stable PPR	0.863	0.849	0.742	5.8	5.7	6.2	
Transition PPR	0.840	0.856	0.666	5.6	5.8	5.6	
Absence of PPR	0.451	0.520	0.438	3.0	3.5	3.7	
Immune and metabolic	0.467	0.486	0.269	21.8	23.0	15.7	
Relative urease activity	0.528	0.378	0.020	3.5	2.6	0.2	
OF superoxide dismutase	0.471	0.505	0.003	3.1	3.4	0.0	
OF reduced glutathione	0.095	0.056	0.242	0.6	0.4	2.0	
Oral fluid catalase	0.111	0.164	0.142	0.7	1.1	1.2	
OF sIgA	0.923	0.953	0.588	6.2	6.4	4.9	
OF lysozyme activity	0.977	0.911	0.777	6.5	6.2	6.5	
OF dysbiosis severity	0.164	0.435	0.108	1.1	2.9	0.9	
Clinical and morphological	0.877	0.800	0.762	29.3	27.0	31.8	
PMA	0.868	0.760	0.609	5.8	5.1	5.1	
OHI-S	0.868	0.770	0.797	5.8	5.2	6.7	
Cariou-filled-removed teeth	0.796	0.796	0.796	5.3	5.4	6.6	
VPABR	0.955	0.834	0.798	6.4	5.6	6.7	
CPITN	0.899	0.839	0.809	6.0	5.7	6.8	
Clinical and biochemical	0.565	0.597	0.505	15.1	16.1	16.9	
Oral fluid pH	0.921	0.813	0.721	6.1	5.5	6.0	
Oral fluid viscosity	0.884	0.806	0.839	5.9	5.4	7.0	
OF buffer capacity	0.181	0.266	0.284	1.2	1.8	2.4	
Saliva flow rate	0.273	0.503	0.177	1.8	3.4	1.5	
System entropy	absolute, bit	14.977	14.805	11.981	100.0	100.0	100.0
	relative, %	100	98.9	80.0			
Correction effectiveness, %		-	1.1	20.0			

Note. PPR – psychophysiological reaction; CVR – cerebrovascular reactivity; VRD – vascular-reflex discirculation; MBE – mitochondrial bioenergetic exchange of buccal epithelium; PPR – psychophysiological reaction; CM-II – early period of clinical monitoring (CM), CM-III – late period of clinical monitoring and CM-IV – remote period of clinical monitoring

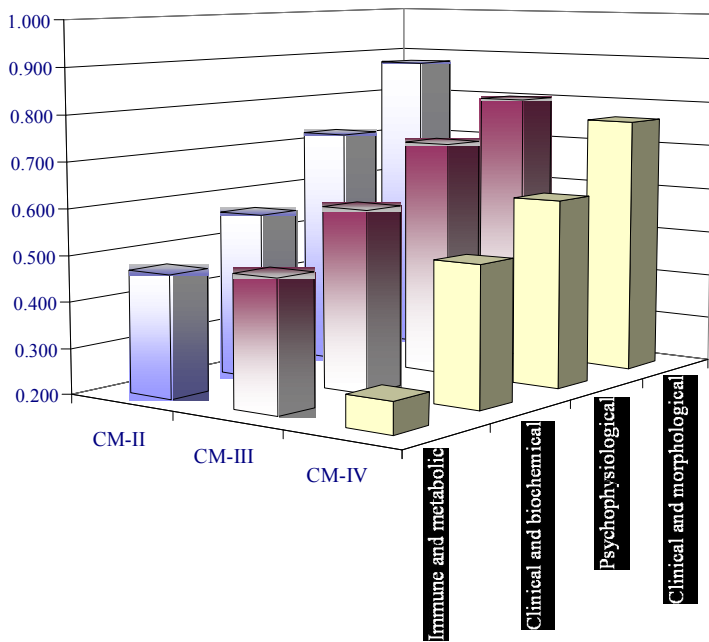


Fig. 1. Comparative clinical informational value (bit) of components of treatment effectiveness assessment at the stages of clinical monitoring of patients with inflammatory diseases of maxillofacial area

generalized parameter and within the individual components and clinical indicators included into the system.

Depending on the CM the contribution of psychophysiological components into the entropy of clinical and informational system of patients with ID of MFA stage was characterized by a significant specific gravity at the level of (33.8÷35.6) % and increased at the end of CM being interrelated with individual psychophysiological indicators. Thus, stable physiological reactions in the form of neurotic disorders with prolonged course (first rank position), patients' neuro-dental reactions in the form of increased cerebrovascular reactivity (third rank position) and decrease in expressiveness of vascular-reflex discirculation (second rank position) had the most significant impact on the orderliness. It should also be noted that the average specific contribution of psychophysiological components into the system entropy increased by 6.2 % (from CM-II – 4.8%, CM-IV – 5.1%), and in absolute values – by 16.0 % (from 0.723 bit to 0.610 bit). Thus, physiological component in the informational system of clinical indices of patients with ID of MFA is significant and the least dynamic component of treatment effectiveness assessment (Table 1, Fig. 1).

Depending on CM stage, contribution of immune and metabolic component into the entropy of clinical and informational system was characterized by a significant specific gravity at the level of (21.8÷15.7) % and decreased at the CM stages being determined by the dynamics of corresponding indicators changes. Thus, levels of sIgA in OF (first rank position), OF lysozyme activity (second rank position) and reduced glutathione activity in oral fluid

(third rank position) had the most significant impact on the orderliness. It should be also note that the average value of the specific contribution of immune and metabolic component into the entropy of the system increased by 40.0% (from CM-II – 3.1%, CM-IV – 2.2%), and in absolute values – by 43.0% (from 0.466 bit to 0.269 bit). Thus, immune and metabolic component in the informational system of clinical parameters in patients with inflammatory diseases of MFA is the most dynamically variable component of treatment effectiveness assessment.

Depending on clinical monitoring stage, the contribution of clinical and morphological component into the entropy of clinical and informational system was characterized by a significant specific gravity at the level of (29.3÷31.8) % and increased at the stages being determined by the dynamics of corresponding indicators changes. Thus, the level of the need for parodontium treatment (first rank place), gingival bleeding index (second rank place), oral hygiene index (third rank place) had the most significant impact on the orderliness state.

It should be also noted that the average value of specific contribution of clinical and morphological component into the system entropy increased by 8.4% (from CM-II – 5.9%, CM-IV – 6.4%), and in absolute values it decreased by 15.0% (from 0.877 bit to 0.762 bit). Thus, clinical and morphological component in the informational system of clinical parameters in patients with ID of MFA is the least dynamic variable constituent of treatment effectiveness assessment.

The contribution of clinical and biochemical component

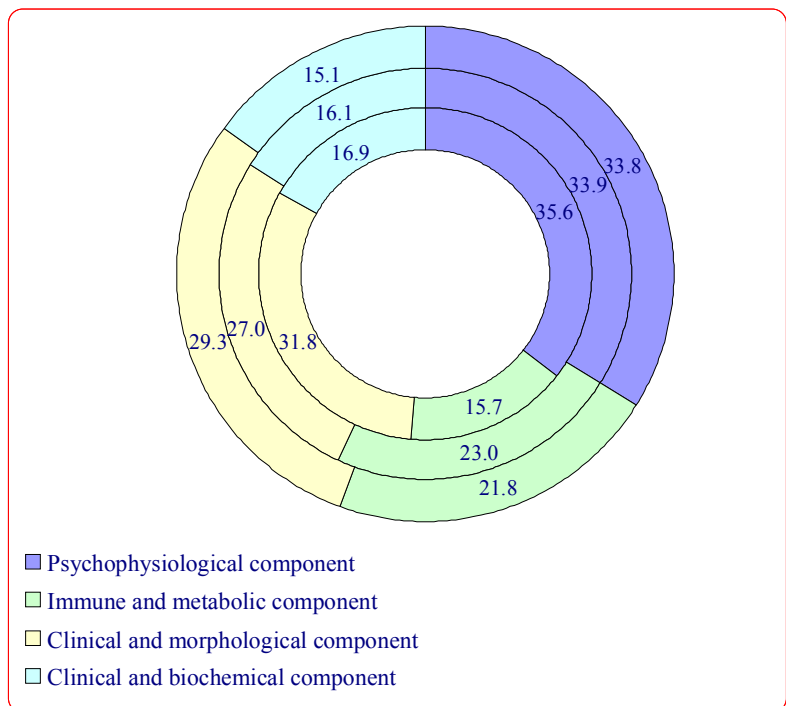


Fig 2. Component structure (%) of decreasing pathometric system entropy of patients with inflammatory diseases of maxillofacial area at the postoperative stages

into the entropy of clinical and informational system was characterized by specific gravity at the level of (15.1÷16.9) % and increased at CM stages determined by dynamic changes of indicative clinical indices. Thus, OF viscosity index (first rank place), OF pH (second rank place), and OF buffer capacity (third rank place) had the most significant impact on the orderliness state. It should be also noted that the average value of specific contribution of clinical and morphological component into the system entropy increased by 10.5 % (from CM-II – 3.8%, CM-IV – 4.2%), and in absolute values it decreased by 11.0% (from 0.565 bit to 0.505 bit).

Conclusions

1. Methodology of clinical and informational assessment of comprehensive treatment effectiveness provides an opportunity to consider multiple-factor effects (both positive negative and negative) of the chosen rehabilitation approach impact in the system of comprehensive treatment.

2. Increase in specific contribution of psychophysiological components into entropy of clinical and informational system and, consequently, the increase in order of adaptation mechanism were proven.

3. Absolute entropy of clinical and informational system was proven to decrease from 14.977 bit to 11.981 bit as a result of comprehensive treatment of patients with maxillofacial area inflammatory diseases. This reduced the disorganization of adaptation mechanisms to 80.0% on average and determined 20.0 % of effectiveness of pathognomonic changes pathogenetic correction.

Prospects for further research are related to the study of individual rehabilitation approach effectiveness in the remote period after surgery.

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