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Analysis of the influence of basic acrylic plastics "Ftoraks" and "Villacryl H Plus" on the main hematological parameters in the experiment

ІНФОРМАЦІЯ

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АНОТАЦІЯ

Summary. The effectiveness of orthopedic treatment significantly depends on the properties of the basic plastics used in the manufacture of dentures.

The aim of the study – to study the effect of acrylic plastics "Ftoraks" and "Villacryl H Plus", the polymerization of which was carried out by different methods, on the main hematological parameters.

Materials and Methods. The study and comparative characterization of the possible toxic effects of dental base acrylic plastics "Ftoraks" and "Villacryl H Plus", which were polymerized by different methods, on the main hematological parameters were performed on white outbred rats, which implanted samples of these materials in periodontal tissue.

Results and Discussion. As a result of the study, it was found that animals implanted with samples of the above acrylic plastics polymerized in a "water bath" method in the blood had a decrease of hemoglobin, leukocytosis, increased number of band and segment nuclear neutrophils, increase in the number of eosinophils and decrease of basophils in comparison with the control and other groups of animals. In the study of samples polymerized in the apparatus for dry polymerization under pressure and in the apparatus for molding plastics, it was found that fluctuations in the content of the main hematological parameters are within the physiological norm and do not differ significantly from the control.

Conclusions. Dental basic acrylic plastics "Ftoraks" and "Villacryl H Plus" polymerization of which was carried out by the method of dry polymerization with pressure and in the apparatus for foundry pressing of plastics cause less toxic effects on hematological parameters of the blood.

Introduction. Current trends in the development of orthopedic dentistry are closely related to the use of new materials and technologies for the manufacture of dentures, which significantly increases their functional value. The effectiveness of orthopedic treatment significantly depends on the properties of the base plastics used in the manufacture of this type of dentures [1, 2]. They are the main construction material for the bases of removable prostheses due to good aesthetic properties, hygiene and high technology. Prostheses made of acrylic plastics

can cause toxic, allergic and traumatic effects on the tissues of the prosthetic bed [3–5]. It is the presence of residual monomer in the base that can cause a number of adverse reactions in the tissues of oral cavity.

Monomer (methyl methacrylate), diffusing from the base of the prosthesis into the tissues of the oral cavity, can cause the development of toxic or allergic stomatitis. According to the research of a number of scientists, hematological parameters in allergic stomatitis are characterized by leukopenia, lymphocytosis, monocytosis, decreased

number of segment nuclear neutrophils, but the number of erythrocytes remains unchanged. Erythrocytopenia and leukocytosis are observed in toxic-chemical stomatitis. The number of monocytes and lymphocytes is within normal limits. Among the causes of these phenomena, one of the most important is the toxic effect of acrylic plastics on the tissues of the prosthetic bed, in particular residual monomer [6–8].

According to a number of scientific researches, it is established that the level of residual monomer does not exceed 0.50 % when observing the polymerization regime when using the polymerization technique in a "water bath" [9–11]. When using the technique of polymerization of acrylic plastics in the apparatus for foundry pressing, the level of residual monomer is 0.23–0.33 % [11–13].

Its excess reduces the physical and mechanical properties of base plastics and causes premature "aging" of the material. In modern scientific periodicals there are some works devoted to the study of the influence of basic dental plastics on hematological parameters of blood [14–16]. The monomer is a strong organic solvent and promotes the activation of procoagulants, which are involved in the initial stages of blood clotting. It is possible that in this process an important role is played by increasing the penetration of membranes of the forming elements of the blood, which contributes to the release of procoagulants. The results of research conducted by scientists [17–19] suggest that increasing the dose of monomer reduces the hypercoagulant effect and promotes its toxic effects on the blood.

Therefore, the study of the effect of acrylic plastics on hematological parameters and searching for effective ways to reduce the level of residual monomer in base plastics is extremely actually.

The aim of study – to study the effect of acrylic plastics "Ftoraks" and "Villacryl H Plus", the polymerization of which was carried out by different methods, on the main hematological parameters.

Materials and Methods. The study was conducted on the basis of the Central Research Laboratory and at the Department of Orthopedic Dentistry of I. Horbachevsky Ternopil National Medical University.

The experiments were carried out according to the rules recommended by the European Convention for the Protection of Vertebrate Animals used for Research and other Scientific

Purposes (Strasbourg, 1986), the Directive of the European Union 2010/10/63 EU on animal experiments, the rules of the International Committee of Medical Journal Editors (ICMJE), recommendations "Bioethical examination of preclinical and other scientific studies performed on animals" (Kiev, 2006).

The study and comparative characterization of the possible toxic effects of dental base plastics "Ftoraks" and "Villacryl H Plus" on the main hematological parameters were performed on 35 white outbred clinically healthy male rats weighing 150–200 g in vivarium condition. Samples of basic acrylic plastics "Ftoraks" and "Villacryl H Plus", which were polymerized by various methods, were implanted into the periodontal tissues of these animals. Animals were divided into seven groups: I group – "control" (intact); II group – with intraoral implantation of base plastic "Ftoraks", the polymerization of which was carried out in a "water bath"; III group – with intraoral implantation of base plastic "Ftoraks", the polymerization of which was carried out "in a pressure apparatus"; IV group – with intraoral implantation of base plastic "Ftoraks", the polymerization of which was carried out in an apparatus for injection molding; V group – with intraoral implantation of base plastic "Villacryl H Plus", the polymerization of which was carried out in a "water bath"; VI group – with intraoral implantation of base plastic "Villacryl H Plus", the polymerization of which was carried out "in a pressure apparatus"; VII group – with intraoral implantation of basic plastic "Villacryl H Plus", the polymerization of which was carried out in an apparatus for foundry pressing. Each group consisted of 5 animals. After 30 days, studies of basic hematological parameters were performed. Attention was paid to the morphological composition of the blood: the number of erythrocytes, platelets, hemoglobin, also performed the calculation of leukocyte formula.

The obtained results were statistically processed using non-parametric statistical methods using STATISTICA 6.1 software (Statsoft, USA) (License AGAR909E415822FA). Differences were considered significant with a probability level of at least 95 % ($p < 0.05$).

Results and Discussion. It was found that in animals implanted with samples of acrylic plastics "Ftoraks" and "Villacryl H Plus" polymerized in a "water bath" in the blood had a decrease by hemoglobin, leukocytosis, increased number of

band and segment nuclear neutrophils, increase in the number of eosinophils and decrease in the number of basophils in comparison with the control and other groups of animals. However, a statistically significant difference was found in the indicators of the total number of leukocytes, eosinophils and basophils ($p < 0.05$). The number of lymphocytes and monocytes was at the same level of the control group (Table).

In animals, which used samples of acrylic plastics "Ftoraks" and "Villacryl H Plus", polymerized in a dry polymerize with pressure and in an apparatus for foundry pressing of plastics, there is a slight increase in the number of leukocytes, monocytosis, lymphocytosis and increased number of segment nuclear neutrophils. Hemoglobin, erythrocytes, band neutrophils, eosinophils, except for the total number of leukocytes and basophils, where there is a significant difference compared with the control group ($p < 0.05$), are at the level of the control group and are slightly better in comparison with the parameters of animals that were implanted with samples of these plastics, polymerized in a "water bath".

The obtained results and their comparisons show that animals treated with samples of acrylic plastics "Ftoraks" and "Villacryl H Plus", polymerized in the apparatus for dry polymerization with pressure and in the apparatus for foundry molding of plastics, has better hematological parameters than animals of the control group and animals implanted with plastic samples polymerized in a "water bath". It was found that fluctuations in

hemoglobin, erythrocytes, leukocytes and leukocyte formula are within the physiological norm and do not differ significantly from the control. Comparison of the obtained research results with the results of the control group of animals did not reveal probable changes ($p > 0.05$).

As a result of our study of the effect of dental acrylic plastics "Ftoraks" and "Villacryl H Plus", polymerized in a "water bath", on hematological parameters, decreased hemoglobin, leukocytosis, increased number of band and segment nuclear neutrophils, increased eosinophils and decreased eosinophils comparable to the control and other groups of animals. Our results are confirmed by the work of a number of scientists [20, 21]. However, we found a statistically significant difference between the total number of leukocytes, eosinophils and basophils ($p < 0.05$) compared with the control and other groups of animals. The number of lymphocytes and monocytes are at the level of the control group.

When studying the effect of base plastics "Ftoraks" and "Villacryl H Plus", which were polymerized in a dry polymerizer with pressure, we observed a slight increase in the number of leukocytes, monocytosis, lymphocytosis, there is an increased number of segment nuclear neutrophils. Indicators of hemoglobin, erythrocytes, band neutrophils, eosinophils are within normal limits. Our results are confirmed by the work of scientists [21–23].

However, we found a statistically significant difference in the total number of leukocytes and

Table. Main hematological parameters of experimental animals (M±m)

Blood counts	Control group (n=5)	Polymerization methods					
		"water bath"		dry polymerization		casting pressing	
		"Ftoraks" (n=5)	"Villacryl H Plus" (n=5)	"Ftoraks" (n=5)	"Villacryl H Plus" (n=5)	"Ftoraks" (n=5)	"Villacryl H Plus" (n=5)
Hemoglobin (g / l)	140.0±5.5	129.0±3.0	128.0±2.9	138.0±1.5	139.0±1.2	136.0±1.3	137.0±1.5
Erythrocytes ($\times 10^{12}$ / l)	4.6±0.4	4.9±0.1	4.9±0.5	4.7±0.4	4.8±0.3	4.6±0.4	4.7±0.6
Leukocytes ($\times 10^9$ / l)	4.0*	7.7*	7.5*	6.2*	6.3*	6.1*	6.0*
Band neutrophils (%)	3.3±0.3	4.0±0.2	3.8±0.5	3.0±0.3	3.1±0.5	3.3±0.3	3.1±0.3
Segment nuclear neutrophils (%)	21.1±2.9	26.4±3.9	25.2±3.2	25.7±4.1	24.2±2.1	23.6±4.0	22.8±3.7
Eosinophils (%)	1.0*	1.5*	1.7*	1.0*	1.1*	1.2*	1.1*
Basophils (%)	1.9*	1.2*	1.1*	1.2*	1.0*	1.1*	1.0*
Monocytes (%)	6.9±0.8	7.0±0.6	7.1±0.4	7.5±1.1	7.2±1.8	7.4±1.0	7.1±1.5
Lymphocytes (%)	68.8±3.9	65.3±0.9	66.5±0.5	71.2±4.1	70.3±4.0	70.7±4.1	69.8±3.7

Note.* – reliability of the result ($p < 0.05$).

basophils, compared with the control group and the group of animals that were injected with samples of acrylic plastic polymerized in a "water bath" ($p < 0.05$). Comparing the results of the study of the effects of base plastics "Ftoraks" and "Villacryl H Plus" polymerized in the apparatus for foundry pressing of plastics, it was found that the content of hemoglobin, erythrocytes, leukocytes and leukocyte formula is within physiological norm and does not differ significantly from control. However, some hematological parameters were found to be better than those obtained in plastics that were polymerized in a "water bath".

The difference in the total number of leukocytes, eosinophils and basophils in the experi-

mental groups ($p < 0.05$), indicates a pronounced toxic or sensitizing effect of residual monomer in animals treated with samples of plastics "Ftoraks" and "Villacryl H Plus" polymerized in a "water bath". This phenomenon is due to a much smaller amount of residual monomer in samples of dental plastics, the polymerization of which was carried out by dry polymerization with pressure, compared with samples whose polymerization was carried out in a "water bath".

Conclusions. Dental basic acrylic plastics "Ftoraks" and "Villacryl H Plus" polymerization of which was carried out by the method of dry polymerization with pressure and in the apparatus for foundry pressing of plastics cause less toxic effects on hematological parameters of the blood.

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Аналіз впливу базисних акрилових пластмас «Фторакс» і «Villacryl H Plus» на основні гематологічні показники в експерименті

Резюме. Ефективність ортопедичного лікування значно залежить від властивостей базисних пластмас, які використовують при виготовленні зубних протезів.

Мета дослідження – вивчити вплив акрилових пластмас «Фторакс» і «Villacryl H Plus», полімеризацію яких проводили за допомогою різних методів, на основні гематологічні показники.

Матеріали і методи. Вивчення і порівняльну характеристику можливого токсичного впливу стоматологічних базисних акрилових пластмас «Фторакс» і «Villacryl H Plus», полімеризацію яких виконували за допомогою різних методів, на основні гематологічні показники проводили на білих безпородних щурах, яким у тканини пародонтального комплексу вживляли зразки вказаних матеріалів.

Результати досліджень та їх обговорення. У результаті проведеного дослідження було встановлено, що у тварин, яким виконували вживлення зразків акрилових пластмас «Фторакс» та «Villacryl H Plus», полімеризованих на «водяній бані», в крові відбувалося зниження кількості гемоглобіну, лейкоцитоз, підвищення кількості паличкоядерних та сегментоядерних нейтрофілів, підвищення кількості еозинофілів та зниження кількості базофілів порівняно з контрольною групою та іншими групами тварин. У тварин, яким вживляли зразки акрилових пластмас «Фторакс» і «Villacryl H Plus», полімеризовані в апараті для сухої полімеризації під тиском та в апараті для ливарного пресування пластмас, виявлено, що коливання вмісту гемоглобіну, еритроцитів, лейкоцитів і лейкоцитарної формули знаходяться в межах фізіологічної норми та не значно відрізняються від контрольної групи.

Висновки. Базисні акрилові стоматологічні пластмаси «Фторакс» та «Villacryl H Plus», полімеризацію яких проводили за допомогою методу сухої полімеризації під тиском та в апараті для ливарного пресування пластмас, спричиняють менший токсичний вплив на гематологічні показники крові.

Ключові слова: знімні протези; акрилові пластмаси; полімеризація; гематологічні показники.

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