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Physicomechanical Features of Bicomponent Membranous Implants Based on Polymers of Cellulose

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ABSTRACT

One of the prospective areas of general surgery is the development of new polymeric film implants, which in surgical interventions create a barrier between the operated organ and surrounding tissues, resulting in a decrease in the severity of various complications. On the basis of the Department of Operative Surgery and Topographic Anatomy of. Professor A. D. Myasnikov Kursk State Medical University studies were carried out, the subject of study were bicomponent resorbable film implants based on cellulose polymers. The selected samples differ from each other in different physical and mechanical properties, which we determined under the experimental conditions in vitro in a comparative aspect. The most suitable membranes, which can be used for further *in vivo* studies, were selected based on the results obtained.

INTRODUCTION

Imperfection of the regenerative capacity of human tissues due to various factors, such as acute and chronic diseases, traumas, injuries, as well as surgical interventions, don't occupy the last place in the structure of clinical problems. So for instance, the intestine is characterized by a relatively free movement in the abdominal cavity. Its mobility depends on the fixing apparatus, which is represented by a mesentery of the intestine, a parietal peritoneum and ligaments [1]. Adhesions of the peritoneum are the most frequent reason of the limiting the motor function of the intestine and its ability to shift relative to other organs of the abdominal cavity [2].

Despite a large number of the studies, the etiology and pathogenesis of the formation of adhesions have not been studied enough, and there are also no reliable means and methods for prevention of the adhesive disease of the abdominal cavity organs and its treatment [3].

Bicomponent polymeric membranous implants provide the most dense and reliable fixation, due to the fact that one side has sufficiently high adhesive properties, while the other side does not have such properties [4, 5]. Because of their physiological characteristics, they are able to fold to a certain level, snug against the organ [6, 7, 8]. Undoubtedly, the bicomponent will be able to become a prospective development in the fight against the adhesive disease.

To substantiate the choice of the most optimal variants of the developed samples, their studies are required with certain functionally important parameters that determine their clinical effectiveness.

Purpose of the study:

To study in a comparative aspect certain properties of new samples of the polymeric membranous implants for their use in operations on the organs of the abdominal cavity under the experimental conditions in vitro.

MATERIALS AND METHODS:

The material for these experimental studies ware series of the prototypes: 1, 2, 3, 4, 5, 6, made on the basis of cellulose polymer, which differed from each other in different manufacturing techniques.

To achieve this goal, photomicrographs of polymeric membranous implants were made using a Levenhuk D320L laboratory microscope with an increase of × 80. The thickness of the experimental samples was measured with the electronic micrometer iGaging 0-1 "/0.00005. Membranes measuring 10 × 10 mm were weighed using a laboratory scale. The volume and density of samples measuring 10 × 10 mm were calculated.

RESULTS

According to the results of the study, it was found that the easiest sample is the sample of 10 × 10 № 6 with a mass of 4.72 ± 0.11 mg, and the sample № 5 has a maximum index for this criterion of 69.1 ± 0, 31 mg (Table 1). Based on the results of analysis of the volume of the sections of the test samples, it was noted that sample № 5 had the highest value of 7.36 ± 2.54 mm, mm^3. The lowest index of 4.22 ± 0.36 mm, mm^3 had the sample № 6. The polymeric membranous implant № 6 turned out to be the thinnest sample, its thickness was 0,042 ± 0,01 mm, on the contrary, polymer № 5 has the largest thickness of 0,736 ± 0,02. The highest index of density in the study of samples corresponded to polymer № 3, which is higher by 1.1 compared with sample № 5. Elasticity studies showed that sample № 5 does not lose its integrity at bending at the angle of 180 °, which can't be said for other samples that lose their structure even when bending at the angle of 80 °. Thanks to this feature, this sample will be able to more accurately repeat the contours and bends of the part of the organ on which the implant was applied, which will ensure the maximum tight fixation to the damaged area.

Table 1. The indicators of weight, thickness, volume, density and elasticity of the membranes with a size of 10×10 mm

Sample	The mass of the section of 10×10mm, mg	Thickness, mm	The volume of the section 10×10 mm, mm^3	The density of the section of 40×40mm, mg/mm3	The elasticity of the sample with a thickness of 10-10mm
1	46,25 ± 0,26	0,2573 ± 0,00	26,03 ± 1,16	1,779 ± 0,75	110± 1,5
2	26,84 ± 0,64	0,196 ± 0,00	19,66 ± 0,74	1,364 ± 0,05	90± 0,5
3	49,2 ± 0,42	0,2403 ± 0,01	24,03 ± 1,20	2,038 ± 0,12	140± 1,4
4	39,15 ± 0,41	0,2404 ± 0,03	24,04 ± 3,08	1,643 ± 0,15	110± 1,2
5	69,1 ± 0,31	0,736 ± 0,02	73,61 ± 2,54	0,938 ± 0,03	180± 1,5
6	4,72 ± 0,11	0,042 ± 0,01	4,22 ± 0,36	1,125 ± 0,86	115± 0,5

It was found that sample № 6 is the thinnest, lightest and has the smallest volume among all the samples, based on the results of analysis of the thickness, weight and volume of the investigated membranes of 10 × 10 mm. Opposite to this sample is sample № 5, which is the densest, heaviest and has the largest volume. Based of the conclusions, in connection with its physical properties, sample № 5 is not suitable for further clinical investigation.

From the data obtained from the analysis of the density of the test samples, it follows that polymers № 6 and № 5 with a size of 10 × 10 mm have the lowest density. Sample № 3 has the highest density. Based on the results, it can be concluded that only samples № 6 and № 5 can provide the most dense fixation to the damaged area.

Determination of the relief of samples 10 × 10 mm in size was performed using microphotographs, which were made with the laboratory microscope Levenhuk D320L with an increase of × 80.

Table No 2 were made up based on the results of the analysis of the relief of the studied samples of polymeric membranous implants.

Table 2. Relief of the studied samples

Sample No.	Side 1		Side 2	
	"high" areas, pix	"low" areas, pix	"high" areas, pix	"low" areas, pix
1	62,54	37,45	75,29	24,70
2	25,28	74,71	13,67	86,32
3	77,41	22,58	63,77	36,22
4	38,49	61,50	40,43	59,56
5	6,05	93,94	34,80	65,19
6	85,04	14,95	85,40	14,59

According to the results of the analysis of microphotographs of the studying samples, the following can be noted: polymeric membranous implants № 1, № 3, № 6 have the largest area of "high sites". Samples № 2, № 4, № 5 have the smoothest surface. Based on the data obtained, it can be concluded that the implants with the largest area of "low areas" are distinguished by better contact with the damaged area and due to the resulting adhesion, they can ensure maximum tightness, which is one of the important characteristics of the samples, which can later be used in time of surgery.

In order to systematize the information obtained, the Spearman ranking was applied. For the lowest rank, the minimum value of mass, thickness, volume, density and elasticity was accepted, which will cause the smallest tissue reaction of the organism. Also, the maximum index of elasticity was accepted for the smallest rank, since this investigated parameter is an important manipulation property. Then the obtained ranks were summed up (table 3). Samples with the lowest number of ranks (№ 6, № 2) are the most suitable implants for use in operations on the abdominal organs.

Table 3

Sample	Study characteristics, grade							Sum
	Weight	Thickness	Volume	Density	Elasticity	Relief		
						1 side	2 side	
1	4	6	5	5	5	3	2	20
2	2	2	2	3	6	5	6	26
3	5	4	3	6	2	2	3	25
4	3	5	4	4	4	4	4	28
5	6	3	6	1	1	6	5	28
6	1	1	1	2	3	1	1	10

Ranking of the samples

Finale

Thus, due to the determination of the physico-mechanical properties of bicomponent membranous implants, we can choose the most suitable samples for implantation and the introduction of further scientific research studied in vivo. These samples were № 6, № 1. The results obtained in the future will help to open the prospects for the use of membranous polymeric implants for the treatment and prevention of various diseases associated with surgical intervention.

CONCLUSION

1. From the point of view of morphology, the most suitable for further use in operations on the abdominal organs are samples No 6, the worst result has sample No 5.

2. Only No 5 has a high elasticity and therefore it is the most acceptable due to the result of manipulation characteristics.

3. Sample No 3 is the most suitable for further studies *in vivo* based on the results of the comparative analysis.

REFERENCES

1. Inarkhov, M.A., Lipatov, V.A., Zatolokina, M.A., Yarmamedov, D.M., Lazarenko, S.V. To the question of the physicomechanical properties and features of degradable polymer film implants for operations on the organs of the abdominal cavity / M.A. Inarkhov, V.A. Lipatov, M.A. Zatolokina, D.M. Yarmomedov, S.V. Lazarenko // Kursk scientific-practical herald "The Man and His Health". — 2016. — № 3. — P. 67-73.

2. Kuznetsov, V.P. Adhesion in glue joint: terms and physical essence / V.P. Kuznetsov // The Bulletin of Kem SU. — 2014. — T.1. — P. 170-174.
3. Kuznetsov, V.P., Baumgarten, M.I., Nevzorov, B.P., Fadeev, Yu.A. Adhesion in composite materials: terms and physical essence / V.P. Kuznetsov, M.I. Baumgarten, B.P. Nevzrov, A.Yu. Fadeev // Bulletin of the Kemerovo State University. — 2014. №2 — P. 173-177.
4. Lipatov V.A., Yarmamedov D.M., Gokin A.G. Research of the indices of relief and adhesion of double-layer antibacterial membranes / Lipatov, D.M., Yarmamedov, A.G. Gokin // Health and Education in the 21st Century. — 2017. — T.19. — № 3. — P. 48-50.
5. Cherdintsev V.V., Senatov F.S., Maksimkin A.V., Stepashkin A.A. Deformation characteristics of UHMWP E films under tension / V.V. Cherdyntsev, F.S. Senatov, A.V. Maksimkin, A.A. Stepashkin // Modern problems of science and education. — 2013. — №5.
6. Shtilman M.I., Biodegradation of Polymers / M.I. Shtilman // Transbaikal Medical Bulletin. — 2015. — T. 8. — № 2. — C. 113-130.
7. Saed G.M., Fletcher N.M., Diamond M.P. The Creation of a Model for Ex Vivo Development of Postoperative Adhesions // Reprod. Sci. — 2016 May. — 23(5). 610-2.
8. Starodubtseva M.N., Yegorenkov N.I., Nikitina I.A. Thermo-mechanical properties of the cell surface assessed by atomic force microscopy // Micron. — 2012. — Vol. 43. — N 12. P. 1232-1238.