

EVALUATION OF THE PERIPHERAL BLOOD CIRCULATION OF AN ABDOMINAL WALL USING OPTOELECTRONIC PLETHYSMOGRAPH

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Abstract

The human health directly depends on the state of peripheral blood circulation. Blood filling disturbance causes various types of disorders of our body. For example it causes the bad healing of postoperative wounds. Therefore, for timely and qualitative diagnosis of such disorders the modern medicine uses non-invasive methods. These methods allow providing painless and non-destructive control of affected areas.

Keywords : blood filling, microcirculation, optoelectronic plethysmograph, biomedical information.

Introduction

The most perspective among them are optical methods for recording and transforming of biomedical information [1,2]. Obesity is one of the actual problems of modern world medicine and it's one of the reasons of the bad healing of postoperative wounds. It is caused by the difference in the blood filling of tissues in patients with different body mass.

Method and results

Determination of the blood filling of the abdominal wall was providing by using the developed optoelectronic plethysmograph. An analysis of the blood filling of the anterior abdominal wall was provided on the basis of the Department of General Surgery VNMU named after M. I. Pirogov and on the basis of the surgical department of the city clinical hospital №1 in the city of Vinnytsia. Were examined 40 patients with inguinal groin hernias (20 men and 20 women) with different body mass, aged 27-75 years. All patients were divided by body mass index (BMI) and by the degree of obesity into 4 groups. The first (control) group included 15 patients with normal body weight (BMI 18.5-24.9). The second group included 9 patients with overweight and the degree of obese – I (BMI 25.0-29.9 and 30.0-34.9 respectively). The third group included 10 patients with degree of obese – II (BMI was 35.0-39.9). And the fourth group included 6 patients with obesity of the III and IV degrees (BMI \geq 40.0).

At that time, starting from the 2nd day after surgery was performed stimulation of microcirculation in the area of the postoperative wound for 50 patients with obesity of the III and IV degrees by vibration acoustic action of the apparatus "Vitaфон" (state registration certificate No. 1626/2003 of the State Department of the Ministry of Health of Ukraine dated March 27, 2003). And was measured the blood filling in the tissues of the postoperative wound area before and after surgery. There were 32 patients (18 men and 14 women) aged 28 to 60 years old with obesity of the II degree (BMI 35.0-39.9) and 18 patients (5 men and 13 women) aged 35 to 58 years with obesity of the III and IV degrees (BMI \geq 40.0).

Were calculated the mean value M , the mean square deviation S , the mean error, the mean value m , the probability criterion t , the probability value P . The differences between the comparable indicators were found to be reliable if the value of probability was greater or equal to 95% ($p \leq 0,05$). The dynamics of factors is shown in the table 1.

Table 1 – Dynamics of the blood filling factor in the tissues of the anterior abdominal wall before and after surgery

Groups of patients	The blood filling factor				
	Before surgery	The 1 st day after surgery	The 3 rd day after surgery	The 5 th day after surgery	The 7 th day after surgery
1 st group	1,16	1,26	1,06	1,62**	1,69**
2 nd group	1,04	1,17	1,05	1,08	1,31
3 rd group	0,94	1,18*	1,43***	0,79	0,82
4 th group	0,68	2,06***	0,34***	0,63	0,71

Notes: * - $p > 0,05$ relatively to the 1st group; ** - $p > 0,01$ relatively to the 1st group; *** - $p > 0,001$ relatively to the 1st group.

To compare the obtained data after the operation, the results of the study were presented in percentages. The start points before the operation were presented as 100% (Table 2).

All patients had the increasing of the blood filling to the postoperative wound area during the next day after surgery. It is due to the reactive phase of inflammation by the classification of M. I. Kuzin (1990). Patients of the control group on the first day after the operation had the increasing of the blood filling in the tissues of the postoperative wound area to 8%, patients of group 2 - to 12.5% ($p > 0.05$ relatively to the control group), patients of group 3 - to 25% ($p > 0.05$ relatively to the control group), patients of group 4 - to three times ($p > 0.001$ relatively to the control group).

Table 2 - Dynamics of relative blood filling rates in the tissues of the anterior abdominal wall before and after surgery

Groups of patients	Relative blood filling rates, %				
	Before surgery	The 1 st day after surgery	The 3 rd day after surgery	The 5 th day after surgery	The 7 th day after surgery
1 st group	100	108	91,38	140**	145**
2 nd group	100	112,5	99,05	103,4	125
3 rd group	100	125*	152***	84	87
4 th group	100	303***	50***	92,65	104

Notes: * - $p > 0,05$ relatively to the 1st group; ** - $p > 0,01$ relatively to the 1st group; *** - $p > 0,001$ relatively to the 1st group.

Such a difference in the growth rate of blood filling in different groups of patients was as a result of vasodilatation associated with the release of histamine, which was excreted in the degradation of mast cells and expanded the clearance of arterioles, capillaries, venules, and also accelerated capillary blood filling. So patients who had increased body weight, a direct proportional increasing of the blood filling in the areas of postoperative wounds was observed [1, 4].

At the 3rd day after surgery in the 1st (control) group, the blood filling in the area of the postoperative wound was 91.38%, in patients of the 2nd group - 99.05% ($p > 0.05$ compared with the rates before the surgery), it indirectly confirmed the beginning the second phase of the wound process with characteristic normalization of the microcirculation. In patients of the 3rd group blood filling level was increasing to 152% ($p > 0.001$ compared with the rates before the surgery), and in patients of the 4th group blood filling level decreased sharply to 50% ($p > 0$. compared with the rates before the surgery). This indicated an extension of the "period" of inflammatory processes in patients of the 3rd group and continued tissue swelling in patients of the 4th group. Such changes indicate a delay in the 2nd phase of the wound process and the corresponding slowdown in wound healing.

Conclusions

On the base of the researches we can confirm about effectiveness of using of optoelectronic plethysmograph for study of the microcirculation of the anterior abdominal wall. It allows with high reliability to diagnose possible deviations in the process of healing postoperative wounds. It is very important for surgery, because helps to stimulate microcirculation in a timely manner [3, 4, 6].

References

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