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PATHOGENETIC RATIONALE AND CLINICAL EFFICACY OF HIRUDOTHERAPY IN THE EARLY POSTOPERATIVE PERIOD

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ABSTRACT

Background. In contemporary global practice, establishing multidisciplinary approaches to postoperative rehabilitation represents a pronounced trend. However, the early rehabilitation arsenal following aesthetic interventions remains significantly limited due to the risk of traumatizing suture zones and delicate vascular anastomoses.

Objective. The aim of this study was to investigate the course of postoperative recovery in patients following plastic and reconstructive surgeries (liposuction, abdominoplasty, and mammoplasty) through the substantiation and implementation of pathogenetically targeted programs of controlled hirudotherapy.

Materials and Methods. A comprehensive clinical examination and subsequent treatment of 38 patients (aged 40 ± 9 years) who had undergone aesthetic surgical interventions were conducted. The primary group (n = 18) received standard postoperative care combined with an early rehabilitation protocol incorporating courses of medical hirudotherapy (Hirudo medicinalis) initiated on the 3rd postoperative day (3–5 sessions performed every other day). The comparison group (n = 20) received exclusively standard baseline therapy in accordance with clinical protocols. Edema-hemorrhagic syndrome was monitored via anthropometric measurements of body circumferences on the 3rd (baseline), 7th, and 14th postoperative days.

Results. On the 7th postoperative day, a distinct regression dynamic of edema was recorded in the primary group: the umbilical circumference decreased from 88.2 ± 1.4 cm to 81.4 ± 0.8 cm ($p < 0.05$) versus 85.1 ± 1.1 cm in the comparison group. Following mammoplasty, the chest circumference in the primary group decreased to 90.8 ± 0.7 cm versus 93.2 ± 0.9 cm in the control group ($p < 0.05$). By the 14th day, the intergroup parameter gap reached a high level of statistical significance according to the Mann–Whitney U test ($p < 0.05$). The incorporation of hirudotherapy achieved early tissue decompression and enhanced microcirculation via the action of salivary biologically active substances (hirudin, hyaluronidase, destabilase, vasodilators), yielding rapid pain resolution and allowing patients to discontinue systemic NSAIDs earlier.

Conclusions. The application of hirudotherapy constitutes a pathogenetically substantiated method that substantially accelerates the regression of postoperative edema and promotes tissue regeneration. This modality can be recommended as an effective and accessible adjunctive component within comprehensive Fast-Track rehabilitation in plastic surgery.

Keywords: surgery, edema, postoperative period, hirudotherapy, rehabilitation.

Relevance. In contemporary global practice, there is a pronounced trend toward establishing multidisciplinary approaches in postoperative rehabilitation. Currently, patients in the postoperative period frequently and intentionally seek assistance from rehabilitation and physical therapy specialists to accelerate the recovery process [1]. Such a conscious request stems from patients' desire to minimize discomfort during the early postoperative period and return to an active social and professional life as expeditiously as possible [2,3]. While the contemporary arsenal of rehabilitation methods is extensive, those applicable from the early days of the postoperative period remain significantly limited, typically comprising non-steroidal anti-inflammatory drugs (NSAIDs) and the utilization of compression garments [4]. Consequently, the rehabilitation specialist is faced with the task of developing programs that are, first and foremost, safe, non-invasive, and pathogenetically justified, aimed at eliminating pain syndrome, reducing edema, and actively promoting the formation of vascular anastomoses [5,6]. For this reason, contemporary practitioners in practical physical therapy and rehabilitation frequently turn to non-traditional biological and nature-based therapeutic modalities as alternative means [7,8]. According to the literature, the utilization of such an ancient treatment modality as hirudotherapy (Hirudo medicinalis) in postoperative plastic surgery rehabilitation represents a highly promising and scientifically substantiated trend. Notably, in the United States and Europe, hirudotherapy has been officially cleared by the FDA as a medical device for the salvage and survival of tissue flaps in plastic and reconstructive surgical interventions [9]. In accordance with international clinical protocols and recommendations from leading surgical centers in the United States and Europe, the local application of hirudotherapy is proposed as an unrivaled, non-invasive method for autograft salvage and the regeneration of cutaneous and subcutaneous structures in the event of critical postoperative venous congestion, lymphostasis, or acute ischemia [6]. The primary therapeutic value of the medical leech resides in the unique chemical

composition of its saliva, which contains over 100 biologically active substances. These components exert a positive effect on the blood coagulation system, enhance microcirculation, mitigate inflammatory and immune responses, and accelerate tissue regeneration. Consequently, hirudotherapy effectively reduces edema, alleviates pain, and facilitates recovery following injuries or chronic conditions [2,6].

The aim of this study was to investigate the course of postoperative recovery in patients following plastic and reconstructive surgeries—such as liposuction, abdominoplasty, and mammoplasty—as well as to substantiate and implement pathogenetically targeted programs of controlled hirudotherapy.

To achieve this objective, a comprehensive clinical examination and subsequent treatment of 38 patients (n = 38) aged 40 ± 9 years who had undergone aesthetic surgical interventions were conducted. The cohort was divided into two groups. Patients in the primary group (n = 18) received standard postoperative surgical care combined with the developed early rehabilitation protocol, which incorporated courses of medical hirudotherapy initiated on the third postoperative day. Patients in the comparison group (n = 20) received exclusively standard baseline therapy in accordance with clinical protocols (comprising n = 6 after mammoplasty, n = 6 after abdominoplasty, and n = 8 after abdominal and thigh liposuction). Notably, all patients utilized compression garments; for the first 2–3 weeks, these were worn continuously (24/7) and removed solely for hygienic procedures or therapeutic interventions, specifically hirudotherapy sessions. Over the subsequent 2–3 weeks, the garments were worn exclusively during the daytime. The rationale for initiating Hirudo medicinalis application on the third postoperative day is predicated on the critical window during which tissue edema and venous congestion peak, while angiogenesis within the vascular system has not yet occurred. The procedures were performed in a specialized unit at the ReVital Medical Clinic (Poltava) in strict compliance with the principles of asepsis and antisepsis. Certified medical leeches sourced from a dedicated biofactory were used exclusively and strictly on a single-use basis; following the procedure, they were subjected to disposal in an Aniozyme DD1 disinfectant solution.

The total number of hirudotherapy sessions and the specific anatomical sites of application were determined by the type and extent of the surgical intervention performed. Thus, following mammoplasty—specifically reduction, mastopexy, and endoprosthetics—2 leeches were applied per breast (n = 6 patients). Following abdominoplasty (n = 4), 3 leeches were applied to the anterior abdominal wall. The application sites were predominantly located in the suprapubic region or within the zones of maximum tissue tension. In the cohort of patients who underwent abdominal and thigh liposuction (n = 8), 3 leeches were applied to the abdomen or 2 leeches per thigh, specifically targeting areas with the most pronounced hematomas and fibrotic edema. Hirudo medicinalis specimens were applied to clean skin prepared with saline solution, running parallel to the postoperative suture lines at a distance of 2–3 cm from their margins, or directly along the perimeter of the identified subcutaneous infiltrate or hematoma. Following mammoplasty, particular attention was directed to the nipple-

areolar complex (NAC); leeches were placed radially around the areola (at a distance of 1.5–2 cm) to achieve decompression of the NAC venous bed [17].

The exposure duration ranged from 20 to 45 minutes, continuing until the leeches detached spontaneously. A thick gauze dressing was then applied to the bite sites, after which the patient donned the compression garment. The dressing was removed after 24 hours, and subsequent hirudotherapy sessions were performed every other day, with the total course comprising 3 to 5 sessions.

Monitoring of the patients' clinical condition, which included assessing the dynamics of edema-hemorrhagic syndrome regression, was performed comprehensively on the third day of the postoperative period, which in the primary group corresponded to the initiation of hirudotherapy (baseline data), as well as on the seventh and fourteenth postoperative days. Monitoring of the edema was carried out by measuring the circumferences of anatomical zones using a flexible, non-stretch measuring tape at clearly fixed points. Thus, following abdominoplasty and abdominal liposuction, measurements were taken at the level of the umbilicus, as well as approximately 5 cm above and 5 cm below the umbilical ring. The measurement of thigh circumference after liposuction was performed at three fixed anatomical landmarks. The first landmark was located horizontally approximately 5 cm below the infragluteal fold, which anatomically corresponds to the level of the greater trochanter of the femur. The second landmark was positioned exactly midway between the inguinal fold and the superior border of the patella. The third landmark was approximately 5 cm above the superior border of the patellar fold. The baseline data prior to the surgical intervention were reflected in the discharge documentation from the clinic where the cosmetic surgery was performed, but we considered it inappropriate to include these data in the statistical processing. Following mammoplasty, the chest circumference was measured at the level of the highest points of the breasts, and the underbust circumference was also recorded. All patients included in the study provided written informed voluntary consent for both the examination and hirudotherapy.

Results and Discussion

Analysis of the baseline anthropometric data of patients in both groups on the third postoperative day revealed no statistically significant differences across any of the specified parameters ($p > 0.05$). This indicated a clear homogeneity of the formed clinical groups, comparable volumes of surgical traumatization, and the initial transparency of the scientific experiment. At this stage, a pronounced reactive tissue edema was recorded in patients following all performed types of aesthetic interventions, which was presumably due to extensive surgical tissue dissection, the acute stage of lymphostasis, and local inflammatory exudation.

The obtained results regarding the dynamics of the patients' body circumferences following abdominoplasty and liposuction during the rehabilitation process are presented in Table 1.

Table 1. Dynamics of body circumferences of patients after abdominoplasty and liposuction during the rehabilitation process, (M±m), cm

Anatomical measurement zone / Patient group	3rd day	7rth day	14th day
Abdominal circumference (at the level of the umbilicus)			
Main group (after abdominoplasty, (n=4); liposuction, (n=8)	(88,2±1,4)	(81,4±0,8)*	(75,9±0,5)*
Comparison group (after abdominoplasty, (n=6); liposuction, (n=8)	(88,6±1,3)	(85,1±1,1)	(80,4±0,7)
Significance level of differences between groups	(p > 0,05)	**(p < 0,05)**	**(p < 0,05)**
Thigh circumference (upper third)			
Main group (after hip liposuction, (n=8)	58,4±0,8	54,1±0,5*	51,0±0,3*
Comparison group (after hip liposuction, (n=8)	58,8±0,7	56,9±0,6	53,7±0,4
Significance level of differences between groups	(p > 0,05)	**(p < 0,05)**	**(p < 0,05)**

Note: * — differences are statistically significant compared to the comparison group (p<0.05).

As demonstrated by the data presented in Table 1, a distinct regression dynamic of the edematous syndrome was recorded in the primary group on the seventh postoperative day, specifically following the performance of two hirudotherapy sessions. Thus, in patients after abdominoplasty and abdominal liposuction, the circumference at the level of the umbilicus in the primary group decreased from 88.2 ± 1.4 cm to 81.4 ± 0.8 cm ($p < 0.05$), whereas in the comparison group, which remained on the standard recovery protocol, this parameter decreased to 85.1 ± 1.1 cm. Similarly, measurements of the upper-third thigh circumference after liposuction in the primary group patients significantly decreased to 54.1 ± 0.5 cm compared to the group without hirudotherapy, where the circumference at this stage was 56.9 ± 0.6 cm ($p < 0.05$).

Following the completion of the full rehabilitation course (3–5 hirudotherapy sessions), an intergroup gap in the parameters was also recorded on the fourteenth postoperative day, demonstrating a high level of statistical significance according to the Mann–Whitney U test ($p < 0.05$). Specifically, the abdominal circumference in the primary group reached 75.9 ± 0.5 cm, whereas in the comparison group, it equaled 80.4 ± 0.7 cm. In turn, the thigh circumference in the primary group was 51.0 ± 0.3 cm, whereas in the comparison group, it decreased to 53.7 ± 0.4 cm.

The dynamics of the anthropometric parameters of the breasts in female patients following mammoplasty are presented in Table 2.

Table 2. Dynamics of anthropometric indicators of the breasts of patients after mammoplasty, (M±m), cm

Anatomical measurement zone / Patient group	3rd day	7rth day	14th day
Breast circumference (at the level of the highest points)			
Main group with hirudotherapy, (n=6)	94,6±1,1	90,8±0,7*	88,1±0,4*
Comparison group without hirudotherapy, (n=6)	94,9±1,2	93,2±0,9	90,5±0,6
Significance level of differences between groups	p > 0,05	**p < 0,05**	**p < 0,05**
Обвод під грудьми			
Main group with hirudotherapy, (n=6)	78,2±0,8	74,9±0,5*	73,0±0,3*
Comparison group without hirudotherapy, (n=6)	78,5±0,9	77,1±0,6	74,9±0,4
Significance level of differences between groups	p > 0,05	**p < 0,05**	**p < 0,05**

Note: * — differences are statistically significant compared to the comparison group (p<0.05).

Statistical analysis of the obtained data indicates that in female patients following mammoplasty who underwent hirudotherapy, the tense postoperative breast edema—which is frequently the primary cause of significant ischemic pain during the initial postoperative days and prolonged subsequent discomfort—resolved substantially faster. On the seventh postoperative day, the chest circumference at the level of the highest points in the primary group decreased to 90.8 ± 0.7 cm, compared to 93.2 ± 0.9 cm in the control group ($p < 0.05$), while the underbust circumference was 74.9 ± 0.5 cm versus 77.1 ± 0.6 cm, respectively. Following 3–5 hirudotherapy sessions, we recorded a parameter gap demonstrating a high level of statistical significance. The chest circumference and underbust circumference in the primary group reached 88.1 ± 0.4 cm and 73.0 ± 0.3 cm, respectively. This indicated the virtually complete elimination of interstitial edema, whereas congested phenomena were still observed in patients within the comparison group, where the chest circumference remained at 90.5 ± 0.6 cm.

The findings of our study support the assertion that the incorporation of hirudotherapy following cosmetic and plastic surgical interventions yields accelerated patient recovery dynamics, presumably mediated by the biologically active substances in the medical leech's saliva. Hirudin, a primary enzyme in leech saliva, blocks thrombin and dissolves local microthrombi within damaged capillaries, thereby exerting a positive effect on the restoration of blood circulation. Hyaluronidase cleaves the hyaluronic acid of connective tissue, significantly enhancing interstitial permeability. Destabilase reduces blood viscosity, improves the patency of microvessels, and promotes faster postoperative tissue healing. Additionally, vasodilators ensure oxygen influx, mitigate vasospasm, and facilitate the active outflow of venous blood [2].

The proposed pathogenetically substantiated rehabilitation of this patient category guarantees the rapid neutralization of the consequences of surgical manipulations during liposuction or abdominoplasty, which inevitably entail damage to capillary and lymphatic collaterals, leading to venous stasis, lymphostasis, and tissue hypoxia. Given that neoangiogenesis processes physiologically unfold only after the 4th–5th day, early decompression constitutes a fundamental task for the rehabilitation specialist [3,4]. The introduction of controlled hirudotherapy into the protocol from the third day allows for the reduction of intercellular fluid congestion and postoperative hematomas, contributing to the reduction of body circumferences in centimeters. Furthermore, tissue decompression diminishes mechanical pressure on nociceptors, which clinically manifests as a rapid regression of pain syndrome in the primary group of patients, enabling them to discontinue systemic non-steroidal anti-inflammatory drugs (NSAIDs) significantly earlier. Although this fact was not the primary objective of our study, it is worth noting that patients receiving hirudotherapy reported no further need to administer analgesic and anti-inflammatory medications.

Conclusions

The application of hirudotherapy in the postoperative period of surgical interventions such as liposuction, abdominoplasty, and mammoplasty constitutes a pathogenetically substantiated method that substantially accelerates the regression of postoperative edema, enhances microcirculation, and promotes tissue regeneration. The proposed method of postoperative rehabilitation leads to an accelerated reduction in abdominal, thigh, and breast volumes during the early rehabilitation period due to a potent lymph-drainage effect, which is confirmed by objective anthropometric monitoring.

Prospects for Implementation

Hirudotherapy can be recommended as an effective, safe, and accessible adjunctive modality within the comprehensive Fast-Track (enhanced recovery after surgery) rehabilitation of patients following aesthetic and reconstructive surgeries, aimed at shortening recovery timelines and optimizing aesthetic outcomes.

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BIVACOR ЯК КОНЦЕПЦІЯ ЦІЛЬОВОЇ ТЕРАПІЇ (DESTINATION THERAPY): ПЕРСПЕКТИВИ ПОВНОЇ ВІДМОВИ ВІД ДОНОРСЬКИХ ОРГАНІВ ПРИ ТЕРМІНАЛЬНІЙ СЕРЦЕВІЙ НЕДОСТАТНОСТІ

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Анотація. У роботі проаналізовано інженерно-гемодинамічні особливості та перші клінічні результати застосування титанового повного штучного серця (Total Artificial Heart — TAH) BiVACOR на основі технології активної магнітної левітації (MAGLEV). Розглянуто передумови трансформації підходу до лікування термінальної біентрикулярної серцевої недостатності: перехід від концепції «мосту до трансплантації» (Bridge-to-Transplant, BTT) до пожиттєвої цільової терапії (Destination Therapy, DT). Оцінено переваги безклапанної роторної конструкції над пульсуючими об’ємно-витісняючими системами попереднього покоління та окреслено основні клінічні бар’єри на шляху до повної відмови від донорських органів.

Ключові слова: термінальна серцева недостатність, повне штучне серце, BiVACOR, магнітна левітація, механічна підтримка кровообігу, цільова терапія, трансплантація серця.