

Justification for the Development of an Algorithm for the Medical Rehabilitation of Patients with Obesity After Laparoscopic Interventions in Private Clinics

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Abstract Obesity is an independent risk factor for complicated postoperative recovery, even after minimally invasive laparoscopic surgery. Patients with obesity demonstrate reduced cardiopulmonary reserve, limited tolerance to physical activity, and a prolonged systemic inflammatory response in the early postoperative period. Standard postoperative management often does not fully address these pathophysiological features. This study substantiates the necessity of developing a structured algorithm of medical rehabilitation for obese patients after laparoscopic interventions. The proposed approach is based on clinical, functional, and laboratory data, including assessment of physical activity, respiratory function, and high-sensitivity C-reactive protein (hs-CRP). The implementation of a targeted rehabilitation algorithm allows optimization of early mobilization, improvement of functional recovery, and reduction of postoperative complications. The presented findings support the clinical relevance of algorithm-based medical rehabilitation and its feasibility in surgical practice.

Keywords Obesity, Laparoscopic surgery, Medical rehabilitation

1. Introduction

In recent years, the issue of postoperative medical rehabilitation in patients with obesity has gained particular clinical importance. Contemporary concepts of enhanced recovery after surgery (ERAS) emphasize early mobilization, respiratory rehabilitation, and metabolic support as key elements of postoperative care. However, analysis of the available literature indicates that most existing protocols are designed for the general surgical population and insufficiently account for the pathophysiological and functional characteristics specific to patients with obesity [1,3].

As a result, standard postoperative management strategies often prove to be suboptimal for this category of patients. This problem is especially pronounced in private medical clinics, where surgical care for patients with obesity is increasingly provided [2,4]. Organizational features of the private healthcare sector—shortened hospital stays, high patient turnover, and limited opportunities for prolonged inpatient observation—necessitate the implementation of clearly structured, practice-oriented medical rehabilitation algorithms [7].

At the same time, issues related to the adaptation of rehabilitation measures to private clinic settings and their effectiveness in patients with obesity after laparoscopic interventions remain insufficiently studied.

The aim of the study was to justify the development of an algorithm for medical rehabilitation of patients with obesity after laparoscopic interventions by assessing postoperative course characteristics, functional recovery, and the dynamics of systemic inflammatory markers in a private clinic setting.

2. Materials and Methods

This study was designed as a prospective, comparative, controlled clinical investigation with parallel allocation of patients into control and main groups.

Patient enrollment was conducted sequentially as patients were admitted, with strict adherence to predefined inclusion and exclusion criteria. Patients in the control group (n = 64) received standard postoperative care without specialized rehabilitation measures. Patients in the main group (n = 72) underwent postoperative rehabilitation according to a newly developed algorithm for the restorative management of patients with obesity after laparoscopic interventions.

The study was conducted at the private medical center “AKFA MEDLINE” (Tashkent, Uzbekistan) and included several observation stages:

- Preoperative stage (T0): collection of medical history, physical examination, assessment of baseline physiological parameters, and determination of hs-CRP levels;
- Early postoperative period (T1, days 1–3): clinical status assessment, monitoring of vital functions, recording of oxygen saturation, pain intensity, and initial rehabilitation activities;
- Early recovery period (T2, days 4–14): evaluation of functional dynamics, repeated hs-CRP measurement, six-minute walk test (6MWT), Borg dyspnea scale, and physical activity indicators;
- Late recovery period (T3, days 15–30 after surgery): assessment of functional outcomes and tolerance to rehabilitation load.

Inclusion criteria were: age ≥ 18 years, obesity class II–III (BMI ≥ 35 kg/m²), elective laparoscopic surgery, stable postoperative condition, and written informed consent.

Exclusion criteria included: emergency surgery, decompensated cardiopulmonary disease, acute infectious conditions, oncological pathology, and refusal to participate.

The surgical profile predominantly consisted of laparoscopic bariatric procedures—laparoscopic sleeve gastrectomy (LSG) and Roux-en-Y gastric bypass (RYGB)—as well as laparoscopic cholecystectomy, hernioplasty, and appendectomy. Distribution of surgical procedures between groups showed no statistically significant differences, ensuring methodological validity of comparative analysis.

Physiological assessment included heart rate (HR), arterial blood pressure (BP), respiratory rate (RR), peripheral oxygen saturation (SpO₂) measured by pulse oximetry, dyspnea severity using the Borg scale (0–10 points), physical load tolerance assessed by the six-minute walk test (6MWT) according to ATS guidelines, and daily physical activity evaluated using the International Physical Activity Questionnaire (IPAQ, short form) with calculation of MET-minutes per week [6].

High-sensitivity C-reactive protein (hs-CRP) was used as a laboratory marker of systemic inflammatory response. Venous blood sampling was performed in the morning, fasting, under standardized conditions. hs-CRP levels were determined using a high-sensitivity immunoturbidimetric method on an automated biochemical analyzer with certified reagents, and results were expressed in mg/L [8,9].

Statistical analysis included assessment of data distribution (Shapiro–Wilk and Kolmogorov–Smirnov tests). Quantitative variables were expressed as mean \pm standard deviation (M \pm SD) for normal distribution or median with interquartile range (Me [Q1–Q3]) for non-normal distribution. Student’s t-test or Mann–Whitney U test was used for independent samples, paired t-test or Wilcoxon test for within-group comparisons, and χ^2 test or Fisher’s exact test for categorical variables. Statistical significance was set at $p < 0.05$.

The study was conducted in accordance with the Declaration of Helsinki, ICH-GCP guidelines, and national regulatory requirements. The study protocol was approved

by the local ethics committee, and all patients provided written informed consent.

3. Results and Discussion

The results of the present study convincingly demonstrate that standard postoperative management is insufficient to ensure optimal functional recovery in patients with obesity after laparoscopic interventions and substantiate the necessity for developing a structured medical rehabilitation algorithm.

Firstly, patients in the control group exhibited an unfavorable functional response during the early and intermediate postoperative periods. By days 7–10 after surgery, a statistically significant decline in physical performance was observed. The distance covered in the six-minute walk test (6MWT) decreased by 43.7 meters compared to baseline values ($p = 0.003$), while the level of daily physical activity assessed using the IPAQ questionnaire decreased by 150 MET-min/week ($p = 0.041$). At the same time, the severity of dyspnea after exertion, measured by the Borg scale, increased by 0.7 points ($p = 0.002$). These changes reflect the development of a pronounced functional “gap” in the early recovery period, indicating the limited adaptive capacity of patients with obesity when managed using standard postoperative approaches.

Secondly, the observed deterioration in functional indicators in the control group occurred despite comparable baseline clinical and demographic characteristics, including age, sex, body mass index, anesthesiological risk (ASA II–III), structure of laparoscopic interventions, and comorbid metabolic and cardiopulmonary conditions. This confirms that the negative dynamics were not related to initial differences between the groups but rather to the absence of systematic rehabilitation measures.

Thirdly, the lack of structured postoperative rehabilitation in the control group resulted in insufficient early mobilization and irregular implementation of respiratory exercises. This contributed to persistent hypoventilation, increased work of breathing, and limited tolerance to physical activity, particularly in patients with obesity II–III degrees. As a consequence, functional recovery was delayed, and patients remained vulnerable to respiratory and thromboembolic complications during the early postoperative period.

Fourthly, the laboratory assessment supported the clinical and functional findings. In the control group, the decline in systemic inflammatory activity, reflected by the dynamics of high-sensitivity C-reactive protein (hs-CRP), was slower and less pronounced, indicating prolonged postoperative inflammatory response. This phenomenon is consistent with the concept of chronic low-grade inflammation associated with obesity, which is exacerbated by surgical stress and insufficient physical activation.

Fifthly, the clinical relevance of these functional and laboratory disturbances was confirmed by the high overall incidence of postoperative complications in the control group, which reached 66.0%. The most common complications were

respiratory disorders, delayed mobilization-related conditions, and prolonged asthenic syndrome. Given the methodological comparability of the study groups ($p > 0.05$ for all baseline parameters), these findings indicate that standard postoperative care does not adequately meet the rehabilitation needs of patients with obesity after laparoscopic surgery.

In contrast, the application of a structured rehabilitation algorithm in the main group was associated with favorable functional and clinical outcomes. By postoperative days 7–10, patients demonstrated a significant improvement in exercise tolerance, with an increase in 6MWT distance by 21.1 meters ($p = 0.012$), an increase in IPAQ scores by 130 MET-min/week ($p = 0.031$), and a reduction in post-exertional dyspnea by 0.7 points on the Borg scale ($p = 0.022$). By day 30, these positive changes became more pronounced: the 6MWT distance reached 369.4 ± 46.1 m ($p < 0.001$ vs. baseline), accompanied by sustained growth in physical activity levels and further reduction in dyspnea severity ($p < 0.001$).

These findings confirm that systematic respiratory training, early and dosed mobilization, and stepwise increase in physical activity facilitate faster restoration of functional reserves and improve tolerance to physical load in patients with obesity after laparoscopic interventions.

An additional and critically important argument in favor of implementing a structured rehabilitation algorithm lies in the organizational specifics of private medical centers. In routine clinical practice, postoperative care in such settings is often characterized by variability in recommendations, irregular performance of respiratory exercises, and lack of standardized monitoring of functional recovery. This variability reduces the reproducibility of clinical outcomes and increases the risk of delayed recovery, particularly in patients with obesity who require coordinated and continuous rehabilitation support.

4. Conclusions

The introduction of a structured algorithm allows for unification of rehabilitation stages, clear definition of the volume and frequency of respiratory and motor interventions, and systematic monitoring of functional and inflammatory indicators. This approach ensures continuity between inpatient and outpatient stages of care, enhances patient adherence, and provides a reproducible framework for optimizing

postoperative recovery. Therefore, the development and implementation of a structured medical rehabilitation algorithm represent a clinically justified and organizationally feasible strategy for improving postoperative outcomes in patients with obesity undergoing laparoscopic surgery, especially in the context of private healthcare institutions.

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