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Original Article

The Minimally Invasive Step: An Algorithm for Postoperative Complications

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ABSTRACT

Postoperative intra-abdominal complications (POIACs) are a major challenge in abdominal surgery, associated with high morbidity and mortality. However, no clinically validated algorithms exist to guide the critical decision between laparoscopic and open surgical access. This single-center cohort study analyzed 253 patients with POIACs. We evaluated the prognostic significance of universal scales (SAPS II, SOFA, APACHE II), peritonitis-specific scores (Mannheim Peritonitis Index (MPI), Surgical Strategy for Peritonitis Scale (SSPS), World Society of Emergency Surgery Sepsis Severity Score (WSES SSS), Abdominal Cavity Index (ACI)), and laboratory markers (procalcitonin (PCT), lactate, C-reactive protein (CRP)) using ROC analysis and binary logistic regression. Independent predictors for selecting open access included age ≥60 years, ASA ≥ IV, SAPS II ≥ 28, SOFA ≥ 4, and APACHE II ≥ 17. For peritonitis, key thresholds were SSPS ≥ 4 (OR 1.69) and MPI ≥ 21 (OR 1.08). The combined criterion of PCT ≥7 ng/mL and lactate ≥2 mmol/L demonstrated high specificity (85%) for predicting laparotomy. Based on these findings, a three-zone risk stratification algorithm ("green," "yellow," "red") was developed. Application of the laparoscopic approach, guided by these criteria, led to significantly better outcomes, including a dramatic reduction in 90-day mortality for infectious complications (1.1% vs. 15.1%, p<0.001). Crucially, successful laparoscopic correction after primary laparotomy ("minimally invasive step") was achieved in 48.7% of patients with peritonitis and 63.5% with non-infectious complications. This algorithm provides a validated, quantitative framework for selecting surgical access in POIACs, potentially improving patient outcomes by optimizing the surgical approach. The concept of a "minimally invasive step" challenges the dogma of mandatory repeat laparotomy after primary open surgery.

Keywords: postoperative complications, relaparoscopy, relaparotomy, prognostic scales, decision-making algorithm.

1 Introduction

Postoperative intra-abdominal complications (POIACs) remain one of the most challenging problems in modern abdominal surgery, associated with high morbidity, significant mortality, and a substantial socio-economic burden [1]. According to multicentre studies, the incidence of POIACs varies from 8% to 31.5%, depending on the type of primary intervention, with the proportion of severe complications (Clavien-Dindo grade III–V) reaching 8% [2–4]. The occurrence of POIACs prolongs hospitalization by 2–3 times, increases treatment costs by 40–60%, and accounts for up to 80% of early postoperative deaths [5,6,7]. Choosing the optimal surgical approach for the correction of POIACs—laparoscopic or open—presents a complex clinical challenge, upon which immediate and long-term treatment outcomes critically depend. On one hand, the laparoscopic approach demonstrates advantages such as reduced surgical trauma, faster recovery, and shorter hospital stays [4,8]. On the other hand, its use in severe infectious complications, generalized peritonitis, and hemodynamic instability is limited by technical difficulties and the risk of inadequate source control [9,10]. Traditional relaparotomy, which retains its status as the "gold standard" in severe cases, is associated with a higher incidence of wound infections, adhesive disease, and prolonged rehabilitation [6,11]. To date, there are no systematized, clinically validated algorithms in the global literature for selecting the surgical approach in the management of POIACs. Existing recommendations are primarily descriptive, based on expert opinion, and do not offer quantitative decision-making criteria [2]. The integration of prognostic scores (SAPS II, SOFA, APACHE II), specific peritonitis indices (MPI, WSES SSS), and laboratory biomarkers (procalcitonin, lactate) into a unified diagnostic and tactical model has not been implemented [12–14]. This leads to significant subjectivity in choosing the approach, high variability in clinical outcomes, and unjustified intraoperative conversions [15–17]. The issue of the so-called "minimally invasive step"—the

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use of a laparoscopic approach for the correction of POIACs in patients who underwent primary open surgery—is particularly relevant. The established dogmatic practice favours repeat laparotomy after an initial laparotomy; however, the evidence base for the effectiveness and safety of laparoscopic revision in this patient cohort is limited [18,19]. Therefore, the development and validation of a comprehensive algorithm for selecting the surgical approach in POIACs, one that integrates objective prognostic criteria and ensures a personalized approach to intervention strategy, represents a priority direction for improving emergency and elective abdominal surgery and adheres to the principles of evidence-based medicine [15,16].

2 Methods and Materials

2. 1 Study Design: A cohort study was conducted, comprising a retrospective (n=152, 60%) and a prospective (n=101, 40%) component. The study was carried out at the I.V. Davydovsky City Clinical Hospital (Moscow) from January 2019 to January 2024. The study protocol was approved by the Local Ethics Committee of the I.M. Sechenov First Moscow State Medical University (№. 25–22 dated 08.12.2022). All patients provided informed consent to participate in the prospective part of the study.

2. 2 Inclusion Criteria: Age ≥18 years; Development of POIACs within 90 days following primary surgical intervention on the abdominal cavity organs, retroperitoneal space, or pelvis; Necessity for surgical correction of the complication (Clavien-Dindo class IIIb–V); Elective or emergency hospitalization.

2. 3 Exclusion Criteria: Age under 18 years; Refusal of surgical treatment; Terminal stage of oncological or incurable somatic disease with a life expectancy of <30 days; Complications manageable with conservative therapy or minimally invasive interventions under local anaesthesia (Clavien-Dindo classes I–IIIa); Incomplete medical records (for the retrospective cohort).

2. 4 Patient Stratification: All patients (n=253) were divided into two groups based on the nature of the complication:

Group A (n=141, 55.7%): Intra-abdominal infectious complications (peritonitis according to the V. S. Saveliev classification, 2014).

Group B (n=112, 44.3%): Non-infectious intra-abdominal complications.

Each group was further subdivided by the type of surgical approach used for the correction:

Infectious Complications: Laparoscopic approach (n=88, 62.4%), Open approach (n=53, 37.6%).

Non-infectious Complications: Laparoscopic approach (n=83, 74.1%), Open approach (n=29, 25.9%).

2. 5 Assessed Parameters:

Baseline Characteristics: Age, sex, body mass index (BMI), physical status according to the ASA classification, type of admission (elective/emergency), nature of the primary intervention.

Prognostic Scales:

Universal: SAPS II, SOFA, APACHE II.

Specific for Peritonitis: Mannheim Peritonitis Index (MPI), Surgical Strategy for Peritonitis Scale (SSPS), World Society of Emergency Surgery Sepsis Severity Score (WSES SSS), Abdominal Cavity Index (), Intra-abdominal view scale.

Laboratory Markers (on the 1st day after primary surgery): C-reactive protein (CRP), procalcitonin (PCT), lactate, lactate dehydrogenase (LDH).

2. 6 Treatment Outcomes: Duration of hospitalization and ICU stay, rate of repeat interventions, 90-day mortality, continuity of surgical approaches.

2. 7 Statistical Analysis: Statistical processing was performed using IBM SPSS Statistics (version 26). The Shapiro-Wilk test was used to assess the normality of distribution. For comparisons between independent groups, the Student's t-test (for normal distribution) or the Mann-Whitney U test (for non-normal distribution) were applied. Qualitative characteristics were compared using Pearson's Chi-square test or Fisher's exact test. Binary logistic regression analysis was used to identify independent predictors. The discriminatory power of the scales was assessed using ROC analysis, determining the area under the curve (AUC) and optimal threshold values. The optimal cut-off point for each predictor was determined by maximizing the Youden index (J = Sensitivity + Specificity – 1). Differences were considered statistically significant at $p < 0.05$.

3 Results

This study included 253 patients requiring repeat surgical intervention for POIACs. The median age was 55.3 years (range 18–94 years), and 56.9% were male. Emergency admission occurred in 88.0% of patients. The distribution of patients by the severity of complications (Clavien-Dindo classification) and the type of surgical approach used is presented in Table 1. Of the total cohort, 141 (55.7%) patients were diagnosed with infectious complications (peritonitis), and 112 (44.3%) with non-infectious complications (such as bile leakage, intra-abdominal bleeding, acute intestinal obstruction, or postoperative hernias). A laparoscopic approach for the correction of POIACs was used in 171 (67.6%) patients, while an open approach was used in 82 (32.4%). This demonstrates a significant association between the type of complication and the chosen approach ($\chi^2 = 3.898$; $p = 0.048$), with laparoscopy used more frequently in non-infectious cases.

Table 1: Baseline Characteristics, Complication Severity, and Surgical Approaches (n=253).

Parameter	Infectious Complications (n=141)	Non-infectious Complications (n=112)	Total (n=253)
Clavien-Dindo Grade			
IIIb	100 (39.5%)	88 (34.8%)	188 (74.3%)
IVa	14 (5.5%)	17 (6.7%)	31 (12.3%)
IVb	18 (7.1%)	5 (2.0%)	23 (9.1%)
V	9 (3.6%)	2 (0.8%)	11 (4.3%)
Surgical Approach for POIACs Correction			
Laparoscopic	88 (62.4%)	83 (74.1%)	171 (67.6%)
Open	53 (37.6%)	29 (25.9%)	82 (32.4%)

3. 1 Predictors of Surgical Approach Selection

Patients who underwent open surgery were significantly older (60.8±17.7 vs. 50.8±17.4 years; $p<0.001$) and had a more severe ASA physical status (4.0±0.5 vs. 3.7±0.5 points; $p<0.001$). Multivariate analysis confirmed that each additional year of age increased the odds of choosing laparotomy by 3.5% (OR=1.035; 95% CI 1.017–1.052; $p<0.001$), and an increase in ASA class raised these odds 4-fold (OR=3.995; 95% CI 2.013–7.930; $p<0.001$).

All universal severity scales demonstrated high prognostic significance for predicting an open approach, with values for SAPS II, SOFA, and APACHE II being significantly higher in the laparotomy group ($p < 0.001$). In the peritonitis subgroup (n=141), the specialized indices—MPI, SSPS, and WSES SSS—were independent predictors. Laboratory markers on the first postoperative day, particularly PCT and lactate, also showed significant predictive value. The predictive accuracy of these scores and markers is summarized in Table 2. Notably, the combined criterion of PCT ≥7 ng/mL and lactate ≥2 mmol/L yielded a high specificity of 85% for predicting the need for laparotomy.

In patients with non-infectious complications (n=112), body mass index (BMI) was a significant independent predictor for choosing an open approach. At a cut-off value of BMI ≥30.6 kg/m², sensitivity was 72.4%, and specificity was 72.3% (AUC 0.747; $p<0.001$).

Table 2: Prognostic Accuracy of Key Predictors for Choosing an Open Approach.

Predictor	Area under ROC curve (95% CI)	Optimal Cut-off	Sensitivity (%)	Specificity (%)
Universal Scales (All Patients)				
SAPS II	0.820 (0.748–0.891)	≥28	79	73
SOFA	0.781 (0.707–0.855)	≥4	76	71
APACHE II	0.776 (0.699–0.854)	≥17	74	70
Peritonitis-Specific Indices (n=141)				
WSES SSS	0.833 (0.764–0.901)	≥6	77.4	80.7
Peritonitis Strategy Scale	0.841 (0.770–0.911)	≥4	85	72
Mannheim Peritonitis Index	0.813 (0.738–0.887)	≥21	79	71
Lab Markers (All Patients)				
Procalcitonin (ng/mL)	0.760 (0.682–0.839)	≥7	68	78
Lactate (mmol/L)	0.715 (0.632–0.798)	≥2	62	75
PCT ≥7 ng/mL + Lactate ≥2 mmol/L	-	-	61	85

3. 2 Clinical Algorithm for Surgical Approach Selection

Based on these findings, clinical algorithms were developed for patients with infectious and non-infectious complications. The algorithm for peritonitis (Figure 1) integrates the sequential assessment of peritonitis extent and exudate character (V.S. Saveliev classification), calculation of the MPI, SSPS, and WSES SSS, and determination of PCT and lactate levels.

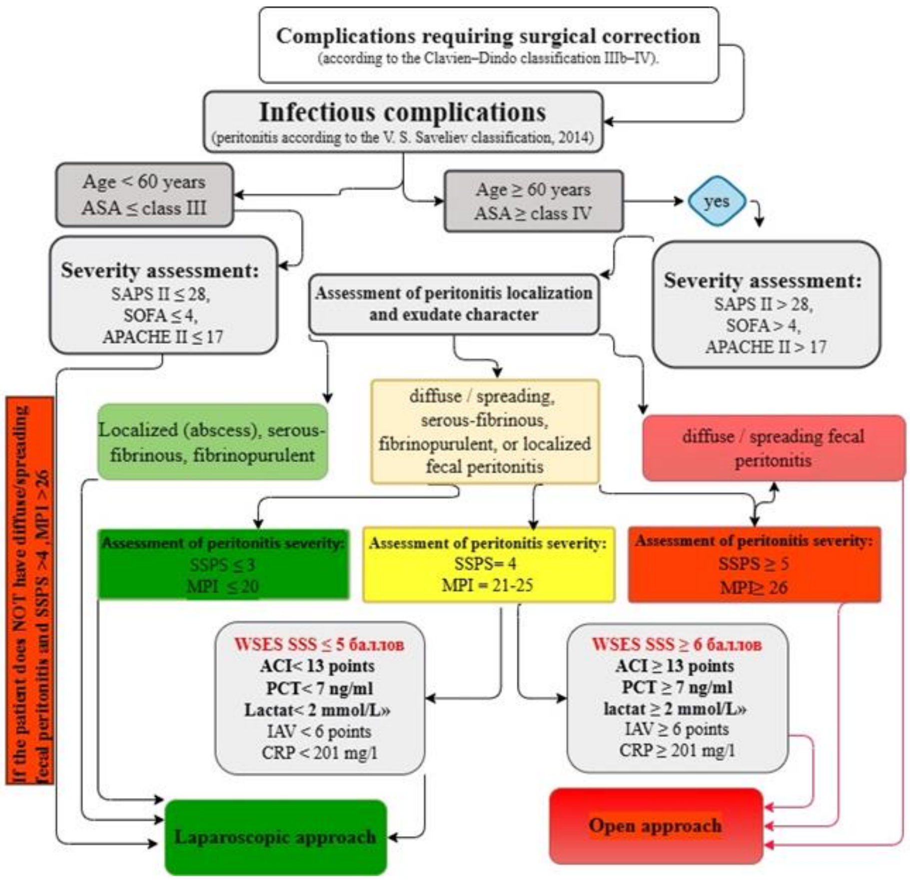

Figure 1: Clinical Algorithm for Selecting Surgical Access in Patients with Peritonitis (Infectious POIACs).

The algorithm for non-infectious complications (Figure 2) integrates universal severity scales (SAPS II, SOFA, APACHE II), BMI, the specific type of complication, and intraoperative findings.

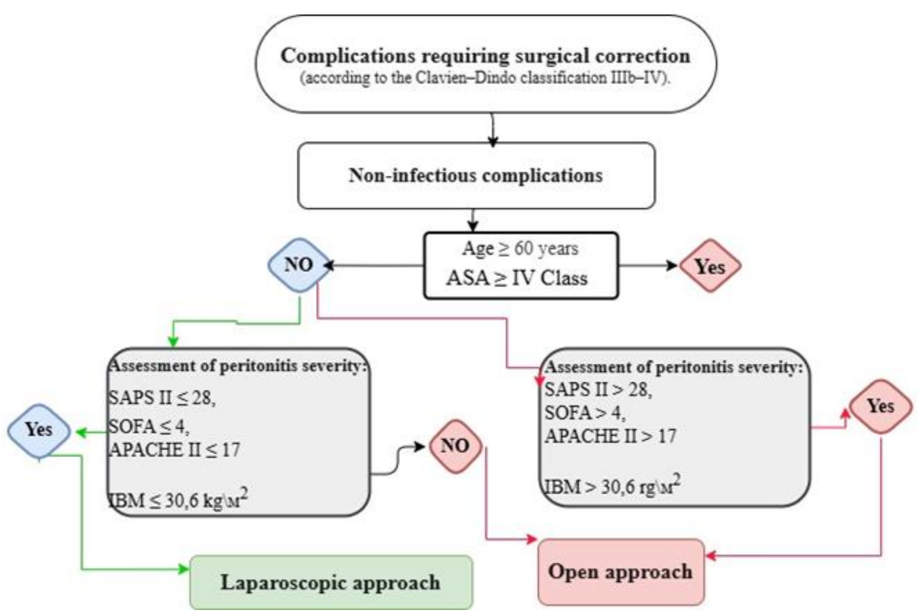

Figure 2: Clinical Algorithm for Selecting Surgical Access in Patients with Non-Infectious POIACs.

Both algorithms stratify patients into three risk zones, guiding the selection of the optimal surgical approach, as detailed in Table 3.

Table 3: Risk Stratification and Recommended Surgical Approach.

Risk Category	Criteria for Peritonitis	Criteria for Non-Infectious Complications	Recommended Approach
Green	MPI ≤20, SSPS ≤3, WSES SSS ≤5, PCT <7 ng/mL, Lactate <2 mmol/L	SAPS II <28, SOFA <4, APACHE II <17, BMI <30.6 kg/m²	Laparoscopy
Yellow	MPI 21–25 OR SSPS =4 OR isolated elevation of one biomarker	Borderline scale values, BMI 30–35 kg/m²	Individualized Decision
Red	MPI ≥26, SSPS ≥5, WSES SSS ≥6, PCT ≥7 ng/mL AND Lactate ≥2 mmol/L	SAPS II ≥28, SOFA ≥4, APACHE II ≥17, BMI ≥30.6 kg/m²	Primary Laparotomy

3. 3 Clinical Outcomes and the "Minimally Invasive Step"

Application of the laparoscopic approach in accordance with the developed algorithm led to significantly better treatment outcomes compared to open interventions, as shown in Table 4. The laparoscopic group demonstrated a higher success rate of the primary re-intervention, shorter hospital and ICU stays, fewer repeat operations, and dramatically lower 90-day mortality. This is particularly striking in the infectious complications group, where mortality was reduced from 15.1% with laparotomy to 1.1% with laparoscopy. Furthermore, the need for three or more reoperations was significantly lower in the laparoscopy group for infectious complications (5.7% vs. 26.4%).

Table 4: Comparative Analysis of Treatment Outcomes by Surgical Approach.

Outcome	Infectious Complications		Non-infectious Complications	
	Laparoscopy (n=88)	Laparotomy (n=53)	Laparoscopy (n=83)	Laparotomy (n=29)
Hospital stay, days (median)	19	23	12	17
ICU stay, days (median)	5	10	1	5
Success of primary re-intervention (%)	73.9%	47.2%	96.4%	89.7%
Reoperations (≥3) (%)	5.7%	26.4%	0%	3.4%
90-day mortality (%)	1.1%	15.1%	1.2%	3.4%

This study provides evidence for the feasibility of a "minimally invasive step"—successful laparoscopic correction of POIACs after primary laparotomy. The data on access continuity, summarized in Table 5, challenge the established dogma that re-intervention after open surgery must be performed via laparotomy. In this cohort, 48.7% of patients with infectious complications and 63.5% with non-infectious complications following primary laparotomy underwent successful repeat intervention using a laparoscopic approach.

Table 5: Continuity of Surgical Approaches ("Minimally Invasive Step").

Primary Approach	Reoperation Approach	Infectious Complications (n=141)	Non-infectious Complications (n=112)
Laparoscopy	Laparoscopy	49 (75.4%)	50 (83.3%)
	Laparotomy	16 (24.6%)	10 (16.7%)
Laparotomy	Laparoscopy	37 (48.7%)	33 (63.5%)
	Laparotomy	39 (51.3%)	19 (36.5%)

4 Discussion

This study presents the first clinically validated algorithm for selecting surgical access in patients with POIACs. The algorithm moves beyond subjective decision-making by integrating objective, quantifiable predictors. The high prognostic value of the universal scales (SAPS II, SOFA, APACHE II) demonstrated in this study aligns with international data [8,9] and confirms the value of their routine use in planning repeat interventions. The identified cut-off values provide objective thresholds to accurately identify patients for whom a laparoscopic approach may be contraindicated due to a high risk of adverse outcomes.

In patients with peritonitis, the specialized indices (MPI, SSPS, WSES SSS) proved most informative, with cut-off values (MPI ≥21, SSPS ≥4, WSES SSS ≥6) consistent with literature associating high scores with increased mortality and the need for more extensive surgery [1,2,10,13]. Notably, the SSPS, proposed by national authors [12], demonstrated predictive accuracy comparable to the MPI with greater simplicity, making it a promising tool for rapid intraoperative assessment. The identified role of a combined PCT and lactate threshold as a highly specific predictor of the need for open surgery adds to the evidence for multi-marker strategies in abdominal sepsis [17,18].

The marked reduction in mortality, hospital stay, and the rate of multiple reoperations in the laparoscopy group strongly confirms the clinical efficacy of the proposed approach. This aligns with the well-documented benefits of minimally invasive surgery, which extend beyond shorter recovery to include reduced surgical stress, lower rates of wound infections, and potentially less postoperative adhesive disease [3,4,17,19].

Furthermore, the demonstration of a successful "minimally invasive step" is a key finding of this study. While recent studies [2,15,16] have suggested the possibility of relaparoscopy in selected patients, clear selection criteria have not been previously formulated. Our data showing that nearly half of patients with peritonitis and the majority with non-infectious complications can safely undergo laparoscopic revision after primary open surgery is a paradigm shift. The algorithm proposed here offers, for the first time, the criteria to identify these patients, potentially expanding the application of minimally invasive techniques in revisional surgery.

4. 1 Study Limitations

This study has several limitations. First, its single-centre design may limit the generalizability of our findings to other populations or healthcare settings. Second, the retrospective component is subject to potential selection bias, although this was partially mitigated by the inclusion of a large prospective cohort and the use of robust statistical methods. Third, while our algorithm performed well in this internal validation, it lacks external validation in an independent, multicentre cohort, which is essential before it can be broadly recommended for clinical use. Fourth, variability in laboratory assays and surgical expertise between institutions could affect the reproducibility of the proposed thresholds. Finally, as a cohort study, it demonstrates association but cannot prove causality. Future prospective, multicentre studies are needed to validate this algorithm and assess its impact on patient outcomes across diverse surgical settings.

5 Conclusion

A comprehensive algorithm for selecting the surgical approach in the management of postoperative intra-abdominal complications has been developed and clinically tested. It integrates the type of complication, universal prognostic scales, specific peritonitis indices, and laboratory markers. Specific, statistically derived threshold values for these tools were established to determine surgical strategy. This three-zone risk stratification model standardizes preoperative planning and minimizes subjectivity. Its application demonstrates that the laparoscopic approach is associated with significantly better clinical outcomes, including dramatically lower mortality. Crucially, the study introduces and validates the concept of a "minimally invasive step," proving that successful laparoscopic correction after primary open surgery is feasible in a significant proportion of patients. This algorithm is recommended for implementation as a decision-support tool for planning revisional interventions, with the understanding that further multicentre validation is warranted.

Authors' contribution

The authors declare the compliance of their authorship according to the international ICMJE. All authors made a substantial contribution to the conception of the work, acquisition, analysis, interpretation of data for the work, drafting and revising the work, final approval of the version to be published and agree to be accountable for all aspects of the work.

Ethics approval

The study protocol was approved by the Local Ethics Committee of I.M. Sechenov First Moscow State Medical University (Sechenov University) (Protocol No. 25-22 dated December 8, 2022). Approval and conduct of the protocol were obtained in accordance with the principles of the Declaration of Helsinki.

Conflict of interests

The authors declare no conflicts of interest.

References

[1] Karkhani, H.M.H., Gallyamov, E. A, Shalygin, A.B., Emelianov, A.Yu., Shubenok, M. V., Yunusov, A.A. The Potential of Minimally Invasive Techniques in a Tailored Diagnostic and Therapeutic Strategy for Acute Necrotizing Pancreatitis. *Creative Sur and Onco* **15**, 282–286, doi:10.24060/2076-3093-2025-15-3-282-286 (2025).

[2] Ivakhov, G.B., Titkova, S.M., Loban, K.M., Teplykh, A.V., Teplyshev, A.V., Sazhin, A.V. Generalized Peritonitis Strategy Score: concept of creation and development of a new score for surgical stratification of patients with generalized peritonitis. *Moscow Sur. J.* **4**, 58–66, doi:10.17238/2072-3180-2024-4-58-66 (2024).

[3] Larichev, A. B. Postoperative complications: definition and classification. *Grekov's Bulletin of Surgery* **183(2)**, 76–81, doi:10.24884/0042-4625-2024-183-2-76-81 (2024).

[4] Timerbulatov, V. M., Timerbulatov, Sh.V., Timerbulatov, M.V. Classification of surgical complications. *Pirogov Russ. J. Surgery* **9**, 61-65, doi:10.17116/hirurgia2018090162 (2018).

[5] Chotchaev, R. M., Zuban, O.N., Prokopovich, M. A. Analysis of surgical complications of reconstructive plastic surgery according to the Clavien–Dindo classification. *Urologiia* **3**, 70–77, doi:10.18565/urology.2023.3.70-77 (2023).

[6] Peregudov, S.I., Tulupov, A.N., Smirenin, S.V., Titov, R.V. Postoperative infectious complications in diffuse peritonitis. *The J. Emer. Surgery named after I.I. Dzhanelidze* **3(8)**, 25-30, doi:10.54866/271296322022324 (2022).

[7] Chia H. S., Pary M. A. Assessment Of Patient's Education and Lifestyle Factors in Ulcerative Colitis: A Cross-Sectional Study. *Passer j. basic appl. Sci* ***8***, 364-373, doi: 10.24271/PSR.2025.449298.1543 (2026).

[8] Safura, R, AbdulWaheed, M. Suhail, S., Showkat A. G,. Mohammad A. Sh., Falak, A., Altaf H. M. Perioperative serum

lactate as a predictor of post-operative length of hospital stay and in-hospital mortality in patients undergoing major emergency abdominal surgeries. *Asian J Med Sci* **15**, 16–21, doi:10.3126/ajms.v15i5.62619 (2024).

[9] Zabolotskikh, I. B., Trembach, N. V. High perioperative risk patients: two approaches to stratification. *Annals of Critical Care* **4**, 34–46, doi:10.21320/1818-474X-2019-4-34-46 (2019).

[10] Revishvili, A. S., Olovyanny, V. E., Kalinin, D. V., Kuznetsov A. V. Mortality in acute appendicitis in Russia. *Pirogov Russ J. Surgery* **2022**, 5–14, doi:10.17116/hirurgia20221015 (2022).

[11] Avan Kh. I. Role of bariatric surgeries on improving subsequent pregnancy outcomes. *Passer j. basic appl. Sci* *7*, 238-244, doi: 10.24271/PSR.2025.486059.1793 (2025).

[12] Gueiros, L.D.S., Fonseca, C.M. D.A., Duarte, N.M.D.M., Antunes, O.S. Mannheim's peritonitis index in the prediction of postoperative outcome of peritonitis. *Rev Col Bras Cir* **49,** e20222991, doi:10.1590/0100-6991e-20222991_en (2022).

[13] Sonker, S. K., Nirala, S. L., Dhruv, B. K. To prognosticate the outcome in patient with perforation peritonitis by evaluating Mannheim peritonitis index & APACHE-II scoring system. *Glob J Res Anal* **11**, 131–134, doi:10.36106/gjra (2022).

[14] Romaric Tobome, S., Allode, S.A., Hodonou ,M.A., Kinnongni Hessou, T., Caronna, R. Mannheim Peritonitis Index: usefulness in a context with limited resources. *Journal of Gastric Surgery* **3**, doi:10.36159/jgs.v3i2.85 (2021).

[15] Hashida, H., Sato, M., Kumata, Y., Mizumoto, M., Kondo, M., Kobayashi, H., Yamamoto, T., Terajima H., Kaihara, S. Usefulness of laparoscopic posterior rectopexy for complete rectal prolapse: A cohort study. *International J. Surgery* **72,**109–114, doi:10.1016/j.ijsu.2019.10.024 (2019).

[16] Lenkov, V., Beffa, L.R.A., Miller, B.T., Maskal, S.M., Ellis, R.C., Tu, C., Krpata D., Rosen, M., Prabhu, A.,Petro, C. Postoperative bleeding after complex abdominal wall reconstruction: A post hoc analysis of a randomized clinical trial. *Surgery* **176**, 148–153, doi:10.1016/j.surg.2024.03.013 (2024).

[17] Agarwal, V., Muthuchellappan, R., Shah, B.A., Rane, P.P. Postoperative Outcomes Following Elective Surgery in India. *Indi J Critical Care Medicine* **25**, 528–534, doi:10.5005/jp-journals-10071-23807 (2021).

[18] Lebedev, N.V., Klimov, A.E., Shadrina, V.S., Belyakov, A.P. Choice of surgical approach and option for completing laparotomy in widespread peritonitis. *Pirogov Russ J Surgery* **10**, 41–46, doi:10.17116/hirurgia202310141 (2023).

[19] Gorgan, C-L., Popa, F., Draghici, L. A comparative study of conventional vs. laparoscopic operations in the surgical management of peritonitis. *Rom. Med. J.* **67**, 277-285, doi:10.37897/RMJ.2020.3.7 (2020).