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ISCHEMIC INTESTINAL OBSTRUCTIONS: EVALUATION OF SURGICAL STRATEGIES AND PROGNOSTIC MARKERS

- ABSTRACT -

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Dedication,

This work is the result of years of effort, study, and perseverance, but above all of the unconditional support I have received throughout my professional and personal journey.

First and foremost, I extend my deepest gratitude to Professor Vasile Sârbu, PhD, the coordinator of this thesis, for his rigorous scientific guidance, his academic standards, and his constant support.

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Last but not least, this thesis is dedicated to my family – my wife and my daughter – who, through their love, patience, and understanding, have always stood by my side, giving me the strength to move forward and to become the person and professional I am today.

This thesis belongs equally to all those who, each in their own way, have contributed to what I am today.

CONTENT

INTRODUCTION

Ischemic bowel obstructions represent a surgical emergency with a major impact on patients' vital and functional prognosis, characterized by the association of multiple factors leading to impaired intestinal vascularization. This overlap results in an increased risk of severe complications and is consistently associated with high morbidity and mortality rates, as highlighted in the medical literature. Beyond the polymorphic clinical presentation, the particularity of these situations lies in the fact that the surgical decision must be made promptly, often based on incomplete evaluation and frequently in the absence of reliable biological or imaging predictive markers.

The surgical management of ischemic obstructions remains a challenge, since the type of intervention, timing of surgery, and perioperative approach must be tailored to each patient's characteristics. The choice of strategy—resection, anastomosis, stoma, or, in extreme cases, diagnostic intraoperative exploration—depends on a complex set of factors: age and comorbidities, ischemia severity, hemodynamic status, as well as the surgeon's experience. In this context, the identification of predictive markers for clinical evolution and the definition of treatment algorithms represent both a practical and scientific necessity.

This work brings together the results of three clinical studies conducted within the same surgical unit, each focusing on a distinct entity of ischemic bowel obstruction. Study 1 analyzed incisional hernia complicated by obstruction and ischemia, comparing the outcomes of open versus laparoscopic surgery and their impact on postoperative recovery and quality of life. Study 2 evaluated acute colonic ischemia, investigating the prognosis of patients surgically treated in the absence of revascularization options and identifying clinical and demographic factors correlated with survival. Study 3 focused on intestinal ischemia associated with sigmoid volvulus, highlighting clinico-biological markers that may guide the optimal timing of surgical intervention and prevent major complications.

By integrating these three experiences, the present thesis aims to provide a unified perspective on ischemic bowel obstructions, emphasizing the comparative assessment of surgical strategies. In doing so, this work contributes both to a deeper understanding of the specific features of these pathologies and to the formulation of practical directions for optimizing the surgical management of ischemic obstructions.

CURRENT STATE OF KNOWLEDGE

INTESTINAL OBSTRUCTIONS - GENERAL CONSIDERATIONS

Intestinal obstructions represent one of the most frequent and complex surgical emergencies, with a major impact not only on patients' vital prognosis but also on healthcare system resources [1]. Their incidence varies depending on multiple factors, including demographic aspects, geographic region, and population structure, yet they consistently occupy an important place in emergency surgical pathology [2]. Clinical evolution is influenced by numerous elements, such as the obstructive mechanism, the patient's general status, the timing of hospital presentation, and the therapeutic approach applied.

Beyond the general aspects of intestinal obstructions, situations in which obstruction is associated with ischemia of the affected segment carry a particular severity. In these cases, the impairment of intestinal vascularization overlaps with the obstructive syndrome, creating a major risk of necrosis, perforation, and sepsis [3]. Early identification of ischemia and initiation of appropriate surgical treatment are essential not only for postoperative recovery but also for reducing morbidity and mortality associated with this condition [4].

Recent advances in medical imaging, laboratory testing, and surgical techniques have significantly contributed to diagnosis and treatment, with obvious repercussions on patient outcomes [5]. However, ischemic intestinal obstructions continue to be associated with high complication rates and variable results, highlighting the importance of a multidimensional approach that integrates rigorous clinical evaluation, judicious use of paraclinical investigations, and prompt surgical decision-making [6].

Intestinal ischemia remains one of the most severe and feared complications of digestive obstructions, given the potential for both local and systemic consequences, and is associated with high mortality rates even in specialized centers. Therefore, the identification of clinico-biological markers and prognostic factors is essential not only for early diagnosis but also for guiding therapeutic decisions, risk stratification, and anticipating postoperative complications. In clinical practice, these elements are integrated into a complex framework that includes clinical parameters, serum biomarkers, severity scores, intraoperative findings, and histopathological features—each carrying distinct yet complementary value.

PERSONAL CONTRIBUTION

1. IMPORTANCE OF THE PROBLEM

The importance of this issue derives primarily from the difficulty of early diagnosis. The clinical presentation is often nonspecific, traditional biomarkers lack sensitivity and specificity, and although imaging techniques are constantly improving, they cannot always provide certainty regarding intestinal wall viability. This uncertainty leads to a significant number of patients being diagnosed late, when ischemia is already established and therapeutic options are dramatically reduced.

A second aspect that highlights the significance of the problem is the complexity of surgical decision-making. The choice between resection with primary anastomosis, diverting stoma, or simple exploratory laparotomy depends not only on intraoperative findings but also on hemodynamic status, patient comorbidities, and available postoperative resources. In this context, defining standardized surgical strategies tailored to patient profiles becomes a necessity in order to reduce decision-making variability and improve survival chances.

Equally important is the evaluation of prognostic markers, which can guide the clinician in choosing the optimal timing of surgery and anticipating complications. Clinical parameters, serum biomarkers, comorbidity and severity scores, as well as intraoperative factors, constitute pieces of the same prognostic puzzle. Identifying elements with strong predictive value represents not only a scientific challenge but also a practical goal, with direct impact on patient survival.

2. MOTIVATION FOR STUDIES

The main motivation of this study therefore lies in the need to identify clinical and biological predictors and to perform a comparative evaluation of surgical strategies in patients with ischemic bowel obstructions. The three studies forming the basis of this work explore distinct yet complementary clinical scenarios: incisional hernias complicated by ischemia, right-sided colonic ischemia, and sigmoid volvulus with Grade II ischemia. Through their analysis, I aimed to highlight common decision-making elements and factors that may guide surgical management.

3. Objectives of the Thesis

Evaluation of surgical strategies and clinico-biological markers involved in the diagnosis and prognosis of ischemic bowel obstructions, with the aim of defining predictive elements and therapeutic decision-making criteria that may contribute to improved postoperative outcomes.

4. GENERAL METHODOLOGY

Three study models were chosen, each adapted to the specificity of the clinical entity:

- a prospective cohort study for patients with obstructive incisional hernias, aimed at a comparative evaluation between open and laparoscopic surgery;
- a retrospective cohort study for patients with right-sided colonic ischemia without the possibility of revascularization, focused on outcomes according to the type of intervention (resection with anastomosis, resection with stoma, or simple exploration);
- a retrospective observational study for patients with sigmoid volvulus and Grade II ischemia, designed to identify clinico-biological markers with predictive value for surgical decision-making.

By combining these models, the thesis integrates the advantages of standardized prospective observation with the value of accumulated experience from retrospective analysis of severe cases, thus allowing the development of a comprehensive perspective on the issue.

5. STUDY I. SURGICAL MANAGEMENT OF OBSTRUCTIVE ISCHEMICAL INCISIONAL HERNIA: IMPLICATIONS ON PROGNOSIS AND QUALITY OF LIFE

Study 1 addressed a frequent issue encountered in emergency practice—obstructive incisional hernias complicated by ischemia—focusing on the choice of surgical strategy and its impact on postoperative recovery and quality of life. The study was conducted prospectively over 6 years (2019–2024) and included 117 patients admitted as emergencies for incisional hernias complicated by bowel obstruction. Patients were divided into two groups: open surgery (n=91) and laparoscopic surgery (n=26). The selection of surgical approach was individualized according to clinical status, comorbidities, size of the parietal defect, and surgeon’s experience.

Postoperative evaluation included clinical parameters, pain assessment using the Visual Analog Scale (VAS), and quality of life assessment using the European Hernia Society QoL questionnaire (EuraHS-QoL). In parallel, data were collected on length of hospital stay, immediate complications, and short-term functional recovery. The results showed that although laparoscopy involved a longer operative time (153 vs. 105 minutes, p=0.002), it provided clear benefits through reduced postoperative pain and faster recovery, allowing for earlier functional reintegration. Moreover, patients in the laparoscopic group reported significant improvements in quality of life, especially at 30 days postoperatively, with these effects maintained at 90 days, even if the differences compared to open surgery became less pronounced.

Postoperative complications were more frequent in the open surgery group (38.5% vs. 23.1%, p=0.024), including seromas, hematomas, and wound infections, underlining the advantage of laparoscopy in reducing morbidity. The length of hospital stay was also shorter in the laparoscopic group (4.6 vs. 5.27 days), with clinical, social, and economic implications. The size of the parietal defect influenced operative decision-making, with larger defects (W3 >10 cm) being predominantly managed through open surgery.

Conclusions

1. Both surgical approaches, open (OD) and laparoscopic (OL), are feasible and safe in the management of ischemic obstructive eventrations, but laparoscopy showed clear advantages in terms of morbidity and quality of life.
2. Demographic characteristics and comorbidities were comparable between groups, except for diabetes mellitus, which was more frequent in the OL group (46.2% vs. 31.9%, $p = 0.017$), suggesting a careful selection of patients eligible for minimally invasive surgery.
3. Intraoperative parameters revealed significant differences: the duration of the operation was longer in OL (153 vs. 105 minutes, $p = 0.002$), but blood loss, although numerically higher in OL, remained clinically acceptable and without major impact on postoperative evolution.
4. The mesh placement technique differs fundamentally: intraperitoneal in OL (100%) versus retromuscular or supraaponeurotic in OD ($p < 0.001$). This difference reflects not only technical peculiarities, but also the impact on pain and long-term complications.
5. The postoperative complication rate was significantly lower in OL (23.1% vs. 38.5%, $p = 0.024$), especially for seromas and hematomas, which confirms the superior safety profile of laparoscopy.

6. The length of hospital stay was shorter in OL (4.6 ± 2.05 days vs. 5.27 ± 1.84 days), which translates into faster recovery and early reintegration, an aspect with favorable economic and social impact.
7. Postoperative pain (VAS) decreased significantly in both groups, but OL patients had lower scores both on day 1 and at discharge. ROC curves showed a better predictive value of VAS for recovery in the subgroups without diabetes and under 65 years.
8. Quality of life assessment using the EuraHS-QoL questionnaire revealed faster benefits of OL, with greater improvements at 30 days in terms of aesthetic discomfort, pain on exertion and resumption of household activities. At 90 days, the differences between groups were reduced, but OL remained associated with better scores.
9. The size of the parietal defect influenced the choice of approach: patients with large defects (W3 >10 cm) were predominantly treated by OD, while small and medium defects (W1–W2) were approached laparoscopically, confirming the importance of case selection.
10. The integration of all results supports laparoscopy as the method of choice in ischemic obstructive eventrations in selected patients, offering faster functional recovery, pain reduction and decreased complications, at the cost of longer operating time and advanced technical expertise.

6. STUDY II: SURGICAL MANAGEMENT OF ACUTE RIGHT COLON ISCHEMIA WITHOUT REVASCULARIZATION: CLINICAL EXPERIENCE AND PROGNOSTIC FACTORS

Study 2 addressed a rare but highly severe condition—acute right-sided colonic ischemia (ARCI), in situations where vascular revascularization was not feasible. The analysis was retrospective and included 73 patients admitted and operated between 2018–2023 in the General Surgery Clinic of Constanța County Emergency Clinical Hospital. All patients were diagnosed with right colonic ischemia, confirmed intraoperatively, and required surgical treatment.

The cohort was divided into three subgroups according to the surgical strategy applied: extended right hemicolectomy with primary anastomosis (n=13), extended right hemicolectomy with diverting stoma (n=34), and exploratory laparotomy without resection (n=26). The choice of procedure depended on the severity of ischemia, the patients' general condition, and their

comorbidities. Advanced age, cardiovascular comorbidities, and diabetes mellitus were identified as important negative prognostic factors.

The results showed a high postoperative mortality rate, especially in the group treated by exploratory laparotomy alone (over 70% at 1 year). In contrast, patients who underwent surgical resection—with or without anastomosis—had better survival rates, although the risk of complications was significant. Primary anastomosis was reserved for patients with better biological status and limited ischemia, while stoma creation represented a safer option for unstable patients, reducing the risk of anastomotic fistula.

Comparative analysis revealed that the main prognostic determinants were the severity of ischemia, the age-adjusted Charlson Comorbidity Index (ACCI), and the presence of multiorgan failure. Patients with ACCI ≥6 and poor hemodynamic status had significantly higher mortality regardless of the type of intervention performed.

Conclusions

1. The type of surgery was the major determinant of survival: patients with extended right hemicolectomy and primary anastomosis had the best results, while exploratory laparotomy was associated with extremely high mortality.
2. Advanced age of patients and rural background were correlated with the need for more invasive or palliative procedures and with increased mortality.
3. High ACCI score (≥6) was an independent predictor of postoperative mortality and the impossibility of performing anastomosis.
4. The prevalence of comorbidities differed significantly between groups, with patients with exploratory laparotomy having the highest burden of associated diseases (renal, cardiovascular, diabetic).
5. Postoperative complications were less frequent in the anastomosis group, while patients with stoma frequently presented sepsis and readmissions, and those with exploratory laparotomy developed ileus and multiorgan failure almost universally.
6. The length of hospital stay was significantly shorter for patients with primary anastomosis, confirming their faster functional recovery compared to those who required stoma.
7. 30-day mortality was minimal in patients with anastomosis (7.7%), moderate in those with stoma (11.8%), and dramatically increased in patients with exploratory laparotomy (≈80%).

8. 1-year mortality followed the same gradient, maintaining the superiority of survival after anastomosis (≈85%), compared with colectomy with stoma (≈70%) and exploratory laparotomy (≈20%).
9. Kaplan–Meier curves demonstrated clear survival differences between the three types of interventions, highlighting the role of surgical decision in short- and long-term prognosis.
10. The results support the individualization of surgical management based on age, ACCI score, and ischemia severity, in a balance between the radicality of the gesture and the patient's ability to tolerate the procedure.

7. STUDY III. PREDICTIVE MARKERS FOR SURGICAL INDICATION IN SIGMOID VOLVULUS COMPLICATED WITH GRADE II ISCHEMIA

Study 3 focused on a particular pathology—sigmoid volvulus complicated by Grade II intestinal ischemia—where the surgical decision often lies between conservative (endoscopic) treatment and surgical resection. The study was retrospective and observational, conducted between 2018–2024, and included 63 patients diagnosed and treated as emergencies.

All patients initially underwent endoscopic decompression, followed by surgical resection of the sigmoid colon, either at the first episode or upon recurrence. Accordingly, patients were divided into two groups: surgery at the first episode (n=41) and surgery at recurrence (n=22).

In addition to clinical and demographic data, the study analyzed an extended set of serum biomarkers (CRP, lactate, D-dimers, CK, LDH), standard laboratory parameters (leukocytes, electrolytes, blood pH), and comorbidity scores (ACCI). The results showed that elevated lactate levels (>4 mmol/L) and D-dimers above 5 μg/mL were significantly correlated with progression to severe ischemia and the need for early surgical intervention. Elevated CK and LDH values reflected intestinal muscle injury and were associated with more complicated postoperative outcomes.

Comparative analysis demonstrated that patients operated at the first episode had a more favorable clinical course, with lower mortality and shorter hospital stays compared to those operated at recurrence. Postoperative quality of life was also better in the early intervention group, due to the prevention of recurrent ischemic episodes and associated complications.

Concluzii

1. Older age was significantly associated with recurrence of sigmoid volvulus, with patients in the recurrent group being on average older than those at the first episode.
2. The higher ACCI score in patients with recurrence suggests that multiple comorbidities contribute to biological fragility and the risk of disease recurrence.
3. Chronic constipation and megacolon were identified as major anatomical and functional factors, independently associated with the risk of recurrence.
4. Abnormal mesenteric fixation was another significant predictor of recurrence, highlighting the role of anatomical features in the pathogenesis of the disease.
5. Elevated CRP and lactate values were correlated with prolonged length of hospital stay and a higher risk of postoperative complications. ROC analysis demonstrated a higher predictive value for lactate (AUC=0.82) compared to PCR (AUC=0.61) in estimating major complications, confirming the role of lactate as an early marker of ischemia and disease severity.
6. D-dimers were significantly higher in recurrent patients, suggesting a pronounced pro-thrombotic and pro-inflammatory status, with potential value as a prognostic marker for the severity of the evolution.
7. Creatine kinase was also higher in patients with recurrence, being correlated with clinical severity and the risk of complications.
8. Postoperative complications were more frequent in patients with recurrence, but most belonged to Clavien-Dindo grades I–II, with an impact on hospitalization, but without increasing mortality.
9. The duration of the surgical intervention and intraoperative hemorrhage were longer in recurrent patients, which indicates an increased technical difficulty and a higher complexity of the cases.
10. Significantly prolonged postoperative hospitalization in patients with recurrence reflects the cumulative impact of comorbidities, anatomical factors, and biological status, confirming the need for early risk assessment and a definitive surgical strategy to reduce complications and recurrence.

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1. Popescu RC, **Buşu D**, Leopa N, Costea DO, Pundiche M. Surgical Outcomes in Acute Right-Sided Colonic Ischemia without Vascular Repair: A Single-Center Experience. *Chirurgia (Bucur)*. 2025;120(2):151-158. doi:10.21614/chirurgia.3144 https://revistachirurgia.ro/pdfs/2025-2-151.pdf Factor de impact = 0.8 **(corresponding author)**
2. **Buşu D,** Sârbu V, Pundiche M, et al. Predictive Markers for Surgical Indication in Sigmoid Volvulus with Grade II Ischemia. *Chirurgia (Bucur)*. 2025;120(3):247-254. doi:10.21614/chirurgia.3148 https://revistachirurgia.ro/pdfs/2025-3-247.pdf Factor de impact = 0.8 **(first author)**
3. Leopa N, **Buşu D**, Sârbu V, et al. The Impact of Surgical Approach on Postoperative Recovery and Quality of Life in Obstructed Incisional Hernias. *Chirurgia (Bucur)*. 2025;120(4):438-445. doi:10.21614/chirurgia.3170 https://www.revistachirurgia.ro/pdfs/2025-4-438.pdf Factor de impact = 0.8 **(corresponding author)**

Another publications:

1. Serbanescu, L.; Badiu, D.; Popescu, S.; **Busu, D**.; Costea, A.C. The Management of Tubo-Ovarian Abscesses Associated with Appendicitis. *J. Mind Med. Sci.* 2021, *8*, 280-285. https://doi.org/10.22543/7674.82.P280285 **(co-author)**
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