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Research Progress on Preoperative Observation and Postoperative Care of Surgical Acute Abdomen

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Abstract

This article reviews the core progress of perioperative management of surgical acute abdomen. Preoperative: CT combined with new markers (such as intestinal fatty acid-binding protein (I-FABP)) to improve the diagnostic accuracy; AI risk assessment model and multidisciplinary team (MDT) mode reduced the time from diagnosis to operation (D2S) to <3 hours. Postoperative: Enhanced Recovery After Surgery (ERAS) pathway (early feeding/extubation, multimodal analgesia) shortened the length of hospital stay to 4 - 5 days, and reduced complications by 20% - 25%; Anastomotic leakage was monitored by drainage fluid amylase for early warning, and 80% of them were treated by endoscopy/interventional minimally invasive treatment. The current challenge is uneven medical resources and drug-resistant bacterial infections. The future direction will focus on AI decision-making, remote home rehabilitation and precise antibacterial strategies, and build a patient-centered continuous management system.

Keywords

Acute Abdomen, Postoperative Care, Rapid Recovery Surgery (ERAS), Preoperative Observation

1. Introduction

In recent years, the incidence rate of surgical acute abdomen has gradually increased in surgery. Acute abdomen is a general term for a class of abdominal diseases with acute abdominal pain as the main clinical manifestation, rapid onset, complex and changeable conditions, and potential fatal risks, which often need emergency assessment and treatment. Its epidemiological characteristics are char-

acterized by diverse causes, the most common of which include acute appendicitis, acute cholecystitis/cholangitis, gastrointestinal perforation (such as gastric and duodenal ulcer perforation), gastrointestinal obstruction (such as intestinal adhesions, hernia entrapment), acute pancreatitis, and mesenteric ischemic disease. These diseases not only have a relatively high incidence rate, but also because of their acute onset, rapid progress, and complex clinical manifestations (such as changes in the nature/location of abdominal pain, and various accompanying symptoms), if they are not identified and intervened in time, they are very likely to lead to serious complications (such as septic shock, multiple organ failure) and even death, thus constituting an important and challenging disease in emergency surgery.

Accurate observation and evaluation in the preoperative stage are the cornerstone of surgical acute abdomen management. Its core lies in quickly identifying the cause, accurately assessing the severity of the condition and surgical risks, and optimizing preoperative preparation accordingly. This stage is directly related to whether the "golden time window" for treatment can be grasped, effectively reducing the incidence and mortality of perioperative complications caused by delayed diagnosis or insufficient preparation, and laying the foundation for successful surgery. Postoperative care plays a crucial role in promoting recovery, ensuring safety, preventing and managing complications, and its quality directly affects the speed of patient recovery, length of hospital stay, and long-term quality of life. Fine postoperative management, including vital sign monitoring, pain control, nutritional support, early activity, and complication warning, is a decisive link in consolidating surgical outcomes and achieving good prognosis. The two together constitute an indispensable continuous process for ensuring the life safety and rehabilitation quality of surgical acute abdomen patients.

This article aims to systematically review and evaluate the important research progress in preoperative evaluation methods, decision support tools, postoperative nursing concepts, technological innovation, and complication management strategies for surgical acute abdomen in recent years. The scope of the review will focus on the types of acute abdomen that require surgical intervention (including emergency surgery or interventional treatment), such as acute appendicitis, cholecystitis, gastrointestinal perforation/obstruction, severe pancreatitis, mesenteric ischemia, etc. The focus will be on exploring new evidence, methods, and trends in key areas such as improving diagnostic timeliness and accuracy (such as imaging and biomarker applications), optimizing risk prediction models, rapid decision-making processes (such as MDT, electronic clinical decision support system (CDSS)), practicing and expanding ERAS concepts, early identification and precise intervention of various complications (such as anastomotic fistula, abdominal infection, intestinal obstruction), and innovating pain management and nutritional support strategies, and analyzing current challenges and future development directions.

2. Research Progress on Preoperative Observation and Evaluation of Surgical Acute Abdomen

2.1. Progress in Rapid and Accurate Diagnostic Technology

In recent years, significant progress has been made in the diagnosis of acute abdomen. In terms of imaging examination, ultrasound has become the first choice for preliminary screening in emergency department due to its convenience and non radiation characteristics, especially for common causes such as cholecystitis and appendicitis. With its high resolution, CT scan can clearly show complex lesions such as intestinal obstruction, perforation and mesenteric ischemia, which has become the "gold standard" for the diagnosis of acute abdomen. Although MRI is rarely used, it has unique advantages in pregnant women, children and other special populations.

Laboratory tests have also become more accurate. In addition to the traditional blood routine and inflammatory indicators (such as C-reactive protein), new markers such as procalcitonin (PCT) can better distinguish bacterial infection and non infectious inflammation. D-dimer, lactic acid and other indicators have important value for early warning of intestinal ischemia [1]. I-FABP demonstrates particular value in diagnosing mesenteric ischemia, where it shows earlier elevation (within 1 - 3 hours) compared to traditional markers like lactate. Its high negative predictive value helps exclude intestinal ischemia, though confirmation with CT angiography remains necessary in positive cases. In addition, the popularization of POCT technology enables emergency doctors to obtain key test results in a short time, which greatly shortens the diagnosis time.

2.2. Optimization of Disease Severity Assessment and Risk Prediction Model

The condition assessment of patients with acute abdomen has become more scientific and systematic. Although the traditional APACHE II, SOFA and other scoring systems can assess the overall severity of the disease, they are not specific enough for acute abdomen. In recent years, scoring systems for specific diseases have been widely used. For example, the bisap score is used to assess the severity of acute pancreatitis, and the Hinchey classification is used to determine the timing of surgery for diverticulitis perforation.

With the development of big data and artificial intelligence, personalized risk assessment model has gradually become a research hotspot. By integrating the patient's age, underlying disease, test results and imaging characteristics, these models can more accurately predict the risk of surgery, the probability of postoperative complications, and even give treatment recommendations. For example, some models can predict the possibility of serious complications such as anastomotic leakage and abdominal infection, and help doctors take preventive measures in advance.

2.3. Improvement of Preoperative Rapid Assessment and Decision Making Process

Modern acute abdomen management emphasizes the concept of "time is life". For some critical acute abdomen (such as mesenteric ischemia, suppurative peritonitis), the "golden time window" from diagnosis to surgery may only be a few hours. To this end, many hospitals have established a multidisciplinary collaboration (MDT) mechanism, with the participation of experts from the emergency department, surgery, imaging department and critical care medicine department to quickly formulate treatment plans.

Decision support tools also play an important role. The electronic clinical decision-making system (CDSS) can automatically analyze patient data and give diagnosis and treatment suggestions according to the latest guidelines to reduce the bias of human judgment. In preoperative preparation, the progress of hemodynamic monitoring technology (such as noninvasive cardiac function monitoring) helps doctors adjust infusion and drug use more accurately to avoid insufficient volume or overload.

2.4. Optimization of Preoperative Preparation

The optimization goal of preoperative preparation is to shorten the preoperative waiting time as much as possible under the premise of ensuring safety. The traditional long-term fasting has been proven to increase the stress response of patients. It is now recommended to drink clear liquid 2 hours before operation and fast solid food 6 hours before operation. For high-risk operations (such as intestinal obstruction and peritonitis), the timing and type of prophylactic antibiotics are more standardized, usually administered within 1 hour before skin incision, to reduce the risk of postoperative infection.

For patients with chronic diseases (such as heart disease, diabetes, respiratory diseases), rapid assessment and targeted treatment will be carried out before operation, such as adjusting antihypertensive drugs, optimizing blood glucose control, etc. In addition, the prevention of venous thrombosis has also been advanced to the preoperative stage. High-risk patients will receive physical preventive measures such as anticoagulants or elastic socks before surgery to reduce the risk of postoperative thrombosis.

The preoperative management of acute abdomen has changed from traditional empirical decision-making to precision, rapidity and individualization. The progress of diagnostic technology, the optimization of risk assessment tools, the promotion of multidisciplinary cooperation mode and the standardization of preoperative preparation have jointly improved the success rate of treatment of acute abdomen and reduced the incidence of complications. In the future, with the development of artificial intelligence and telemedicine, the preoperative management of acute abdomen will be more efficient and accurate.

3. Research Progress on Postoperative Nursing of Surgical Acute Abdomen

3.1. Deepening the Practice of Rapid Rehabilitation Surgery (ERAS) Concept

Rapid rehabilitation surgery (ERAS) has become the core paradigm of postoperative care for acute abdomen. The core breakthrough is to break a number of traditional taboos: studies have confirmed that patients can drink clear liquid diet (such as water and rice soup) within 24 hours after operation [2], and early intestinal stimulation can significantly accelerate the recovery of gastrointestinal function, making the first exhaust time 12 hours earlier on average. The pipeline management strategy was optimized synchronously. The gastric tube was removed 6 hours after awake anesthesia (without vomiting risk), and the abdominal drainage tube was removed when the drainage volume was <50 mL/day, avoiding the infection and activity limitation caused by long-term catheterization. Pain control is transformed through multimodal analgesia programs—combined application of nonsteroidal anti-inflammatory drugs (such as intravenous flurbiprofen axetil), incision infiltration of long-acting local anesthetics and patient-controlled analgesia pump (PCA), under the premise of reducing the dosage of opioids by 30%, the postoperative NRS pain score of patients is stable below 3, laying the foundation for early ambulation. But clinical application varies depending on the condition, e.g.:

- Appendicitis: Early oral intake (6hr post-op) reduces ileus risk.
- Cholecystitis: Accelerated ambulation decreases pulmonary complications.
- Bowel resection: Protocolized fluid management prevents anastomotic leaks

The systematic implementation of the ERAS pathway brings significant clinical benefits. The data showed that for patients with acute abdomen who received complete ERAS management, the postoperative hospital stay was shortened to 4 - 5 days (7 - 8 days for traditional nursing), and the incidence of complications such as pulmonary infection and intestinal adhesion decreased by 20% - 25%. Especially for patients undergoing laparoscopic surgery, the ambulation rate within 24 hours after surgery was more than 90%, which significantly reduced the risk of venous thrombosis. These advances mark the transformation of postoperative nursing from "conservative observation" to active functional reconstruction.

3.2. Early Warning System of Complications and Minimally Invasive Intervention

The management of postoperative complications has established a new mode of "early recognition - minimally invasive treatment". For the most dangerous anastomotic leakage, early warning can be achieved by monitoring the nature of drainage fluid (turbid/bile like), amylase level (>1000 u/L) and CT findings of perianastomotic effusion [3], so that the diagnosis time can be advanced from 5 - 7 days to 2 - 3 days after the symptoms appear.

Anastomotic Leak Clinical Pathway:

i) Daily drain amylase measurement (post-op day 1 - 5).

ii) If >1000 U/L + clinical signs:

1) Immediate CT with oral contrast.

2) Stable patients: Endoscopic stenting.

3) Unstable: Percutaneous drainage.

The treatment strategy has shifted from open surgery to endoscopy/intervention: endoscopic placement of a covered stent to close the fistula, or CT-guided puncture and drainage of abscess, with a success rate of 80%, avoiding secondary open trauma.

The control of abdominal infection also tends to be precise. Based on microbial metagenome detection (mngs) technology, pathogenic bacteria and drug resistance genes can be identified within 48 hours [4], guiding antibiotics from empirical use (such as carbapenems) to target treatment (such as sensitive antibiotics descending ladder). For abdominal abscess, ultrasound-guided catheter drainage has become the first choice. Combined with local antibiotic lavage, 70% of patients can avoid surgery. In the prevention and treatment of venous thrombosis, the popularity of caprini risk assessment model makes anticoagulation prevention more targeted: high risk patients (score ≥ 5) received low molecular weight heparin injection 12 hours after operation, and intermittent pneumatic compression device was used to control the incidence of deep venous thrombosis below 1% [5].

3.3. Individualized Upgrading of Nutritional Support

The core progress of postoperative nutrition strategy is to establish the principle of "enteral priority and immune enhancement". Even if the bowel sounds have not recovered, the start of enteral nutrition (EN) 24 - 48 hours after operation has been proved safe and effective [6]: the nasogastric tube or jejunal nutrition tube infusion of short peptide formula (such as bepril), the initial rate of 20 ml/h gradually increased, can quickly restore the intestinal barrier function. For severe patients (such as septic shock), en formula added ω-3 fatty acids (fish oil), arginine, glutamine and other immune nutrients, by regulating the inflammatory reaction, the abdominal infection rate was reduced.

The application of parenteral nutrition (PN) is more prudent. Only when en can not reach 60% of the target calories (such as high intestinal fistula), can PN support be started, and all-in-one (three chamber bag) formula is used to optimize the proportion of glucose and lipid, and strictly control blood glucose (target range: 6 - 10 mmol/L). The addition of new fish oil fat emulsion (e.g., omegaven®) can reduce the risk of liver injury.

3.4. Precise Hierarchical Control of Pain Management

Pain control has developed from a single drug program to a dynamic evaluation layered intervention system. The digital Rating Scale (NRS) was used to evaluate the resting pain and active pain every hour, and the ladder treatment was implemented according to the score (**Table 1**).

Hourly NRS pain assessment

Tiered intervention:
Mild pain (NRS ≤ 3): NSAIDs + acetaminophen
Moderate (NRS 4 - 6): Add weak opioids
Severe (NRS ≥ 7): Strong opioids + regional blocks

Table 1. Stratified pain intervention protocol.

Severity	Score	Treatment plan
Mild pain	NRS ≤ 3	NSAIDs + acetaminophen
Moderate	NRS 4 - 6	Add weak opioids
Severe	NRS ≥ 7	Strong opioids + regional blocks

To prevent chronic pain, intraoperative neuroprotective techniques (such as avoiding excessive traction of subcostal incision) were used, and the opioid drugs were replaced with gabapentin (100 mg TID) from the 3rd day after operation.

4. Accelerated Rehabilitation Model of Physical and Mental Integration

Postoperative rehabilitation has been extended to physiological psychological two-dimensional intervention. In view of the high incidence of delirium in elderly patients, the CAM-ICU scale was used for daily screening, and the incidence of delirium was reduced from 30% to 10% through non drug intervention (such as family members' company, circadian rhythm maintenance) and low-dose dexmedetomidine (0.1 μg/kg/h). In terms of psychological support, the HADS scale was used to assess the anxiety and depression status 3 days after operation. For moderate and severe patients (score ≥ 11), the psychiatric team intervened in cognitive behavioral therapy.

The key to functional rehabilitation lies in early activities: 6 hours after operation, assist in turning over in bed, 24 hours sitting and standing beside the bed, and 48 hours walking for 50 meters under the support of walking aids. Family members learned auxiliary skills (such as incision protection and fall prevention) through standardized education videos, which improved the activity compliance of patients after discharge.

5. Current Challenges and Prospects

5.1. Core Challenges of Current Clinical Practice

Perioperative management of surgical acute abdomen is still facing multiple practical difficulties. Regional imbalance of medical resources is the primary problem: primary hospitals generally lack rapid CT scanning equipment and intensive care capabilities, leading to the misdiagnosis rate of time sensitive diseases such as mesenteric ischemia as high as 40%, while tertiary hospitals delay the timing of surgery due to tight beds. The increasing complexity of patient factors is also prominent: under the trend of aging, Many patients with acute abdomen complicated with ≥2 basic diseases (such as coronary heart disease, chronic obstructive pul-

monary disease, diabetes), the risk of postoperative complications is increased by three times, but the existing eras path is mostly based on the data of young people, which is not suitable for the elderly and vulnerable groups.

The threat of super resistant bacteria infection continues to escalate. The lag in the development of new antibiotics forced the repeated use of toxic drugs such as polymyxin in clinical practice, and the incidence of renal injury increased. In addition, the full implementation of eras concept encountered systemic resistance: many medical institutions were unable to implement pain assessment six times a day due to the shortage of nursing manpower, and the compliance of patients with early diet decreased year by year (influenced by traditional ideas), which limited the maximization of eras benefits.

5.2. Innovation Direction of Future Development

Future research will focus on two dimensions: technology driven and pattern reconstruction. The development of artificial intelligence (AI) decision-making system is the top priority: by integrating genomic data (such as IL-1 β gene polymorphism to predict the risk of infection), real-time vital signs and image characteristics, an individualized operation risk early warning model is constructed, with the goal of reducing the diagnosis delay of intestinal ischemia and other emergencies to less than 2 hours. The innovation of minimally invasive technology will also accelerate: the flexible robot assisted laparoscopic system can realize single holes and multi quadrant exploration, reducing the operation time of complex adhesion release by 40%. Biodegradable biomaterial for omental closure is expected to reduce the anastomotic leakage rate to less than 1%.

Perioperative management mode is facing fundamental changes. Home based rehabilitation based on remote monitoring has become a trend: implantable abdominal sensors (such as pH sensitive chips) can wirelessly transmit intestinal function data. Combined with AI early warning platform, low-risk patients can be safely discharged 48 hours after surgery, and the length of stay is expected to be shortened by 50%. The precise antibacterial strategy will rely on rapid pathogen detection (such as crispr-cas13 diagnostic kit, with results in 30 minutes) and phage customized therapy, with the goal of reducing the mortality of drug-resistant bacteria infection by 25%. At the same time, a patient-centered evaluation system has been gradually established: collect patient reported outcomes (PROs) in real time through mobile app, incorporate pain experience and quality of life into the core indicators of curative effect, and promote the transformation of diagnosis and treatment from “doctor led” to “doctor-patient joint strategy”.

6. Conclusions

6.1. Core Progress: Transformation from Experience Treatment to Precision System

The perioperative management of surgical acute abdomen has achieved a paradigm level breakthrough. At the preoperative stage, the establishment of a multimodal rapid diagnosis system became a key turning point: CT angiography (CTA)

combined with new biomarkers (such as I-FABP) increased the early diagnosis rate of mesenteric ischemia to more than 90% [7], while the AI aided decision-making system reduced the time from emergency to operation (D2S) to less than 3 hours, which was 50% shorter than the traditional mode [8]. The trend of minimally invasive surgery is significant. The proportion of laparoscopic surgery has increased from 35% in 2015 to 70% in 2024, which directly promotes the acceleration of postoperative rehabilitation process.

In terms of perioperative management, the comprehensive promotion of the concept of rapid rehabilitation surgery (ERAS) has brought revolutionary changes. By optimizing preoperative preparation, improving anesthesia methods and strengthening postoperative management, the ERAS pathway significantly improved the rehabilitation quality of patients. In particular, the implementation of key measures such as early oral feeding, goal-directed fluid management and multimodal analgesia effectively reduced the incidence of postoperative complications and accelerated functional recovery.

These developments have jointly constructed a more systematic and standardized treatment system for acute abdomen and realized the transformation from traditional empirical treatment to individualized treatment under the guidance of evidence-based medicine. Clinical practice shows that this comprehensive management strategy not only improves the treatment effect but also optimizes the utilization efficiency of medical resources.

6.2. Future Action: Breaking Bottlenecks and Reconstructing Ecology

Although significant progress has been made, the current management of acute abdomen still faces many challenges. The uneven distribution of medical resources leads to the limited treatment capacity of grass-roots hospitals. The increase in elderly patients and complex cases puts forward higher requirements for diagnosis and treatment programs, and the problems of drug-resistant bacteria infection also need to be solved.

The future development direction should focus on the following aspects: first, the development and application of artificial intelligence aided decision-making system will improve the efficiency and accuracy of diagnosis, especially in primary medical institutions with limited resources. Secondly, the continuous innovation of minimally invasive technology, including robotic surgery and the application of new biomaterials, is expected to further improve the surgical effect. Moreover, precise treatment strategies for drug-resistant bacterial infections, such as rapid pathogen detection and targeted antibiotic use, will become the focus of research.

In addition, a patient management system covering the whole cycle should be established to integrate all links of preoperative assessment, intraoperative intervention and postoperative rehabilitation, to achieve real continuous medical care. At the same time, we should pay attention to the collection and application of patients' reported outcomes (PROs), integrate the subjective feelings and quality

of life of patients into the efficacy evaluation system, and promote the transformation of medical services into a "patient-centered" mode.

These developments will not only improve the treatment level of acute abdomen but also provide reference for the diagnosis and treatment of other acute and severe diseases and ultimately achieve the overall improvement of medical quality and efficiency.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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