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Physiology-Driven Risk Stratification and Outcome Heterogeneity in Emergency Colorectal Cancer Presenting with Obstruction or Perforation: A Systematic Review

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ABSTRACT

Background: Obstructed and perforated colorectal cancer with emergency presentation represents a high-risk clinical condition associated with significant morbidity and mortality. Although outcomes are consistently inferior to elective surgery, marked variability was demonstrated in reported mortality, operative strategy, and long-term survival across studies leading to considerable heterogeneity. Differences in reporting physiological status, sepsis severity, tumor characteristics, and lack of standardized reporting contribute to this heterogeneity. **Objectives:** This systematic review aimed to assess current evidence on obstructed and perforated colorectal cancer, focusing on risk stratification, physiological determinants of outcome, and variability in operative frameworks and outcome reporting. **Methods:** A systematic search of electronic databases including PubMed, Embase, Scopus, Cochrane Library, and Google Scholar were performed to retrieve randomized trials, meta-analyses, cohort studies, and international guidelines addressing adult emergency colorectal cancer. Primary outcomes included postoperative morbidity and short-term mortality. Secondary outcomes included stoma formation, intensive care utilization, recurrence, and survival. The review findings were synthesized narratively in accordance with PRISMA guidelines because of substantial heterogeneity in definitions of emergency presentation, obstruction, perforation, and outcome measures. **Results:** Obstructed and perforated colorectal cancer presenting as emergency demonstrated consistently inferior outcomes compared to elective surgery; however, morbidity and mortality rates were variably reported across literature. Perforation was associated with the highest early mortality, particularly in patients presenting with sepsis and physiological instability. Operative strategies ranged from primary resection with anastomosis to staged surgery and Hartmann's procedure, demonstrating variability in risk assessment and institutional expertise. Substantial variations in definitions and outcomes reporting limited direct inter-study comparability. **Conclusion:** Perforated and obstructed colorectal cancer presenting as emergency represent a high-risk surgical condition associated with considerable morbidity and mortality. Evidence generated in this review demonstrates that outcomes are primarily determined by physiological instability, septic burden, and system-level factors, rather than tumor characteristics alone. Perforation with generalized peritonitis carries the greatest early mortality, whereas obstructive disease characterized by a broader physiological spectrum in which risk is strongly modulated by baseline physiological reserve and the timeliness of resuscitative care.

Keywords: Colorectal cancer; emergency; obstruction; perforation; risk stratification; outcome heterogeneity.

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INTRODUCTION

Introduce Colorectal cancer (CRC) is a major global health concern and among the most common malignancies worldwide, leading to substantial morbidity and mortality, with increasing incidence among younger population. Global cancer statistics database (GLOBOCAN 2020) estimate that CRC is one of the most commonly diagnosed malignancies with significant contributor to global cancer deaths [1,2,3,4]. A clinically significant proportion of patients continue to present as surgical emergencies, despite improvement in early detection and long survival in many reports secondary to population-based screening programs and advances in multimodal oncologic care [5,6].

Colonic obstruction or tumor perforation are the most common emergency presentations of CRC. Several studies demonstrated that emergency presentation is associated with poorer short and long-term outcomes compared to elective cohorts [7,8,9]. With variable screening uptake, socioeconomic class, definition of emergency, and referral pathway, reported rates of emergency presentation are considerably different between studies and healthcare systems [8,10,11]. Identified predeterminants of emergency presentation include socioeconomic disparities and delayed diagnostic pathways [11,12,13]. Although, obstruction and perforation both present as emergency, they represent pathophysiologically distinct clinical entities. Obstruction may present with minimal to maximal physiological instability along a spectrum from compensated colonic dilation to ischemia and impending perforation, while perforation is consistently accompanied by generalized peritonitis, systemic inflammatory response, and eventually organ failure [14,15,16]. Several studies demonstrated that perforation is associated with high early mortality and worse long-term oncologic outcomes, potentially acting as both a clinical and biological risk modifier [15,16,17,18]. These differences underscore the need to distinguish between subtypes of emergency presentation rather than treating them as a homogeneous entity.

Physiological status at emergency presentation is a predictor of outcomes in emergency CRC, beyond tumour stage. Factors that increase postoperative morbidity and mortality include advanced age, comorbidity burden, and high American Society of Anesthesiologists (ASA) classification [19,20]. Additionally, postoperative complications in turn adversely affect long-term oncologic outcomes [21], suggesting that perioperative physiological instability may have durable prognostic implications. Importantly, emergency resection has been independently associated with reduced long-term survival even after adjustment for confounding factors [22]. Other factors related to system-level factors introduce additional differences. Institutional surgical volume, availability of surgical subspecialization, and perioperative protocols and resources impact short- and long-term outcomes in emergency CRC [23]. Variability in referral pathways and access to specialized service may partly explain inter-study heterogeneity in morbidity and mortality rates [7,11]. Consequently, interpretation of published data requires consideration of both patient-level and healthcare system–level determinants.

Surgical management in emergency CRC is inherently heterogeneous. Practical approaches include resection with primary anastomosis, Hartmann's procedure, staged diversion, and—in selected cases of left-sided obstruction—endoscopic decompression using self-expanding metal stents (SEMS) as a bridge to surgery [14,24-29]. Several reports from randomized and observational studies on SEMS show variable short- and long-term outcomes, and ongoing controversy persists regarding optimal patient selection [27,28,30-33]. Similarly, minimally invasive procedures and enhanced recovery protocols have been explored in selected emergency settings, but evidence remains heterogeneous and influenced by case selection [34-37].

Although, there is a growing body of literature focusing on emergency CRC management, substantial heterogeneity and variability persists in defining emergency presentation, classification of obstruction and perforation, reporting of mortality endpoints (in-hospital, 30-day, or 90-day), complication classification, and colonic diversion outcomes [38,39]. These differences constrain comparison among studies and complicates

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synthesis of operative outcomes and survival data. Additionally, many comparative studies do not adjust for severity of physiological instability or sepsis status, potentially magnifying apparent variation between operative strategies.

This systematic review therefore aims to examine current evidence with particular focus on: (1) physiological determinants of outcome, (2) variability in operative decision-making, and (3) inconsistencies in outcome reporting standards, in order to clarify interpretation of existing data and identify priorities for methodological standardization in future research. Unlike several reviews focusing primarily on surgical procedures or stent placement, this review specifically evaluates emergency colorectal cancer through the lens of physiological risk stratification and methodological heterogeneity in outcome reporting. By focusing on physiological risk stratification and methodological heterogeneity, this review aims to provide a clinically relevant framework to improve interpretation of existing evidence and inform future research and guideline development in emergency colorectal cancer.

METHODS

Protocol and reporting framework:

This systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. A written protocol explaining objectives, eligibility criteria, outcomes, and analysis protocol was finalized before study selection and was filed with the institutional research ethics board to document the planned methodology and enhance transparency. Two reviewers independently screened titles, abstracts, and full texts for eligibility. Disagreements were resolved through discussion, and where necessary by consultation with a third reviewer. The review protocol was finalized prior to study selection and approved by the institutional research ethics board; however, it was not prospectively registered in PROSPERO.

Search strategy and information sources

A systematic search was performed in electronic databases including PubMed, the Cochrane Library, Embase, Scopus, and Google Scholar to the most recent search date. The search was directed to retrieve evidence relevant to adult colorectal cancer presenting as an emergency due to large bowel obstruction and/or perforation, including both management and outcome reporting. Search strategies combined controlled vocabulary (e.g., MeSH/Emtree terms where applicable) and free-text keywords including colorectal/colon/rectal cancer, emergency presentation, malignant large bowel obstruction, perforation, stoma/diversion, resection and anastomosis, Hartmann's procedure, self-expanding metal stents (SEMS), postoperative complications, mortality, recurrence, and survival. To maximize retrieval, the bibliographies of eligible articles and key reviews were hand-searched, and forward screening was performed where relevant to identify additional studies not captured in database queries. The full Boolean search strategy used for PubMed and adapted for other databases is provided in Appendix 1.

Eligibility criteria

Studies were considered eligible if they evaluated adult patients with colorectal cancer presenting emergently with obstruction and/or perforation and provided extractable information on outcomes and/or operative strategy. Eligible studies included randomized controlled trials (RCTs), observational cohort studies (prospective or retrospective), systematic reviews/meta-analyses, and international or national clinical guidelines.

Inclusion criteria

Studies were included when they met one or more of criteria such as reporting incidence or outcomes of emergency CRC presentations, evaluating postoperative morbidity and/or short-term mortality, reporting longer-term endpoints (recurrence, survival, or related oncologic outcomes), comparing emergency with elective CRC outcomes (when relevant to the review question), assessing emergency operative strategies (e.g., primary anastomosis ± diversion, Hartmann's procedure, staged diversion, SEMS as bridge to surgery), and/or addressing multidisciplinary care or perioperative pathway components applicable to emergency CRC (including modified ERAS elements).

Exclusion criteria

Excluded studies included case reports, letters, editorials, and non-systematic expert opinion pieces, studies

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restricted to elective CRC populations without emergency data, studies focused on benign colorectal disease, pediatric-only cohorts, and non-English publications.

Study selection process

Articles identified through the search were collated, and screened after removal of duplicates. Screening of titles and abstracts against eligibility criteria, and eligible relevant records underwent full-text assessment. The selection process is illustrated in the PRISMA flow diagram (Figure 1). Using this strategy, 950 records were retrieved (850 from electronic databases and 100 from additional sources). After removal of duplicates, 480 records underwent title and abstract evaluation, of which 193 full-text articles were assessed for eligibility. Ultimately, 65 studies met the inclusion criteria and were included in the final qualitative synthesis after exclusion of pediatric cohorts, elective-only populations, case reports, and other ineligible study designs.

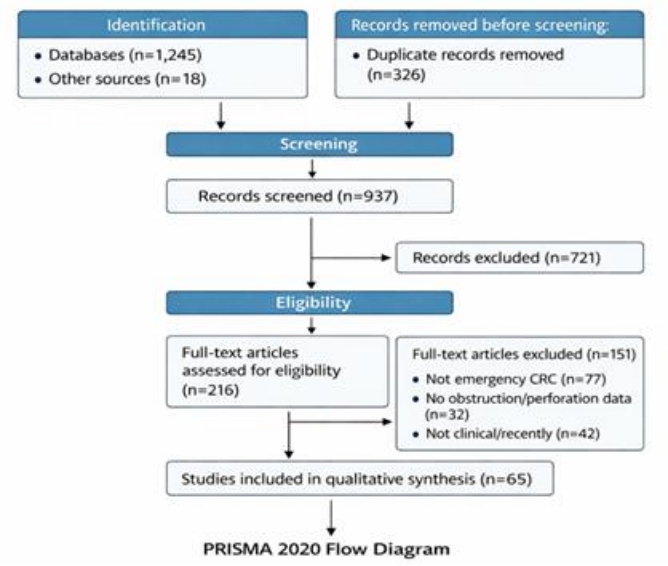

Figure 1 PRISMA 2020 Flow Diagram of Study Selection

RISMA 2020 flow diagram illustrating the study identification, screening, eligibility assessment, and inclusion process for this systematic review of emergency colorectal cancer presenting with obstruction or perforation.

Data extraction and variables of interest

Data were extracted using a structured template retrieving study setting and design, population characteristics, emergency type (obstruction, perforation, or mixed cohorts), operative strategy, and reported outcomes. Because the focus of this review includes risk stratification and outcome heterogeneity, additional extraction domains included the operational definitions used by authors for "emergency presentation" (e.g., admission route, timing to intervention), obstruction (clinical/radiologic/intraoperative criteria; complete vs partial when available), perforation (free vs contained; tumor vs diastatic when reported), mortality timepoints (in-hospital, 30-day, 90-day), complication reporting (overall vs graded systems), and stoma reporting (temporary diversion vs permanent end stoma where distinguishable). Primary outcomes were postoperative morbidity and short-term mortality (as defined by each study). Secondary outcomes included stoma formation, length of hospital stay, intensive care utilization, recurrence, and survival endpoints. Data extraction was performed independently by two reviewers using a standardized template.

Quality assessment

Study quality was appraised using design-appropriate tools such as AMSTAR 2 for systematic reviews/meta-analyses, the Cochrane Risk of Bias tool for RCTs, the Newcastle–Ottawa Scale for cohort studies, AGREE II for clinical guidelines, and SANRA for narrative/scoping reviews. A structured summary of appraisal findings is provided in Appendix 2.

Data synthesis

Taking into consideration the substantial heterogeneity across included articles formal meta-analysis was not performed, results were presented narratively with structured tables underscoring differences between obstructed and perforated disease, the influence of physiological risk and case-mix on outcomes, and variability in reporting standards that limits inter-study comparability. Summary statistics were reported where clinically appropriate and methodologically relevant, without combining effect estimates across incompatible definitions.

KJMHS 2026; Vol. 3 (Issue 2)
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Ethical considerations

This systematic review is not presenting any identifiable patients' information and not applying any intervention. The included articles had passed their ethical approval therefore; additional ethical approval was not required.

RESULTS

Study selection and evidence profile

The included studies were methodologically diverse, comprising registry-based analyses, retrospective and prospective cohort studies, randomized trials, systematic reviews, and international guideline statements [14,25,40,41]. Geographical distribution of included studies covered Europe, the Americas, Asia, the Middle East, and Africa, reflecting considerable geographic variability in healthcare infrastructure and screening programs [8,11, 23]. Across studies, heterogeneity was evident at multiple levels including case definitions, phenotyping of obstruction and perforation, physiological instability reporting, operative approaches, and outcome measurement. This variability informed the decision to prioritize structured narrative synthesis rather than quantitative pooling. **(Table 1)**

Table 1 Characteristics of Studies Included in the Systematic Review and Primary Sources of Methodological Heterogeneity

Study (Author, Year)	Country	Study Design	Study Population	Emergency Phenotype	Primary Outcomes Reported	Key Methodological Features Influencing Heterogeneity
Pisano et al., 2018	Italy	International guideline (WSES)	CRC with obstruction/perforation	Obstruction & perforation	Mortality, morbidity, operative strategy	Guideline-based consensus; heterogeneous source evidence; no uniform physiological stratification
Ansaloni et al., 2010	Italy	Consensus guideline	Left-sided obstructing CRC	Obstruction	Operative options, short-term outcomes	Focused on left-sided disease; limited long-term oncologic reporting
Golder et al., 2022	UK	Systematic review & meta-analysis	CRC emergency presentation	Mixed emergency CRC	Incidence, short-term mortality	Administrative coding variability; mixed mortality timepoints
Ma W et al., 2023	China	Systematic review & meta-analysis	Obstructive CRC	Obstruction	Mortality, complications, SEMS outcomes	Selection bias in SEMS cohorts; exclusion of perforated/septic patients
Esswein et al., 2023	Austria	Matched retrospective cohort	Emergency CRC resection	Emergency CRC	Long-term survival, morbidity	Case-mix severity adjustment; residual confounding by indication
Arnarson et al., 2023	Sweden	Registry-based retrospective cohort	Emergency colon cancer	Emergency CRC	Mortality, overall survival	Subspecialization effect; institutional volume influence
Kaewubon et al., 2024	Thailand	Retrospective cohort	Stage II emergency colon cancer	Emergency CRC	Recurrence, prognostic factors	Stage-restricted cohort; perforation as recurrence modifier
Chen et al., 2017	Taiwan	Retrospective cohort	CRC with obstruction/perforation	Obstruction & perforation	Mortality, short-term outcomes	Variable perforation definition (free vs contained not standardized)
Moura et al., 2014	Brazil	Retrospective cohort	Emergency CRC surgery	Emergency CRC	Stoma rate, mortality	High stoma prevalence; unclear distinction between temporary vs permanent
Ocak et al., 2021	Turkey	Retrospective cohort	Emergency oncologic CRC	Emergency CRC	Morbidity, mortality	Mortality timepoint not uniformly specified
Bin Traiki et al., 2023	Saudi Arabia	Retrospective cohort	Emergency CRC surgery	Emergency CRC	Outcomes, survival	Regional referral bias; mixed colon/rectal denominators

KJMHS 2026; Vol. 3 (Issue 2)
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Öistämö et al., 2016	Sweden	Retrospective cohort	Emergency CRC	Emergency CRC	Mortality	Limited physiological severity reporting
Krutsri et al., 2021	Thailand	Retrospective cohort	Elderly emergency CRC	Emergency CRC	Morbidity, mortality	Age-stratified cohort; high comorbidity burden
Kobayashi et al., 2023	Japan	Multi-institutional registry cohort	Obstructed/perforated CRC	Obstruction & perforation	Mortality	Registry-based design; limited contamination grading
Norman et al., 2023	South Africa	Retrospective cohort	Emergency CRC	Emergency CRC	Mortality, survival	Resource-limited setting; system-level variability

- CRC = colorectal cancer.
- NR = not reported or not extractable from published data.
- Study populations varied in inclusion of colon-only versus combined colon and rectal cancers.

Variability in definitions of emergency presentation

Across studies, operational definitions of "emergency presentation" varied substantially. Some studies defined emergency status based on acute admission requiring urgent surgery, whereas others relied on administrative coding or timing from admission to operation [7,8,11]. Few studies clearly differentiate between emergency admission and emergency operative intervention. Emergency presentation was frequently linked to socioeconomic variations and delayed diagnostic pathways [8,11,13]. However, the threshold at which a presentation was labeled "emergent" was inconsistently reported, limiting cross-study comparability.

Heterogeneity in phenotyping obstruction and perforation

Considerable variation was identified in definitions of obstruction and perforation. Obstruction was variably classified using clinical criteria (e.g., obstipation, abdominal distension), radiologic findings (CT-confirmed transition point), or intraoperative confirmation [38,42,43]. Few studies distinguished complete from partial obstruction [42]. While perforation definitions ranged from free intraperitoneal perforation to contained or tumor-related microperforation; differentiation between diastatic and tumor perforation was inconsistently specified [15,16,18,44]. Incidence estimates therefore varied widely as demonstrated in **Table 2**. Emergency presentation overall was frequently reported in the 15–45% range [2,3,40], but obstruction and perforation proportions differed markedly across cohorts [15,16,42]. These variable definitions likely contributed significantly to the broad reported ranges.

Physiological instability and risk stratification reporting

Reporting of baseline physiological status was inconsistent across studies. Worse postoperative outcomes were observed with advanced age, comorbidity burden, and higher ASA class [19,20]. However, detailed documentation of hemodynamic instability, sepsis severity, organ failure, or contamination grading was absent in many reports. Where physiological variables were reported, they identified strong associations with short-term mortality, particularly in perforated colonic tumors with generalized peritonitis [15,16,18]. Nonetheless, absence of standardized severity metrics limited relevant comparison between operative strategies and between obstructed and perforated cohorts.

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Table 2 Incidence of Emergency Presentation, Obstruction, and Perforation in Colorectal Cancer: Impact of Definition and Mortality Timepoint Variability

Study (Country, Year)	Study Design	Definition of Emergency Used	Emergency CRC (%)	Obstruction (%)	Perforation (%)	Mortality Timepoint Reported
Kaewubon 2024 (Thailand)	Retrospective cohort	Urgent admission requiring surgery	37.3	NR	5.5	30-day
Esswein 2023 (Austria)	Matched cohort	Emergency operative resection	30.0	NR	2–9	90-day
Storli 2023 (Norway)	Registry analysis	Acute presentation	11.0	NR	NR	NR
Bin Traiki 2023 (KSA)	Retrospective cohort	Emergency surgery	32.5	8.4	12.9	In-hospital
Nahar 2022 (KSA)	Cohort	Admission-based	33.0	NR	NR	NR
Maertens 2022 (UK)	Case series	Emergency surgical episode	25.0	NR	NR	NR
Golder 2022 (UK)	Systematic review	Administrative coding	20.0	14.4	NR	Mixed
Ocak 2021 (Turkey)	Retrospective	Emergency resection	18.0	NR	NR	NR
Acar 2020 (Turkey)	Retrospective	Urgent oncologic surgery	18.4	NR	NR	In-hospital
Pisano 2018 (WSES)	Guideline	Clinical emergency definition	13.2	3.4	NR	Not standardized

- Percentages refer to the proportion reported within each individual study population. Mortality percentages reflect the timepoint specified in each original study (in-hospital, 30-day, or 90-day).
- Definitions of "emergency presentation," "obstruction," and "perforation" varied across studies and were based on authors' criteria (e.g., clinical presentation vs operative findings).
- NR = not reported in the original publication.

Short-term outcomes

Across studies, emergency CRC was consistently associated with worse short-term outcomes compared to elective surgery [7,9,22]. However, reported mortality rates varied substantially, influenced by case-mix, institutional capacity, and mortality timepoint definitions (in-hospital vs 30-day vs 90-day) as demonstrated in **Table 3**. Perforated CRC demonstrated the highest early mortality in most studies [15,16,18], whereas obstructed CRC outcomes were more heterogeneous and appeared strongly modulated by physiological reserve [19,29]. Postoperative morbidities were independently associated with adverse long-term oncologic outcomes in several studies [21], suggesting that perioperative physiological insult may extend beyond short-term morbidity.

Resource utilization and perioperative burden

Length of hospital stay (LOS) and ICU utilization were frequently reported but inconsistently defined. Some studies revealed mean LOS, others median values; and criteria for ICU admission were rarely standardized. Higher ICU use and prolonged hospitalization were most often observed in patients with sepsis, hemodynamic instability, or multi-organ dysfunction [15,16,20]. Institutional variations in perioperative pathways and system-level resources likely contributed additional variability [23,45].

Long-term outcomes

Long-term endpoints showed considerable heterogeneity. Overall survival (OS), disease-free survival (DFS), cancer-specific survival (CSS), and recurrence rates were variably reported. Follow-up duration ranged widely across studies, and censoring practices were inconsistently described [39,46, 47,48]. Emergency surgery was associated with inferior long-term survival in several matched or registry-based analyses, even after adjustment for confounders [22,49,50,51]. Perforation

KJMHS 2026; Vol. 3 (Issue 2)
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was a particularly adverse prognostic factor, including in stage II disease [51]. However, inconsistent endpoint definitions and surveillance intervals limited quantitative synthesis and prevented robust comparative conclusions.

Table 3 Short- and Long-Term Outcomes of Emergency Colorectal Cancer Surgery: Impact of Mortality Timepoint, Follow-Up Duration, and Cohort Phenotype

Study (Country, Year)	Emergency Cohort Phenotype	Stoma Formation (%)	Morbidity (%)	Mortality (%)	Mortality Timepoint	Recurrence (%)	Survival Endpoint Reported	Follow-up Duration	Key Source of Outcome Variability
Moura (Brazil, 2014)	Mixed emergency CRC	85.0	33.4	50.0	In-hospital	NR	NR	NR	High permanent stoma rate; unclear stoma classification
Ma W (China, 2023)	Obstructive CRC	NR	53.4	50.0	30-day	NR	OS (77.8%)	Variable	SEMS selection bias; obstruction-only cohort
Elmessiry (Egypt, 2023)	Curative emergency CRC	NR	11.1	28.9	30-day	25.2	OS (71.1%)	3–5 years	Curative-only selection; lower physiological severity
Arnarson (Sweden, 2023)	Emergency colon; subspecialist vs generalist	42.5	35.4	33.4	90-day	28.3	OS (47.0%)	Long-term	Volume and subspecialization effect
Boeding (Netherlands, 2023)	Right-sided obstructing CRC	29.0	10.0	NR	Not specified	NR	OS (60.9%)	Long-term	Right-sided disease focus; registry data
Zamaray (Netherlands, 2023)	Emergency CRC	NR	29.0	NR	Not specified	NR	NR	NR	Mortality endpoint not uniformly defined
Pisano (UK, 2018)	CRC emergencies (guideline synthesis)	NR	NR	25.2	Mixed	NR	NR	NR	Heterogeneous source data
Öistämö (Sweden, 2016)	Emergency CRC	6.5	26.0	12.0	30-day	NR	NR	NR	Registry-based; limited physiological data
Esswein (Austria, 2023)	Emergency resection	39.0	47.4	47.5	90-day	35.6	NR	Long-term	Matched analysis; residual confounding
Krutsri (Thailand, 2021)	Elderly emergency CRC	NR	41.3	26.3	In-hospital	NR	NR	NR	Age-stratified high-comorbidity cohort
Kobayashi (Japan, 2023)	Obstruction & perforation	8.3	18.5	53.3	In-hospital	NR	NR	NR	Mixed obstruction/perforation; contamination grade unreported
Norman (South Africa, 2023)	Emergency CRC	4.3	31.0	2.2	30-day	5.4	OS (55.4%)	Variable	Resource-limited setting; referral bias

KJMHS 2026; Vol. 3 (Issue 2)
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Bin Traiki (KSA, 2023)	Emergency CRC	28.6	NR	NR	Not specified	NR	OS (60.9%)	Variable	Regional tertiary referral cohort
Ocak (Turkey, 2021)	Emergency CRC	NR	31.0	NR	Not specified	NR	NR	NR	Mortality timepoint unspecified
Kim (Korea, 2010)	Emergency CRC	NR	NR	45.9	In-hospital	NR	NR	NR	Early-era cohort; unspecified severity stratification

- Mortality percentages are not directly comparable across studies due to differences in reporting timepoints and baseline physiological severity.
- Survival percentages reflect study-specific follow-up durations and should be interpreted within individual study context.
- Mortality endpoints varied across studies (in-hospital, 30-day, or short-term postoperative mortality).
- Morbidity definitions were heterogeneous and included overall complications or major complications as defined by individual authors.
- Survival outcomes represent overall survival where reported; follow-up duration varied between studies.
- NR = not reported.

Operative strategy variation

As illustrated in **Table 4** operative approaches included primary resection with anastomosis (with or without diversion), Hartmann's procedure, staged diversion, and SEMS as a bridge to surgery in selected left-sided colonic obstruction [14,25,27,28,29,32,33,52]. Operative strategies differed considerably across studies and healthcare systems. In several reports, higher-risk or septic patients were more likely to undergo diversion or Hartmann's procedure, reflecting confounding by indication [19,22]. Current multidisciplinary reviews highlight the importance of structured collaboration between colorectal surgeons, endoscopists, anesthesiologists, and oncologists in the management of malignant colonic obstruction, particularly on performing SEMS placement versus immediate resection [53]. SEMS outcomes differed across randomized and multicenter trials, with variations in technical success, perforation risk, and oncologic endpoints [27,28,32,33,54]. Guideline recommendations consistently emphasized selective application based on physiological stability and institutional expertise [14,25,41] (Figure 2). Minimally invasive approaches were reported in specialized settings but were influenced by case selection, surgeons' experience, and institutional capacity [34,55].

Table 4 Risk-Stratified Emergency Management Strategies in Obstructed or Perforated Colorectal Cancer: Evidence Strength, Physiological Context, and Sources of Controversy

Clinical Scenario	Strategy / Approach	Evidence Level in Included Literature	Physiological Context Driving Selection	Principal Controversy	Structured Practical Implication
Obstructing CRC (general)	Immediate emergency resection (various procedures)	Observational cohorts; registry analyses	Variable physiological reserve; risk of ischemia or impending perforation	High morbidity and mortality; outcomes strongly influenced by case-mix and institutional capacity	Prioritize preoperative resuscitation; document physiological status; centralize to experienced colorectal units when feasible
Left-sided obstructing CRC	SEMS as bridge-to-surgery (BTS)	RCTs, meta-analyses, guideline updates	Hemodynamically stable; absence of perforation or generalized peritonitis	Perforation risk; potential oncologic compromise; selection bias in stable patients	Use selectively in stable patients; explicitly report technical success, perforation rates, and selection criteria

KJMHS 2026; Vol. 3 (Issue 2)
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Left-sided obstruction	Diverting stoma / staged surgery	Guidelines; consensus statements; cohort studies	Physiological instability; high ASA; uncertain anastomotic safety	Balancing delayed definitive resection vs reduced leak risk	Recommended in unstable or high-risk patients; include rationale (physiology vs contamination) in operative documentation
Obstructing CRC	Primary resection + anastomosis (± diversion)	Guidelines; observational cohorts	Hemodynamically stable; limited contamination; adequate tissue perfusion	Anastomotic leak risk vs oncologic adequacy; confounding by indication	Restrict to carefully selected stable patients; require explicit intraoperative risk assessment documentation
Perforated CRC (localized or free)	Damage-control principles / staged reconstruction	Guidelines; retrospective perforation cohorts	Septic physiology; generalized peritonitis; organ dysfunction	One-stage reconstruction vs staged management	Source control and sepsis resuscitation take precedence; consider staged reconstruction after stabilization
Perforated CRC	Hartmann's procedure / resection without anastomosis	Cohort studies; guideline recommendations	Shock, fecal peritonitis, severe contamination, high ASA	Reduced leak risk vs permanent stoma burden	Define institutional criteria for Hartmann; mandate reporting of permanent vs temporary stoma outcomes
Perforated CRC (stage II subgroup)	Recurrence risk stratification	Observational stage-specific cohorts	Perforation as biological and inflammatory modifier	Whether perforation mandates intensified adjuvant therapy	Incorporate perforation status into multidisciplinary oncologic discussion and surveillance planning
Operator-related factor	Specialist colorectal vs general surgeon	Registry-based cohort studies	Institutional volume; subspecialization availability	Volume-outcome relationship; access disparities	Establish referral networks and on-call colorectal pathways; audit outcomes stratified by surgeon specialty
Surgical approach	Minimally invasive (laparoscopy/robotics)	Case series; selected cohorts	Hemodynamic stability; limited contamination	Feasibility vs oncologic adequacy under emergency conditions	Restrict to stable patients with institutional expertise; avoid compromise of oncologic principles
Perioperative pathway	Adapted ERAS in emergency CRC	Systematic reviews; prospective cohorts	After initial resuscitation; stabilized physiology	Applicability in unstable or septic patients	Implement pragmatic emergency-ERAS bundle; clearly distinguish from elective ERAS protocols

- This table summarizes *management-relevant contributions* of included sources; effect sizes and direct head-to-head comparisons were not consistently extractable across studies.
- Evidence level reflects study design within included literature and does not represent formal GRADE classification
- "NR" indicates details were not reported in the extracted dataset or were not comparable across studies.
- CRC = colorectal cancer; SEMS = self-expanding metal stent; BTS = bridge to surgery; ERAS = enhanced recovery after surgery.

KJMHS
KORDOFAN JOURNAL OF MEDICAL AND HEALTH SCIENCES
KJMHS 2026; Vol. 3 (Issue 2)
Online ISSN: 3027-5601
Manuscript ID: KUJMS-V.3.I.2.02

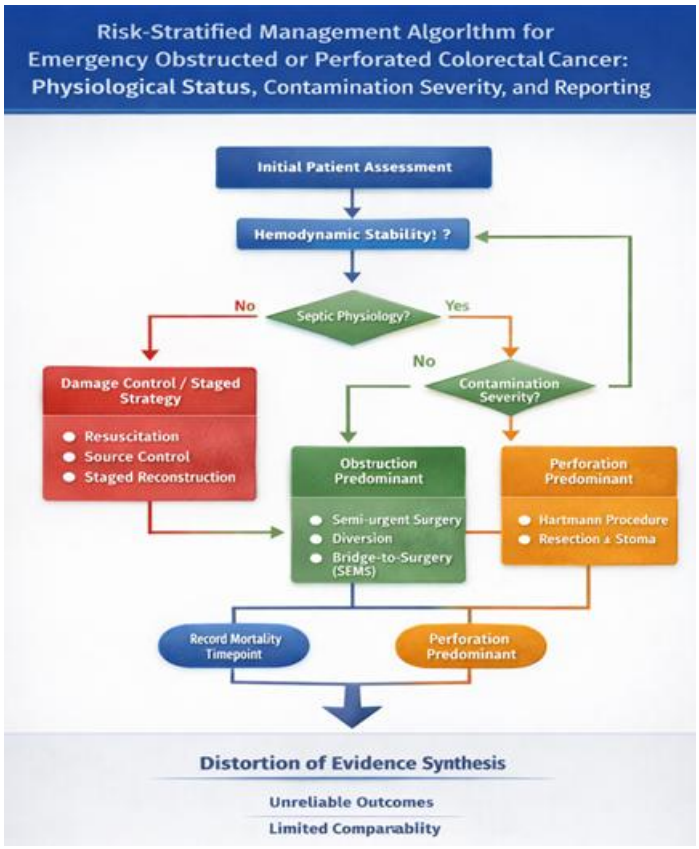

Figure 2 . Evidence-Based Management Algorithm for Emergency Obstructed or Perforated Colorectal Cancer

Evidence-based decision pathway for the management of colorectal cancer presenting as an emergency with acute obstruction or perforation. Algorithm synthesized from included guideline statements and cohort evidence; intended as a conceptual risk-stratified framework rather than prescriptive protocol.

Reporting inconsistencies as a source of outcome heterogeneity

A central finding across included studies was the absence of harmonized reporting standards. Variability was observed in definition of emergency presentation [7,8], classification of obstruction and perforation [15,38], mortality timepoints (in-hospital vs 30-day vs 90-day), complication classification systems, reporting of temporary versus permanent stoma, and long-term oncologic outcomes [39,47]. This methodological heterogeneity constrained direct inter-study comparison and precluded meta-analysis (Figure 3). Variations in definitions and baseline severity reporting likely account for a substantial proportion of the variability observed in documented morbidity and mortality across the studies. These findings highlight that heterogeneity in methodology and documentation contributes considerably to apparent differences in outcomes across published studies. **(Table 5)**

Summary of key results

Across 65 studies, outcome variability in emergency obstructed or perforated CRC appears strongly influenced by inconsistent definitions of emergency presentation and disease subtype, variable reporting of physiological severity and contamination, confounding by indication in operative strategy selection, divergent mortality timepoints and endpoint definitions, and differences in institutional infrastructure and system-level capacity.

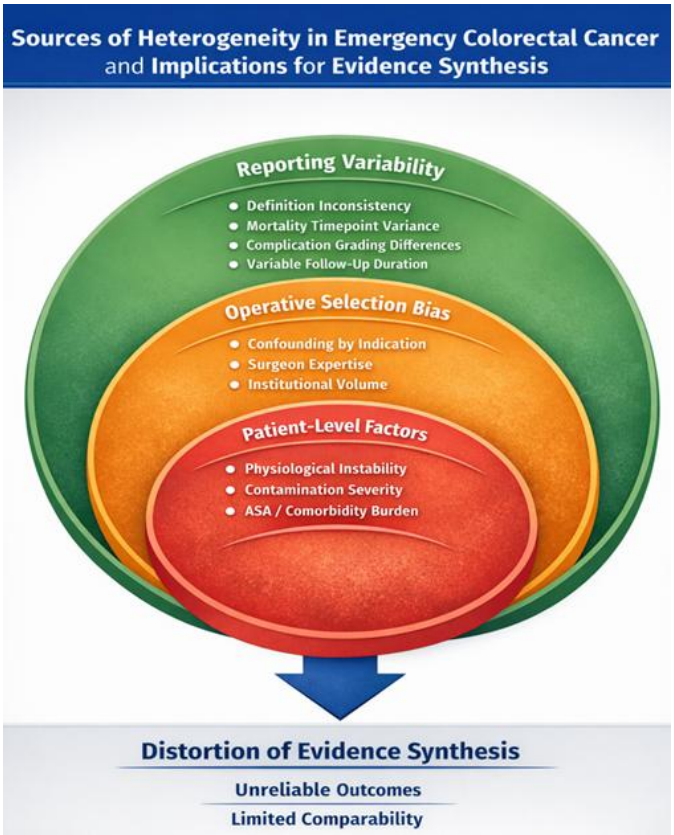

Figure 3 Sources of Outcome Heterogeneity in Emergency Colorectal Cancer: Implications for Evidence Interpretation

Conceptual illustration of major sources of heterogeneity influencing outcomes and interpretation of evidence in emergency colorectal cancer.

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KJMHS 2026; Vol. 3 (Issue 2)
Online ISSN: 3027-5601
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Table 5 Proposed Harmonized Reporting Framework for Emergency Obstructed or Perforated Colorectal Cancer: Addressing Definition Variability and Methodological Heterogeneity

Domain	Definition Applied in This Review	Observed Variability Across Studies	Consequence for Evidence Synthesis	Analytical Handling in This Review	Recommended Standardized Reporting Framework
Emergency presentation	Unplanned admission requiring urgent intervention for CRC-related obstruction or perforation	Defined variably by admission route, operative timing, administrative coding, or unclear criteria	Distorts reported incidence; impairs inter-study comparability	Incidence reported per study without pooling across inconsistent definitions	Emergency CRC defined as unplanned admission requiring operative or interventional management within 24–72 hours due to obstruction or perforation
Obstruction	Clinical and/or radiologic large bowel obstruction attributable to CRC	Complete vs partial obstruction inconsistently specified; CT vs clinical vs intraoperative diagnosis; inclusion of ileus	Influences operative selection (SEMS vs diversion vs resection); confounds outcome comparison	Obstruction rates retained as published; contextualized narratively	CT-confirmed mechanical obstruction secondary to CRC, stratified as complete vs partial, with documentation of ischemia/perforation risk
Perforation	CRC-associated perforation at presentation or during index surgery	Free vs contained perforation inconsistently distinguished; tumor vs diastatic perforation often merged; sepsis status variably reported	Major determinant of mortality and operative strategy; pooling unreliable without subtype stratification	Interpreted as marker of septic physiological burden	Mandatory classification: (1) tumor perforation, (2) diastatic perforation, (3) free vs contained, with documented sepsis severity and contamination grade
Baseline physiological status	ASA class and comorbidity data where available	Hemodynamic instability, organ dysfunction, and contamination grading inconsistently reported	Limits risk adjustment; exaggerates apparent operative strategy differences	Interpreted qualitatively in narrative discussion	Mandatory reporting of: ASA class, shock status, vasopressor use, organ dysfunction, and contamination severity
Mortality	Short-term postoperative mortality as reported by authors	In-hospital vs 30-day vs 90-day mortality inconsistently reported	Prevents valid comparison; inflates perceived heterogeneity	Mortality retained as reported; timepoint variability explicitly identified	Mandatory reporting of 30-day mortality; optional 90-day mortality; specify in-hospital deaths separately
Morbidity / complications	Postoperative complications following emergency CRC surgery	Overall vs major complications; inconsistent grading systems	Restricts severity stratification and benchmarking	Not pooled; interpreted descriptively	Complications graded using Clavien–Dindo classification; specify major morbidity (≥III)
Stoma formation	Any stoma created during index admission	Temporary vs permanent stoma often not distinguished;	Overestimates permanent stoma burden; misrepresents	Reported as given; limitations acknowledged	Mandatory distinction between temporary diverting stoma and permanent end stoma;

KJMHS 2026; Vol. 3 (Issue 2)
Online ISSN: 3027-5601
Manuscript ID: KUJMS-V.3.I.2.02

		reversal rates rarely reported	long-term impact		report reversal rate and follow-up duration
Recurrence	Any reported oncologic recurrence post-emergency surgery	Local vs distant recurrence inconsistently separated; follow-up duration variable; stage-specific cohorts	Survival bias; non-comparable recurrence estimates	Reported only when explicitly defined	Report local and distant recurrence separately; minimum follow-up 3–5 years; specify stage distribution
Survival	Overall survival (OS) where available	OS vs DFS vs cancer-specific survival; heterogeneous follow-up intervals	Precludes pooled survival analysis	Presented descriptively without meta-analysis	Primary endpoint: OS; secondary: DFS; define fixed follow-up intervals (3- and 5-year)
Population denominator	Emergency CRC presenting with obstruction and/or perforation	Colon-only vs colon+rectum; resected-only vs all admissions; guideline vs registry populations	Denominator shifts distort incidence and mortality rates	Populations clearly labeled per study	Explicit reporting of denominator (all emergency admissions vs resected cases); specify colon vs rectal cancer inclusion
Operative strategy documentation	Procedure type as reported	Rationale for diversion vs anastomosis rarely documented; confounding by indication unmeasured	Limits causal interpretation of strategy comparisons	Interpreted within confounding framework	Mandatory documentation of operative rationale (physiology, contamination, technical factors)

- Proposed definitions represent authors' synthesis based on observed reporting variability and are not derived from formal consensus methodology.
- Recommendations are intended to guide future observational research and registry design rather than replace existing international guideline criteria.
- CRC = colorectal cancer; NR = not reported.
- Substantial heterogeneity in definitions and outcome reporting justified a structured narrative synthesis rather than quantitative pooling.
- The proposed standardized definitions are intended to inform future observational studies, registries, and guideline development.

DISCUSSION

1. Emergency CRC as a physiology-dominated clinical state

The collective evidence synthesized in this review demonstrates that emergency colorectal cancer (CRC) presenting with obstruction or perforation should be considered primarily as a physiologically unstable oncologic state, rather than simply an alternative presentation of tumor location or stage. Across several studies, short-term mortality is consistently higher in emergency resections compared with elective surgery [7,8,9,22]. However, this increased risk is not uniformly distributed and appears strongly influenced by baseline physiological status. Perforation with generalized peritonitis and systemic inflammatory response, is consistently associated with the highest early mortality [15,16,18]. In contrast, obstruction demonstrates a broader risk spectrum, ranging from relatively compensated dilation to impending ischemia or septic deterioration [15,56]. The physiological reserve is identified as the predominant factor influencing the postoperative risk as demonstrated in studies that adjust for age, comorbidity burden, and ASA classification [19,20]. Comparative evaluations of perioperative risk prediction models in major abdominal surgery further revealed variability in predictive accuracy between ASA, POSSUM-derived systems, and NSQIP-based tools, highlighting the need for standardized risk adjustment in

KJMHS 2026; Vol. 3 (Issue 2)
Online ISSN: 3027-5601
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emergency CRC research [57]. Additionally, postoperative morbidities have been independently linked to worse long-term oncologic outcomes [21]. This demonstrates that perioperative physiological stress may not merely influence short-term morbidity but may also alter long-term disease pathways. These findings support a strategy in which physiological instability and sepsis severity act as primary determinants of outcome, with tumor factors contributing secondarily.

2. Confounding by indication and operative strategy interpretation

Across the studies, a recurrent limitation is confounding by indication. Operative strategy in emergency CRC is guided and influenced by intraoperative judgment, physiological stability status, sepsis burden, and institutional expertise. Higher-risk patients presenting with septic shock, diffuse peritonitis, or limited physiological reserve are more likely to undergo diversion or Hartmann's procedure [14,41], whereas primary anastomosis is preferentially performed in more stable patients [57,58]. Consequently, comparative analyses between approaches often reflect baseline case-mix variations rather than intrinsic superiority of one strategy. Similarly, the literature on self-expanding metal stents (SEMS) demonstrates how selection bias influences outcomes. Randomized trials and multicenter studies (Dutch Stent-In, ESCO, CReST) demonstrate variable short- and long-term findings [27,28,32,33], but eligibility criteria typically exclude patients with overt perforation or severe peritonitis. Observed variations therefore suggest patient selection and procedural expertise rather than a uniform therapeutic effect [25,30]. Economic analyses further demonstrate that the cost-effectiveness of SEMS as a bridge to surgery is highly context-dependent, influenced by institutional expertise, morbidity rates, and reduce stoma reversal probabilities [59]. Minimally invasive procedures were reported in specialized settings but were influenced by case selection and institutional volume and expertise [34,54]. Recent reviews reveal that minimally invasive emergency colorectal surgery remains largely restricted to hemodynamically stable patients managed in high-volume centers, reinforcing the central role of physiological selection in interpreting outcomes [60]. Registry-based analyses show that emergency resection is associated with worse long-term survival even after adjustment for confounders [4,19], but the extent to which residual physiological confounding persists is unclear. Without structured standardized documentation of sepsis grade, shock parameters, and organ failure, interpretation of operative comparisons remains inherently limited.

3. Reporting heterogeneity as a structural limitation

A major observation of this review is the lack of harmonized reporting standards across studies, resulting in substantial methodological heterogeneity. Variability was demonstrated in definitions of emergency presentation [7,8,11], classification of obstruction (clinical vs radiologic vs intraoperative) [38,42], perforation subtyping (free vs contained; tumor vs diastatic) [15,16,18], mortality timepoints (in-hospital, 30-day, 90-day), complication classification systems, reporting of temporary versus permanent stoma, and long-term oncologic endpoints such as overall survival (OS), disease free survival (DFS), and cancer specific survival (CSS) [39,47,48]. These inconsistencies magnify apparent inter-study differences and constrain quantitative synthesis. For example, mortality comparisons are inherently unreliable as some studies report in-hospital mortality while others report 90-day mortality. Similarly, recurrence patterns cannot have relevant comparison when follow-up intervals and outcome ascertainment methods vary. Importantly, only a limited number of studies stratify outcomes by physiological severity or contamination grade, despite these factors emerging as major determinants of risk. The absence of this stratification constrains attempts to generate practice-defining conclusions from pooled observational data.

4. Toward a minimum reporting dataset for emergency CRC

Based on the heterogeneity revealed, this review emphasizes the need for a structured standardized minimum reporting dataset for emergency obstructed and perforated CRC which should include, at minimum:

KJMHS 2026; Vol. 3 (Issue 2)
Online ISSN: 3027-5601
Manuscript ID: KUJMS-V.3.I.2.02

I. Baseline physiological variables

These include age and comorbidity indices, ASA classification, hemodynamic parameters such as shock status, vasopressor requirement, sepsis classification, organ failure markers, and frailty assessment in older adults using validated frailty indices, given contemporary evidence that frailty is an independent predictor of postoperative morbidity and mortality in colorectal cancer surgery [61]

II. Disease phenotype classification

This includes obstruction if it is complete or partial; radiologic criteria specified [38,42], perforation (free vs contained; tumor vs diastatic) [15,18], and contamination grading (localized vs diffuse peritonitis).

III. Operative documentation

The data should include procedure type such as primary anastomosis ± diversion, Hartmann's, staged procedure, justification for diversion such as physiology, contamination, or technical factors, and SEMS technical success and complications where applicable [27,28,32,33].

IV. Outcome definitions

This demonstrates that mortality reported at standardized intervals (30-day and/or 90-day), morbidities graded using a recognized system, clear distinction between temporary and permanent stoma, and consistent definition of long-term oncologic endpoints (OS, DFS, CSS) [39,47]. Adoption of such a standardized dataset would resolve interpretive ambiguity and improve comparability across institutions and studies.

5. Implications for guidelines and registry-based research

Existing international guidelines appropriately emphasizes tailored management based on physiological stability and contamination severity [14,25,41]. However, recent data from resource-limited settings show that comparative outcomes between bridge-to-surgery strategies and immediate emergency resection are strongly influenced by institutional volume and expertise and perioperative support capacity, further underscoring system-level determinants of outcome heterogeneity [62]. Large-scale registry initiatives have revealed the capacity to generate more robust outcome analyses when standardized variables are collected [63,64]. Expansion of such registry approach incorporate physiological stratification and contamination grading could considerably enhance benchmarking and evidence synthesis. Additionally, incorporation of standardized emergency CRC modules within national colorectal registries may allow risk-adjusted outcome comparison across centers, evaluation of subspecialized service and institutional capacity effects [23] (Figure 4), and assessment of perioperative trajectories implementation [35,36,45]. Future registry-linked assessments may also evaluate perioperative systemic therapy protocols in selected emergency presentations, including neoadjuvant therapy in biologically advanced but operable colon cancer [65]. Similar system-level standardization may reduce variability and clarify the true comparative effectiveness of operative strategies.

The findings of this review demonstrate that emergency colorectal cancer should be formulated as a physiologically-driven surgical condition characterized by varying degrees of septic burden and physiological instability and not merely as an oncologic presentation. Understanding of outcomes across literature is therefore strongly influenced by variations in baseline physiological derangement, sepsis status, and institutional infrastructures rather than tumor characteristics alone. Recognizing emergency colorectal cancer as a physiology-dominated condition may facilitate improved risk stratification, more relevant interpretation of operative outcomes, and more reliable comparisons across international datasets.

Strengths: This systematic review integrates evidence across multiple studies with variable designs and healthcare system with different infrastructures and institutional volumes and capacities, underscoring the global variability in emergency CRC presentation and management. A central strength is the explicit focus on risk stratification and heterogeneity, illustrating the reason of the constrained of direct comparison of strategies.

Limitations: This review is limited by major heterogeneity in multiple aspects including study design, definitions, physiological instability reporting, and

KJMHS 2026; Vol. 3 (Issue 2)
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outcome measures, which precluded meta-analysis and constrained causal inference. Most included studies were observational, with likely confounding by indication and risk selection as higher-risk patients preferentially receiving diversion or Hartmann's procedure. Long-term outcomes such as recurrence, survival, quality of life, and permanent stoma rates, were inconsistently reported, limiting robust conclusions regarding oncologic and functional outcomes.

RECOMMENDATIONS

- For decision making in obstructed and perforated CRC management adopt risk-stratified decision-making by documenting physiological status such as sepsis, hemodynamic stability, contamination severity, and comorbidity burden at presentation.
- Use structured standardized reporting in future studies including definition of emergency presentation, obstruction/perforation subtype, mortality timepoints (30- and/or 90-day), morbidity grading (e.g., Clavien–Dindo), and stoma type (temporary vs permanent).
- Use SEMS as BTS selectively for left-sided obstructing tumors in the absence of perforation/peritonitis and only where appropriate facilities and expertise is available.
- Adopt a pragmatic a perioperative strategy for the emergency management after initial resuscitation including analgesia optimization, fluid strategy, early mobilization when, rather than claiming full ERAS equivalence across unstable cohorts.
- Implement system-level audit and registry protocols to reduce outcome variability and enable relevant benchmarking across institutions.

CONCLUSION

Perforated and obstructed colorectal cancers presenting as emergency are a high-risk surgical condition associated with considerable morbidity and mortality. Evidence generated in this review demonstrates that outcomes are primarily determined by physiological instability, septic burden, and system-level factors**,** rather than tumor characteristics alone. Perforation with generalized peritonitis carries the greatest early mortality, whereas obstructive disease characterized by a broader physiological spectrum in which risk is strongly modulated by baseline physiological reserve and the timeliness of resuscitative care. Interpretation of the literature is considerably constrained by heterogeneity in definitions, severity reporting, and outcome measurement**,** together with confounding by indication in operative strategy selection. Consequently, reported differences between surgical approaches often demonstrate case-mix variation rather than primary treatment superiority. These findings support a physiology-driven approach for interpreting emergency colorectal cancer outcomes, in which the predeterminant risk factors include septic burden, physiological reserve, and system-level factors. Standardization of definitions and outcome documentation is critical to enable reliable comparison across studies and to guide future clinical research.

ABBREVIATIONS:

ASA: American Society of Anesthesiologists
CRC: Colorectal cancer
ERAS: Enhanced Recovery After Surgery
ICU: Intensive care unit
LOS: Length of Stay
MDT: Multidisciplinary team
SEMS: Self-expandable metallic stent
POSSUM: Physiological Operative Severity Score enumeration of Morbidity and Mortality
NSQIP: National Surgical Quality Improvement Program
OS: Overall survival
DFS: disease free survival
CSS: Cancer specific survival

DECLARATION:

Authors contribution:
A.K.E.: Conceptualization, methodology, literature search, writing – original draft.
M.P.K.W.: Writing – review and editing.
I.S.: Supervision, review, and manuscript finalization.

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