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Laparostomy and Diverting Enterostomy During Relaparotomy for Acute Abdominal Surgical Conditions: A Retrospective Cohort Study of Mortality and Clinical Outcomes

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Laparostomy and Diverting Enterostomy During Relaparotomy for Acute Abdominal Surgical Conditions: A Retrospective Cohort Study of Mortality and Clinical Outcomes

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Abstract

Background: Relaparotomy for acute abdominal surgical conditions is associated with substantial morbidity and mortality. Laparostomy and diverting enterostomy may be selected in patients with severe contamination, physiological derangement, unsafe fascial closure, or high-risk intestinal reconstruction, but their observed outcomes are strongly affected by confounding by indication.

Methods: We conducted a retrospective cohort study of adult patients undergoing relaparotomy for acute abdominal surgical conditions at Yerevan State Medical University between 2011 and 2022. After consolidation of repeated records by hospital history number and exclusion of records without an identifiable patient, 226 unique patients were analyzed. The exposure was an explicitly documented combined strategy of laparostomy plus diverting enterostomy/stoma (n=30) versus all other relaparotomy strategies (n=196). The primary outcome was in-hospital mortality. Secondary outcomes included hospital length of stay, timing of relaparotomy, repeat relaparotomy, documented postoperative events, and discharge outcome. Multivariable logistic regression adjusted for age, APACHE II score, combined strategy, and diffuse peritonitis.

Results: Among patients with known outcome, mortality was 13/30 (43.3%) in the combined-strategy group and 60/185 (32.4%) in the comparison group (Fisher exact P=0.299; unadjusted OR 1.59, 95% CI 0.73–3.49). In the complete-case multivariable model (n=215), the combined strategy was not independently associated with mortality (adjusted OR 1.44, 95% CI 0.63–3.32, P=0.388). Age (OR 1.025

per year, 95% CI 1.006–1.045, P=0.011) and APACHE II score (OR 1.100 per point, 95% CI 1.039–1.163, P=0.001) were independently associated with mortality; diffuse peritonitis was not (OR 0.666, 95% CI 0.345–1.285, P=0.225).

Conclusions: In this retrospective cohort, patients receiving combined laparostomy and diverting enterostomy had greater clinical severity and a higher crude mortality, but the adjusted association with mortality was not statistically significant. The findings should be interpreted as observational associations rather than evidence of treatment benefit or harm. Selection of laparostomy and diversion should remain individualized according to physiology, contamination, intestinal viability, and the safety of abdominal closure.

Keywords: relaparotomy; laparostomy; diverting enterostomy; open abdomen; acute abdominal surgery; peritonitis.

Background

Relaparotomy is performed for persistent or recurrent intra-abdominal pathology after an initial operation and remains associated with substantial morbidity and mortality. Common indications include postoperative peritonitis, anastomotic insufficiency, bowel obstruction, bleeding, ischemia or necrosis, and ongoing intra-abdominal sepsis. Outcomes are influenced not only by the operative strategy but also by baseline physiological derangement, age, comorbidity, contamination, and the underlying indication for reoperation.

In selected critically ill patients, primary fascial closure may be unsafe because of visceral edema, ongoing contamination, abdominal hypertension, or the need for planned re-exploration. Damage-control principles may therefore include abbreviated source-control surgery and delayed abdominal wall closure [1,10]. Evidence for damage-control strategies in non-traumatic abdominal emergencies remains largely observational, and careful patient selection is emphasized in the literature.

An important distinction is that laparostomy and diverting enterostomy address different surgical problems. Laparostomy concerns abdominal wall management and access to the abdominal cavity when fascial approximation is considered unsafe or further reassessment is anticipated. Diversion creates a controlled intestinal outlet and may reduce the consequences of leakage from a compromised or newly constructed intestinal anastomosis; it does not guarantee prevention of anastomotic failure.

Modern open-abdomen management also recognizes important potential harms [2–5,11,12,15], including fluid and protein losses, intestinal adhesions, enteroatmospheric or enterocutaneous fistulation, loss of abdominal domain, ventral hernia, and difficulty achieving definitive fascial closure. Contemporary strategies commonly emphasize visceral protection, negative-pressure therapy when appropriate, early re-exploration, and progressive fascial medialization or other dynamic closure techniques [2,11,12,15]. Thus, leaving the abdomen open is generally a selected strategy rather than a routine method of infection control.

The present study evaluates the association between an explicitly documented combined strategy of laparostomy and diverting enterostomy and outcomes after relaparotomy for acute abdominal surgical conditions in a real-world tertiary surgical cohort. Particular attention was given to baseline severity, indications, reoperation patterns, and mortality, while avoiding causal interpretation of treatment effects.

Abbreviations

APACHE II: Acute Physiology and Chronic Health Evaluation II; CI: confidence interval; OR: odds ratio; SD: standard deviation; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology; WSES: World Society of Emergency Surgery; NPWT: negative-pressure wound therapy.

Materials and Methods

Study design and setting

This retrospective observational cohort study was conducted at the Department of Emergency and Abdominal Surgery, Yerevan State Medical University, Armenia. The study period was January 2011 through December 2022. The study was reported with reference to the STROBE recommendations for cohort studies [8,9].

Eligibility and cohort ascertainment

Adult patients who underwent relaparotomy for an acute abdominal surgical condition during the study period were eligible. Pediatric patients were not included. Eligible records were identified from the institutional surgical database and consolidated by hospital history number to obtain a patient-level cohort. Records without an identifiable hospital history number were excluded from the final patient-level analysis. No additional exclusion criterion was applied beyond the requirement that the record represent an eligible relaparotomy episode with an identifiable patient history number.

The source dataset contained 263 records. After removal of records without an identifiable patient identifier and consolidation of repeated records belonging to the same hospital history number, 226 unique patients constituted the final cohort. Repeated records were retained for cohort ascertainment but were not counted as independent patients.

Exposure definition

The primary exposure was an explicitly documented combined surgical strategy consisting of laparostomy together with diverting enterostomy or stoma during the relaparotomy course. Classification required explicit documentation of the combined strategy in the surgical records; mere co-occurrence of a

stoma and laparostomy at different points in the record was not sufficient. Thirty patients met this definition and 196 patients comprised the comparison group.

Laparostomy technique

In the study cohort, laparostomy did not consist of leaving the abdominal cavity completely uncovered. The aponeurotic/fascial edges were deliberately not approximated at the end of the procedure, while the skin edges were approximated to each other and sutured, providing soft-tissue coverage over the abdominal contents. This represents a controlled laparostomy technique and should be distinguished from contemporary temporary open-abdomen systems in which the viscera may be protected with a dedicated temporary abdominal closure method, including negative-pressure therapy.

Outcomes

The primary outcome was in-hospital mortality. Secondary outcomes included hospital length of stay, timing of relaparotomy, repeat relaparotomy, documented postoperative events, and discharge outcome. Because the source database did not contain standardized prospective definitions for all postoperative events, these were treated as documented clinical events rather than a validated composite complication endpoint. The intra-abdominal pressure field was insufficiently populated for inferential analysis and was not included.

Clinical variables

Demographic characteristics, comorbidities, initial operative indication, indication for relaparotomy, relaparotomy timing, relaparotomy procedure, repeat relaparotomy, APACHE II score, and outcome were extracted. Diffuse peritonitis was defined from the documented peritonitis category in the clinical record. The timing of relaparotomy was represented by the documented relaparotomy day rather than hospital length of stay.

Statistical analysis

Continuous variables were summarized as mean ± standard deviation where appropriate. Categorical variables were summarized as counts and percentages. Group comparisons used appropriate categorical tests, including Fisher exact testing when expected cell counts were small, and continuous-variable comparisons were performed according to distributional characteristics. The association between the combined strategy and in-hospital mortality was first assessed using an unadjusted odds ratio with an exact 95% confidence interval. A complete-case multivariable logistic regression model included combined strategy, age, APACHE II score, and diffuse peritonitis. No missing-data imputation was performed. Two-sided P values <0.05 were considered statistically significant. Because treatment allocation was not randomized and the combined strategy was preferentially used in more severely ill patients, all adjusted estimates were interpreted as associations rather than causal treatment effects.

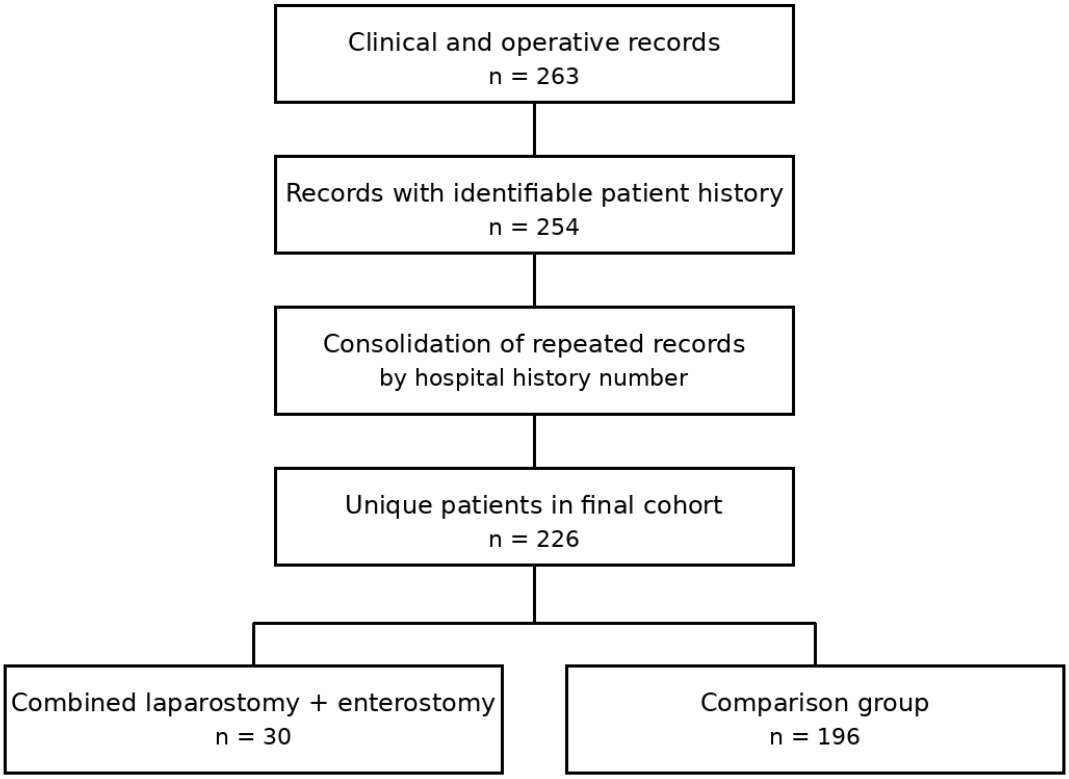
Results

Cohort

The final patient-level cohort comprised 226 unique adult patients. Thirty patients (13.3%) met the explicit definition of combined laparostomy plus diverting enterostomy/stoma, while 196 (86.7%) were classified in the comparison group. The STROBE flow diagram summarizes record identification, exclusion of records without an identifiable patient, consolidation of repeated records, and final cohort allocation. The cohort ascertainment and final allocation are shown in Figure 1.

Figure 1. STROBE flow diagram of cohort ascertainment and final patient allocation

Figure 1. STROBE-style flow diagram of patient selection



Baseline characteristics

Patients receiving the combined strategy had similar mean age but somewhat higher mean APACHE II scores and longer mean hospital stay. Documentation of comorbidity was more frequent in the combined group. Because several source variables had incomplete documentation, percentages are reported using the available group denominator where applicable. Baseline characteristics are summarized in Table 1.

Table 1. Baseline characteristics of the final patient-level cohort

Characteristic	Combined strategy (n=30)	Comparison (n=196)
Age, years, mean ± SD	50.6 ± 15.4	50.4 ± 17.0
Male sex	14 (46.7%)	111 (56.6%)
Female sex	16 (53.3%)	75 (38.3%)
Sex missing	0	10 (5.1%)
APACHE II, mean ± SD	23.83 ± 5.90	22.12 ± 5.85
Hospital stay, days, mean ± SD	30.9 ± 18.7	26.1 ± 18.9

Relaparotomy day, mean ± SD	6.53 ± 4.07	7.58 ± 8.62
Documented comorbidity	18 (60.0%)	92 (46.9%)
Diffuse peritonitis	10 (33.3%)	62 (31.6%)

Indications and procedures

The combined strategy was most frequently documented in patients with bowel or gastric necrosis accompanied by peritonitis and in those with anastomotic insufficiency. These indications illustrate the strong clinical selection underlying exposure assignment. The documented indications and procedures are summarized in Tables 2 and 3.

Table 2. Documented indications for relaparotomy in the combined-strategy group

Combined-group relaparotomy indication	n
Bowel/gastric necrosis with peritonitis	10
Anastomotic insufficiency	9
Persistent/tertiary peritonitis	6
Adhesive obstruction	2
Continuing pancreatic necrosis	1
Intra-abdominal/retroperitoneal abscess	1
Bile leakage/biliary hypertension	1

Table 3. Documented relaparotomy procedures in the combined-strategy group

Combined-group relaparotomy procedure	n
Enterostomy + laparostomy	10
Stoma formation	6
Anastomosis resection + stoma	4
Bowel resection	3
Anastomotic suture reinforcement	3
Perforation closure	1
Abscess drainage/sanitation	1
Sanitation + laparostomy	1
Anastomosis resection + new anastomosis	1

Mortality

Outcome was known for 215 patients. There were 73 deaths and 142 survivors. Mortality occurred in 13 of 30 patients (43.3%) in the combined-strategy group and in 60 of 185 patients (32.4%) in the comparison group. The unadjusted association was not statistically significant (Fisher exact P=0.299; OR 1.59, 95% CI 0.73–3.49). Detailed mortality and selected secondary outcome data are presented in Table 4.

Table 4. Mortality and selected secondary outcome data

Outcome / variable	Combined strategy (n=30)	Comparison (n=196)

Known outcome	30	185
Deaths	13 (43.3%)	60 (32.4%)
Survivors among known outcome	17 (56.7%)	125 (67.6%)
Hospital stay, mean ± SD	30.9 ± 18.7 days	26.1 ± 18.9 days
Relaparotomy day, mean ± SD	6.53 ± 4.07	7.58 ± 8.62
Crude mortality OR	1.59 (95% CI 0.73–3.49)	Reference
Fisher exact test	P=0.299	—

Multivariable analysis

In the complete-case multivariable model (n=215), the combined strategy was not independently associated with mortality. Increasing age and higher APACHE II score were independently associated with mortality, whereas diffuse peritonitis was not statistically significant in the adjusted model. The adjusted estimates are shown in Table 5.

Table 5. Complete-case multivariable logistic regression for in-hospital mortality

Predictor	Adjusted OR	95% CI	P value
Combined laparostomy + enterostomy	1.444	0.628–3.323	0.388
Age, per year	1.025	1.006–1.045	0.011
APACHE II, per point	1.100	1.039–1.163	0.001
Diffuse peritonitis	0.666	0.345–1.285	0.225

Discussion

Principal findings

The principal finding of this retrospective cohort is that patients receiving the explicitly documented combined strategy of laparostomy and diverting enterostomy were clinically heterogeneous but generally represented a high-risk surgical population. Crude mortality was numerically higher in the combined group; however, the difference was not statistically significant, and the adjusted association was also not statistically significant. Age and APACHE II score showed stronger independent associations with mortality. These findings support cautious interpretation and do not establish that the combined strategy either improves or worsens survival.

Confounding by indication

The most important interpretive issue is confounding by indication. Laparostomy and diversion are not assigned randomly: surgeons select them in response to disease severity, contamination, bowel viability, anastomotic risk, visceral edema, anticipated need for re-exploration, and the safety of abdominal closure. The combined group in this cohort had higher APACHE II scores and a substantial burden of severe intra-abdominal pathology. Therefore, crude differences in mortality cannot be interpreted as effects of the surgical strategy itself. Multivariable adjustment reduces, but does not eliminate, this concern.

Role and limitations of laparostomy

Laparostomy should not be conceptualized simply as an infection-control procedure. Contemporary open-abdomen literature describes selected indications such as severe abdominal sepsis with ongoing source-control needs, abdominal compartment syndrome or a high risk of intra-abdominal hypertension, major visceral edema preventing safe fascial approximation, and planned re-exploration in damage-control surgery. Damage-control principles may be appropriate in physiologically deranged patients, but the evidence base in non-traumatic abdominal emergencies remains limited and largely observational.

The technique used in this cohort also requires clarification. The abdominal cavity was not left completely exposed: the fascial/aponeurotic edges were not approximated, but the skin edges were brought together and sutured to provide soft-tissue coverage. This controlled form of laparostomy differs from contemporary temporary abdominal-closure systems designed to protect the viscera and facilitate progressive fascial closure. The distinction is important when comparing this historical cohort with modern open-abdomen series.

Leaving the fascia unclosed can nevertheless carry clinically relevant consequences. Open-abdomen management may be associated with substantial fluid and protein losses, adhesions, enteric fistulation, loss of abdominal domain, ventral hernia, and failure or delay of definitive fascial closure. Contemporary practice therefore emphasizes visceral protection, appropriate temporary abdominal closure, early re-exploration, and strategies that promote progressive

fascial approximation. Negative-pressure wound therapy and dynamic fascial traction techniques are among the approaches described in modern open-abdomen management [11,12,15]. These principles also highlight why the decision to leave the fascia unclosed should be individualized and periodically reassessed.

Role of diverting enterostomy

Diverting enterostomy addresses a different problem from laparostomy. Diversion may reduce the clinical consequences of intestinal leakage by directing enteric contents away from a vulnerable distal segment or anastomosis, but it does not guarantee prevention of anastomotic failure [13,14]. In the present dataset, anastomotic insufficiency was an important indication for relaparotomy in the combined group. Because the source records do not provide standardized prospective measurements of leakage severity or subsequent stoma reversal, the study cannot quantify a protective effect of diversion.

Comparison with the literature

The findings are consistent with the broader literature in emphasizing selective use of damage-control and open-abdomen strategies in physiologically compromised patients. WSES guidance and surgical reviews stress [2–5] that the open abdomen should be used for defined indications and managed with attention to early closure and prevention of complications. Observational studies have also shown that the timing of re-exploration and factors present at the initial open-abdomen operation influence the probability of later fascial closure [6,7]. The current cohort adds real-world data from a non-traumatic emergency-surgery setting but cannot determine comparative treatment effectiveness.

Strengths and limitations

Strengths include reconstruction of a patient-level cohort from repeated institutional records, an explicit reproducible exposure definition, reporting of crude and adjusted mortality estimates with confidence intervals, and adjustment for age, APACHE II score, and diffuse peritonitis. The study also provides a transparent STROBE flow diagram and separates the abdominal-wall strategy from the intestinal-diversion concept.

Several limitations should be considered. The retrospective design is susceptible to selection bias, confounding by indication, and incomplete documentation. The source dataset did not contain standardized prospective definitions of all postoperative complications, detailed open-abdomen duration, definitive fascial-closure timing, use of negative-pressure therapy, nutritional support, fistula classification, or long-term abdominal-wall outcomes. Consequently, these variables could not be reliably analyzed. The intra-abdominal pressure field was insufficiently populated for analysis. The relatively small exposed group (n=30) also limits statistical power and precision. Residual confounding therefore remains possible despite multivariable adjustment.

Clinical interpretation

The data support a pragmatic interpretation: laparostomy with diversion was used as part of a complex surgical response to severe and potentially unstable abdominal pathology. The observed outcomes should not be interpreted as evidence that the strategy itself determines mortality. Decisions regarding laparostomy and diversion should instead be based on the patient's physiology, source-control requirements, intestinal viability and anastomotic risk, visceral edema, and the feasibility of safe fascial closure, with early reassessment and closure whenever clinically appropriate.

Conclusion

In this retrospective cohort of 226 adult patients undergoing relaparotomy for acute abdominal surgical conditions, 30 patients had an explicitly documented combined strategy of laparostomy and diverting

enterostomy/stoma. Crude mortality was 43.3% in the combined group versus 32.4% in the comparison group, but the difference was not statistically significant, and the adjusted association with mortality was also not statistically significant (adjusted OR 1.44, 95% CI 0.63–3.32; P=0.388). Age and APACHE II score were independently associated with mortality. The findings underscore the substantial confounding by indication surrounding laparostomy and diversion and do not establish a causal benefit or harm. Laparostomy should be regarded as a selective abdominal-wall and damage-control strategy rather than a routine infection-control procedure, while diverting enterostomy serves a distinct role in managing intestinal continuity and the consequences of leakage.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ethics Committee of Yerevan State Medical University, Armenia. Because this was a retrospective analysis of anonymized clinical data, the need for informed consent to participate was waived by the committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available because they contain patient-related clinical information and are subject to institutional confidentiality requirements. De-identified data may be available from the corresponding author on reasonable request, subject to applicable ethical and institutional requirements.

Competing interests

The authors declare no competing interests.

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Clinical trial registration

Not applicable.

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Authors' contributions

A.H.M. conceived the study, designed the research, analyzed the data, and drafted the manuscript. H.L.M., A.M.V., and D.R.A. contributed to data collection and interpretation. A.B.A., A.S.V., and A.R.A. participated in surgical management and data acquisition. A.A.O. contributed to data collection and manuscript revision. All authors read and approved the final manuscript.

References

1. Weber DG, Bendinelli C, Balogh ZJ. Damage control surgery for abdominal emergencies. Br J Surg. 2014;101(1):e109-e118. doi:10.1002/bjs.9360.

2. Coccolini F, Roberts D, Ansaloni L, et al. The open abdomen in trauma and non-trauma patients: WSES guidelines. World J Emerg Surg. 2018;13:7. doi:10.1186/s13017-018-0167-4.

3. Sartelli M, Abu-Zidan FM, Ansaloni L, et al. The role of the open abdomen procedure in managing severe abdominal sepsis: WSES position paper. World J Emerg Surg. 2015;10:35. doi:10.1186/s13017-015-0032-7.

4. Demetriades D, Salim A. Management of the open abdomen. Surg Clin North Am. 2014;94(1):131-153. doi:10.1016/j.suc.2013.10.010.

5. Regner JL, Kobayashi L, Coimbra R. Surgical strategies for management of the open abdomen. World J Surg. 2012;36(3):497-510. doi:10.1007/s00268-011-1203-7.

6. Lambertz A, Mihatsch C, Röth A, et al. Fascial closure after open abdomen: initial indication and early revisions are decisive factors—a retrospective cohort study. Int J Surg. 2015;13:12-16. doi:10.1016/j.ijsu.2014.11.025.

7. van Ruler O, Lamme B, Gouma DJ, Reitsma JB, Boermeester MA. Variables associated with positive findings at relaparotomy in patients with secondary peritonitis. Crit Care Med. 2007;35(2):468-476. doi:10.1097/01.CCM.0000253399.03545.2D.

8. Vandenbroucke JP, von Elm E, Altman DG, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. PLoS Med. 2007;4(10):e297. doi:10.1371/journal.pmed.0040297.

9. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. PLoS Med. 2007;4(10):e296. doi:10.1371/journal.pmed.0040296.

10. Girard E, Abba J, Boussat B, et al. Damage Control Surgery for Non-traumatic Abdominal Emergencies. World J Surg. 2018;42(4):965-973. doi:10.1007/s00268-017-4262-6.

11. Petersson P, Petersson U. Dynamic Fascial Closure With Vacuum-Assisted Wound Closure and Mesh-Mediated Fascial Traction (VAWCM) Treatment of the Open Abdomen—An Updated Systematic Review. Front Surg. 2020;7:577104. doi:10.3389/fsurg.2020.577104.

12. Poortmans N, Berrevoet F. Dynamic closure techniques for treatment of an open abdomen: an update. Hernia. 2020;24(2):325-331. doi:10.1007/s10029-020-02130-9.

13. Hyman N, Manchester TL, Osler T, Burns B, Cataldo PA. Anastomotic leaks after intestinal anastomosis: it's later than you think. Ann Surg. 2007;245(2):254-258. doi:10.1097/01.sla.0000225083.27182.85.

14. Hüser N, Michalski CW, Erkan M, et al. Systematic review and meta-analysis of the role of defunctioning stoma in low rectal cancer surgery. Ann Surg. 2008;248(1):52-60. doi:10.1097/SLA.0b013e318176bf65.

15. Acosta S, Björck M, Petersson U. Vacuum-assisted wound closure and mesh-mediated fascial traction for open abdomen therapy—a systematic review. Anaesthesiol Intensive Ther. 2017;49(2):139-145. doi:10.5603/AIT.a2017.0023.