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Enhanced recovery after emergency surgery: A systematic review

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Abstract
Objective: To evaluate the present scientific evidence for feasibility and efficacy of enhanced recovery after surgery (ERAS) protocol in emergency surgery compared to conventional care in terms of LOH, post-operative complications, early functional recovery, re-occurrence and mortality.
Method: Studies and relevant literature comparing the effects of enhanced recovery after surgery and conventional care for emergency surgery were identified in PubMed and Google Scholar. Out of the 340 studies generated, 10 eligible papers were selected for analysis which included 6 RCTs and 4 cohort studies. Data extracted for analysis consisted of: patient age, type of surgery performed, ERAS elements implemented, surgical outcomes in terms of postoperative complications, mortality, length of stay and reoccurrence rates.
Results: Based on the outcome of 1802 patients, in comparison with conventional care, ERAS protocol resulted in significant decrease in length of hospitalization and complications.
Functional recovery parameters like early removal of nasogastric tube, drain and early semisolid diet showed better outcomes in ERAS than conventional care. More research is required to confirm the effect of ERAS protocol on morbidity and reoccurrence.
Conclusion: ERAS is feasible and efficient in emergency surgery compared to conventional care resulting in better and early patient recovery.

Keywords: Enhanced Recovery after Surgery (ERAS), LOH, PubMed and Google Scholar

Introduction
ERAS protocol is a multimodal and multidisciplinary approach to peri-operative management which aims for evidence-based reduction of physiological stress, post-operative complications and organ dysfunction, reoccurrence and mortality whilst also increasing mobility, ultimately leading to early discharge and better surgical outcomes [1, 2, 3]. This fast-track protocol was pioneered by colorectal surgeon Henrik Kehle in 1995 who was given the title "Father of enhanced recovery after surgery" [2]. ERAS protocol was first applied for colorectal elective surgery and now has gained popularity [10, 11]. There is already substantial evidence in the literature demonstrating the effectiveness of adopting ERAS based protocols in elective surgery [10, 12, 13]. Emergency surgery is a key hospital service carrying high rate of complications and mortality [4]. Due to the time critical nature of emergency surgery, ERAS is not well established in emergency yet. Intuitively, ERAS should benefit emergency surgery due to its integration of multidisciplinary elements to reduce length of hospitalization, post-operative mortality and enhance functional parameters.
The aim of this study is to evaluate the present scientific evidence for the applicability and efficacy of eras protocol in emergency cases compared to conventional care in terms of LOH, post-operative complications, early functional recovery, re-occurrence and mortality.
Can ERAS be a standard care in emergency surgery as compared to elective surgery where the course of recovery is usually predicted?

Patients and Methods
Search Strategy
A search was done using the databases- PubMed and Google Scholar for all relevant literature. Articles dated 10 years ago were not considered to avoid pre-ERAS Protocol.

Full - Text Articles written only in English were considered. The medical subject headings (MeSH) and keywords used in PubMed and Google Scholar: "ERAS emergency" and "enhanced recovery" and "fast track". The last search was done on December 15th 2020. References, reviews and meta-analysis were scanned for additional articles.

Study Selection

Titles and abstracts were screened, Duplicates and citations were removed. References of relevant papers were reviewed for possible additional papers. Papers only on abdominal surgery were considered. ERAS guidelines recommend elements (divided into preoperative, intraoperative and postoperative) were assessed in the papers [14, 15], however not all of these are feasible for emergency patients and no restriction was placed on the number of elements applied as part of the protocol in each study. Papers with detailed patient information and statically supported results were selected.

The inclusion criteria were as follows: (1) only abdominal surgery focused papers were studied; (2) studies that provided information about at least one of the outcomes; (3) studies published in English; (4) studies with statistical heterogenicity in terms of patient's age and surgery performed (5) studies done between 2010 to 2020.

The exclusion criteria were as follows: (1) articles that were not full text; (2) articles published before 2000s to avoid pre-ERAS guidelines; (3) unpublished articles.

The study characteristics of the review is to study the safety and efficacy of ERAS protocol (I)in emergency cases (P) compared to conventional care (C) by analysing the outcomes length of hospitalization, post-operative complications, early functional recovery, reoccurrence and mortality (O).

Data Extraction and Outcome Measures

Data extracted for analysis consisted of: patient age, type of surgery performed, ERAS elements implemented, surgical outcomes in terms of postoperative complications, mortality, length of stay (LOS) and reoccurrences rate.

Quality Assessment

Two reviewers independently assessed the quality and risk of bias of the papers selected using SIGN levels of evidence and grades of recommendation as shown in table 1 [APPENDIX 1].

Table 1: Type of study and Quality Assessment using Sign

Study	Type	Overall Assessment of the study	Level of Evidence
Yuanyuan Shang [5]	RCT	Acceptable	1++
M.N Chndan [8]	RCT	Acceptable	1++
J.C Wisley [7]	Cohort	Acceptable	2+
Lohisiriwat [6]	Cohort	High quality	2++
ARAA Fattah [16]	RCT	Acceptable	1++
X Vinas [9]	Cohort	Acceptable	2+
Mohsina [17]	RCT	High quality	2++
Shida [18]	Cohort	Acceptable	2+
Saurabh [19]	RCT	Acceptable	1+
Gonenc [20]	RCT	Acceptable	1+

Results

Study Selection

A total of 340 papers were generated from PubMed and google scholar. 300 papers were eliminated after not meeting the initial search criteria by title, 30 abstracts were selected for screening. Out of the 30, 6 were removed based on exclusion criteria; 5 were not available in English and the other 9 were not full text. Remaining 9 eligible papers were selected. 1 additional paper was retrieved from references. A total of 10 papers were selected for analysis. Flow chart in figure 1 summaries the selection process.

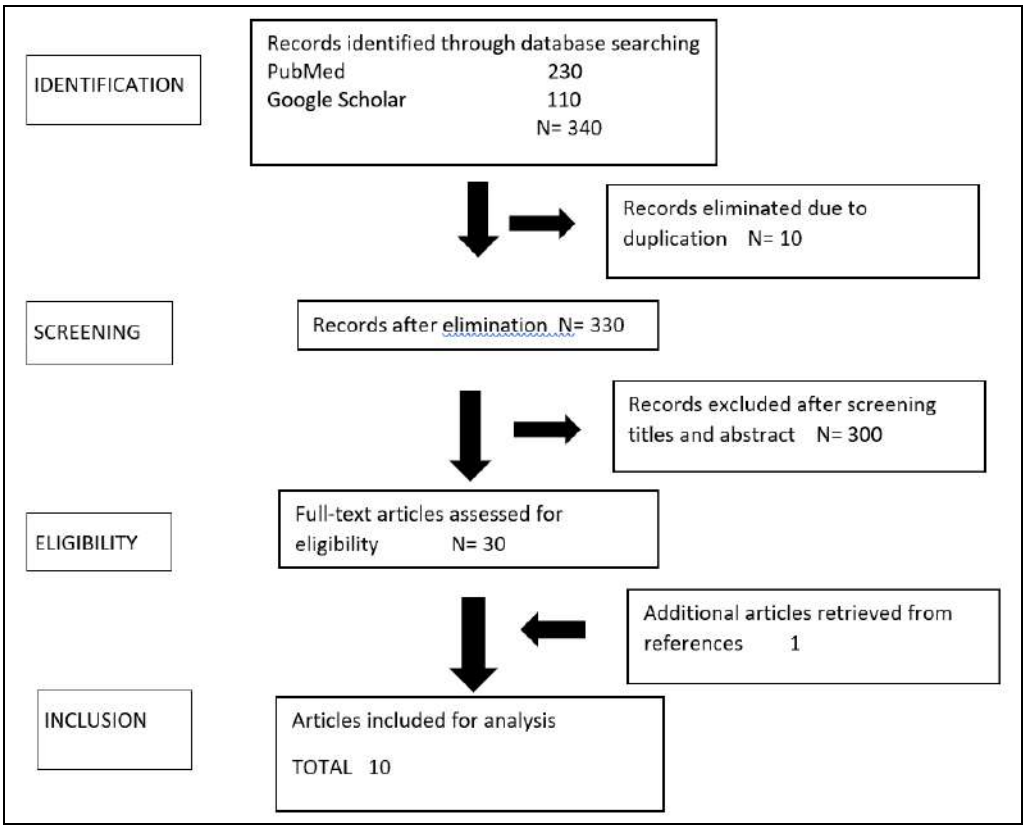

Fig 1: Flow of literature selection

Study Characteristics

The study characteristics of the studies are given in table 2. These studies investigated a total of 672 patients; 311 followed ERAS protocol and 361 received conventional care. The outcomes were reported on a 30 day follow up. Table 3 depicts the ERAS protocol followed by each study divided into pre, intra, and post elements [14, 15].

Table 2: Characteristics of the included studies

Study	Pre	Intra	Post
Yuanyuan Shang [5]	5/7	5/6	4/6
M.N Chndan [8]	3/7	3/6	5/6
J.C Wisley [7]	4/7	5/6	5/6
Lohisiriwat [6]	1/7	6/6	5/6
ARAA Fattah [18]	2/3	4/4	2/3
X VINAS [9]	3/7	6/6	4/6
Mohsina [17]	5/7	4/6	5/6
Shida [18]	4/7	4/6	5/6
Saurabh [19]	5/7	4/6	4/6
Gonenc [20]	4/7	4/6	4/6

Table 3: ERAS elements implemented in the included studies

Study	Year	Number of patients studied (er/cc)	Type of surgery	Mean age (in years)
Yuanyuan Shang [5]	2018	356/483	Obstructed colorectal cancer	65.5
M.N Chndan [8]	2020	42/43	Perforated peptic ulcer	46.16
J.C Wisley [7]	2016	169/201	Abdominal surgery	68
Lohisiriwat [6]	2014	20/40	Colorectal surgery	59.8 ±13.2
ARAA Fattah [16]	2020	30/30	Abdominal surgery (pediatric)	6.6 Months
X Vinas [9]	2020	29/21	Colon perforation	56 ± 2
Mohsina [17]	2016	50/49	Perforated duodenal ulcer	47.145±2.28
Shida [18]	2012	80/42	Obstructed colorectal cancer	68.25
Saurabh [19]	2020	35/35	Emergency small bowel surgery	44.37±5.6
Gonenc [20]	2014	21/26	Perforated peptic ulcer	-

Discussion

In this review, we assessed 6 randomized control trials and 4cohort study to check if ERAS protocol can be a standard care in emergency surgery. The studies we studied focused on ERAS in ES with two distinct comparators of outcomes post-ERAS and conventional care, different pathologies (abdominal, perforated ulcer and colorectal) and different mean ages.

Table 5: Length of hospitalisation

Study	Length of hospitalization (days) Eras cc
Yuanyuan Shang [5]	6(3-22) 9(7-27) $P<0.001$
M.N chndan [8]	5.31±1.102 9.05±1.27 Mean difference 3.74 $P<0.0001$
J.C wisley [7]	8 8
Lohisiriwat [6]	6.0±2.9 9.4±5.1 $P<0.002$
Araa Fattah [16]	1.93±2.23 4.23±2.21 $P<0.001$
X vinas [9]	7 9
Mohsina [17]	5.36±1.399.78±4.30 $P<0.0001$
Shida [18]	7(7-8.75) 10(10-14.25) Interquartile range
Saurabh [19]	8±0.38 10.83±0.42
Gonenc [20]	3.8±1.9 6.9±2.2 P=0.0001

$P<0.001$ is considered significant

Length of Hospitilization

LOH was significantly reduced in post ERAS compared to conventional care in 9 out of 10 studies and remained constant in 1 study. Yuanyuan Shang case series analysis study's LOH outcome was post-ERAS 6 (IQR 3-22) days compared to CC 9(IQR 7-22) days with $P<0.001$.M.N Chndan RCT's LOH outcome was 5.31±1.102 Days compared to 9.05±1.27 days, $P<0.0001$.Lohsiriwat cohort study also gave similar result with post-ERAS 6±2.9 and CC 9.4±5.1 with a mean difference of 3.4 ($P<0.002$). 9 out 10 studies showed a 30% reduction in LOH when ERAS elements were followed. Although, the number of pre, intra and post ERAS elements followed has no correlation the reduction in LOH. The results are shown in Table 5.

Mortality

Emergency services carry a high rate of mortality so assessing this outcome is very beneficial. Only 4 studies out of 10 provide us mortality rates, other 5 reported no 30 day mortality. Wisely shows a constant rate in mortality. The results are shown in Table 6. This is not enough evidence to assess the role of ERAS protocol in mortality outcome. More studies should be encouraged to evaluate the role of ERAS protocol on mortality as an outcome in emergency surgery. SSI: surgical site infection, PONV: postoperative nausea and vomiting, UTI: urinary tract infection. $P<0.001$ is considered significant

Table 6: Complications, Mortality and Reoccurance rates of the included studies

Study	Re occurrence rate Eras cc	Mortality rate Eras ccc	Complications Eras cc
Yuanyuan [5]	25(7.9%)28(8.8%)	0.9% 0.6%	29.6% 37.1% Claviendindo classification system grade II 33.6% 45% P=0.002
M.N Chndan [8]	0/42(0%) 2/43(4.6%)	No 30 Day mortality	SSI- 6/42(14.29%)13/43(30.23%) Postop ileus- 7.14%11.63% Pulmonary –2/42(4.76%) 7/43(16.28%) PONV- 8/42(19.05%) 28/43(65.12%)
J c wisely [7]	17/201 (9%) 15/169 (9%)	21/201 17/169 (10%)(10%)	Major – eras showed 31% reduction Minor -159/201 (79%) 140/16 (83%)
Lohisiriwat [6]	0/20 0/40	No 30 day mortality	5/20 (25%) 19/40 (48%) P=0.094 Claviendindo classification system 2/20 (10%) 8/40 (20%)
ARAA fattah [16]	0/30 (0%) 1/30 (3.3%)	No 30 day mortality	4/30(13.3%)8/30(26.6%)

x.vinas [9]	2/29 (6.8%) 1/21 (4.7%)	No 30 day mortality	6/29 (20.7%) 8/21 (38%) Clavien Dindo classification
Mohsina [17]	-	No 30 day mortality	SSI- 10% 29% Pulmonary-4% 16% UTI-2% 18%
Shida [18]	0% 2.5%	0% 2.5%	10% 15% GRADE 2 or more
Saurabh [19]	-	-	SSI- 37% 49% Deep SSI- 6% 11% Pulmonary- 3% 11% UTI- 14% 23%
Gonenc [20]	-	0/21 1/26	SSI - 0/21 1/26 Pulmonary - 1/21 4/26 Organ SSI- 2/21 2/26

Re Occurrence

Re-occurrence after surgery increases length of hospitalization and delays functional recovery. 5studies show a reduction in re-occurrence rates when ERAS was applied. Yuanuang Shang shows 7.9% with ERAS compared to 8.8% with CC and Aliaa shows 3.3% reoccurrence rate with CC. Whereas 2 studies show an increase in reoccurrence rate post ERAS. The evidence is varied and does not conclude the role of eras in reoccurrence as an outcome as shown in Table 6.

Complications

Post-operative complications were significantly reduced in all the studies. M.N Chndan, Mohsina, Gonenc and Saurabh measured complications as superficial skin infections, pulmonary infections, post-operative ileus whereas Yuanyuan, Lohsiriwat and Vinas used the Clavien Dindoclassication. Wisley reported complications as major and minor. irrespective of the classification used, ERAS evidently proves its role in complications reduction after emergency surgery as evident in Table 6.

Functional Recovery Parameters

The patients in the ERAS group had a significantly early recovery in terms of functional parameters compared with standard care group. The patients in the ERAS group had early withdrawal of nasogastric tube in 7 studies out of 10 whereas in the other 3 studies this parameter was not measured. ERAS group also hada significantly early return of bowel functions in terms of first stools, and a earlier resumption of oral feeds. The patients in the ERAS group had the drain removed significantly early compared to CC group. The results are show in Table 7.

Table 7: Functional parameters of the included studies

Study	Withdrawal of NG tube(days) ERAS(CC)	First Fluid Diet (days) ERAS(CC)	First semisolid Diet(days) ERAS(CC)	First Stool Passed (days) ERAS(CC)	Removal of drain (days) ERAS(CC)
Yuanyuan [5]	0.7±0.5 (3.1±0.3)	0.8±0.5(3.1±0.4)	3.2±1.5(5.6±1.6)	2.5±1.5(3.5±1.4)	-
MN Chndan [8]	1.43±0.5(3.54±0.92)	1.9±0.72(3.37±0.78)	3.1±0.48(5.72±0.95	3.81±0.76(6.19±1.08)	2.91±0.3(6.024±0.99)
JC Wisley [7]	57%(66%) Placed longer than 2 days	-	63% (52%) On 4th day	-	57% (40%) Within 48 PO hours
Lohsiriwat [6]	-	-	3.4±1.75(5.5±2.4)	3.4±1.2(3.7±1.4)	-
ARAA Fattah [16]	86.7% (33%) Removed early	-	1.23±0.68(2.9±1.45)	1.43±0.86(1.83±1.02)	Early removal in ERAS
X Vinas [9]	79.3% (0%) Within 12 PO hours	-	79.3% (0%) Within 24 PO hours	-	42.3% (4.76%) Within 48 PO hours
Mohsina [17]	1.22±0.42(3.37±0.97)	1.52±0.76(4.24±2.64)	2.64±1.08(4.24±2.64)	3.52±0.79(5.78±1.26)	1.38±1.09(5.04±2.12)
Shida [18]	-	-	-	-	-
Saurabh [19]	1.68±0.11(2.88±0.15)	1.94±0.13(3.42±0.12)	2.71±0.14(4.83±0.09)	3.31±0.19(5.11±0.19)	1.58(4.19)
Gonenc [20]	-	-	-	-	-

PO: post operative

Limitations of the systematic review

The major limitation is only 10 reviews were included. The heterogeneity of the scales used to report postoperative complications in the studies (Clavien-Dindo, major-minor complications, superficial-organ/space type SSI) and the fact that not all studies reported the different parameters in functional recovery and mortality rates limited the comparative analysis between studies. Unpublished and non-english articles were not considered in the review.

Recommendation for future research

We encourage researchers to conduct numerous more studies on the efficacy of ERAS using a conventional care group and an ERAS adapted group comparing LOH, functional parameters, reoccurrence, mortality and complications.

Conclusion

The results of implementing ERAS protocol in emergency surgery showed positive impact. Our current study reports the results of patients treated with the ERAS protocol compared with those of a group of patients treated with conventional care following emergency surgery. This study demonstrates that ERAS protocol in emergency has a positive impact on incidence of complications and better functional recovery parameters, thus accelerating patient recovery and reducing mortality and morbidity. These parameters also help to decide the time to initiate adjuvant chemotherapy in cases of colorectal cancer.

Few studies on the implementation of ERAS guidelines in emergency surgery are currently available [5, 6, 7, 8]. A randomised control trial conducted by MNchndan *et al*. evaluates the feasibility and efficacy of ERAS pathways in patients undergoing emergency surgery for perforated peptic ulcer based on the outcome of 85 patients. The study showed significant decrease in length of hospitalization (Mean difference of 5.31$\pm$ 1.102 days; $P<$ 0.001) and complications (14.29% Vs 30.23%). A slight decrease in re-occurance and all the parameters of early functional recovery were seen. However, the study did not follow all the guidelines of ERAS protocol and failed to use a classification system for complications. Yuanyuang Shang's case series analysis study evaluates ERAS pathway in obstructed colorectal surgery. The length of stay was significantly lower, 6(3-22) Vs 9(7-27) $P<$ 0.001. A slight difference was seen in complications 29.6% Vs 37.1% (p=0.002) classified by clavien-dindo classification system. This study also releaved early recovery of functional parameters like withdrawal of NG tube and ability to have first fluid diet. Lohisiriwat *et al*, the cohort study evaluated 60 patients undergoing emergency colorectal surgery. The study showed a decrease in re-occurance rate and

complication thus, reduced the length of hospitalization (5.5 d Vs 7.5 d; p=0.009) However the study included a relatively small sample size with selected group of patients and did not evaluate all the functional recovery parameters. Alia *et al*, randomised control trial evaluated the efficacy of ERAS protocol in paediatric abdominal surgery based on 60 patients. The study showed significant decrease in length of hospital stay (1.93±2.23 d Vs 4.23±2.21;*P*< 0.001).the outcomes revealed early recovery of functional parameters and a decrease in complications. However the study failed to use a grading parameter of complications and failed to define the indications for emergency surgery.

Main barriers in implementing ERAS protocol maybe lack of awareness, insufficient resources, fear of application. Based on the individual elements of the ERAS protocol, we tried to correlate the elements applied in the studies and their outcomes and infer their level of recommendation. Pre-operative counselling has proved to be very effective in reducing anxiety level in patients before emergency surgery. Non-opioid analgesic showed better post-op outcomes in terms of early mobilization, lesser complications and reduced LOH [6,8] the key is to avoid opioids and apply multimodal analgesia in combination with epidural analgesia (in open surgery) when indicated. NSAIDS are also vital and key opioid-sparing component in multimodal analgesia. ERAS care group showed a significantly reduced need for extra analgesic (16.67% Vs 46.51) as they were treated with multimodal analgesia for management for post-operative pain [5, 8].

Safe omission of routine nasogastric decompression showed promising results in ERAS pathways, studies showed prolonged ileus, delayed resumption of orals and increased pulmonary complications in conventional care [8]. Majority of ERAS patients reflected a significant reduction in incidence of UTI, when the urinary catheter was removed within 2 days [8]. A multimodal approach to PONV prophylaxis showed quicker recovery in many ERAS patients [6]. Patients with 1–2 risk factors should ideally receive a two-drug combination prophylaxis using first-lineantiemetics. Patients with C 2 risk factors undergoing colorectal surgery should receive 2–3 antiemetics. Restrictive intraoperative fluid administration has been proposed to favour beneficial postoperative outcomes [5, 7, 8]. The goal is to maintain fluid homoeostasis avoiding fluid excess and organ hypoperfusion. Fluid excess leading to perioperative weight gain more than2.5 kg should be avoided, and a perioperative near-zero fluid balance approach should be preferred.

Elements of pre-operative counselling, non-opioid analgesia, Nasogastric intubation, Urinary drainage, post operative nausea and vomiting (PONV) prophylaxis and Intra-operative fluid administration have a strong level of recommendation. Peri-operative nutritional screening and screening of anaemia is highly recommended in ERAS pathway as it lowers the risk of complications and long-term effect of cancer patients, but early treatment is not feasible in emergency cases. Pre-operative optimisation by cessation of smoking and alcohol consumption four weeks before surgery is clearly not achievable in ES cases. Post-operative hyperglycaemia for ward-based patients who are not a known case of diabetes mellitus, requires a judicious use of insulin.

In conclusion, ERAS protocol has proved to be effective and feasible in emergency surgery to reduce the length of hospitalization, rate of re-occurance and complications without compromising on the patient's safety. More studies and trials following the complete ERAS protocol and examining all parameters is recommended to gather more information about its importance.

Appendix 1

SIGN Levels of Evidence and Grades of Recommendation

Levels of evidence

1++

High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

1+

Well conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias

1–

Meta-analyses, systematic reviews or RCTs, or RCTs with a high risk of bias

2++

High quality systematic reviews of case-control or cohort studies *or*

High quality case-control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal

2+

Well conducted case-control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal

2–

Case-control or cohort studies with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal

3

Non-analytic studies, eg case reports, case series

4

Expert opinion

Grades of recommendations

A

At least one meta-analysis, systematic review, or RCT rated as 1++ and directly applicable to the target population *or*

A systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+ directly applicable to the target population and demonstrating overall consistency of results

B

A body of evidence including studies rated as 2++ directly applicable to the target population and demonstrating overall consistency

of results *or*

Extrapolated evidence from studies rated as 1++ or 1+

C

A body of evidence including studies rated as 2+ directly applicable to the target population and demonstrating overall consistency

of results *or*

Extrapolated evidence from studies rated as 2++

D

Evidence level 3 or 4 *or*

Extrapolated evidence from studies rated as 2+

http://www.sign.ac.uk/guidelines/fulltext/50/annexoldb.html

Table 8: Guidelines for enhanced perioperative care in neonatal intestinal surgery: Enhanced Recovery after Surgery (ERAS) Society

Item	Recommendation	Quality	Strength
Surgical practices	Perform primary anastomosis as the first choice in patients with uncomplicated intestinal atresia	Very low	Weak
Antimicrobial prophylaxis	Administer appropriate preoperative antibiotic prophylaxis within 60 min prior to skin incision Discontinue postoperative antibiotics within 24 h of surgery, unless ongoing treatment is required	Low	Weak
Preventing intraoperative hypothermia	Continuously monitor intraoperative core temperature and take pre-emptive measures to prevent hypothermia (\36.5 _C) and maintain normothermia	Low	Strong
Perioperative fluid management	Use perioperative fluid management to maintain tissue perfusion and prevent hypovolemia, fluid overload, hyponatremia, and hyperglycemia	Moderate	Weak
Perioperative analgesia	Unless contraindicated, administer acetaminophen regularly during the early postoperative period (not on an ‘‘as needed’’ basis) to minimize opioid use Use an opioid-limiting strategy is recommended in the postoperative period. Manage breakthrough pain with the lowest effective dose of opioid with continuous monitoring Use regional anesthesia and acetaminophen perioperatively in combination with general anesthesia. Multimodal strategies including regional techniques should be continued Postoperatively Provide lingual sucrose/dextrose to reduce pain during naso/orogastric tube placement and other minor painful procedures	High Moderate High High	Strong Strong Strong Strong
Optimal hemoglobin	Restrict transfusions to maintaining HgB ‡ 90 (9 g/dL for a term neonate with no oxygen requirement. Term neonates within the first week of life, intubated or with an oxygen requirement should be transfused to maintain a HgB ‡ 110 (11 g/ dL)	low	weak
Parental involment	Facilitate hands on care and purposeful practice by parents that is individualized to meet the unique needs of parents early during the admission. Sustain these to build the knowledge and skills of parents to take on a leading role as caregivers and facilitate their readiness for discharge	High	Strong
Early feed	Start early enteral feeds within 24–48 h after surgery when possible. Do not wait for formal return of bowel function Use breast milk as the first choice for nutrition	High High	Weak Strong
Urinary sodium monitoring	Monitor urinary sodium in all neonates with a stoma. Target urinary sodium should be greater than 30 mmol/L and exceed the level of urinary potassium	Low	Weak
Mucous fistula refeeding	Use mucous fistula refeeding in neonates with enterostomy to improve growth	Moderate	Weak

Brindle ME, McDiarmid C, Short K, Miller K, MacRobie A, Lam JYK, Brockel M, Raval MV, Howlett A, Lee KS, Offringa M, Wong K, de Beer D, Wester T, Skarsgard ED, Wales PW, Fecteau A, Haliburton B, Goobie SM, Nelson G. Consensus Guidelines for Perioperative Care in Neonatal Intestinal Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. World J Surg. 2020 Aug;44(8):2482-2492. doi: 10.1007/s00268-020-05530-1. PMID: 32385680; PMCID: PMC7326795

Table 9: Guidelines for perioperative care colonic surgery: enhanced recovery after surgery (ERAS) society recommendations.

Item	Recommendations	Evidence level	Recommendation grade
Preoperative information, education and counselling	Patients should routinely receive dedicated preoperative counselling	low	Strong
Preoperative optimisation	Preoperative medical optimization is necessary before surgery. Smoking and alcohol consumption (alcohol abusers) should be stopped four weeks before surgery	Alcohol: low Smoking: high	Strong
Preoperative bowel preparation	Mechanical bowel preparation should not be used routinely in colonic surgery.	High	Strong
Preoperative fasting and carbohydrate treatment	Clear fluids should be allowed up to 2 h and solids up to 6 h prior to induction of anaesthesia. Preoperative oral carbohydrate treatment should be used routinely. In diabetic patients carbohydrate treatment can be given along with the diabetic medication	Moderate	Fasting guidelines: strong Preoperative carbohydrate drinks: strong
Preanaesthetic Medication	Patients should not routinely receive long- or short-acting sedative medication before surgery because it delays immediate postoperative recovery	High	Strong
Prophylaxis against thromboembolism	Patients should wear well-fitting compression stockings, have intermittent pneumatic compression, and receive pharmacological prophylaxis with LMWH. Extended prophylaxis for 28 days should be given to patients with colorectal cancer.	high	Strong
Antimicrobial prophylaxis and skin preparation	Routine prophylaxis using intravenous antibiotics should be given 30–60 min before initiating surgery. Additional doses should be given during prolonged operations according to half-life ofthe drug used. Preparation with chlorhexidine-alcohol should be used.	High	Strong
Standard anaesthetic Protocol	A standard anaesthetic protocol allowing rapid awakening should be given. The anaesthetist should control fluid therapy, analgesia and haemodynamic changes to reduce the metabolic stress response. Open surgery: mid-thoracic epidural blocks using local anaesthetics and low-dose opioids. Laparoscopic surgery: spinal analgesia or morphine PCA is an	Open surgery: high Laproscopic surgery: moderate Reduce stress response: moderate	Strong

	alternative to epidural anesthesia.		
PONV	A multimodal approach to PONV prophylaxis should be adopted in all patients with ≥2 risk factors undergoing major colorectal surgery. If PONV is present, treatment should be given using a multimodal approach	Low	Strong
Nasogastric intubation	Postoperative nasogastric tubes should not be used routinely. Nasogastric tubes inserted during surgery should be removed before reversal of anaesthesia.	High	Strong
Preventing intraoperative hypothermia	Intraoperative maintenance of normothermia with a suitable warming device and warmed intravenous fluids should be used routinely to keep body temperature >36 °C	High	Strong
Perioperative fluid management	Patients should receive intraoperative fluids (colloids and crystalloids) guided by flow measurements to optimise cardiac output. Vasopressors should be considered for intra and post operative management of epidural induced hypotension provided the patient is normovolaemic. The enteral route for fluid postoperatively should be used as early as possible, and intravenous fluids should be discontinued as soon as is practicable.	Balanced crystalloids(OD): high Flow measurement in open surgery: high Vasopressors: high Early enteral route: high	Strong
Drainage of peritoneal cavity after colonic anastomosis	Routine drainage is discouraged because it is an unsupported intervention that is likely to impermeabilization.	High	Strong
Urinary drainage	Routine transurethral bladder drainage for 1–2)days is recommended. The bladder catheter can be removed regardless of the usage or duration of thoracic epidural analgesia.	Low	Routine bladder drainage: strong Early removal if epidural removed: weak
Prevention of postoperative ileus	Mid-thoracic epidural analgesia and laparoscopic surgery should be utilized in colonic surgery if possible. Fluid overload and nasogastric decompression should be avoided. Chewing gum can be recommended, whereas oral magnesium and alvimopan may be included.	Thoracic epidural laproscopy: high	Strong
Postoperative analgesia	Open surgery: TEA using low-dose local an aesthetic and opioids. Laparoscopic surgery: an alternative to TEA is a carefully administered spinal analgesia with alow-dose, long-acting opioid	TEA,open surgery: high Local anaesthetic and opioid: moderate	Strong
Perioperative nutritional Care	Patients should be screened for nutritional status and if at risk of under-nutrition given active nutritional support. Perioperative fasting should be minimized. Postoperatively patients should be encouraged to take normal food as soon as lucid after surgery. ONS may be used to supplement total intake	Postoperative early enteral feeding, safety: high Improved recovery and reduced morbidity: low Perioperative ONS: low IN: low	Postoperative early feeding and perioperative ONS: strong IN could be considered in open colonic resections: weak
Postoperative glucose Control	Hyperglycaemia is a risk factor for complications and should therefore be avoided. Several interventions in the ERAS protocol affect insulin action/resistance, thereby improving glycaemic control with no risk of causing hypoglycemia. For ward-based patients, insulin should be used judiciously to maintain blood glucose as low as feasible with the available resources.	Using stress reducing elements of ERAS to minimize hyperglycemia: low Insulin treatment in the ICU: low Glycemic control in the ward setting: low	Using stress reducing elements of ERAS to minimize hyperglycemia: strong Insulin treatment in the ICU: strong Insulin treatment in the ward setting: weak
Early mobilisation	Prolonged immobilisation increases the risk of pneumonia, insulin resistance and muscle weakness. P	low	Strong

U. O. Gustafsson, M. J. Scott, W. Schwenk, N. Demartines, D. Roulin, N. Francis, *et al.* - Guidelines for Perioperative Care in Elective Colonic Surgery: Enhanced Recovery After Surgery (ERAS) Society Recommendations, World J Surg (2013) 37:259–284.

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