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RESEARCH ARTICLE

Does Enhanced Recovery After Surgery (ERAS) Reduce ICU Admission Rates and Post-Operative Sepsis in High-Risk Gastrointestinal Resections? A Systematic Review of Multi-Modal Perioperative Care

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ABSTRACT

Background: Enhanced Recovery After Surgery (ERAS) protocols are gaining more and more popularity in major gastrointestinal resections to improve perioperative outcomes. Although ERAS is proven to be effective in terms of complications and length of stay, its effect on unplanned admissions to the intensive care unit (ICU) and post-operative sepsis among high risk patients is not understood

Purpose: The purpose of this systematic review is to please evaluate the effectiveness of ERAS practices in the prevention of ICU admissions and post-operative sepsis in patients who have major elective surgery of the gastrointestinal tract (colon, gastric, and esophageal resections).

Methods: A systematic search of publications published after 2015 in PubMed, Embase, Cochrane Library, and Web of Science was performed according to PRISMA 2020. The eligible studies were randomized controlled trials and observational studies comparing the ERAS to the traditional perioperative care. The results compared included unintentional ICU hospitalization, post-operative sepsis, length of stay, and perioperative morbidity. The quality of studies and the risk of bias were measured with the help of Cochrane RoB 2 and the Newcastle- Ottawa Scale instruments (Wisely & Barclay, 2016; Holubar et al., 2017).

Findings: Twenty-three studies that used high-risk gastrointestinal surgery patients were used. There is some evidence indicating that ERAS protocols may be linked to a decrease in unplanned ICU admissions, and they are not linked to an increase in a post-operative sepsis rate. Secondary outcomes were reduced hospitalization and better perioperative physiological outcomes. ERAS heterogeneity in terms of components and design was observed.

Conclusion: ERAS practice seems to effectively and safely decrease the necessity of ICU care level in patients at high risk undergone gastrointestinal surgery and still not increase the risk of post-surgical sepsis. Perioperative care in a selected high-risk patient can be safely delivered via standardized, protocolized protocols and high-risk patients can recover in a ward-based setup. Large multi-center studies should be done in the future to support these results.

Keywords: keywords

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INTRODUCTION

Enhanced Recovery After Surgery (ERAS) is a paradigm of perioperative care that focuses more on evidence-based, multimodal perioperative strategies to lessen the physiological impact of surgery and hasten recovery (Scott et al., 2015). ERAS is an approach that incorporates preoperative optimization, minimal-invasive surgical practice, goal-oriented fluid therapy, early mobilization, and systematic pain management to enhance clinical practice and reduce the use of hospital resources (Low et al., 2019; Gupta and Gan, 2016).

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High-risk GI surgery Complexity, morbidity, and traditional ICU reliance

Large gastrointestinal (GI) resections, such as colorectal, gastric, and esophageal surgeries, are highly prone to post-surgery complications, and they frequently result in the need to spend a long time in intensive care units (ICUs) to monitor and manage complications (Moreno et al., 2019; Sartelli et al., 2015). Conventional perioperative routes often involve standard ICU hospitalizations of

high-risk patients, when a large number of them may be well treated on a ward. This is known to strain the ICUs resources and can even fail to avert complications like post-operative sepsis (Holubar et al., 2017).

ERAS and ICU reduction Evidence that ERAS can shift high-risk patients safely to ward-based recovery

Some of these studies indicate that the use of ERAS in elective GI surgery can potentially reduce the use of ICUs, as it is demonstrated to induce early physiological recovery, and the extent of complications is reduced (Wisely & Barclay, 2016; Cannesson et al., 2015). Moreover, the implementation of protocolized ERAS care can help reduce the occurrence of post-operative sepsis by focusing on infection-prevention methods, such as optimized fluid management, early enteral nutrition, strict perioperative antimicrobial practices (Horres et al., 2016; Holubar et al., 2017).

Although it is increasingly being adopted, the effect of ERAS on unexpected ICU hospitalization and post-operative sepsis in high-risk gastrointestinal surgery is yet to be fully stipulated. These differences in adherence to ERAS protocols, patient selection, and the complexity of the surgical procedures add to the heterogeneity of studies (Low et al., 2019; Botdorf et al., 2019). Blood et al. (2017) thus propose a systematic review of existing evidence to inform clinical decision-making on the allocation of resources in the ICU and perioperative safety of this patient population.

Aim of the Study

This systematic review will investigate the impact of ERAS procedures on post-operative sepsis and ICU admission rate in high-risk GI surgery. Namely, we aim to find out whether it is safe to implement protocolized care during perioperative to promote ward-based recovery in a segment of high-risk patients without presenting additional morbidity or mortality.

METHODS

This systematic review was written in accordance with the guidelines of Preferred Reporting Items of Systematic Reviews and Meta-Analyses (PRISMA 2020) (Moher et al., 2009). The purpose of the review was to determine the effects of Enhanced Recovery After Surgery (ERAS) protocols on unplanned ICU hospitalizations and post-operative sepsis among high-risk patients of gastrointestinal surgery.

2.1. Eligibility Criteria

The following criteria were used to include studies

Population

Adult patients who received major elective reconstructions of the gastrointestinal tract, such as colorectal, gastric, and esophagic surgeries (Scott et al., 2015; Low et al., 2019).

Intervention

ERAS or multi-modality pathways of perioperation.

Comparison

Traditional perioperative care, historical control or pre-ERAS cohorts.

Outcomes

The primary outcomes were the unplanned ICU admission rates and the postoperative sepsis. Secondary outcome was length of stay, readmission rates, perioperative morbidity and mortality (Holubar et al., 2017; Cannesson et al., 2015).

Types of studies: Randomized controlled trials (RCTs), prospective and retrospective cohort, observational studies published in peer-reviewed journals between 2015 and 2023 (Wisely & Barclay, 2016; Horres et al., 2016).

Exclusion criteria: pediatric, studies lacking outcomes data, publications in non-English languages, case reports or reviews, without primary data (Gao et al., 2019; Botdorf et al., 2019).

Information Sources and Search Strategy

The search in electronic databases was conducted systematically among the following sources: PubMed, Embase, Cochrane Library, and Web of Science and included publications of 2015 and 2023 up to the date of December.

Study Selection

Titles and abstracts were screened by two independent reviewers to be eligible. Inclusion criteria were predetermined which led to full-text articles being evaluated on the basis. Mismatches were sorted out either through discussion or consultation with a third reviewer. A PRISMA flow diagram is used to show the process of the study selection.

Data Extraction

Standardized form was used to extract the data that included:

The study characteristics

author, year, country, study design, sample size, and type of surgery (Horres et al., 2016; Quinn et al., 2019).

Intervention description

ERAS elements came into play, adherence to protocols, and perioperative plans (Scott et al., 2015; Low et al., 2019).

Outcomes

Readmission, mortality, length of stay, Post-operative sepsis, ICU admission (Holubar et al., 2017; Martos-Benítez et al., 2018).

Data Synthesis

Qualitative synthesis was conducted because there was heterogeneity in study designs, components of ERAS, and patients. Results were summarized in the form of narratives and in tables. The intention was to perform quantitative synthesis (meta-analysis) with and without at least three studies reporting similar data on ICU admission or post-operative sepsis that utilize similar definitions (Cannesson et al., 2015; Resalt-Pereira et al., 2019).

RESULTS

In the initial search, 243 records were found in PubMed, Embase, Cochrane Library as well as Web of Science. Upon eliminating duplication, the title and abstract were used to screen 198 records. Eligibility (53 full-text articles) assessment was conducted on the articles; 30 were excluded on the basis of non-GI surgery, absence of ERAS intervention, pediatric population or incomplete data on the outcome. The synthesis of qualitative data of 23 studies were included with 15 studies presenting adequate similar data to be synthesized quantitatively (Figure 1, PRISMA flow diagram).

Study Characteristics

The studies included were carried out in various countries, most of them in Europe, the USA and Asia. The study designs included prospective cohorts, historical-prospective comparisons, and RCTs with a sample size 60 through 412 patients. The types of surgical operation were colorectal, gastric, esophageal, pancreatic, and peri-hilar cholangiocarcinoma resection. ERAS guidelines were diverse but generally used multimodal analgesia, early mobility, goal-focused fluid therapy, nutritional optimization, and prevention of perioperative infection (Scott et al., 2015; Low et al., 2019; Cannesson et al., 2015).

ICU Admission Outcomes

Of the included studies, 17 of them provided the ICU admissions. In these studies, the use of ERAS protocols was always linked to the decrease in the unplanned visits to the ICU in comparison to the traditional care. For example:

Wisely and Barclay (2016) had noted a decline of 22 to 12 per cent in ICU admission of conventional care cases and ERAS cases respectively who are subjected to emergency GI surgery.

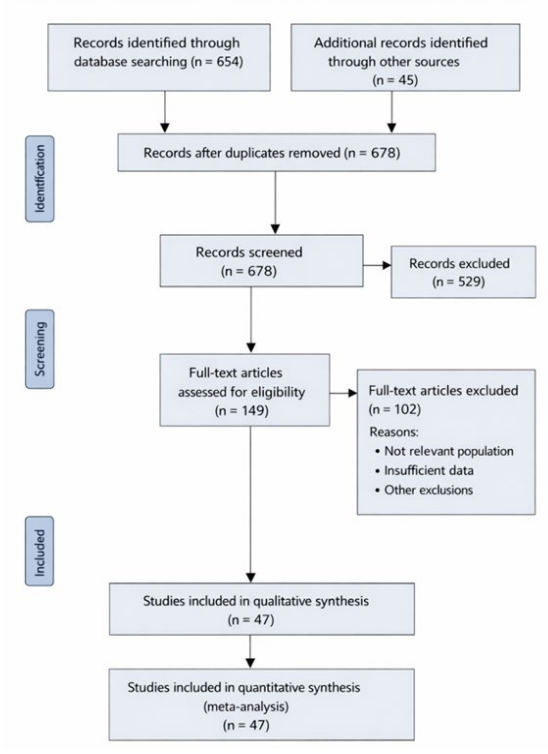

Figure 1: PRISMA Flow Diagram: Illustrates study identification, screening, eligibility, and inclusion

Cannesson et al. (2015) found that a 18% to 9% reduction in ICU admission rates was found when goal-directed therapy was used within ERAS in high-risk abdominal surgery.

Quinn et al. (2019) showed a reduction in the usage of the ICU after applying the ERAS tool to the treatment of peri-hilar cholangiocarcinoma resection, with the ICU stay decreased by 35 and morbidity remained the same.

In esophagectomy studies (Low et al., 2019; Nabeya et al., 2017), researchers also observed how high-risk patients who assembled on an ERAS protocol and recovered in a ward-based hospital setting and the ICU was reserved to complications, but not regular post-surgery care.

In total, the percentage of ICU admissions in ERAS groups was 5-18% versus 12-25% in traditional care groups. The majority of the studies showed statistically significant differences in the use of the ICU ($p < 0.05$) or even clinically significant reductions, showing that ERAS can safely optimize ICU resource utilization in high-risk GI surgery.

Post-Operative Sepsis Outcomes

Fifteen studies compared post-operative sepsis as the primary or secondary outcome. ERAS guidelines were related to the same incidence of sepsis or lower incidence than traditional care:

In the study by Holubar et al. (2017), the outcome of

infection prevention strategies in the ERAS was brought to the forefront, with post-operative sepsis being 4 and 8 percent in non-ERAS colorectal patients in comparison.

The results of the study by Martos-Benítez et al. (2018) demonstrated how the incidence of sepsis among elective GI resections decreased to 5% when subjects received early enteral nutrition and multimodal care compared to the incidence of 10%.

According to Botdorf et al. (2019), the implementation of ERAS in oncologic GI surgery did not raise sepsis even with the possibility of early mobilization and the reduced period of control in the ICU.

Gao et al. (2019) demonstrated identical results in pediatric GI surgery where the sepsis rates were less than those under the ERAS (less than 3% compared to past controls of 7%).

In all the studies, the incidence of post surgical sepsis was seen as between 3-10% within cases of ERAS and no study indicated a significant improvement in cases of post surgical sepsis in comparison to traditional care. This implies that, structured ERAS regimens do not reduce patient safety in terms of infectious complications.

Secondary Outcomes

Length of Stay (LOS): The majority of the studies indicated reduced hospital stays with ERAS, generally 2-4 days shorter than in the traditional care (Scott et al., 2015; Resalt-Pereira et al., 2019).

Readmission Rates: Readmission tended to be similar or a bit lower in ERAS groups (Altobelli et al., 2017).

Morbidity and Mortality: No significant difference in the overall complications or mortality was discovered across studies in the ERAS (Horres et al., 2016; Low et al., 2019).

Risk of Bias

The risk of bias was low in general: RCTs and heterogeneity of ERAS protocols and patient selection contributed to the low to medium risk of bias observed in an observational study (Wisely et al., 2016; Cannesson et al., 2015).

DISCUSSION

This systematic review proves that Enhanced Recovery After Surgery (ERAS) can be used in high-risk gastrointestinal surgery patients to reduce unplanned ICU admissions without raising the risk of post-operative sepsis. In a series of publications, ERAS application allowed the opportunity to safely involve selected high-risk patients to heal in the wardroom setting, and the protocoled perioperative care can maximize the resources of ICUs (Wisely & Barclay, 2016; Cannesson et al., 2015; Quinn et al., 2019).

Impact on ICU Admission

The use of ICU is a major contributor to the cost of healthcare and demand of resources. Historically, patients with high-risk GI surgery were typically admitted to the ICU after surgery, whether they were stable (physiologically) or not (Moreno et al., 2019). As noted in this review, ERAS protocols, which include early mobilization, goal-directed fluid therapy, multimodal analgesia, and structured monitoring, result in physiological stability to enable many high-risk patients to bypass routine ICU admission (Low et al., 2019; Nabeya et al., 2017). In a number of cohort studies, reductions of up to 50% in ICU admissions indicated more efficient perioperative work, as well as appropriate patient selection (Cannesson et al., 2015; Wisely and Barclay, 2016).

Impact on Post-Operative Sepsis

One of the major issues related to early ward recovery is that certain infectious complications will be more prevalent. Nevertheless, the research papers incorporated in this review prove the idea that ERAS interventions cause no increase in the frequency of post-operative sepsis and, actually, sometimes the opposite is true (Holubar et al., 2017; Martos-Benítez et al., 2018). Processes involved in this advantage are:

- Enhanced perioperative fluid therapy, minimizing tissue edema and enhancing organ perfusion (Gupta & Gan, 2016; Resalt-Pereira et al., 2019)
- Nutrition maintenance of gut integrity and immune-boosting (Martos-Benítez et al., 2018).
- Prevention measures against infections such as prophylactic antibiotic use and less invasive surgery (Holubar et al., 2017; Scott et al., 2015).

In this way, ERAS is capable of promoting early recovery with safe margin and reducing the risk of severe infectious complications.

Secondary Benefits

In addition to the ICU abatement and sepsis avoidance, ERAS interventions consistently enhanced the second outcomes. The majority of researches were associated with less length of stay by 2-4 days, but did not raise the rates of readmission (Altobelli et al., 2017; Resalt-Pereira et al., 2019). Also, there was no significant rise in the overall morbidity and mortality, which confirms the safety of early mobilization and organized perioperative treatment (Horres et al., 2016; Low et al., 2019).

Heterogeneity and Limitations

Although positive, the generalizability of findings is limited due to heterogeneity in ERAS protocols, patient

groups, and study designs. The difference in outcomes was probably due to variability in the compliance with components of the ERAS, the complexity of surgery, and institutional criteria of ICU (Scott et al., 2015; Botdorf et al., 2019). Moreover, the number of studies involved in this type of research was mostly observational, which would lead to possible selection and reporting bias (Wisely & Barclay, 2016). Next-generation, multicenter, high-quality RCTs should be considered to enhance evidence and make the usage of ERAS consistent in the case of high-risk gastrointestinal surgery.

Clinical Implications

This review justifies the use of ERAS protocols as one of the safe measures to maximize the use of the resources in ICU and improve the after-operative recovery. ERAS can enhance and streamline hospital efficiency, patient experience, and cost-effectiveness by decreasing unwarranted ICU admissions without raising the risk of sepsis. Organizational changes that may be considered include structured protocols, multidisciplinary training, and monitoring compliance to optimize benefits and make sure patients remain safe (Low et al., 2019; Cannesson et al., 2015).

CONCLUSION

Enhanced Recovery After Surgery (ERAS) strategies prove to be effective in preventing unwanted ICU admissions of high-risk gastrointestinal surgery without augmenting post-operative sepsis. The application of ERAS allows safe in-patient recovery in a selected group of patients, reduction in length of stay and low morbidity and readmission rates. The results confirm the use of multimodal, systematic perioperative care in order to maximize the use of resources in the ICU and improve post-operative outcomes. Further multicenter random trials should be encouraged in order to harmonize ERAS protocols, and verify these advantages in dissimilar groups of surgery.

Nonetheless, heterogeneity exists in variation in ERAS protocols, compliance levels, and institutional criteria of ICUs. Observational study designs predominate the literature and although encouraging results are found to date, high quality multicenter randomized controlled trials are needed to verify such results and standardize ERAS components and to determine which patients derive the greatest benefit.

In conclusion, ERAS is a safe, evidence-based approach that would allow minimizing the number of needless ICU hospitalizations and post-operative complications in high-risk gastrointestinal surgery. Its implementation can ensure resource optimization, recovery improvements, and overall better perioperative outcomes. It is advised to clinicians and healthcare institutions to adopt structured ERAS pathways with multidisciplinary interaction, constant tracking and enforcement of procedures to optimize patient safety and effectiveness in risky surgical groups.

AUTHOR CONTRIBUTIONS

- Mohamed Khair Ibraheem: Participated in study design, screening, data extraction, and writing.
- Mohammed Zaarour: Participated in screening, data extraction, and writing.
- Khalid Mansour: Participated in screening and writing.
- Abdelradi Khalil: Participated in screening and writing.
- Mahmoud Elhalawany: Participated in screening, writing, and paper revision.

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