



Current and future implementation of ERAS pathways

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Abstract

Enhanced recovery after surgery (ERAS) a path which enhances patients' recovery period using pathways which are not necessarily similar to our normal hospital routine. We have discussed current ERAS pathways and their significance in patients' early recovery process, we also outlined the challenges, arguments, improvements and future directions which would interpret the future of early patients' recovery.

Methods: 130 patients which performed gastrointestinal surgery were included in our study from the affiliated hospital of Jiangsu university, from 2015.01 to 2019.12. The patients were randomly assigned to either (ERAS) enhanced recovery after surgery or conventional care group. The total number of patient's gender were 86 male and 44 female patients, all the patients had resectable tumours of the gastrointestinal tract. ERAS patients had a mean age of 65 while conventional group patients had a mean age of 61.

Results: Patients in the ERAS group had a reduced length of hospital stay compared to the conventional care group with a (Mean±SMD of 13.56 ± 3.73 and 20.344 ± 11.62 with a p value of < .05) respectively. Cost ERAS (Mean±SMD 6104.28 ± 2028.37) whereas conventional group (Mean±SMD 7361.68 ± 2256.48)

Conclusion: ERAS patients had quicker recovery durations and they had low cost compared to the conventional group. Our main conclusion was formulating optimal ERAS protocols on different scenarios after careful screening of the patients.

Keywords: ERAS, early recovery, surgery, perioperative rehabilitation

Introduction

Surgery is usually used to treat painful urgencies and other human demands, and it can be difficult to avoid pain insult due to tissue damage accompanied by surgery itself. Mortality rates in surgical patients' have been seen to be aggrandized by the pathophysiological response to surgery and its complications (1). Early scientists have seeded the foundation of surgery which accommodates understanding of the bodies response to surgery resulting in progress and development not only in the armamentarium of surgery but also convalescence involving the entire perioperative period. Post-operative complications and early recovery is a difficulty in surgery, not only for the specific patient involved but also a challenge for the entire surgical team⁽¹⁾. In our current age evidence-based medicine has conquered the health care field due to its comprehensive methodologies meanwhile surgeons' opinions alone are now incompetent in the practice of medicine.

In the 1990s a Danish professor Henrik Kehlet initiated Enhanced recovery after surgery (ERAS) designed to solve the inflicted stress caused by surgery, (Kehlet *et al* 2018) Strongly relying on ERAS to diminish postoperative complications and accelerate the recovery process. ERAS is based on pathways which comprehend medical optimization including, pre-operative counseling, pain relief, reduced

fasting, thromboembolism prophylaxis, standard anesthetic protocol, intra-operative fluid management, control of postoperative ileus, and early mobilization⁽²⁻¹⁰⁾. The development of surgical techniques and the innovation of surgical instruments promote the changes in surgical methods, which in turn, leads to the reforms in surgical ideas⁽¹¹⁾. The core of ERAS approach is to improve early recovery⁽¹²⁾. The ERAS concept involves a collaborative team of trained medical staff who aim to improve the quality of care by integrating evidence-based knowledge into clinical practices⁽¹³⁾. Kehlet published a series of papers on ERAS in colorectal surgery, which has been proven to reduce complications and shorten the length of hospital stay influencing the adaptation of ERAS in other surgical departments⁽¹³⁻¹⁶⁾. ERAS modifies the physiological and psycho-logical responses to stress inflicted by surgery, which in return reduces complications, hospital stay, improvements in cardiopulmonary function, earlier return of bowel function and earlier resumption of normal activities.⁽³⁾ Advancements in surgical procedures such as minimal invasive surgeries have promoted ERAS interventions through a diverse surgical procedures by research and big data analysis, previous studies indicated that ERAS is safe and effective in laparoscopic gastrectomy for gastric carcinoma⁽¹⁷⁾.

Table 1

	Preadmission	Preoperative	intraoperative	postoperative
<i>Patient</i>	1-Alcohol and smoking termination ⁽⁷⁾ 2-Nutritional diet ⁽¹⁸⁾	1-Meeting with the entire ERAS team. ⁽¹⁸⁾ 2- 2 hours fluid and 6 hours solid intake before induction of anesthesia ⁽¹⁹⁾	Well informed of the procedure and outcome ⁽¹⁹⁾	1-Early mobilization ⁽²⁰⁾ 2- Early oral feeding ⁽¹⁸⁾
<i>Anesthesiologist</i>		1- Epidural pain control ⁽²¹⁾ 2-Meeting with the patient and the entire ERAS team ⁽¹⁸⁾ 3-Carbohydrates loading ⁽²²⁾	1-Temperature control ⁽²³⁾ 2-Non opioids agents ⁽²⁴⁾ 3-Regional anesthetics ⁽²⁵⁾ 4-Goal directed fluid therapy ⁽²⁶⁾	1-Multimodal analgesia ⁽¹⁴⁾ 2-Thromboemolism prophylaxis ⁽²⁷⁾
<i>Surgeon</i>	1-Plan from the day of admission to discharge ⁽⁴⁾ 2-Full patients' Screening and adjusting patients'' physiological response ⁽²⁸⁾	1-Bowel preparation with respect to the type of surgery ⁽²⁸⁾	1-Minimal invasive surgery ⁽²⁹⁾ . 2- Reduce tubes and catheters ⁽³⁰⁾ . 3-Minimize the use of blood transfusion ⁽⁹⁾	1-Early removal of tubes depending on the nature of the patient and reason of intubation ⁽³¹⁾ 2-Termination of IV fluids ⁽³²⁾
<i>Nurse</i>	1-counselling ⁽⁷⁾	1-Information ⁽⁴⁾ 2-Patients' therapeutic preparation to surgery ⁽⁹⁾		1-Physiotherapy and rehabilitation ⁽³³⁾ 2-Follow up plan.

Preoperative Period

Preoperative screening and counselling is one of the early enhanced recovery program based on a system composed of protocols in enhancing early recovery, its goal is to allow the doctors to understand the patients' capabilities prior to surgery and also give a detailed explanation to the patients' current and future outcomes. Risk scoring systems have been implemented to identify patients' who are at a higher risk of death and complications from surgery⁽⁷⁾. A study performed by (Y. Siba *et al* 2017) showed screened patients' decreased mortality of patients' suffering from colorectal cancer⁽³⁴⁾.

Information

Fear of the unknown, Information on preoperative counseling and education before surgery helps reduce the fear of surgery and prepares the patient towards the perioperative period. The information includes the role of perioperative feeding, early postoperative mobilization, pain control, and respiratory physiotherapy to reduce the prevalence of complications.^(4- 19). Preoperative patient counseling and clear information to patients' before surgery through contact or multimedia tools between patients' and medical staff can avoid the anxiety through sharing of details, perioperative stress reactions, facilitates postoperative recovery, pain control and increases care plan adherence allowing for earlier recovery and discharge which is seen to promote patients' general outcome^(27- 30- 35). Patients' poor self-valuation and esteem, unaddressed psychopathology, poor sleep, poor nutrition, sedentary lifestyle, alcohol and tobacco limitations and the abstinence from opioids should be considered ⁽²⁴⁾. After a comprehensive engagement with the patients' physiological ability to surgery a multidisciplinary team meets with the patient to inform the patients' diagnosis and convey the patients' treatment information and hospital stay plan lucidly and succinctly before surgery putting into a count patients' pre-existing comorbidities⁽¹⁸⁾. ERAS pathways should address the patients entire journey from referral to

discharge ⁽⁹⁾. Hence the patients' and family should receive detailed information addressing the entire patients' journey.

Optimization

General preoperative medical assessment and optimization is crucial in patient's outcome. Smokers and heavy alcohol drinkers often have comorbidities due to smoking such as (COPD) chronic obstructive pulmonary disease, emphysema, peripheral vascular, ischemic heart disease and cerebrovascular⁽⁷⁾. Smoking increases the risk of postoperative complications. Smoking should cease preoperatively for at least 4 weeks prior to surgery to reduce respiratory and wound-healing complications^(27- 32). counselling and other therapies to limit nicotine use are most likely to be effective^(9- 28). Pulmonary dysfunction causes not only pulmonary complications but also an oxygen supply disorder, and circulatory disorders, diminished immune levels and nutritional status will result in difficulty to supply sufficient energy for tissue repair. As a result, patients' with pulmonary dysfunction might develop respiratory infections at a higher rate⁽³⁶⁾. Risk factors such as anemia should be identified and corrected before surgery⁽⁶⁾. Perioperative maintenance of blood glucose levels at (b180–200mg/dL) results in improved perioperative outcomes. Glucose levels above this range should be corrected with insulin infusions and regular blood glucose monitoring to avoid the risk of hypoglycemia, furthermore, preoperative carbohydrate loading improves perioperative insulin sensitivity and helps maintain lean body mass and muscle strength^(23- 37). Previous unresolved conditions such as hypertension, joint pain and other factors that impairs recovery should be reformed. Other methods rather than pharmacological methods to relieve preoperative anxiety should be used in patients' with severe anxiety⁽⁹⁾.

Physiotherapy

Enhanced recovery programs need patients' ability to overcome the underlying setbacks in patients' recovery program such as lack of motile functions and reduced

oxygen absorption. Physiotherapy is regarded as a useful minimal-invasive method that evaluates the ability of a patients' cardiopulmonary system to adapt to a sudden increase in oxygen demand⁽⁷⁾. Breathing exercises increases trans-pulmonary pressure, helps improve lung volume, ventilation and oxygenation, prevent basal atelectasis, re-inflate collapsed lung regions, and reverse minimal postoperative atelectasis⁽³³⁾. Early ambulation decreases the length of hospital stay, and optimization of early ambulation reduced the occurrence of episodes of pain, nausea and vomiting in gynecological surgeries⁽³⁸⁾. An increase in moderate-intensity aerobic exercise is safe, cheap and feasible intervention that would be possible to implement in surgical patients.⁽³⁹⁻⁴⁰⁾ Exercise rehabilitation programs can decrease hospital durations by decrease in complications such as pulmonary complications⁽⁹⁾.

Nutrition support

Malnutrition is a potentially modifiable risk factor which can lead to unwanted complications after surgery. It is crucial for medical staff to screen patients preoperatively for nutritional status and weight loss. If deemed at risk, they should be given active nutritional support⁽⁴⁻⁹⁾. Preoperative routine nutritional screening makes its easy to correct malnutrition. Preoperatively, patients' who are considered as undernourished should receive nutritional treatment preferably using the oral route for a period of at least 7–10 days⁽²⁸⁾. Postoperative routine fasting was regarded as a standard guideline but current evidence explains surgery-related stress due to certain factors, such as underlying disease and surgical procedures, can impair the patients nutritional status⁽⁴¹⁾. Patients' should commence drinking clear fluids 2 hours before anesthesia. Patients' should abstain from solids for 6 h prior to induction of anesthesia. Oral carbohydrates use prior to surgery is seen to reduce postoperative insulin resistance, improve preoperative well-being and should be used routinely⁽⁹⁾.

Mechanical bowel preparation

Studies show that mechanical bowel preparation alone with systemic antibiotic prophylaxis is believed to have no clinical advantage and can rather cause dehydration and discomfort hence should not be used routinely⁽²⁸⁾. Furthermore, mechanical bowel preparation can increase the possibility of infections leading to longer hospital durations and cost.

Fasting

Some studies have shown that the use of preoperative carbohydrate loading may be unnecessary⁽⁴²⁾ although several studies have indicated the superiority of carbohydrates loading on diabetic, weak and undernourished patients' in need of energy supply for postoperative early recovery. Patients' should avoid overnight fasting. Preoperative oral carbohydrate loading should be administered unless patients' demonstrate increased risk of aspiration, such as bowel obstruction⁽⁷⁻¹⁹⁾. The ERAS policy makers have decreased the fasting preoperative period since this can decrease the insulin resistance. Fasting patients' leaves them surgically insulted, opioid intoxicated malnourished with a diminished immunity⁽¹⁴⁻⁴³⁾.

Opioid sparing

Amount of preoperative opioid use is parallel to addiction

levels. Furthermore, opioids can be a burden to early recovery. Conversely, there is evidence that preoperative opioid decrease may result in substantial improvements in patients clinical and psychological outcomes. In order to optimize chronic pain in surgical patients', addressing preoperative opioid reduction is believed to not only be logical but also imperative⁽²⁴⁾.

Operative Period

Prophylactics

Prophylactics are necessary in establishment of perioperative ERAS pathways, infections in surgical patients' can be devastating when they lead to multiple organ dysfunction⁽⁴⁴⁾. Antibiotic prophylaxis should be given within an hour before surgical incision in colorectal surgeries. Additionally, studies suggest that patients' receiving oral mechanical bowel preparation, antibiotic prophylaxis must be administered. No recommendation for the use of oral antibiotic decontamination can be given for patients' having no bowel preparation. ⁽²⁸⁾. Furthermore, (DVT) deep venous thrombosis is an important condition which can occur anytime postoperatively, Pharmacological prophylaxis such as low molecular weight heparin 12 h before surgery or 6–8 h after surgery against venous thrombosis should be used; moreover, compression stockings postoperatively decreases the incidence of symptomatic venous thromboembolism without increasing the risk of bleeding^(19: 27).

Anesthesia

Regional anesthesia is shown in studies that it can inhibit the stress response to surgery integrated with organ function and cost⁽²⁵⁾. (A. FELDHEISER *et al* 2016) indicated that, Combination of opioids with local anesthetics has improved postoperative analgesia although they should be avoided or minimized whenever possible since opioids can delay recovery⁽⁷⁾. It is well acknowledged that preoperative use of opioid drugs significantly worsens the outcome of patients.

Surgical stress

Surgical insult often leads to immunodepression due to uncontrolled inflammatory syndrome. During surgical stress, liver protein synthesis switches its normal physiology to production of acute phase proteins. This process is responsible for a substrate deprivation and worse outcomes.^(45, 46). The surgical insult leads to a reaction injury which encircles a wide range of endocrinological, immunological and hematological effects⁽²⁵⁾. The stress response is initiated by a variety of physical insults, such as tissue injury, infection, hypovolemia or hypoxia⁽³⁾. Modern surgical techniques have helped minimize tissue damage caused by increased surgical stress and a weakened immunity, these factors can deprive early patients' recovery. A study indicated that In patients' with a carcinoma in the right colon, laparoscopic surgery within ERAS based programs leads to a better immune response and lessens postoperative stress after surgery⁽⁴⁷⁾.

Fluid therapy

Optimal fluid therapy is associated with a reduction in overall morbidity including the duration of hospital stay⁽²⁶⁾. Studies conclude the use of goal-directed fluid management, or fluid-restricted management and early oral hydration⁽⁴⁸⁾. It is crucial for the patient before surgery to be in a hydrated state and any preoperative fluid and electrolyte excesses or deficits must be corrected. However, prior to surgery mechanical bowel preparation is associated with, up to 2 L of fluid loss as a consequence⁽²⁸⁾. In case of hypovolemic conditions colloids should be considered. Postoperative use of balanced crystalloid solutions are preferred to 0.9% normal saline, strongly recommended by G. Nelson *et al* (2016) ⁽³⁷⁾. Fluid therapy is to be used to maintain fluid

homeostasis, excess fluid should routinely be avoided ⁽⁷⁾

Prophylactic Use of Feeding Tubes

ERAS recommend avoiding enteral nutrition but a meta-analysis performed by Fan *et al* showed a significant decrease in hospital cost in the EN group as compared to the PN group [SMD -0.87 (95% CI -1.08, -0.65), P<0.00001] and EN had significantly decreased the duration of postoperative fever, as compared to those who received PN [SMD -1.77, (95% CI -3.07, -0.47), P=0.008].⁽⁴³⁾ Increasing immune levels and supply of necessary nutrition to the patients is key⁽⁴⁹⁾. It is well known that abnormal postoperative immune activity can result in increased occurrence of postoperative infections and metastasis of cancer cells⁽⁴⁷⁾. Supplements added to enteral feeding tubes such as arginine, omega-3 fatty acids, glutamine, nucleotides, vitamins C and E, have shown great improvement in patients' surgical wound healing, collagen synthesis of pro- and anti-inflammatory cytokines, for the innate immune responses after surgery, this influences self-healing, and early patients' recovery⁽⁵⁰⁾. Hypoxemia and tissue hypoxia has long been considered to be the responsible mechanism for multiple organ dysfunction syndrome in critical illness⁽⁴⁴⁾. Nevertheless, feeding tubes are said to cause pulmonary aspiration accompanied with infections. Uncontrolled infection response may be harmful and clinically cause hypoperfusion, organ dysfunction and tissue hypoxia. The use of feeding tubes should still be considered in weak and immune insufficient patients.

Postoperative Period

ERAS perioperative pathways, are formulated to provide a comprehensive postoperative clinical routes that optimizes anesthesia and analgesia, limits surgical strain, enhances early mobilization, ensures early oral feeding and sepsis prevention⁽⁵¹⁾. Balance between the inflammatory and anti-inflammatory response is important for the host response to sepsis⁽⁵²⁾.

PONV

PONV is frequent in postsurgical patients⁽⁵³⁾. Severe PONV leads in dehydration, prolonged ileus which may require the placement of feeding tubes, increase intravenous fluid administration which will generally prolong hospital stay, and increase healthcare costs.⁽²⁸⁾ Decrease use of opioids and appropriate analgesia tends to decrease the incidence of PONV.

Early oral feeding

Early oral feeding has been shown to accelerate recovery after various types of operations whereas nil by mouth has been advised only when oral feeding is not possible^(18: 42). Postoperative ileus still remains a concern but a study performed by B.U. Su'a *et al* showed that chewing gum can reduce postoperative ileus time and early oral feeding can commence earlier⁽⁵⁴⁾. Nutrition deficiency is very common in gastrointestinal surgeries and it is usually associated with postoperative complications and increased hospital stay. Perioperative nutritional support and patients' optimization reduce malnutrition-associated complications such as wound infection and anastomotic dehiscence and enhances early patients' recovery⁽⁵⁵⁾. Furthermore, early postoperative oral feeding can promote the recovery of gastrointestinal motility, protect the gastrointestinal mucosal barrier, shorten time to pass flatus as well as stool and reduce the incidence

of complications, finally hospital cost will also be reduced⁽¹⁴⁾. Whenever early oral feeding is tolerated it should immediately begin.

Balanced analgesia

The primary goal of ERAS program is reducing postoperative side effects and enhancing patients' recovery as soon as possible⁽⁴⁸⁾. ERAS emphasizes on the administration of several pain control regimens to preeminent analgesia as well as reducing opioid dosage hence eliminating related side effects as much as possible⁽⁵⁶⁾. Post-operatively, opioids should be administered orally to patients' who can tolerate diet⁽³⁷⁾. Analgesic techniques should not only aim at providing maximum pain relief but most importantly facilitate the achievement of important ERAS pathways including early tolerance of oral intake, early mobilization and reduced length of hospital stay⁽⁷⁾. A randomized controlled trial showed that intrathecal bupivacaine provides a short-lasting analgesic effect during postoperative day 1 after gastrointestinal laparoscopic surgery resulting in; faster recovery, reduced pain, and less opioid use after laparoscopic gastrointestinal surgery when compared with patients' on systemic opioids.⁽⁴⁸⁾

Early mobilization

ERAS pathways come from the evidences available in the current research, supporting patients wellbeing after major operations⁽⁸⁾. ERAS based protocols, suggests that patients should immediately ambulate after surgery. ERAS recommends shorter incisions to minimize pain. Long incisions might lead to intolerable postoperative pain that interferes with early mobilization.⁽⁴⁹⁾ Surgeries with difficulty in early mobilization such as gynecology participants began ambulation approximately 6 h following surgery. Ambulation 6 h after gynecological surgery characterizes ultra-early ambulation which was deemed possible due to protocol optimization and the fact that the entire staff was available. Certainly, the participants benefited from the physical therapy optimization of early ambulation ⁽³⁸⁾. Following ERAS pathways such as carbohydrates loading, early removal of tubes and non-opioid agents will consequently influence in early mobilization.

Benefits of ERAS

Studies showed that using minimal invasive techniques and ERAS significantly relieved postoperative stress, reduced perioperative complications, and accelerated recovery of postoperative bowel function and insulin sensitivity. ERAS protocols are set to decrease the stress responses to injury caused by operation and thus help to maintain homeostasis, avoiding catabolism and cellular dysfunction eventually a reduction in hospital stay and satisfactory outcomes are followed.^(1: 6: 57) A meta-analysis indicated that enhanced recovery directly impacts postoperative hospital stay by more than 30%, shorter time to first flatus, improved levels of postoperative CRP and IL-6 as well as decreased hospital stay when compared with the normal methodologies. Additionally, no difference in postoperative complications and readmission rate was observed when comparing ERAS and conventional care within conventional practice. ERAS has established a Society that structures implementation programs used in more than 20 countries^(16: 58). ERAS

programs are cost effective as a meta-analysis showed that ERAS has shorter postoperative hospital stay and decreased hospital cost compared to conventional recovery strategies in laparoscopic gastrectomy patients, in the ERAS group at a low cost hospital charge of 523.43 dollars compared to conventional group⁽¹⁷⁾. Studies also show that patients' can resume their normal routine and safely discharged earlier under ERAS pathways ⁽¹⁵⁾. Generally ERAS lessens complications, shortens hospital stay, which eventually leads to economic benefits consequently in the majority of surgical disciplines.⁽³⁵⁾

Materials and Methods

130 patients which performed gastrointestinal surgery were included in our study from the affiliated hospital of Jiangsu university, from 2015.01 to 2019.12. The patients were randomly assigned to either (ERAS) enhanced recovery after surgery or conventional care group. The total number of patients gender were 86 male and 44 female patients, all the patients had resectable tumours of the gastrointestinal tract. ERAS patients had a mean age of 65 while conventional group patients had a mean age of 61.

Statistical Analysis

Statistical analysis was performed with the statistical package for the social sciences (SPSS) version 26.0.0 software (SPSS Inc., Chicago, IL, USA). Normal distribution was computed by ANOVA or independent sample t-test, presented as mean \pm standard deviation. Non-parametric data was analyzed by 2-independent sample performed by Mann-Whitney U test or several independent sample by Kruskal-Wallis test.

Results

Patients in the ERAS group had a reduced length of hospital stay compared to the conventional care group with a (Mean \pm SMD of 13.56 \pm 3.73 and 20.344 \pm 11.62 with a p value = 0.10) respectively. Cost ERAS (Mean \pm SMD 6104.28 \pm 2028.37) whereas conventional group had (Mean \pm SMD 7361.68 \pm 2256.48 p = 0.001)

Figure 1: Length of hospital stay between the 2 groups

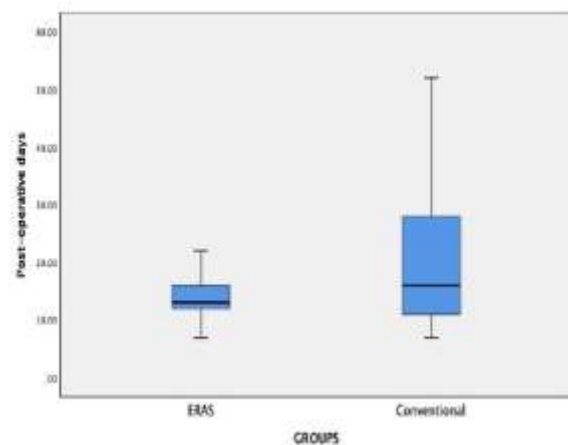


Fig 1

What is Being Done to Improve

Establishment of ERAS SOCIETY with activities including publishing and updating a range of guidelines, and international meetings⁽¹²⁾. ERAS is currently implemented

in several surgical departments. Technologies which helps monitor surgical patients' prognosis helps both the patient and practitioner to have a critical follow up and monitor the patients' outcomes. Triaxial accelerometry is currently used to measure postoperative physical activity, which is the first such objective method used to assess the efficacy of the ERAS protocol in patients' after gastric cancer resections⁽⁵⁹⁾. Non-invasive wireless and sensors which can monitor physiological variables such as heart rate, heart rate variability, respiratory frequency, arterial oxygen saturation and thoracic fluid content are slowly implemented⁽⁵⁶⁾. Other technological innovations are also implemented in ERAS programs such as non-invasive hemodynamic monitoring machine with goal directed fluid therapy. Applications that connects a smartphone and an electronic scale helps to read blood pressure levels, blood glucose levels as well as daily physical activity trackers.⁽⁵⁶⁾

Eras Pathway in Our Hospital

1	(MDT) Multi department team screening
2	Preoperative carbohydrate loading 600ml administered 2-14 hours prior to surgery
3	Evaluation of gastric retention after maltodextrin administration
4	Antibiotic prophylaxis 2g cefmetazole sodium iv
5	Balanced IV fluid therapy during the day of surgery according to the (MDT) Screening
6	Type of surgical approach to be used according to MDT
7	One group of surgeons routinely use nasogastric tubes (NTG) nutrition tube group while the other group removes the nasogastric tube after surgery (NNTG) non-nutrition tube group
8	Intra-operative temperature monitoring
9	Pain score and visual analogue score (VAS)
10	(TAP) transversus abdominis plane and normal routine anesthesia
11	Non opioid postoperative analgesia
12	A small amount of water and bed activities after the patient awakes from anesthesia
13	Monitor patient's temperature after every 4 hours
POD 1	500 ml of sodium gluconate at 50ml/h IV for both groups. Out of bed exercise
POD 2-4	Enteral nutrition suspension begins in the combined EN and PN group, mobilization
POD 5	Commencement of oral fluid diet and normal mobilization until discharge

Feasibility

Enhanced recovery after surgery (ERAS) protocol is well established in many surgical disciplines and leads to a decrease in the length of hospital stay morbidity and cost⁽⁶⁰⁾. ERAS is deemed feasible on colorectal, HIP surgery ^(61- 62), gastric surgery ^(17- 53- 63), esophagectomy⁽¹⁰⁾ Nevertheless, additional studies are essential for optimizing ERAS protocols⁽⁶⁴⁾. ERAS studies have indicated decreased Postoperative complication rate, length of hospital stay and reduced number of hospital readmissions which are deemed to be the indicators of a successfully implied ERAS protocol⁽⁶⁵⁾. Studies show that ERAS pathways are feasible for older and fragile patients. ERAS serves these patients' especially well by reducing complications and supporting their recovery to optimal desired conditions. However, data is still limited and more research is needed certain type of patients' and other surgical fields.⁽⁸⁾

Arguments

Nasogastric feeding tubes is not recommended as studies show that NG tubes were correlated to postoperative ileus, emesis, aspiration pneumonia, anastomotic leak and time to first flatus in patients' after surgery, although cancer patients' are generally weak and malnourished, immune-nutrition using feeding tubes is still unresolved.^(7- 22- 31) Other studies have also indicated that early oral feeding could cause anastomotic leakage due to direct stimulation of anastomotic sites and rise the intraluminal pressure. Furthermore no significance on preoperative carbohydrate loading as studies showed that carbohydrates could not improved postoperative nutritional status nor maintain muscle strength after surgery .⁽⁴²⁾

Overview of the Difference Methods Under the Eras Umbrella

Delayed patients' recovery is not only inflicted by surgery, but also from fear, pain, hypothermia, hypoxia, sepsis, fasting, PONV, sleep disorders, fatigue use of tubes. All these factors could cause organ dysfunction and ultimately affect wound healing and postoperative rehabilitation. ERAS is designed to enhance patients' recovery by influencing on intraoperative methods, enhance gut function and integrity, reduce pain, cost and length of hospital stay⁽³⁰⁾. ERAS team helps Patients' receive dedicated preoperative counselling routinely, increases staff to patients' care with evidence based protocols.⁽²⁸⁾ ERAS provides the comfort of Shorter feeding duration prior to surgery as compared to conventional methods, enhance patients' preparation prior to surgery including antibiotics, anticoagulants and opioids sparing agents whenever possible, reduced IV blood during surgery, early postoperative oral feeding, eliminating pathways that will limit early recovery including PONV, infection and reduced capability for early mobilization such as the use of feeding tubes and opioids medications. ERAS has a high perioperative consideration to sepsis, reducing incidence of complications, decreased hospital stay and better outcomes. These differences observed in patients under ERAS pathways are crucial in enhancing patients' early recovery.

Challenges

Enhanced recovery after surgery is based on research which adopts positive results and eliminates negative outcomes. Statistical medical data has influenced elimination of old medical doctrines with no evidence. ERAS compliance to protocols suggests early mobilization to influence recovery but prolonged bed rest which was early used as a medical treatment it was also believed to promote recovery, this doctrine remains unchanged even today in many hospitals.^(3- 66) Early mobilization when practiced by the patient may be difficult due to orthostatic intolerance which could cause syncope due to blood and body fluid loss caused by total peripheral resistance and cardiac output response as indicated by Bundgaard-Nielsen *et al* (2009), in a study, orthostatic intolerance impeded early postoperative mobilization in 50% of the patients' 6 h after operation.⁽²⁰⁾ Advanced age is said to be accompanied by pre-existing diseases hence aging is a proven risk factor of postoperative complication⁽⁶⁵⁾. Patients' with advanced age are difficult to operate upon and more difficult to follow the ERAS pathway when operated. A major reason of failure to

comply with ERAS include single definitive strategies to adopt perioperative enhanced recovery programs in different scenarios is difficult to accomplish. Compliance by the staff and the patients' to the protocol elements of the ERAS pathways is crucial to ensure a well-established and successful a program.⁽⁶⁾ ERAS pathways neglect the fasting routine before surgery, but patients' with obstructive colorectal cancer cannot eat orally preoperatively, which is in direct contradiction with the requirement of ERAS protocols⁽⁶⁷⁾⁽⁶⁸⁾.

Other challenges facing ERAS is the role of nutrition and the use of nutrition feeding tubes, the assumption that the nutritional needs and catabolic state are the same for the various clinical conditions is a major gap in our current knowledge. The actual composition of the immune nutrition may vary from patient group to patient group^(22: 55). Challenges of modern anesthesia is to provide efficient and suitable regimens depending on individual status and surgery so as to avoid unwanted side effects⁽²¹⁾. Reasons behind lack of appropriate pain management are not precisely known, outdated, conflicting and confusing evidence as well as lack of clear guidance could be contributing factors⁽⁶⁹⁾. Despite years of studies on the most appropriate ERAS pathway, differences on the most appropriate pathway still exist among surgeons.

Future Direction

So much more needs to be done on future implementation of ERAS protocols in different surgical departments which we think might play a role in improving ERAS pathways using easily accessible and cheap material we already have at our pre-modern hospitals of our current time. Just to mention a few, Counteracting PONV, studies should focus on drug - body interactions although several studies have been published on opioids sparing agents Nevertheless, more studies are in demand on strictly non opioid pharmacological agents which are less expensive with benefit to patients' postoperative status. Studies on intraoperative step by step techniques should be published on a regular basis with postoperative follow up to reduce surgical insult, IV fluid and blood interventions, unnecessary maneuvers in surgical practice, pain and fatigue after surgery should be regularly updated. A study performed by B.U. Su'a *et al* (2015) shows that chewing gum is a safe and well tolerated method to reduce time to resolution of postoperative ileus⁽⁵⁴⁾ although this method is cheap and easily accessible it is not sufficient to implement the use of chewing gum to combat postoperative ileus especially in more severe patients' further studies should focus on combination strategies with the help of chewing gum and other non-invasive nerve stimulants to reestablish gut functions. Diet modification may help improve patients' immune and metabolic functions although studies are needed to support the use of feeding tubes in ERAS pathways further studies on the relations between patients' diagnosis, immunity, nutrition, sepsis and metabolic capacity are needed ⁽⁵²⁾. Notwithstanding the fact that ERAS recommends removal of nasogastric tubes 3 days after surgery, the impact of feeding tubes should not be attenuated in both nourished and undernourished surgical cancer patients. Optimal fluid therapy should be established in different patients' in fluid management as well as evaluation of cerebral perfusion and oxygenation need further evaluation in analyzing the patients' future

mobilization and orthostatic intolerance^(20: 48). Original studies need to be updated beginning from a cellular level explaining the physiological reasons of supported ideas with updates and follow ups of patients' outcome and survival.

Conclusion

ERAS pathways include a multidisciplinary approach done by a team of specialties working together using a series of optimal and evidence-based management measures to lessen perioperative complications by patients' education, goal-directed fluid therapy, prevention of nausea and ileus, temperature monitoring, early nutrition, and mobilization^(14: 17). From our study we have found that ERAS is less costly and patients have less durations of hospital stay compared to non-ERAS patients. Its significance is of value as several studies have showed positive postoperative prognosis leading to early hospital discharge and low readmissions as compared to old doctrines. ERAS is evidence based, this characteristic allows further research to develop and convince practitioners to comply with ERAS protocols. Implementation of ERAS protocols need's auditing for the compliance and application of pathways. Although guidelines are drafted in ERAS protocols, some patients differ in their physiological nature of the diagnosis and treatment responds thence concept of ERAS should be flexible to enhance recovery according to patients' needs and not forced into patients' without assessment of the nature of their disease. From our study we have found that ERAS is less costly and patients have less durations of hospital stay compared to non-ERAS patients

Authors contribution

Said Abdulrahman Salim, and Aaron Gia Kanton were the key contributors in drafting the written manuscript. Abdul Nazif, Muslimat and Jutamas participated in revision of the manuscript and Ahmed Fadhl participated in proof reading of this manuscript.

All authors have acknowledged and approved the manuscript before submission.

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