

Carol Rees Parrish, M.S., R.D., Series Editor

Enhanced Recovery After Surgery: If You Are Not Implementing it, Why Not?



Aditya J. Nanavati



Subramaniam Prabhakar

Multimodal interventions, under the umbrella of a single program applied to the care of the surgical patient in the peri-operative period, have come to be known as Enhanced Recovery After Surgery (ERAS). The basic premise is that the impact of surgery on the metabolic and endocrine response is reduced leading to earlier recovery. Implementation leads to reduced length of hospital stay and earlier return to productivity. It has also been shown to actually reduce complications without a rise in re-admissions. Beginning with colorectal surgery, the scope of ERAS has gradually been expanded to other surgical sub-specialties. With focused research in the area, both contraindications and limitations seem to be diminishing. Implementation at an institutional level needs the constitution of a multi-disciplinary team with representatives from all specialties involved in patient care. Nutrition plays a central role in ERAS, with almost all interventions related to it either directly or indirectly.

INTRODUCTION

What is Enhanced Recovery After Surgery (ERAS)?

Surgical intervention leads to an endocrine and metabolic stress reaction, which slows down recovery.¹ Effectively modulating these responses to attenuate the impact of surgery may help promote an early recovery and has been associated with reduced²:

- length of stay
- complication rates

- use of analgesia
- costs for patients
- increased patient comfort and satisfaction

Aditya J. Nanavati¹ Subramaniam Prabhakar²
¹Surgical Registrar, Department of Surgery, Sir JJ Group of Hospitals, Mumbai, India
²Professor, Department of Surgery, Lokmanya Tilak Municipal Medical College, Mumbai, India

A single program incorporating multimodal interventions in the peri-operative period to expedite recovery has come to be known as Enhanced Recovery after Surgery (ERAS), or Fast-track surgery (FTS). The interventions included in ERAS are shown in (but are not limited to) Table 1. The program was initially developed and promulgated for use in colorectal surgery.^{3,4} However, recently it has been effectively expanded to various surgical sub-specialties.^{5,6}

Table 1. Interventions in Enhanced Recovery After Surgery (ERAS)

Pre-operative interventions	Operative interventions	Post-operative interventions
◆ Evaluation and optimization of existing organ function	◆ Pre-operative Antibiotic, acid suppression and pro-kinetic	◆ Pre-emptive and adequate analgesia
◆ Ensuring good nutritional status	◆ Thoracic epidural analgesia	◆ Post-operative nausea and vomiting prophylaxis
◆ Improving physical fitness	◆ Elective use of nasogastric decompression, urinary catheterization and abdominal drainage	◆ Early removal of all drains and tubes if inserted
◆ Patient education	◆ Goal directed fluid therapy	◆ Early enteral nutrition
◆ Minimal starvation	◆ Maintaining Normothermia	◆ Early enforced ambulation
◆ Oral Carbohydrate drink	◆ Minimal tissue handling	◆ Ensure follow-up after discharge
◆ No mechanical bowel preparation	◆ Minimize operative time	
	◆ Minimal access surgery	

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How Does it Work?

The basic principle behind ERAS is successfully delivering surgical care with minimum deviation from normal physiology/functioning. It may be better understood by plotting the physiologic or functional state versus time in the peri-operative period (Figure 1(a)). When undergoing surgery, the fall from normal physiologic state actually exceeds a level caused by illness alone. This is due to the endocrine and metabolic impact of the surgical stress.⁷ This is followed by a slow recovery back to a pre-existing level of functioning. When ERAS is implemented a graph is likely to show an earlier recovery (Figure 1 (b)). Three distinct phases shown in the graph are pre-, intra-, and post-operative phases. In the pre-operative phase, the upswing in the graph is a reflection of the attempt to optimize the patient. This has also been called 'prehabilitation'. In the intra-operative phase surgical and anesthetic maneuvers are used to minimize the downswing i.e. the surgical stress response. The small vertical arrow demonstrates a reduced impact observed as a smaller fall in functional status. The post-operative rehabilitation seeks to hasten recovery demonstrated by shortening of the recovery to pre-existing functioning (long horizontal arrow). It may

be ideal to rehabilitate the patient to a level as close to optimum as possible (dotted line). A sample institutional protocol and how it differs from conventional care is shown in Table 2.

Why Implement ERAS?

ERAS programs, when implemented successfully, have been associated with a 35-40% reduction in length of hospital stay.⁸ This benefit has been observed without a concurrent rise in complications or re-admissions. Some studies have noted a fall in surgical (anastomotic leaks, etc.), as well as non-surgical complications (nosocomial infections, etc.) in the post-operative period.⁹ ERAS has also been associated with an earlier return to work and productivity.¹⁰ Compared to conventional care, ERAS is associated with better quality of life outcomes.^{8,11} Institutes benefit from ERAS as implementation of a structured peri-operative program streamlines patient care. Written protocols are available to staff members minimizing errors in care delivery. Early discharge means patient turnover times are reduced and institutes may be able to serve more patients within the available infrastructure. Another favorable impact of ERAS has

Table 2. A Sample Enhanced Recovery After Surgery (ERAS) Protocol

Period	Enhanced Recovery Protocol (ERP)	Conventional care Protocol (CCP) (key differences only)
Pre-operative	<ul style="list-style-type: none"> • Provide complete information about the protocol and take an informed consent • Advice given regarding exercise, smoking and alcohol cessation • Optimize any pre-existing co-morbidity • Minimal starvation (6 hrs for solids and 2 hrs for liquids) • 100g oral carbohydrate drink • Avoid mechanical bowel preparation • Pre-operative antibiotic 	<ul style="list-style-type: none"> • Overnight starvation • No carbohydrate drink • Mechanical bowel preparation • Parenteral hydration (to compensate for bowel preparation)
Operative	<ul style="list-style-type: none"> • Epidural anaesthesia (0.125% bupivacaine, continuous infusion) along with spinal or general anaesthesia • Arterial/Central lines inserted only if unavoidable • Goal directed fluid therapy • Maintain optimal oxygenation • Avoid hypothermia • Minimal tissue handling • Elective use of nasogastric tubes, abdominal drains and urinary catheters 	<ul style="list-style-type: none"> • Done under spinal or general anaesthesia • Routine use of Nasogastric tubes, abdominal drain and urinary catheter • Liberal hydration
Post-operative	<ul style="list-style-type: none"> • Maintain supplemental oxygen • Strict post-operative nausea and vomiting prophylaxis • Early enforced mobilization • Early enteral nutrition • Removal of epidural catheter by day 2 • Ensuring adequate analgesia after epidural catheter removal • Early removal of all tubes, drains and catheters 	<ul style="list-style-type: none"> • No emphasis on PONV prophylaxis • No enforced mobilization • Removal of nasogastric tube and abdominal drain delayed till markers of bowel motility are observed • Oral or Enteral nutrition given once bowel motility is restored
Post-discharge	<ul style="list-style-type: none"> • Ensure 30-day follow-up including: <ul style="list-style-type: none"> ○ Phone call at 48 hours ○ 7th day Clinic visit ○ Any Emergency visit 	<ul style="list-style-type: none"> • Patient follows up on day 7 in the clinic or else as and when required

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been cost-control. Studies from both developed, as well as developing countries, have noted a 28-32% fall in healthcare costs incurred.^{12,13}

When Should ERAS be Used? Are There any Limitations?

ERAS has traditionally been used in elective colorectal surgery. Programs tailored to upper gastrointestinal, hepatobiliary and pancreatic surgeries have been described in recent years.^{14,15} Scope of ERAS has been expanded to other surgical sub-specialties like cardiovascular, orthopaedic and gynecologic surgery.^{5,6,16} The patient populations in early studies have

belonged to the young and middle-aged populations with a few, or no, co-morbidities. There had been some controversy regarding safety and applicability of ERAS in the elderly, but recent evidence suggests that they can achieve success on the program also.¹⁷ Patients needing complex abdominal or pelvic surgery have also been observed to benefit from the program in spite of initial fears of failure. Success with multicavity surgeries like Ivor-Lewis esophagectomy in the elderly on the other hand has been limited.¹⁸ While the horizons of ERAS expand gradually, the limitations and contraindications for it seem to diminish. Tailored programs to various sub-specialties as well as individual surgical procedures help overcome most limitations. However, an important

Table 3. ERAS Pre-Op Beverages – Evidenced-Based and Others Used

Beverage	Mfg/Available In	Total Carb (g)	Maltodextrin (g)	% Carb	Calories	Volume (ml)	Osm
Carbohydrate-Rich Beverages Of Enhanced Recovery Programs Around The World*							
Clearfast®	BevMD/USA	50	44	14	200	355	270
Arginaid® H2O	Nestle/Japan	52	52	18	200	250	200
Fortijuce®	Nutricia/UK	67	40.8	24-34	300	200	750-955
Maxijul®	Nutricia/UK/EUR	47.5	43.25	32	190	150	420
Nidex®	Nestle/Brazil	50	50	12.5	200	400	200
ONS400®	Fresenius Kabi/ Germany	50	50	12.5	200	400	200
ONS300®	Fresenius Kabi/ Germany	50	50	16.6	200	300	266
Polycal® Liquid	Nutricia/UK	122	98.4	61	494	200	845-1400
PreOp®	Nutricia/EUR/ Canada	50.4	40	12.5	200	400	260
Preload®	Vitaflor/Nestle/UK	52	47.5	13	200	400	135
Beverages Also Used							
Impact AR®	Nestle	45	0	18.5	340	237	930
Ensure Clear®	Pepsico	43	0	21.5	200	200	700
Pedialyte®	Pepsico	6	0	2.5	25	237	270
Gatorade® Thirst Quencher	Pepsico	21	0	n/a	80	355mL	n/a
G2 Gatorade®	Pepsico	7	0	n/a	30	355mL	n/a
Lemonade	Country Time	35	0	12%	140	355mL	n/a

*www.bevmd.com/compare-pre-op-beverages

issue is that of compliance. Even in large multi-centric trials, adherence of approximately 65% has been observed.¹⁹ It has been widely acknowledged that full compliance may be difficult to achieve.²⁰

How is it Implemented?

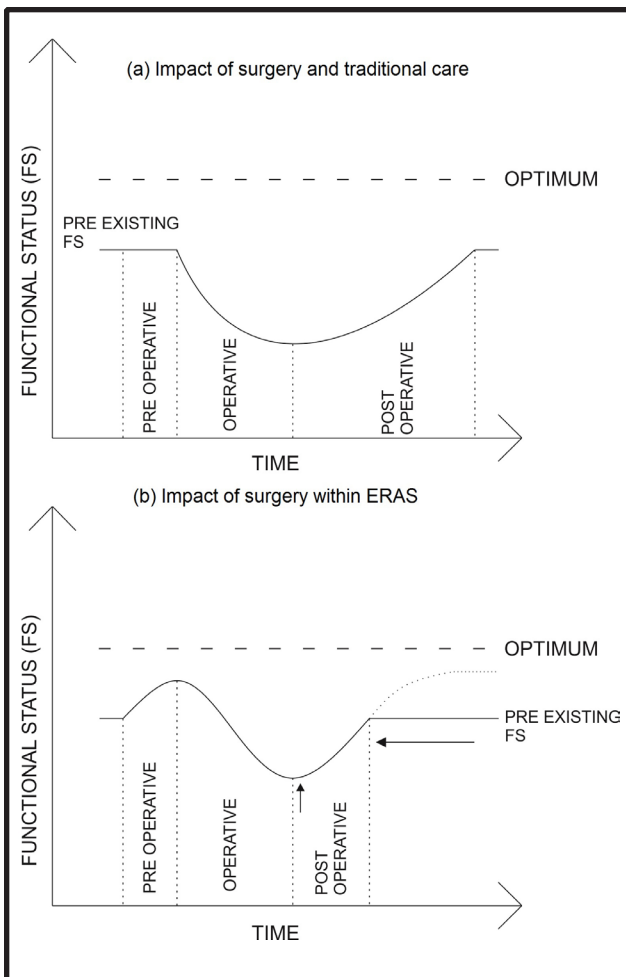
Implementing ERAS at an institutional level requires the formation of a multi-disciplinary team. According to this author, the core team should consist of a representative from each the following branches: surgical, anesthesia, and nursing. Other important members include nutritionists, physicians (belonging to various specialties), physical & occupational therapists and social workers. Membership may be extended to any

other staff from specialties/branches who are involved with patient care. This team is given the responsibility of reviewing available literature and formulating the ERAS program to be implemented at their institute. This assumes that the components of the program will be tailored to match locally available expertise and facilities. Each member is expected to communicate the role of his/her specialty in the program. Understanding where the needs of two or more specialties may converge is imperative for the smooth delivery of peri-operative care. Once formulated, written protocols must be made available to all those involved. An important component of implementation is receiving feedback, provisions for which should be provided for within the program.

Table 4. One Institution's Nutrition Component to ERAS Protocol*

University of Virginia Health System	
Clinical Pathway: Colorectal Early Recovery After Surgery (ERAS)	
Diagnosis: All elective Colorectal Surgical Procedures—MEDIAN LOS: 3	
Pre and Post-Op Day	Protocol
Surgical Clinic	<ul style="list-style-type: none"> Screen for malnutrition: <ul style="list-style-type: none"> Weight loss > 10% body weight
Day Prior to Surgery	<ul style="list-style-type: none"> Regular diet until 6pm when Golytely starts and then clear liquids (if applicable)
Day of Surgery: Surgical Admissions Suite (SAS)	<ul style="list-style-type: none"> Clear liquids until 2 hours prior to surgery Carbohydrate drink for morning of surgery (Gatorade/Powerade)—20oz bottle
Day of Surgery: Post anesthesia care unit (PACU)	<ul style="list-style-type: none"> Clear liquids as tolerated
Day of Surgery: Acute Care	<ul style="list-style-type: none"> Clear liquid diet immediately after surgery. Patients are permitted soft diet items as tolerated – ice chips, ice cream, jello, pudding, etc. Clear liquids as tolerated
POD1	<ul style="list-style-type: none"> Clear liquids as tolerated Transitional (soft) diet to start lunchtime on POD1
POD2	<ul style="list-style-type: none"> Regular diet to start on POD2
POD3/Day of Discharge	<ul style="list-style-type: none"> Regular diet
<p>* Guidelines are general and cannot take into account all of the circumstances of a particular patient. Judgment regarding the propriety of using any specific procedure or guideline with a particular patient remains with that patient's physician, nurse, or other health care professional, taking into account the individual circumstances presented by the patient.</p>	

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Feedback is taken in the form of ease of delivering care and problems encountered by each worker within their specialty in carrying out work designated under ERAS programs. Feedback from individual staff members must be made available to the multidisciplinary team at subsequent team meetings. Along with regular audits, feedback provides a sound basis for process improvement to advocate and implement changes to the program. Apart from these internal quality check mechanisms, an external review or audit may be asked for if needed. Once changes are made the entire cycle must be re-initiated.

Nutrition in ERAS

Almost all the interventions in ERAS are either directly or indirectly related to the nutrition of the patient. In the pre-operative period the patient's nutritional status should be evaluated. Ensuring a good nutritional status is crucial to the success of the program.²¹ Consultation and evaluation by a nutritionist is preferable and should

be followed by advice to meet objective dietary goals to achieve designated end-points (like optimum body weight, etc.). ERAS protocols do not recommend specific tools for nutrition screening or assessment. However, a nutritional assessment might include:

- Insufficient oral intake
- Percent unintentional loss of usual body weight over time
- Low BMI

In the immediate pre-operative period under ERAS it is advised to keep starvation time to a minimum. A 2-hour fast for liquids and a 6-hour fast for solids are considered safe and adequate.²² Along with minimal starvation an oral carbohydrate drink 2 hours before surgery is administered (See Table 3 for available options). Oral carbohydrate loading is known to attenuate insulin resistance, minimize protein and muscle loss, and improve patient comfort.^{7,23} There is a possibility that scheduling cases in the morning may interfere with the ability to adequately maintain this interval. This must be accounted and planned for in advance. This author prefers to advise patients to consume what they normally would for dinner and administers 100g of an oral carbohydrate drink (complex carbohydrate maltodextrin based formula with water) early in the morning up to 2 hours before surgery; however, even 50gm has been shown to be adequate.²⁴ As an added safety measure, the author's institution prefers to use a prokinetic agent early in the pre-operative period. The safety and efficacy of avoiding mechanical bowel preparation has been adequately demonstrated with only some controversy remaining around its use in rectal surgery;²⁵ there are surgeons who may still suggest its use in cases of low anterior resections.

Although operative interventions are not directly related to nutrition, it is important to note that any untoward incident in the operating room can impact the nutrition of the patient and, by extension, his/her hospital stay. Principles of minimal tissue handling, selective use of drains and catheters are crucial to be able to promote ambulation, as well as to initiating oral/enteral nutrition early in the post-operative period and epidural catheter insertion for analgesia in the post-operative period. This has been shown to reduce the incidence of ileus, improve post-operative insulin

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*(continued from page 52)***Table 5. University of Virginia Health System's Transitional Diet****How to order the diet:**

Diet order entered as "Transitional"

Description:

This diet is designed to be used after surgery and indicated in patients who have nausea or are just beginning to take an oral diet after a prolonged period NPO, prior to advancing to regular diet. It consists of patient and research-reported tolerable foods and beverages after surgery and is more nutritionally adequate than the traditionally used clear liquid diet. Once the patient demonstrates tolerance to this diet, their diet can be advanced to a regular diet or another therapeutic diet based on the patient's clinical condition.

Nutritional Adequacy:

The Transitional Diet nutritional adequacy varies significantly based on the items selected by patients. The nutrient content can be inadequate to meet DRIs but this diet is meant to be used for a short period of time.

Food Group	Foods Allowed	Foods Excluded
Beverages	All: Juice, milk, soda, coffee, tea (hot or iced); Ensure, Carnation Instant Breakfast, Resource Breeze, etc.	None
Cereals, Breads and Grains	Soft breads, toast, crackers Muffins Cooked or dry cereals	
Vegetables	Cooked vegetables Vegetable juices Soups Potatoes	Raw vegetables, salads
Fruit and Juices	Fruit Juices Applesauce Fresh Fruits: banana, melon, peaches, pears, oranges Canned peaches, pears, apricots, pineapple, fruit cocktail, citrus sections	Dried fruit Fresh fruits not listed under "food allowed"
Milk	Cottage Cheese Cheese Milk Yogurt	None
Meats and Meat Substitutes	Tender meat, fish, poultry or egg salads Eggs Peanut butter Cheese Cottage Cheese	Tough fibrous meats (e.g., sausage casings)
Fats	All	Fried foods
Desserts	Graham crackers, vanilla wafers Popsicles, gelatin, pudding Yogurt Ice cream Sherbet custard	Desserts containing nuts, coarse dried fruit, or tough fruit Cake, tender cookies Desserts baked to a hard consistency
Condiments	All	None

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Table 6. Sample Transitional Menu

Breakfast	Lunch	Dinner
Low Cholesterol Scrambled Eggs	Broth-based soup (regular soup)	Chicken salad sandwich on white bread
Toast (white)	Grilled cheese sandwich on white bread	Mashed Potatoes
Yogurt	Saltines	Canned fruit
Jello	Banana or fresh fruit cup	Vanilla wafers
Margarine	Jello	Yogurt
Jelly	Iced tea	
Coffee or hot tea	Sugar	
Sugar and Creamer		

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resistance, improve quality of life scores, facilitate earlier discharge and reduce overall morbidity and mortality after surgery.²⁶⁻²⁸ Intra-operative goal-directed fluid therapy²⁹ and minimizing use of opioids/ using opioid antagonists like alvimopam contribute to the early return of bowel function in the post-operative period.³⁰

In the post-operative period nutritional management is carried out in the form of early oral (see Table 4 for one institution's diet progression post-op) or enteral nutrition (EEN). Within ERAS programs EEN is facilitated by prophylaxis against post-operative nausea and vomiting, epidural analgesia, minimizing use of nasogastric tubes (Salem sump type decompression tubes) and other drains, catheters and tubes. Oral or Enteral nutrition can be started as early as 6-8 hours after surgery.³¹ Even though early post-operative feeding is recommended the evidence base for these recommendations is weak at best³² and there have been varying opinions regarding to the best time to initiate oral feeding. In the experience of this author, an overwhelming majority of the surgeons are more comfortable starting oral feeds on the morning after the surgery. Oral feeding is usually started with liquids. Once tolerated transition to regular diet is immediate while some may prefer to advise eating ad libitum (Food items allowed/excluded in a typical transition diet and a sample menu is shown in Table 5 and Table 6 respectively). Early oral or enteral nutrition has been demonstrated to be safe, promotes sense of well-being, preserves post-operative nutritional profile, reduces incidence of ileus and does not lead to an increase in anastomotic dehiscence.^{31,33}

CONCLUSION

Developments in ERAS have highlighted the importance of peri-operative care. The ability to achieve a reduced hospital stay, patient satisfaction, and reduced rate of complications without an increase in re-admissions has demonstrated how powerful a tool ERAS can be. ERAS has resulted in a significantly increased understanding of peri-operative physiology and how to modulate it to improve outcomes. This has led to the belief among some that the role peri-operative care plays may be so crucial that it warrants recognition as a separate sub-specialty since it does not exclusively fall into the domain of any of the existing specialties.³⁴ Until ERAS becomes a routine reality, it may be in the best interest of all those involved in the peri-operative care of the surgical patient to be familiar with ERAS and its principles. ■

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