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Enhanced recovery protocol in early recovery of patients undergoing abdominal surgery

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Abstract---Background: Enhanced recovery after surgery (ERAS) programme is designed to reduce perioperative and intraoperative stress responses, and to support the recovery of organ function aiming to help patients getting better sooner after surgery. There is paucity in literature regarding successful application of Enhanced recovery after surgery (ERAS) protocol in India. Material and Methods : 100 patients underwent abdominal colorectal surgery. Fifty patients underwent enhanced recovery after surgery protocol while other half were observed under conventional protocol. Time for 1st flatus , 1st defecation , time to tolerance of diet , time to normal routine , Hospital stay , complications , readmission within 30 days and hospital cost were compared as study outcome variables. Result : Patients underwent ERAS protocol were found to have statistically significant shorter time for 1st flatus , 1st defecation , time to tolerance of diet , time to normal routine and hospital stay than compared to conventional group ($p < 0.001$). The readmission after 30 days and complications were also non significantly lesser than conventional group. Hospital cost was significantly minimizes using ERAS protocol.

Conclusion : It can be concluded that ERAS protocol leads to early recovery of bowel function , leads to lesser hospital stay and minimizes complications as compared to conventional protocol.

Keywords---enhanced recovery protocol, early recovery, patients undergoing abdominal surgery.

Introduction

Abdominal surgery is one of the most common surgery performed in community . Despite all advances in surgical and anesthetic care, morbidity after abdominal surgery remains high. ¹ The prevalence of surgical procedures shows a greater need for public health efforts to improve the monitoring, safety, and availability of surgical services, especially in view of their high risk and expense. ² The absence of general guidelines for perioperative care has not only resulted in different types of practice in various clinics but also limited the possibility of congruent audits of perioperative processes and outcomes in different surgical centers. Thus, in surgical literature, there is a vast diversity in the way postoperative complications are reported ³ and significant variations in complication rates makes interpretation and evaluation difficult.

A potential method of improving surgical outcomes after such an operation is by optimising perioperative care. Significant improvements in outcomes subsequent to abdominal major operations can be accomplished by implementing a consistent protocol on evidence-based medicine in all perioperative steps. ⁴ Enhanced recovery after surgery (ERAS) programme is designed to reduce perioperative and intraoperative stress responses, and to support the recovery of organ function aiming to help patients getting better sooner after surgery.⁵

The ERAS® Society has published evidence-based guidelines for perioperative care in elective colon surgery and rectal/pelvic surgery. ^{6,7} Over the last decade, ERAS programs have produced a real revolution in the management of colorectal surgery, vascular surgery, and thoracic surgery patients. Several studies have demonstrated that the ERAS-protocol as a whole compared with traditional perioperative care is associated with earlier recovery and discharge after colonic resection. Implementation of ERAS not only resulted in clinical outcome improvements, but also had a significant beneficial impact on scarce health system resources. ⁸

Despite all great benefits of ERAS, there are major limitations in employing such protocols; this may be attributed to the difficulties in patients' acceptance of all interventions within the program ⁹. There is a wide acceptance to ERAS in western countries and the USA, whereas in the developing countries, ERAS programs are still facing considerable challenges for application.¹⁰ Traditional perioperative care practices, such as overnight fasting before operation, mechanical bowel preparation and routine use of drains, nasogastric tubes and catheters, continue to be commonplace in many centres across India. The most commonly identified barriers were lack of awareness, lack of importance given to

perioperative care, lack of initiative on the part of healthcare providers, and lack of interdepartmental coordination

Thus, there are restricted numbers of studies recording successful application of ERAS in India. ERAS protocol is a promising approach and we attempt to achieve it among patients submitted to abdominal surgery at our tertiary care hospital. Therefore the present study was planned to evaluate effectiveness of ERAS protocol as compare to conventional protocol in terms of early recovery of organs function, hospital stay and cost.

Material and Methods

This was a single centric prospective observational study conducted in department of surgery of a tertiary care, teaching hospital for a period of 18 month from June 2017 to November 2018 on patients undergoing abdominal surgery. A sample size of 100 was calculated considering the mean duration of Post operative ICU stay in Days from the study by Elgohary H et al ⁸. Patients in the age group of 18 to 60 years undergoing abdominal surgery having no emergency medical condition like shock, IHD, renal failure, non-pregnant or lactating females and able to understand and follow the necessities of the program and willing to participate were included in our study.

Preoperative preparation for the enhanced recovery after surgery pathway group

1. All staff and nurses dealing with patients were educated about the ERAS care strategy.
2. In the preoperative anesthesia visit, patients were informed broadly about our ERAS protocols and the objective of early postoperative discharge.
3. The preoperative preparation procedure did not comprise mechanical bowel preparation. However, in patients undergoing left colonic and rectal resection, an evacuating fleet enema (120 ml) was carried out the night before and the morning of the surgery for the safety of colorectal anastomosis.
4. Patients received 200 ml of carbohydrate-rich drinks four times a day earlier to the surgery and two doses on the morning of the operation.
5. Patients kept fasting before the operation: 2 h for liquids and 6 h for solids.
6. Prophylactic IV antibiotic (metronidazole 500mg and ceftriaxone 1 g) was given 1 h before surgery and sustained for 24 h subsequently (two extra doses).
7. Prophylactic therapy against thromboembolism: subcutaneous enoxaparin 40mg given 12 h before insertion of epidural catheter and sustained as 40mg once daily until discharge.
8. The continuation of medicines the patient is already taking.
9. Starting at midnight before the surgery, patients did not take any medications recognized to cause longterm sedation. Short-acting drugs only allowed to aid in insertion of epidural catheter.

Standard surgical technique

1. All patients underwent abdominal colorectal surgery.
2. The laparoscopic approach was considered as the first-choice surgical technique, and if not possible, conventional laparotomy was carried out with smallest incision, and transverse incisions was preferred.
3. To minimize postoperative pain, wounds were infiltrated with a local anesthetic agent before closure.
4. No regular placement of intra-abdominal drainage.
5. The NGT was removed inside the operating theater at the time of extubation.

Postoperative items for enhanced recovery after surgery pathway

1. Immediate postoperative monitoring was completed in the postanesthesia care unit. Subsequent to full recovery, patients were shifted to ordinary ward.
2. Postoperative analgesia: in postanesthesia care unit, patients received a continuous epidural low-dose local anesthetic (0.125% bupivacaine) as well as a low-dose opioid (2 mg/ml of the analgesic solution). Ketorolac 1 mg/kg was given means three times a day (TID) till patients were able to tolerate enteral feeding, and then oral analgesia was provided.
3. Throughout the postoperative period, patient controlled analgesia pumps were not used.
4. Metoclopramide hydrochloride was received if nausea or vomiting really occurred.
5. Early ambulation: patients were managed in a situation that encouraged independence and quick mobilization.
6. Patients were strongly enforced to be out of bed on the day of the surgery, and then mobilized not less than 2 h throughout the first postoperative day.
7. Immediate postoperative cessation of intravenous fluids; 6 h postoperatively, patients restarted a liquid diet. Twelve hours postoperative patients were allowed to eat the semisolid meal sitting at the table.
8. On the first postoperative day, patients were reassessed and the care plan was discussed again.
9. Urinary catheter was removed (except in patients who underwent low anterior rectal resection or abdomino perineal resection, in whom it was removed on the second postoperative day).
10. On the second postoperative day, ordinary hospital meals were allowed. The epidural catheter was removed.
11. On the third post operative day, assessment of patient status and discharge was approved according to discharge criteria, which were as follows: patient should be alert and oriented, no fever, no tachycardia, tolerance of oral feeding, pain control with oral analgesia, mobilized independently, and suitable care at home. (Passage of flatus or stool was not considered at the time of discharge.)
12. Post discharge care: at the time of discharge, patients of the ERAS group were instructed how to contact the hospital when needed; moreover, they received a phone call by the anesthetist 1 day after discharge.

Follow up

Patients of both groups attended a follow-up outpatient visit on the seventh postoperative day and every 1 month for 3 months

Statistical analysis

Data was collected in Microsoft excel version 365. Descriptive statistics for quantitative variables was represented as mean $\pm$ SD. Qualitative variables was represented as frequency & percentages. Unpaired or Mann Whitney test was use to calculated categorical variants. Graphical representations were done wherever applicable. Level of significance will be considered as $P \leq 0.05$. Software used for analysis was Graph pad prism.

Results

In our study 100 participants were enrolled and were divided in two group, one group followed standard protocol and other group follows ERAS protocol. The Demographic characteristics of the patients were as follows:Table 1

Table 1. Demographic characteristics

characteristic	Conventional	ERAS	P value
Age(in years)	47.48 $\pm$ 4.22	48.42 $\pm$ 5.81	0.21*
Gender			
Male	17	21	0.53**
Female	33	29	
BMI	27.02 $\pm$ 1.67	27.56 $\pm$ 2.01	0.13*
Duration of surgery	135.2 $\pm$ 15.53	133.2 $\pm$ 11.09	0.46
Comorbidities			
Hypertension	21	25	0.88
Diabetes	25	23	
COPD	16	14	
Asthma	18	15	
Chronic renal disease	10	7	

* Mann Whitney test

We found statistically significant difference amongst both the groups in terms of the studied parameters viz. Time for 1st flatus , 1st defecation , time to tolerance of diet , time to normal routine and hospital cost. ERAS protocol reduces the overall time of the study outcomes and hospital cost for the patients than conventional programme. Table 2

Table 2. Study outcome in conventional and ERAS group

Parameter	ERAS	Conventional	P value
Time for 1st flatus (mins)	28.48 $\pm$ 3.80	33.86 $\pm$ 3.32	<0.0001*
Time for first defecation	59.32 $\pm$ 7.00	74.76 $\pm$ 8.12	<0.0001*

(mins)			
Time to tolerance of diet (mins)	149.92 ± 21.05	235.96 ± 16.65	<0.0001*
Time to normal routine (days)	43.82 ± 5.48	66 ± 8.72	<0.0001*
Hospital stay (days)	8.64± 1.42	12.46 ±1.46	<0.0001*
Readmission within 30 days of discharge	5	11	0.17
Complications	8	13	0.32
Hospital Cost (in INR)	11726.88 ± 1391.2	14168.3 ± 1389.3	<0.0001*

*Mann Whitney test

Discussion

The present study was an observation study conducted in department of surgery after obtaining permission from institutional ethics committee. In our study 100 participants were enrolled and were divided in two group, one group followed standard protocol and other group follows ERAS protocol. Demographic characteristics of patients enrolled in our study showed, the average age in conventional group was 47.48 ± 4.22 years while in ERAS group was 48.42 ± 5.81 years. No significant difference ($p=0.21$) was seen in the mean age of participants enrolled in two group. Females were in majority in both the groups (66% in conventional group and 58% in ERAS group) but no significant difference was seen in the gender wise distribution among the two group. Similar results were seen in study conducted by Lohsiriwat V. ⁴ where no significant difference was seen in basic demographic characteristics of patients. In his study the average age of participants in ERAS group was 57.6 ± 13.2 years while those in Non ERAS group was 62.0 ± 13.2 , but males were in majority in his study in both the group. Similar results were seen in study conducted by Elgohary et al ⁸ where the average age of participants in ERAS group was 60.5 ± 10.67 years while those in Non ERAS group was 58.2 ± 11.13 years, and males were in majority in his study in both the group, 67.5% in conventional group and 60% in ERAS group. Results similar to our study was seen in study conducted by El-Shakhs ¹¹ where the mean age of patients in ERAS studied group was 42.8 ± 14.98 years and most patients in the studied group were female (80%).

The average BMI among participants in conventional group was 27.02 ± 1.67 and in ERAS group was 27.56 ± 2.01 . No significant ($p=0.13$) was seen in the average BMI among the two group. Yilmaz et al ¹² in their study reported average BMI in ERAS group as 29.69 ± 5.01 and I conventional group as 30.55 ± 5.55 , with no significant difference. Similar results were seen in study conducted by Ripollés-Melchor et al ¹³ where no significant difference was seen in BMI among patients in both group. Lohsiriwat V and colleagues⁴ also reported no significant difference in BMI among patients in two groups.

No significant difference ($p=0.46$) was seen in the average duration of surgery in conventional (135.2 ± 15.53 mins) and ERAS group (133.2 ± 11.09 mins). Similar results were seen in study conducted by Elgohary et al ⁸ where the average duration of surgery in conventional was 155 ± 9.6 mins and ERAS group was 160 ± 5.4 mins and no significant difference in two group. Hypertension and

diabetes were the two most common co-morbid conditions in our study group. But, no significant difference was seen among the study group. Other co-morbid condition were COPD, asthma and chronic renal failure. Similarly hypertension and diabetes were common in study conducted by Elgohary et al.⁸ with no significant difference between group. Ripollés-Melchor et al.¹³ in his study also reported hypertension and diabetes to be most common associated condition with no significant difference.

Early recovery of bowel function was seen in our study, with significant difference ($p < 0.0001$) seen in ERAS group in time for 1st flatus, time for first defecation and recovery of normal diet. Lohsiriwat V et al.⁴ in their study also reported shorter time to first flatus in ERAS group (1.6 d vs 2.8 d, $P < 0.001$) and time to resumption of normal diet (3.5 d vs 5.5 d, $P = 0.002$), but not time to first defecation (3.4 d vs 3.7 d, $P = 0.428$). similar results were reported by Elgohary et al.⁸ where patients in the ERAS group had a shorter time to first flatus (55 vs. 20% in the first postoperative day) and a shorter time to resumption of normal diet, ($P < 0.001$) which is statistically significant. Yilmaz G et al.¹² in their study reported time to first flatus ($p = 0.001$), time to first defecation ($p < 0.001$), and time to eating solid food ($p < 0.001$) all significantly shorter in the ERAS group. The above results might be partly due to the combination of the administration of postoperative nausea/vomiting prophylaxis, judicious fluid therapy, and the preferential use of non-opioid analgesia in the ERAS pathway.⁴ Marx et al. demonstrated that 50% of the patients in the ER group had their first defecation within 48 h after surgery.¹⁴

The average hospital stay in ERAS group was 8.64 ± 1.42 days as compared to 12.46 ± 1.46 days in conventional group. Significant difference ($p < 0.0001$) was seen in the hospital stay duration among them. Also, time to get back to normal routine in life was less in ERAS group (43.82 ± 5.48 days) as compared to conventional group (66 ± 8.72 days). Elgohary et al.⁸ in their study reported ERAS group was associated with a significant decline in mean postoperative hospital stay, which was 3.8 ± 1.95 days in comparison with 8.5 ± 1.52 days for conventional group. Median of hospital stay was significantly shorter in the ERAS group compared with non-ERAS group [5.5 d (range: 3-16) vs 7.5 d (range: 5-25), $P = 0.009$] in study conducted by Lohsiriwat V et al.⁴

Implementation of ERAS protocol ensured fast-track postoperative recovery, and shortened hospital stay was demonstrated in a study by Carter et al. on 72 patients who had undergone laparotomy, the researchers observed that application of ERAS protocol enabled discharge within a short time¹⁵. Still, the same author in his earlier study on 389 patients who had undergone laparotomy with the indication of gynecologic cancer and indicated that though elder people had generally lower ASA scores, their operative times, and blood loss relatively decreased. Although their hospital stays had been longer when compared with younger patients, their complication rates had not increased¹⁶. Çağlı et al. performed a study on 100 patients aged > 65 years who had undergone coronary artery surgery, and observed significantly shorter intensive care unit stay, and decreased time interval to their discharge in patients who were under ERAS protocol.¹⁷ According to Relph et al. postoperative hospital stays after vaginal hysterectomy was an average of 42.9 hours in patients who received conventional

postoperative care, and 23.5 hours in patients who were treated with ERAS protocol.¹⁸

No significant difference was seen in the rate of complications ($p=0.32$) and readmission ($p=0.17$) among ERAS and conventional group in our study. This was in contrast to study conducted by Teeuwen PH et al.³ where significant difference ($p=0.008$) was seen in the complication rate in ERAS group and conventional group but no difference in the readmission rate (3.3% vs. 1.6%; $P=0.60$). Relph et al.¹⁸ investigated 90 patients who underwent vaginal hysterectomy, and revealed that 15.6 % of these patients who received conventional health care had applied to the emergency service after their discharge, while none of the patients in the group which received ERAS protocol had applied to the emergency service.

In study conducted by Yilmaz et al.¹², although there were no significant differences in complications, readmission rates differed significantly. One patient in the ERAS Group and 11 patients in the Conventional Group required hospital readmission after discharge. Marx et al.¹⁴ found that the rate of cardiopulmonary complications and sepsis was 75% higher in the C group than in the ER group. This is the result of the fast-track pathway, which involves reduced intraoperative fluid administration, early completion of postoperative IV fluid administration and routine antibiotic prophylaxis.

In our study significant difference ($p<0.0001$) was seen in cost involved in two group. Gerardi et al.¹⁹ included a financial aspect in their study, demonstrating that fast-track pathway directed management was associated with a median reduction in hospital cost of \$5410 per patient in comparison to the conventional approach. According to Nelson et al. 2014 the most important elements of enhanced recovery such as early diet and mobilization, may be implemented at low or no cost, and universally improve patient comfort and satisfaction²⁰. There was a general view that fast-track surgery programs would save money in terms of reducing hospital stay. Almost all studies showed decreases in costs. Evaluations varied widely, with some including only hospital costs and others attempting to quantify costs more broadly. This is an important consideration given that any cost reduction shown in the included studies could be tempered by transference of costs to community health services, which could potentially result from a shortened LOS. Similarly, there are few studies reporting on the indirect costs associated with surgery, such as convalescence before resuming employment and a prolonged inability to participate in day-to-day household and community activities.¹⁸

Thus in our study, the use of ERAS pathways has resulted in more rapid surgical recovery, shorter length of stay, greater patient satisfaction, and decreased costs when compared with traditional approaches. The implementation of the ERAS program requires collaboration from all members of the surgical team. Successful ERAS pathway implementation across the spectrum has the potential to improve patient care and health care delivery systems, and the use of ERAS pathways should be strongly encouraged within institutions.

Conclusion

Our study concludes that

- ERAS protocol leads to early recovery of bowel function in terms of time for 1st flatus, time for 1st defecation and time to tolerate normal diet
- ERAS protocol leads to lesser hospital stay
- ERAS protocol lead to early recovery to normal life
- ERAS protocol lead to lesser cost to the patients, in terms of hospital cost
- Though no significant difference was seen, ERAS protocol lead to lesser complication and readmission rate.

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