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Methods: After comprehensive data collection, the study protocol was designed considering The SAGES/ERAS® Society Manual of Enhanced Recovery Programs for Gastrointestinal Surgery. A total of 52 oncosurgical cases were studied. Pre-, intra-, and postoperative outcomes were recorded,and using ANOVA, observations related to various organ systems involved in the surgery, such as gastrointestinal, genitourinary, hepatopancreatobiliary and gynecological, were compared. The included surgeries were gastrectomies, pancreatobiliary resections, colorectal resections, nephrectomies, radical cystectomies, Wertheim's hysterectomies, total abdominal hysterectomies, and bilateral salpingo-oophorectomies.

Keywords: enhanced recovery after surgery (ERAS), multisystem surgical outcomes, "fast-track" programs, anova, surgical oncology.

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Results: ANOVA revealed that the mean operative times; mean blood loss; nasogastric tube retention period; mean day of appearance of bowel sounds and that of passage of flatus; mean ambulation day; and visual analog scores on days 1 3, and at discharge did not differ significantly ($P < .05$) for any given surgery performed as per the protocol irrespective of the organ system involved. However, mean values of number of drains; epidural catheter removal; Foley's catheter removal; and day of starting oral sips, liquid diet, soft diet, and full diet were significantly different for various organ systems operated as per the protocol.

Conclusion: Conventional attitudes, fundamental changes, and non intuitive protocols have found an uneasy reception in most of the surgeons. ERAS is feasible to use in vivid abdominal oncosurgeries because it renders shorter hospital stays. Quicker return to physiological normalcy without morbidity and mortality risks to patients is the foremost advantage in most of the cases.

Keywords: enhanced recovery after surgery (ERAS), multisystem surgical outcomes, "fast-track" programs, anova, surgical oncology.

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I. INTRODUCTION

Enhanced recovery after surgery (ERAS), first introduced by Danish physicians Wilmore and Kehlet, consists of a series of evidence-based procedures for optimizing perioperative treatment.[1] ERAS was designed to reduce the

length of hospital stay, relieve patients' psychological stress response, and reduce perioperative complications.[2] ERAS has been applied in various procedures of gastrointestinal and urogynecological surgeries. ERAS protocols are multimodal perioperative care pathways maintaining organ function and reducing the profound stress response postoperatively. The key elements of ERAS protocols include preoperative counseling, optimization of nutrition, standardized analgesic and anesthetic regimens, and early mobilization.[1,3-6] Despite the significant body of evidence indicating that ERAS protocols lead to improved outcomes,[7,8] they challenge traditional surgical doctrine; as a result, their implementation has been slow. ERAS or "fast-track" programs have become important aspect to focus in perioperative management after colorectal surgery,[9] vascular surgery,[10] thoracic surgery,[11] and more recently, other abdominal surgeries such as radical cystectomy.[5,6,12] These programs have been shown to lead to reduction in complications and hospital stay, improvements in cardiopulmonary function, earlier return of bowel function, and earlier resumption of normal activities.[7,13]

II. METHODS

2.1 Literature study

To screen published articles reporting the outcomes of the ERAS program in patients, literature review was performed comprehensively using following databases: Medline (via PubMed), Embase, and the Cochrane Central register of Controlled Trials (Cochrane Library). Following Medical Subject Headings (MeSH) search terms were used: "fast track surgery," "fast-track rehabilitation," "enhanced recovery protocol," or "enhanced recovery after surgery." After comprehensive data collection, the protocol to be followed during the study was prepared considering The SAGES/ERAS® Society Manual of Enhanced Recovery Programs for Gastrointestinal Surgery. To check any study which might have been missed, we verified the reference lists of all related articles and published abstracts from authoritative academic conferences.

2.2 The protocol

2.2.1 Preoperative management

i. Preoperative counseling: tobacco abstinence, 4 weeks alcohol abstinence, 4 weeks
ii. Fluid and carbohydrates: solid food, 8 h before surgery light food, 6 h before surgery fluids (12.5% carbohydrate- containing drink), up to 800 mL overnight the night before and up to 400mL 2 h before surgery as and when required
iii. No prolonged fasting
iv. No/selective bowel preparation with oral antibiotic
v. Skin preparation: Iodine soap bath
vi. No premedication/sedative
vii. Routine thrombo-prophylaxis, if indicated

2.2.2 Intraoperative management

i. Mid thoracic epidural to be used wherever possible
ii. No/minimal drains
iii. No NG tube wherever possible or removal after procedure
iv. Avoid salt and water overload
v. Maintenance of normothermia
vi. Saline wash before closure

2.2.3 Postoperative management

i. Epidural early removal
ii. NG tube early removal
iii. Nausea/vomiting prophylaxis to be used
iv. Avoidance of salt and water overload
v. Early Foley's removal
vi. Early ambulation
vii. IVF management (as per NICE guidelines for resuscitation and maintenance fluids)
viii. Nonopioid/oral analgesic use with assessment of postoperative pain with visual analog scale (on days 1 and 3,and at discharge)
ix. Early stimulation of gut motility (chewing gums or oral sips)

2.2.4 Meta-analysis

A total of 52 cases were studied on the basis of preoperative (nbm protocol, bowel preparation, antibiotic prophylaxis, and premedication), intraoperative (type of anesthesia, blood loss,

number of drains, and operative times) and postoperative (day of removal of epidural, nasogastric, and Foley's catheters; postoperative distension; day of passage of flatus; appearance of bowel sounds; day of commencement of oral sips, liquid diet, soft diet, and full diet; day of ambulation; postoperative pain score on the visual analog scale on days 1 and 3, and at discharge; antibiotic coverage; analgesia; drain output on day 1, day 3, and day of removal; and postoperative complications and their management) parameters. The included surgeries were gastrectomies, pancreatobiliary resections, colorectal resections, nephrectomies, radical cystectomies, Wertheim's hysterectomies, total abdominal hysterectomies, and bilateral salpingo-oophorectomies. Esophagectomies were excluded from oral early feeds, but enteral feed in the form of jejunostomies was initiated as early as at day 1.

The differences between two or more aforementioned groups were determined using ANOVA. Additionally, the study included a comparison of varied abdominal oncosurgeries and their respective outcomes after application of the ERAS protocol.

Uniqueness of the study

- Varied range of abdominal oncosurgeries were studied under the ERAS protocol.
- Outcomes of the ERAS protocol in gastrointestinal, genitourinary, hepatopancreatic biliary, and gynecological procedures were compared.
- Comprehensive assessment of various parameters in the postoperative period was performed.

III. RESULTS

Demographic data:

Mean age of the study population was 53.42 ± 14.51 years.

Table 1: Age-wise distribution of the study population

Age group (years)	Percent (%)
<50	42.3
51-60	23.1
61-70	26.9
>71	7.7

Maximum percentage of the study population was <50 years (42.3%) and minimum was >70 years (7.7%).

Table 2: Sex-wise distribution of study subjects

Gender	Frequency	Percent (%)
Female	36	69.2
Male	16	30.8
Total	52	100.0

Females and males constituted 69.23% and 30.76% of the study population, respectively.

Preoperative preparation:

The nil per oral protocol was followed in 46 (88.5%) patients. Overall, 51 (98.07%) patients were given minimal bowel preparation as per the protocol. Overall, 37 (71.2%), 13 (25%), and 1 (1.9%) patients received lime-based sodium preparation, polyethylene-glycol-based preparation, and oral and proctoclysis enema, respectively.

Preoperative antibiotic prophylaxis was given to 43 (82.69%) patients in the form of oral amoxicillin plus clavulanic acid.

Overall, 24 patients were hypertensive and were given a preoperative morning dose of antihypertensive medication, whereas 3 patients were diabetic and were given a morning dose of antidiabetic medication. Thus, 27 (51.92%) patients had comorbid conditions.

Intraoperative statistics:

A total of 49 (94.23%) patients received general with epidural anesthesia, and others received only general anesthesia. The mean blood loss per surgery was 367.3 ± 180.38 mL. The mean operative time was 195.76 ± 76.14 min. The mean number of drains used per surgery inclusive of all specialties was 1.34 ± 0.71.

Postoperative statistics:

The patients received antibiotic coverage of cephalosporins, aminoglycosides, antiprotozoal, and penicillin-based drug combinations. For nonopioid patients, selective analgesia was used, and opioids were used only as last resort. All patients were ambulated on mean day 2.54.

The epidural catheter was removed on day 1.69 ± 0.70, whereas the nasogastric tube and Foley's catheter were removed on day 2.03 ± 0.73 and 2.90 ± 1.56, respectively.

The mean drain output on day 1, day 3, and day of removal was 116.80 ± 79.00, 58.26 ± 68.98, and 3.88 ± 1.88 cc, respectively.

Mean days of passage of flatus and arrival of bowel sounds were 2.38 ± 0.66 and 2.26 ± 0.74, respectively.

Oral sips and liquid diet were commenced on days 2.4 ± 0.95 and 3.09 ± 1.27, respectively. Soft diet and full diet were commenced on mean day 3.74 and 4.07, respectively. This was well-tolerated by 50 (96.15%) patients, whereas 2 patients required reversal to nil per oral status but were managed medically.

Pain scores, as assessed with the visual analog scale, on days 1 and 3, and at discharge were 3.34, 1.78, and 0.32, respectively.

Overall, 2 (3.84%) patients experienced complications in the postoperative period. One patient with known diabetes and hypertension suffered acute kidney injury, which was managed medically. The other patient suffered from anastomotic leak, which was managed with re-exploration and repair.

Table 3: Organ systems involved in surgery

Organ system involved in surgery		Frequency	Percent (%)
	GI	21	40.4
	GU	7	13.5
	GYNAEC	22	42.3
	HPB	2	3.8
	Total	52	100.0

GI: gastrointestinal, GU: genitourinary, GYN: gynecology, HPB: hepato-pancreato-biliary

System-wise distribution:

Of the 52 surgeries, 42.3%, 40.4%, 13.5%, and 3.8% were gynecological onco-, gastrointestinal, genitourinary, and hepato-pancreato-biliary surgeries, respectively.

Table 4: System-wise comparison of various parameters

	Groups	Mean	Std. Deviation	ANOVA *F* Values	*P* Values
No. of drains	GI	1.4762	.87287		
	GU	2.0000	.63246		
	GYN	1.0870	.28810	3.574	0.021
	HPB	1.0000	1.41421		
	Total	1.3462	.71083		
Operative time	GI	207.6190	109.63142		
	GU	216.6667	46.33213		
	GYN	179.5652	36.24140	0.654	0.584
	HPB	195.0000	63.63961		
	Total	195.7692	76.14090		
Blood loss	GI	385.714	237.77240		
	GU	366.666	136.62601		
	GYN	360.869	133.95769	0.351	0.789
	HPB	250.000	70.71068		
	Total	367.307	180.38211		
Epidural removal day	GI	2.0476	.66904		
	GU	2.3333	.51640		
	GYN	1.1739	.38755	13.524	0.000
	HPB	2.0000	.00000		
	Total	1.6923	.70122		
Ng tube removal day	GI	2.2381	.94365		
	GU	1.5000	.54772		
	GYN	2.0000	.42640	1.652	0.190
	HPB	2.0000	1.41421		
	Total	2.0385	.73994		
Foley's removal day	GI	3.4762	2.13586		
	GU	3.5000	1.37840		
	GYN	2.2609	.44898	2.854	0.047
	HPB	2.5000	.70711		
	Total	2.9038	1.56255		
Flatus day	GI	2.3810	.80475		
	GU	2.1667	.40825		
	GYN	2.4348	.58977	0.270	0.847
	HPB	2.5000	.70711		
	Total	2.3846	.66137		
Bowel sound appearance day	GI	2.1429	.96362		
	GU	2.1667	.40825		
	GYN	2.3913	.58303	0.495	0.687
	HPB	2.5000	.70711		
	Total	2.2692	.74401		
Oral sips day	GI	2.8571	1.27615		
	GU	1.8333	.40825		
	GYN	2.1304	.45770	3.326	0.027
	HPB	2.5000	.70711		
	Total	2.4038	.95506		
Liquid diet day	GI	3.8095	1.63153		
	GU	2.3333	.51640		

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	GYN	2.6522	.64728	4.698	0.006
	HPB	3.0000	.00000		
	Total	3.0962	1.27202		
Soft diet day	GI	4.6667	1.85293		
	GU	3.1667	.40825		
	GYN	3.2174	.59974	5.380	0.003
	HPB	4.0000	.00000		
	Total	3.8269	1.42418		
Full diet day	GI	5.0476	1.77415		
	GU	3.3333	.51640		
	GYN	3.3043	.70290	8.204	0.000
	HPB	5.0000	.00000		
	Total	4.0769	1.49307		
Ambulation day	GI	3.0476	2.17890		
	GU	2.3333	.51640		
	GYN	2.1304	.45770	1.504	0.226
	HPB	2.5000	.70711		
	Total	2.5385	1.47478		
VAS day 1	GI	4.5238	1.07792		
	GU	3.5000	.83666		
	GYN	4.3043	1.14554	2.185	0.102
	HPB	5.5000	.70711		
	Total	4.3462	1.11820		
VAS day 3	GI	2.7143	.71714		
	GU	2.6667	.51640		
	GYN	2.9565	.70571	1.487	0.230
	HPB	2.0000	.00000		
	Total	2.7885	.69555		
VAS day of discharge	GI	.3333	.48305		
	GU	.3333	.51640		
	GYN	.3478	.48698	.321	0.810
	HPB	.0000	.00000		
	Total	.3269	.47367		

GI: gastrointestinal, GU: genitourinary, GYN: gynecology, HPB: hepato-pancreato-biliary, VAS: visual analog scale (pain score), Ng: nasogastric

Evidently, the mean operative times were maximum for genitourinary cases and minimum for gynecological cases (P = .584). Thus, the mean operative times did not differ significantly under the protocol. The mean blood loss was maximum for gastrointestinal and minimum for pancreatic surgeries (P = .789). The nasogastric tube retention period was maximum for gastrointestinal and minimum for genitourinary cases (P = .190). The mean day of appearance of bowel sounds and that of passage of flatus were maximum for pancreatic surgeries and minimum for gastrointestinal and genitourinary surgeries, contrary to the popular belief (P = .687 and .847, respectively). The mean ambulation day and visual analogue scores on days 1 and 3, and at discharge were not significantly different in various systems involved in the surgery under the designed protocol (P = .226, .102, .230, and .810, respectively). Thus, these parameters did not change for any given surgery performed under the protocol irrespective of the organ system involved. The maximum number of drains were used in genitourinary cases and minimum in hepato-pancreato-biliary cases (P = .021). Thus, the mean number of drains differ significantly for surgeries for different organ systems under the protocol.

Epidural catheter removal, Foley's catheter removal, oral sips, liquid diet, soft diet, and full

diet were significantly different in various organ systems operated under the protocol (P = .00, .047, .027, .006, .003, and .00). Thus, the parameters of operative time, blood loss, nasogastric tube retention, appearance of bowel sounds and that of passage flatus, ambulation day, and pain scores were not correlated with the organ system involved in the surgery, contrary to the popular belief.

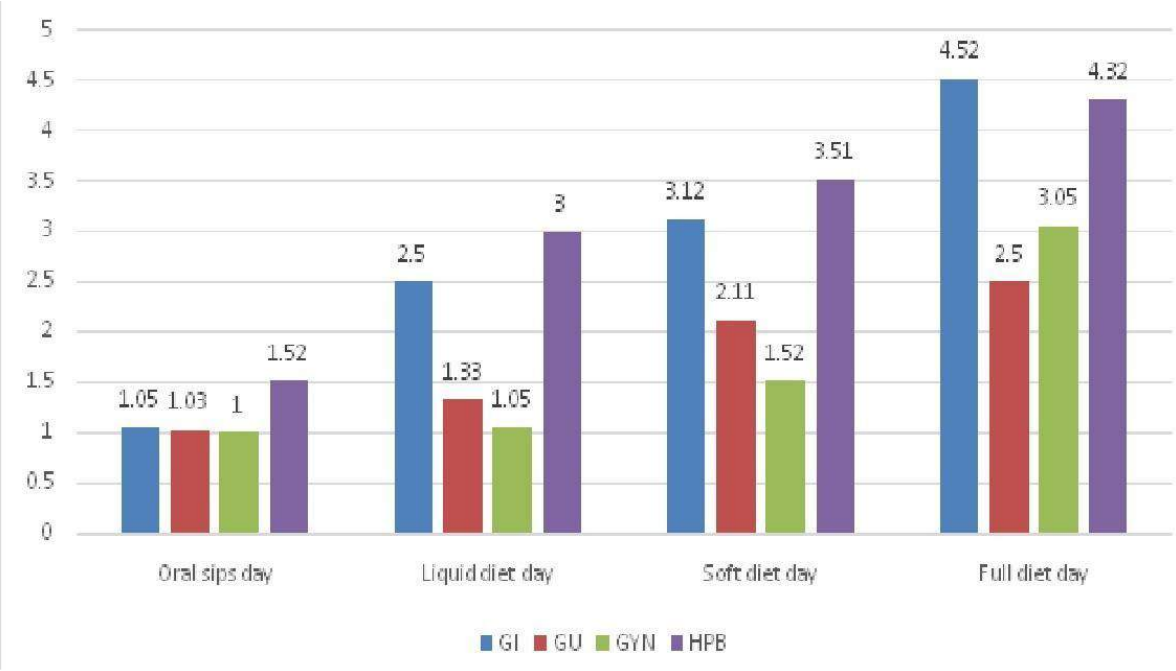

Figure 1: Comparison of commencement of diet with various organ systems.

IV. DISCUSSION

The ERAS pathway (fast-track surgery) has been described over the last 20 years.[14] Its intentions are faster patient ambulation, rapid physiological recovery, proper postoperative discharge, and quick return to work.[11] This program deals with the patients pre-, intra-, and postoperatively.[15] The concurrent use of such guidelines has a synergistic outcome, which achieved the desired goals of the program.[16] Our ERAS management plan included patient counseling, avoidance of mechanical bowel preparation and preanesthetic medications, suitable anesthesia and pain control, nasogastric tube removal with extubation, use of controlled volumes of intravenous fluids to diminish the effect of fluid overload, quick ambulation, and early enteral feeding. All steps in our ERAS program were based on scientific evidence. Some deficits in compliance were considered as acceptable.

Table 5: Comparative analysis of various study parameters with a similar study

Data	Elgohary et al [17]	Present study
Age (in years)	60.50	53.42
Male/Female (%)	60/40	30.8/69.2
Comorbidities (% sample size)	50	51.92
Mean operative time (min)	160	207
Mean blood loss (cc)	175	385
Post op complication events	4	2

Adherence to protocol (%) Preoperative counselling Bowel preparation Nil per oral Nonopioid medication Prophylactic antibiotic Drain protocol Epidural analgesia Early oral intake Day 2 catheter removal Ambulation day Post op need for nasogastric tube Early oral intake	 100 65 70 90 95 80 60 90 100 100 15 90	 100 98.1 88.5 88.6 82.69 100 94.2 100 46.52 100 13 100
Pain scores	3.1, 2.1, 1.8	3.34, 1.78, 0.32
Passage of flatus on day 2 (%)	75	59.61
Reoperation (%)	2.5	1.9
Mortality (in no.)	0	1

As seen from Table 5, better adherence to the protocol can facilitate performance of wider range of surgeries with comparable outcomes.

Table 6: Comparative analysis of multiple international trials

	Lassen et al [18]	Kehlet et al [1]	Walter et al [19]	Hasenberg et al [20]	Present study
Routine bowel preparation	52%-95% oral, 0%-15% enema, 3%-18% both	86%-97%, use of one or more methods	No data	96% overall	71.2% lime-based drink, 25% polyethylene glycol-based preparation, 1.9% oral and enema
Ng tube	11%-30% till day 1, 0%-17% 2 days or more, 0%-25% until bowel motion	Mean time of removal, 2.3–3.2	70%-75% avoided Ng tube	10% at day 1 or more	Mean time of removal, 1.3-2.7
Epidural anesthesia	74% overall	No data	55%-62% whenever possible	75% overall	94.2% overall whenever possible

Postoperational oral restriction	38%-96% started on day of surgery.	Mean time to drink, normally 3.1–5.3 days, and to eat, normally 4.8–6.9 days	32%-55% commenced on day 1	51% clear fluids and 13% solid foods on day of surgery	Mean time to drink, normally 1.8-4.2 days, and to eat, normally 3.74-4.07 days
Mobilization	No data	Europe 44%-63% by day 3, USA 71% by day 2 and 85% by day 3	65%-70% enforced mobilization day 1	No data	Mean ambulation day 2.54, 92.3% mobilized by day 3

Table 6 shows a comparison of the various international trials with the present study and illustrates the comprehensiveness of the study.

Thus, it can be safely stated that early ambulation, early enteral nutrition, reduction in intravenous fluids, reduction in analgesia, and earlier return of bowel function can be observed with the use of the study protocol. Additionally, this leads to a better sense of wellbeing among patients. Reduction in nosocomial infections may be an added advantage when long stays are curtailed. The earlier oral feed institution reduces the IV antibiotics analgesics and IV fluids; this has an overall positive economical impact.

The present study showed a comparative analysis of surgical outcomes in a wider range of surgeries compared with any other trial in literature.

Limitations:

The study was limited to elective procedures, and emergency procedures could not be considered. Multiple comorbidities, hemodynamic instability, active bleeding, and nutritional poverty made the implementation of the protocol difficult and impractical.

Nonabdominal surgeries were not considered in the present study; however, consideration of the protocol for the same is under trial.

V. CONCLUSION

Although growing evidence from several randomized controlled trials, systematic reviews, and meta-analyses has suggested considerable benefits from ERAS pathways, there are still major difficulties while introducing these evidence-based guidelines into routine practice.[7,21,22]

Conventional attitudes, fundamental changes, and nonintuitive protocols have found an uneasy reception in most of the surgeons.[21-24]

However, it is proved beyond doubt that the ERAS pathway is feasible to use in vivid abdominal oncosurgeries because it renders shorter hospital stays. Quicker return to physiological normalcy without morbidity and mortality risks to patients is the foremost advantage in most of the cases. Currently, the dilemma is not the use of ERAS protocols in perioperative oncosurgery or conventional care but how to improve the protocol and facilitate its distribution. As further evidence grows, structured perioperative care will evolve. Surgeons must be able to adapt their practice to incorporate these changes.

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