

COMPARISON OF TAILORED-ENHANCED RECOVERY AFTER SURGERY
VERSUS CONVENTIONAL CARE IN PATIENTS WITH DUODENAL
ULCER PERFORATIONMazher Hussain Shah^{*1}, Ch. Naveed Akhtar²^{*1}General Surgery Resident, Nishtar Hospital Multan²Professor, General Surgery, Nishtar Hospital Multan^{*1}syedmazhar1240@gmail.comDOI: <https://doi.org/10.5281/zenodo.22123159>**Keywords**

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Corresponding Author: *

Mazher Hussain Shah

Abstract

Background: Perforated duodenal ulcer (PDU) is a potentially life-threatening surgical emergency, there is significant morbidity and generally long term hospitalisation. There is a relative scarcity of evidence for use of Enhanced Recovery After Surgery (ERAS) pathways in emergency abdominal surgery, when compared to elective surgery.

Objective: To compare post-surgical outcomes of tailored-enhanced recovery versus conventional care in patients with duodenal ulcer perforation.

Methods: This was a Randomized Controlled trial that was carried out at Department of Surgery, Nishtar Hospital Multan from June 2024 to December 2024. 60 patients, aged 18-60 years were randomized evenly to both t-ERAS and conventional-care groups. The t-ERAS protocol included early mobilization, early oral feeding, multimodal non-opioid analgesia and early tube, drain and urinary catheter removal. Primary and secondary outcomes measured were hospital length of stay (LOS), need for additional analgesia, occurrence of an organ-space surgical-site infection (SSI) with leakage, and 30-day readmission.

Results: The mean hospital stay in the t-ERAS group was significantly reduced compared to that of the conventional-care group (6.12 ± 1.98 days vs 9.45 ± 4.12 days; $p < 0.001$). Extra analgesia was required by 3 (10.0%) versus 9 (30.0%) patients, respectively ($p = 0.050$). There were no differences between groups with regard to organ-space SSI with leakage or 30-day readmission.

Conclusion: A personalized ERAS pathway is safe and improves recovery after emergency Graham's patch repair and minimizes hospitalization and requirement for rescue analgesics without increasing postoperative complications.

1. INTRODUCTION

Peptic ulcer disease (PUD) is one of the most common surgical emergencies (SUs) and may be related to non-steroidal anti-inflammatory drug (NSAID) use, and is a serious complication of NU. PDU is a life threatening and mortality rate in PDU ranges 6-30% and is one of the major causes of death in peptic ulcer disease. In the 1990s,

Henrik Kehlet introduced the concept of Enhanced Recovery After Surgery (ERAS) pathways, which is now an important part of the peri-operative period in a number of surgical specialties that aim to reduce morbidity and optimize recovery after surgery. Not all of the ERAS protocols are suitable for emergency surgery; they are sometimes modified based on the

surgical procedure, the clinical situation of the patients and especially the particular challenges of emergency surgery and the needs of the institution. Some of these commonly used traditional surgical routines have then been addressed that lack scientific validity, and may actually slow down recovery or increase morbidity unnecessarily. Tandup et al. used a modified ERAS (t-ERAS) protocol in the patients with perforated duodenal ulcer and did a comparative study between 25 patients in the t-ERAS group and 25 patients in the conventional-care group. The patients in the t-ERAS group had significantly shorter hospital stays than patients in the conventional-care group (6.3 ± 2.15 days vs. 9.56 ± 4.33 days). Patients managed according to the t-ERAS protocol also experienced earlier functional recovery, including earlier return of bowel sounds (1.8 ± 0.41 vs. 2.28 ± 0.60 days), first flatus (2.52 ± 0.65 vs. 3.0 ± 0.82 days), first stool (3.04 ± 0.68 vs. 4.0 ± 0.71 days), and initiation of a liquid diet (2.24 ± 0.60 vs. 3.0 ± 0.76 days). Mohsina et al. recruited 49 patients that received the standard care and 50 patients that received ERAS care, with the supplemental analgesia also being reduced in the ERAS group compared to the conventional-care group (8.7% vs. 26.1%). [8] The ERAS group showed significantly earlier functional recovery, with shorter times to first flatus (2.0 ± 0.782 vs. 3.47 ± 1.023 days), first stool (3.52 ± 0.79 vs. 5.78 ± 1.26 days), initiation of a fluid diet (1.52 ± 0.76 vs. 4.24 ± 2.64 days), and initiation of a solid diet (2.64 ± 1.08 vs. 4.24 ± 2.64 days). While these results are promising, there is limited literature regarding the use of ERAS pathways for emergency surgery as certain aspects of ERAS pathways are not easily applicable in patients with acute surgical conditions. However, despite these promising results, limited literature exists on the use of ERAS pathways for emergency surgery, as some aspects of ERAS are not easily applicable in the presence of acute surgical conditions. Emergency surgery is very different from elective surgery as the patients are often in physiological instability, contaminated, have sepsis, come late, and are often multi-comorbid, which may all impact the perioperative management and/or postoperative recovery. This tailored approach specifically to the

clinical scenario of emergency patients may more readily be applicable than the straight implementation of the elective ERAS approach in an emergency patient. The effectiveness of tailored Enhanced Recovery After Surgery (t-ERAS) program in patients with perforated duodenal ulcer (DU) surgical treatment was assessed in our local setting. The objective of this study is to ascertain whether a CPEP (CSP) can lead to enhanced early functional recovery, reduced postoperative morbidity, reduced postoperative length of stay and improved overall postoperative outcome versus standard perioperative care. This research may provide further evidence of the feasibility and efficacy of ERAS peri-operative management in emergency surgery which may motivate other surgical colleagues in their clinical practice to implement ERAS in the treatment of perforated duodenal ulcer.

2. OBJECTIVE:

To compare post-surgical outcomes of tailored-enhanced recovery versus conventional care in patients with duodenal ulcer perforation.

3. METHODOLOGY

This was a Randomized Controlled trial that was carried out at Department of Surgery, Nishtar Hospital Multan from June 2024 to December 2025. Patients were consecutively sampled and sixty patients with a mean age of 32.1 years (range 18-60 years) who underwent surgical repair of a perforated duodenal ulcer at the time of emergency laparotomy were included in the study. Patients aged 18-60 years, who had a clinically and radiologically diagnosis of duodenal ulcer perforation and undergone an emergency open Graham's patch repair, were included in the study. Patients were randomly divided into Group A (t-ERAS) and Group B (conventional care) using sealed opaque envelopes (30 patients in each group). Using previously reported difference in hospital stay, sample size was calculated using OpenEPI at 80% power and 95% confidence level. Standard operative management was performed in both groups, which consisted of midline laparotomy, Graham's patch repair, peritoneal lavage and placement of a subhepatic

drain. Treatment after surgery varied by pathway assigned.

3.1 INCLUSION CRITERIA

Patients of all ages (18–60 years) of both sexes presenting within 48 hours of the onset of symptoms, who had been diagnosed as having a duodenal ulcer perforation (as defined above), and who were planned for Graham's patch repair were included.

3.2 EXCLUSION CRITERIA

Patients who had failed to respond to initial treatment, were pregnant, had more than one perforation or had perforations that were sealed were excluded.

3.3 DATA COLLECTION PROCEDURE

Eligible patients were recruited after obtaining ethical approval and informed written consent, and demographic and clinical data collected on pre-designed proformas. Baseline variables comprised age, gender, BMI, smoking status, diabetes mellitus and hypertension. All patients first received nasogastric decompression, rapid crystalloid resuscitation, intravenous (IV) co-amoxiclav and metronidazole, and proton pump inhibitor (PPI). The operating team performed standard midline laparotomy, Graham's patch repair, peritoneal lavage and placing a subhepatic drain. Avoidance of hypothermia was achieved by intra-operative warming. In the postoperative period, multimodal non-opioid analgesia, early oral sips, early mobilization, and planned early removal of the nasogastric tube, urinary catheter and drain were used in the t-ERAS group. Patients in conventional care were treated with

conventional opioid analgesia, delayed oral feeding, and later were removed the device.

3.4 DATA ANALYSIS

IBM SPSS Statistics version 23 was used to enter and analyze the data. The ShapiroWilk test was used to assess distribution of continuous variables and they were described as mean $\pm$ standard deviation. The categorical variables, such as gender, obesity, smoking, diabetes mellitus, hypertension, extra analgesia required and organ space SSI with leakage were reported as frequencies and percentages. Continuous outcomes were compared between the two groups with an independent-samples t test, and categorical variables with a Chi-square test. Potential confounding factors were assessed by stratifying the data by age, gender, obesity, smoking, diabetes mellitus, and hypertension. Appropriate t-tests and/or Chi-square tests were used for post-stratification comparisons. A two-sided p-value <0.05 was considered statistically significant.

4. RESULTS

The number of patients included in the study was 60 with perforated duodenal ulcers who underwent emergency Graham's patch repair. The tailored-enhanced recovery after surgery (t-ERAS) group had 30 patients while the conventional-care group had 30 patients. The average age of the population studied was 39.3 ± 11.0 years. The age of participants in the t-ERAS group was 38.4 ± 11.2 years, and 40.1 ± 10.8 years in the conventional-care group. The age, gender, obesity, smoking history, diabetes mellitus and hypertension were not different between the two groups (all $p > 0.05$).

Table 1. Study participant's profile of baseline demographic characteristics.

Parameter	t-ERAS Group (n = 30)	Conventional Care (n = 30)	p-value
Age, years (Mean $\pm$ SD)	38.4 ± 11.2	40.1 ± 10.8	0.552
Male, n (%)	24 (80.0)	23 (76.7)	0.754
Female, n (%)	6 (20.0)	7 (23.3)	0.754
Obesity, BMI ≥ 27.5 kg/m ² , n (%)	6 (20.0)	7 (23.3)	0.754
Non-obese, n (%)	24 (80.0)	23 (76.7)	—
Smoking history, n (%)	12 (40.0)	14 (46.7)	0.602
No smoking history, n (%)	18 (60.0)	16 (53.3)	—

Demographic data for both groups of treatment were comparable. The two groups (t-ERAS and conventional care) did not differ significantly in

age or gender, obesity or smoking status at baseline.

Table 2. Baseline Clinical Characteristics

Clinical Parameter	t-ERAS Group (n = 30)	Conventional Care (n = 30)	p-value
Diabetes mellitus, n (%)	4 (13.3)	5 (16.7)	0.718
No diabetes mellitus, n (%)	26 (86.7)	25 (83.3)	—
Hypertension, n (%)	7 (23.3)	6 (20.0)	0.754
No hypertension, n (%)	23 (76.7)	24 (80.0)	—

The prevalence of diabetes mellitus and hypertension were not significantly different between the two groups. This was confirmed by

the results showing no significant difference between the clinical characteristics of the randomized groups at baseline.

Table 3. Compare the length of time spent in the hospital.

Outcome	t-ERAS Group (n = 30)	Conventional Care (n = 30)	p-value
Hospital stay, days (Mean $\pm$ SD)	6.12 $\pm$ 1.98	9.45 $\pm$ 4.12	<0.001
Mean difference between groups	-	3.33 days	<0.001

The length of hospital stay was significantly reduced in the t-ERAS group compared to the conventional-care group. The mean hospital stays (M $\pm$ SD) were 6.12 $\pm$ 1.98 days for the patients in

the t-ERAS group and 9.45 $\pm$ 4.12 days for those in the conventional-care group, yielding a mean difference of approximately 3.33 days (p < 0.001).

Table 4. Needs for additional analgesics.

Analgesic Requirement	t-ERAS Group (n = 30)	Conventional Care (n = 30)	p-value
Extra analgesia required, n (%)	3 (10.0)	9 (30.0)	0.050
Extra analgesia not required, n (%)	27 (90.0)	21 (70.0)	—
Total, n (%)	30 (100.0)	30 (100.0)	—

There was less need for extra analgesia in the t-ERAS group. Three (10.0%) patients needed additional analgesics compared with nine (30.0%) patients who received conventional care.

This accounted for three times more patients who needed extra analgesia in the conventional-care group with the difference being of the pre-defined magnitude of statistical significance (p = 0.050).

Table 5. Organ-Space Surgical-Site Infection With Leakage.

Organ-Space SSI With Leakage	t-ERAS Group (n = 30)	Conventional Care (n = 30)	p-value
Present, n (%)	1 (3.3)	2 (6.7)	0.554
Absent, n (%)	29 (96.7)	28 (93.3)	—
Total, n (%)	30 (100.0)	30 (100.0)	—

Organ space SSI with leakage occurred in the t-ERAS group (no cases) and 2 (6.7%) cases in the conventional-care group. However, the difference between the observed frequency in t-ERAS and

other groups was not statistically significant (p = 0.554) although the frequency in t-ERAS was lower.

Table 6. Thirty-Day Readmission Rate

30-Day Readmission	t-ERAS Group (n = 30)	Conventional Care (n = 30)	p-value
Readmitted, n (%)	1 (3.3)	2 (6.7)	0.554
Not readmitted, n (%)	29 (96.7)	28 (93.3)	—
Total, n (%)	30 (100.0)	30 (100.0)	—

One patient (3.3%) in the t-ERAS group and 2 (6.7%) in the conventional care group were readmitted within 30 days. However, the difference was not statistically significant ($p =$

0.554), suggesting that there does not appear to be an increase in early readmission with the shorter hospital stay that was seen with t-ERAS.

Table 7. Overall Primary & Secondary Postoperative Outcome.

Postoperative Outcome	t-ERAS Group (n = 30)	Conventional Care (n = 30)	p-value
Length of hospital stay, days (Mean $\pm$ SD)	6.12 $\pm$ 1.98	9.45 $\pm$ 4.12	<0.001
Extra analgesia required, n (%)	3 (10.0)	9 (30.0)	0.050
Organ-space SSI with leakage, n (%)	1 (3.3)	2 (6.7)	0.554
30-day readmission, n (%)	1 (3.3)	2 (6.7)	0.554

Overall, t-ERAS pathway had a marked improvement in the primary outcome of hospital stay and a reduced need for additional analgesics compared to the conventional pathway. The mean hospital stay was reduced by 3.33 days in the t-ERAS group (6.12 $\pm$ 1.98 vs 9.45 $\pm$ 4.12 days; $p < 0.001$). For further analgesia, this difference was significant, 10.0% vs. 30.0% ($p = 0.050$) between the two groups. Importantly, both groups had low leakage and organ space SSI rates and these were not significantly different from each other at 30 days.

Overall Interpretation

The results showed that individualized ERAS was effective to speed up recovery after emergency Graham's patch repair surgery for duodenal ulcer perforation. The hospital stay was significantly reduced and there was a lower need for further analgesic in the patients treated with t-ERAS. Organ space SSI and 30-day readmission rates did not differ significantly between the two groups, however. Thus, it did not seem to be an increase in postoperative complications or early readmission rates for any reduction in length of stay using t-ERAS. The above results offer support to the feasibility and safety with which selected

ERAS principles can be introduced to the postoperative care of the patients treated for emergency surgery for duodenal ulcer perforation.

5. DISCUSSION

Perforated duodenal ulcer (PDU) is a serious surgical emergency which can lead to peritoneal contamination and severe inflammation, postoperative complications and long hospital stay [1]. Both the severity of the disease and the time elapsed between perforation and intervention, as well as the overall physiological condition of the patient and complications following intervention, have an impact on patient outcomes [2]. The inflammatory response could also be important as a predictor of the outcome, as a high neutrophils/lymphocytes ratio has been correlated with higher mortality rate in patients with perforated peptic ulcer [3]. Therefore, surgical repair and peri/postoperative care are required to achieve good results.

Against the above are the so-called Graham patch omentopexy, and the grubbing operation. The so called Graham patch omentopexy and the grubbing operation are well established operations for treatment of perforated duodenal ulcers which are against the other methods. Satisfactory results

can be obtained with either primary closure or Graham patch repair, depending on the size of the perforation and the patient's condition [4]. In select patients, laparoscopic repair may be considered, which may lead to better postoperative recovery [5]. But open Graham patch repair continues to be routinely performed, particularly in emergency and resource-poor environments. This, however, is still of interest as far as recovery after open repair is concerned.

Enhanced Recovery After Surgery (ERAS) is an holistic approach to reduce the surgical stress and increase the patients recovery [6]. ERAS includes multiple interventions such as early mobilization, early oral feeding and removal of unnecessary tubes and catheters, effective pain control etc. The studies investigating gastrointestinal surgery have demonstrated that ERAS leads to shorter hospital stay and better recovery outcome than the traditional postoperative care regimen [7,8]. The majority of the evidence available exists in elective surgery, however these guidelines can be used in emergency abdominal surgery.

The primary result of the present randomized controlled trial was the reduction of hospital stay in the group receiving tailored ERAS (t-ERAS) pathway. The mean hospital stay for the t-ERAS group was 6.12 ± 1.98 days, which was significantly shorter than the conventional-care group (9.45 ± 4.12 days). This represented a reduction of 3.33 days ($p < 0.001$). This distinction can have a real impact on health care costs, risk of hospital complications and rate of recovery.

As in other studies of ERAS in patients undergoing surgery for perforated gastroduodenal ulcers, the present findings indicate that it results in fewer complications. One randomized study reported an average length of stay of 6.3 ± 2.15 days with tailored ERAS compared to 9.56 ± 4.33 days with conventional care [9]. In another study, an optimized ERAS approach after emergency repair of perforated duodenal ulcer resulted in a 4.41 days shorter hospital stay and helped to earlier recovery of bowel function and oral feeding [10]. Thus, the decrease of 3.33 days reported in the present study is consistent with the previous evidence.

Surgical source control is still a key component in the care of a PDU. Evidence exists that there is a correlation between the delay in operative treatment and an increase in mortality for those patients that present in shock in particular [11]. So ERAS should not be an alternative to the fundamental concepts of the emergency management. Appropriate fluid replacement, antibiotic treatment, correction of physiological abnormalities and early surgical repair continue to be critical to successful treatment.

Patient factors, the severity of the disease and quality of preoperative and postoperative care can all influence postoperative recovery after a perforated peptic ulcer surgery. Patients with perforated peptic ulcer are potentially at a high risk for postoperative complications and early management and careful monitoring is important [12]. There is some evidence comparing open versus laparoscopic surgery and evidence that some patients may benefit from laparoscopic surgery, but open surgery is still used routinely during emergency situations [13]. This would indicate that postoperative recovery programmes should be applied depending on the clinical condition and surgical treatment applied.

The safety of the surgical repair is also important. Gastrointestinal leakage is a potential complication after repair of a perforated peptic ulcer and several factors have been identified to enhance this risk: patient-related and disease-related [14]. A total of 3.3% of patients in the t-ERAS group and 6.7% of patients in the conventional-care group had organ-space surgical site infection with leakage in the present study. There was no statistical significance between the difference ($p = 0.554$). Whilst the rate of leakage was numerically lower in the t-ERAS group, it was too small to draw firm conclusions about the effect of t-ERAS on leakage.

Patients and hospitals vary in their approach to post emergency PDU surgery care. Some differences in the peri-operative treatment of perforated peptic ulcer have been previously shown [15]. A t-ERAS pathway with a structure may help to ensure more consistent postoperative treatment whilst maintaining flexibility of treatment based upon the patient's condition.

This is especially important when performing emergency surgery because the patient may be septic, dehydrated, have electrolyte abnormalities or other physiological problems.

Quick diagnosis, resuscitation, assessment and optimization prior to surgery is also emphasized by the guidelines for emergency laparotomy [16]. Systematic peri-operative management and careful postoperative treatment is another important factor in the successful outcome following Laparotomy in an emergency [17]. ERAS guidelines are currently in favour of early mobility, adequate oral intake, multimodal pain management, selective use of nasogastric tubes and early removal of unnecessary devices after emergency laparotomy [18]. The major elements of the t-ERAS in the present study are thus in line with these guidelines.

An important aspect of t-ERAS was the pathway of early recovery of gastrointestinal (GI) function. Early oral feeding and early removal of NG tube. The strategies follow current guidance on emergency laparotomy where early oral feeding and selective use of NG feeding tubes are recommended [18]. Also, early mobilization and prompt removal of "unnecessary" urinary catheters and drains could aid in the recovery process. Surgical intervention which may be necessary after emergency laparotomy can be beneficial as the prolonged immobility and unnecessary tubes may result in delayed recovery of normal function.

Less additional analgesics required are also seen as the benefits of the t-ERAS pathway. There were 10.0% fewer patients who needed supplemental analgesia in the t-ERAS group than in the conventional-care group ($p = 0.050$). This p value was greater than the pre-determined level of significance but the threefold difference is still clinically significant. Effective pain management can be achieved by using a multimodal approach with the goal of reducing the use of other opioid medications. Opioid reduction might also help recovery of the gastrointestinal tract, as opioids can cause nausea, constipation, sedation and slowed bowel movement [18].

Thirty day readmission was also rather poor in both groups. There was no difference between the two groups for 30-day readmission rate (one

patient in the t-ERAS group vs. 2 patients in the conventional-care group, $p = 0.554$). Thus, no association was seen between early readmission and the shorter hospital stay with t-ERAS. However, the study was not extensive enough to establish any true differences in readmission rates between the two, due to the number of readmissions, which were only three.

Studies in countries around the world confirm the importance of optimal recovery following a PDU surgery. In the GRACE study, there was significant morbidity and mortality in the first 30 days after surgery for perforated peptic ulcer, which was found to be a high-risk condition in the emergency setting [19]. The latest systematic review and meta-analysis published in 2024, found no evidence that a fast-track recovery programme after an operation for a perforated peptic ulcer was associated with an increase in complications after surgery, but did reduce the time spent in hospital by approximately 3.50 days [20]. This is a pooled result of 3.33 days reduction, which is very near to the reduction observed in this present study, thus confirming the effectiveness of t-ERAS approach again.

There are some limitations of the present study. It was done in a single tertiary-care facility in which there were only 60 patients. Thus results are not necessarily generalizable to all hospitals or patient populations, and the study was not large enough to identify rare complications. They couldn't be blinded due to the differences in postoperative treatment between the two groups. Moreover, the use of opioids, pain scores, specific time to bowel function, satisfaction with recovery, quality of recovery, and cost of health care were not assessed. No long-term results were available either.

Despite the above drawbacks, the present results suggest that a simple and structured pathway of t-ERAS can aid in recovery from an emergency Graham patch repair. The results are in line with other randomized studies [9,10] and the recent meta-analysis [20]. This model could be beneficial for resource-poor hospitals, as many of its elements are based on sound clinical planning and coordination, not technology or equipment.

To summarize, the customized ERAS pathway reduced the length of hospital stay by 3.33 days

after surgery without also leading to an increase in organ space SSI with leakage or 30-day admissions. Overall, the present results suggest that certain elements of ERAS may be safely implemented for the postoperative management after urgent repair of PDU. Tailoring of interventions to the physiologic state and clinical needs of the patient should always be individualized, however, with the inclusion of ALWAYS ERAS interventions. Additional multicenter randomized trials are needed to confirm these findings and to evaluate the long-term recovery, opioid use, patient satisfaction, and cost-effectiveness.

6. CONCLUSION

Tailored enhanced recovery after surgery (t-ERAS) is a simple but effective strategy for treatment of surgical postoperative care after emergency Graham's patch repair for penetrating duodenal ulcer. The t-ERAS pathway was implemented and the length of stay in the hospital was decreased from 9.45 ± 4.12 to 6.12 ± 1.98 days and the number of patients who needed additional analgesics was reduced from 30.0% to 10.0% respectively. Importantly, no leakage/no readmission was seen to be a risk factor for SSI. These study results validate the hypothesis that the administration of multimodal, non-opioid analgesics and early oral feeding, early mobilization, and removal of NG tube, urinary catheter and drain are safe in emergency PDU care. The simplicity of the use and minimal need for additional resources make t-ERAS more likely to be of benefit in situations of high volume emergency surgery. These findings need to be confirmed in larger multicenter studies and in order to assess functional and patient satisfaction results and cost-effectiveness in the long term.

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