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Effect of the enhanced recovery after surgery (ERAS®) program on postoperative complications in the Whipple operation: A prospective cohort

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Abstract---Background: The Whipple operation treats pancreatic, bile duct, and intestinal malignancies. ERAS® usage in the Whipple surgery is seldom documented. So, this study examined how the ERAS® regimen affected postoperative complications in Whipple patients. Method: From January 2017 to December 2022, 97 patients were admitted to the general surgery department at Hayatabad Medical Complex, Peshawar, Pakistan, a tertiary care hospital. This study recruited Whipple patients. The prospective group was treated with ERAS methods, whereas the control group was handled using the non-ERAS treatment (Jan 2017–Dec 2018). The Whipple technique was performed on 18-year-olds with pancreatic, duodenum, and bile duct cancer. The present study's primary outcomes were CDC grading, surgical complications, 30-day readmission rate, 30-day re-operation for any reason, and hospital stay. SPSS 26.0 examined data.

Results: This study has 97 patients. Both groups had equal comorbidities. The ERAS® technique minimized postoperative complications, as seen by the considerable drop in CDC grading ($p = 0.003$). Non-ERAS® patients had increased mortality (2 vs. 8). ERAS® also decreased stay duration ($p = 0.001$). ERAS® patients also had a lower readmission rate ($p = 0.001$). Conclusion: The Whipple procedure's ERAS® protocol has lowered postoperative complications, duration of stay, and readmission rates. Our results suggest adding the ERAS® protocol to the Whipple operation standard of treatment. A study is needed to determine the “long-term” benefits of the ERAS® regimen in Whipple surgery and other major procedures.

Keywords--Whipple procedure, ERAS, pancreatectomy.

Introduction

Pancreatic cancer has the worst prognosis. Late diagnosis contributes to this dismal prognosis. Most early-stage patients are asymptomatic [1-3]. 6% of individuals survive five years following diagnosis. Successful Whipple procedures have a 25% five-year survival rate [4, 5]. Whipple operation, commonly known as a pancreaticoduodenectomy, removes the pancreas head, duodenum, and bile duct. The Whipple surgery often treats pancreatic, intestinal, and bile duct malignancies. This treatment is most typically used to treat head-of-pancreatic carcinoma. The Whipple technique is risky but lifesaving for pancreatic, intestinal, and bile duct malignancies [6-8]. The Whipple technique may cause bleeding, systemic infection, delayed stomach emptying, and leaking from the anastomotic site, generally the pancreas or bile duct. Surgery usually requires pancreatic removal, increasing the risk of temporary or permanent diabetes. Expert surgeons' Whipple procedures had fewer problems [9-11].

The patient-centered, evidence-based, multidisciplinary Enhanced Recovery After Surgery (ERAS®) protocol reduces pre-operative stress and anxiety, optimizes perioperative physiological functions, and reduces postoperative problems [12-14]. ERAS® includes five stages. Pre-hospital, intra-operative, postoperative, and post-discharge are these stages. This strategy emphasizes patient and family education, optimization before admission, surgery preparation, anesthetic management, and diet return. ERAS® procedure reduces postoperative complications and speeds recovery, improving patient quality of life [12, 15, 16]. ERAS® usage in the Whipple surgery is seldom documented. So, this study examined how the ERAS® protocol affected postoperative complications in Whipple patients.

Method

This prospective, observational study has a historical control group. Patients who had Whipple operation were separated into two groups: a historical control group (non-ERAS) in which the ERAS protocol was not followed (January 2017 to December 2018) and a prospective group (ERAS group) after the organizational protocol adopted ERAS (January 2019 to December 2022). The Whipple technique was performed on 18-year-olds with pancreatic, duodenum, and bile duct cancer.

Cognitive impairment, urgent surgery, acute malnutrition, postoperative critical care, and refusal to give informed permission were excluded. Our ethical review committee authorized the study, which followed the Declaration of Helsinki. The general surgery department of Hayatabad Medical Complex, Peshawar, recruited our study group from January 2017 to December 2022. One hundred two patients received the Whipple surgery (pancreatic tumor: 36.2%; periampullary carcinoma: 35.2%; distal CBD tumor: 15.6%; cancer of the second half of the duodenum: 13.7%). Ninety-seven patients were separated into historical control (non-ERAS) and prospective groups (ERAS). This study followed STROCCS criteria.

ERAS

The Whipple procedure's ERAS® protocol included patient education, no mechanical bowel preparation, postoperative multimodal analgesia, restricted intravenous fluid treatment, early oral feeding and mobilization, early nasogastric tube removal, urinary catheter, and intraabdominal drains. Table 1 shows details. ERAS® included a general surgeon, pancreatic surgeon, anesthesiologist, physiotherapist, nutritionist, and nurse. Scheduled meetings evaluated ERAS® implementation.

Results

A total of 97 patients participated in the current study. The mean age of the participants in the non-ERAS® group was 62.32 ± 9.82 , while in the ERAS® group, the mean age was 59.79 ± 5.74 . The patients in each group had equal comorbidities. General anesthesia was commonly used in the non-ERAS® group, whereas tap block was used in the ERAS® group. The details can be seen in Table 3.

Table 1
Protocol between ERAS and Non-ERAS groups

| | ERAS® group | Non-ERAS® group |
|-----------------------|---|---|
| Prior to surgery | Special informed consent | Traditional informed consent |
| | No mechanical bowel preparation | Liquid food intake |
| | Clear liquids until 4h before surgery | Overnight fasting |
| Intra-operative | Antimicrobial prophylaxis | Antimicrobial prophylaxis |
| | Epidural PCA | IV PCA |
| | Central line | Central line |
| | Nasogastric tube | Nasogastric tube |
| | Urinary catheter | Urinary catheter |
| | 2 intra-abdominal drains | 2 intra-abdominal drains |
| | Heated blanket | Heated blanket |
| | Removal of NGT | Removal of NGT if output =300 mL |
| | Mobilization out of bed | Mobilization according to patient's ability |
| | Removal of urinary catheter | Continue urinary catheter |
| Post-operative | Oral sips of water | Fasting until flatus |
| | Restricted IV fluid | Nonrestrictive IV fluid |
| | Mobilization | Mobilization according to patient's ability |
| | Oral liquids | Removal of urinary catheter |
| | Drain removal (if output < 100 ml and drain amylase less than three-fold serum) | Drain fluid amylase |
| | Oral semisolid diet | |
| | Normal diet | Oral liquids |
| Continue mobilization | Untargeted mobilization | |

Abbreviations: ERAS (enhanced recovery after surgery); IV, intravenous; NGT, nasogastric tube; PCA, patient-controlled analgesia.

Table 2
Detail of Clavien–Dindo classification (CDC).

| (Grades) | (Definition) |
|----------|--|
| 01 | any variation from the typical postoperative course that cannot be treated with medication or managed with surgery, endoscopy, or radiology. Drugs like antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physical therapy are permitted treatment regimens. Also included in this Grade are wound infections discovered at the bedside. |
| 02 | Grade I problems were permitted by the necessity for pharmacological therapy using medications other than those mentioned above. Also covered are complete parenteral feeding and blood transfusions. |
| 03 | requiring intervention that is surgical, endoscopic, or radiological |
| 04 | problems needing intensive care unit (ICU) treatment that are life-threatening |
| 05 | (Death) |

Outcome variable

The postoperative complications were rated using the Clavien-Dindo classification (CDC). According to Table 2, the postoperative problems were categorized into five categories, ranging from Grade I to Grade V. In addition, the primary outcomes of the present research were duration of hospital stay, surgical complications, readmission rate at 30 days, re-operation for any reason within 30 days, and readmission rate at 30 days.

Table 3
Demographic characteristics of the patients

| | | Non-ERAS® | ERAS® | P-value |
|---------------|-------------------------|--------------|-------------|---------|
| | | N (%) | N (%) | |
| Age (mean±SD) | | 62.32 ± 9.82 | 59.79± 5.74 | 0.127 |
| Gender | Male | 35 (50.0) | 35 (50.0) | 0.624 |
| | Female | 15 (55.6) | 12 (44.4) | |
| BMI (mean±SD) | | 24.98 ± 2.09 | 24.32± 1.97 | 0.113 |
| Comorbidities | Hypertension | 15 (53.6) | 13 (46.4) | 0.968 |
| | Diabetes Mellites | 12 (48.0) | 13 (52.0) | |
| | CHD | 6 (46.2) | 7 (53.8) | |
| | COPD | 10 (52.6) | 9 (47.4) | |
| | Other | 7 (58.3) | 5 (41.7) | |
| Anesthesia | General anesthesia | 31 (67.4) | 15 (32.6) | 0.003 |
| | combined TAP block | 19 (37.3) | 32 (62.7) | |
| Site | Pancreatic tumor | 20 (58.8) | 14 (41.2) | 0.293 |
| | Periampullary carcinoma | 14 (38.9) | 22 (61.1) | |
| | Distal CBD tumor | 8 (57.1) | 6 (42.9) | |

| | | | | |
|------------------------|--|----------------|--------------|-------|
| | Carcinoma of the second part of the duodenum | 8 (61.5) | 5 (38.5) | |
| (Length of operation) | (mean±SD) | (13.78 ± 2.30) | (12.45±2.06) | 0.003 |

The substantial drop in CDC grading ($p = 0.003$) demonstrated that the postoperative complication was dramatically decreased in patients undergoing the ERAS® treatment compared to patients who had not received the ERAS® protocol. (ERAS® vs. non-ERAS®: 2 vs. 8) The mortality was considerably more significant in the non-ERAS® group. Also, the ERAS® group's duration of stay was dramatically shortened ($p = 0.001$). Moreover, the ERAS® group had a lower risk of readmission than the non-ERAS® group ($p = 0.001$). Table 4 displays the specifics.

Table 4
Comparison of postoperative complications between the ERAS® and non-ERAS®.

| | | Non-ERAS® | ERAS® | P-value |
|---------------------------------------|------------------------------------|--------------|--------------|---------|
| | | N (%) | N (%) | |
| CDC | [Grade] | 6 (22.2) | 21 (77.8) | 0.003 |
| | [Grade II] | 8 (47.1) | 9 (52.9) | |
| | [Grade III] | 16 (61.5) | 10 (38.5) | |
| | [Grade IV] | 12 (70.6) | 5 (29.4) | |
| | [Grade V] | 8 (80.0) | 2 (20.0) | |
| Surgical complication | [DVT] | 5 (62.5) | 3 (37.5) | 0.103 |
| | [Postoperative Pancreatic fistula] | 4 (66.7) | 2 (33.3) | |
| | [Abdominal abscess] | 7 (70.0) | 3 (30.0) | |
| | Surgical site infection | 9 (60.0) | 6 (40.0) | |
| | Anastomotic leak | 8 (72.7) | 3 (27.3) | |
| Length of stay (mean±SD) | | 12.78 (2.55) | 11.17 (2.11) | 0.001 |
| Rate of 30-day all-cause readmissions | Yes | 30 (69.8) | 13 (30.2) | 0.001 |
| | No | 20 (37.0) | 34 (63.0) | |
| Rate of 30-day all-cause readmissions | Yes | 6 (54.5) | 5 (45.5) | 0.833 |
| | No | 44 (51.2) | 42 (48.8) | |

Data analysis

The data was collected on pre-formulated Microsoft forms and then exported into Microsoft Excel for datamanagement. The statistical analysis using SPSS 25.0 The categorical variable was presented as frequency and percentages, while the scale variable was tabulated as mean and standard deviation. The parametric test was applied to assess the impact of ERAS® on postoperative complications. The P-value ≤ 0.05 was considered significant.

Discussion

This study examined how the ERAS® gateway affected postoperative complications in Whipple patients. The ERAS® procedure significantly decreased (postoperative complications). The ERAS® group had a much lower CDC rating. Non-ERAS® mortality was high. ERAS® also shortened stay duration. ERAS® patients also had a lower readmission rate. Surgeons, nurses, anesthesiologists, and other specialists collaborate on the evidence-based ERAS® protocol to reduce surgical stress and improve postoperative recovery. Fast-track recuperation is ERAS® [17]. They were first used during colorectal cancer procedures. 15 Nonetheless, this treatment was evaluated and used in pancreatic, gynecological, and urological surgeries. ERAS® improved postoperative problems, healing, and hospital expenses [18].

Whipple operation is complex and has high morbidity and fatality rates. Its incidence has dropped to 2% due to surgical advances. ERAS® application in pancreatic procedures has been shown safe and practical by many systematic evaluations. ERAS® pancreatic surgery improved hospital stay, morbidity, mortality, and readmission rates [19, 20]. Our study showed that ERAS® dramatically reduced hospital stays, death, and readmission. Another study found that pancreatic procedures using the ERAS technique may shorten hospital stays without affecting outcomes like delayed gastric emptying, pancreatic fistula, death, or readmission. ERAS had decreased delayed stomach emptying, infection complications, and hospital stay in the meta-analysis. Our investigation found no differences in pancreatic fistula, severe postoperative complications, death, readmission, or re-operation [21].

Shorter hospital stays measure ERAS implementation. ERAS was favored in this study. The ERAS group had a lower hospital stay and readmission rate, suggesting that the program prevented morbidity. Conversely, ERAS in cancer procedures improved adjuvant chemotherapy's on-time beginning and completion [22, 23]. Our study's shortcomings. The study is single-center. Second, experienced surgeons may alter ERAS results. Moreover, the study's limited sample size may reduce external validity.

Conclusions

The Whipple procedure's Extended Recovery After Surgery (ERAS®) regimen reduces postoperative problems, duration of stay, and readmissions. The ERAS® protocol improves patient outcomes and decreases mortality, suggesting it should be part of the Whipple surgery standard of care. The long-term effects of the ERAS® regimen in Whipple and other primary surgery patients need further study.

Ethical Approval

(Ethical Approval was obtained from Hayatabad Medical Complex, the institutional review board)

Consent

Written informed consent was obtained from the patients for publication of this study and accompanying images. A copy of the written permission is available for review by the Editor-in-Chief of this journal on request.

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N/A

Conflict of interest

Authors have no conflict of interest to declare.

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