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Original Research

The Effect of Enhanced Recovery After Surgery (ERAS) Protocols with Tailored Anesthesia Plans on Patient Outcomes: A Prospective Cohort Study

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ABSTRACT:

Aim: This study aimed to evaluate the effect of Enhanced Recovery After Surgery (ERAS) protocols combined with tailored anesthesia plans on patient outcomes, including postoperative complications, hospital length of stay, recovery time, pain control, and patient satisfaction. **Material and Methods:** This prospective cohort study enrolled 110 patients aged 18–80 years, undergoing elective surgeries across various specialties, with ASA classifications of I–III. Patients followed ERAS protocols involving preoperative optimization, intraoperative tailored anesthesia plans, and postoperative care strategies. Data collected included demographics, surgical characteristics, adherence to protocols, and patient outcomes. Primary outcomes were postoperative complications, hospital stay length, and time to recovery. Secondary outcomes included patient satisfaction, pain scores, and 30-day readmission rates. Statistical analyses identified associations between protocol adherence and outcomes. **Results:** Of the 110 patients, 45.45% were aged 41–60 years, and 56.36% were male. ASA II patients constituted 50.00%, followed by ASA III (31.82%) and ASA I (18.18%). Abdominal surgeries were most common (45.45%). General anesthesia was used in 54.55% of cases, regional in 31.82%, and combined techniques in 13.64%. Adherence to ERAS protocols was high (86.36%). Postoperative complications were observed in 18.18% of patients, with minor complications in 13.64% and major in 4.55%. Hospital stays were ≤3 days for 72.73%, and 77.27% returned to normal function within 7 days. Patient satisfaction was high, with 68.18% reporting being very satisfied. Pain scores decreased progressively, and the 30-day readmission rate was low (9.09%). Adherence was significantly associated with preoperative counseling ($p < 0.01$) and tailored anesthesia plans ($p < 0.05$). **Conclusion:** The combination of ERAS protocols and tailored anesthesia plans significantly improved patient outcomes, including fewer complications, shorter hospital stays, faster recovery, and higher patient satisfaction. These findings emphasize the importance of personalized perioperative care and multidisciplinary collaboration, supporting the broader implementation of ERAS protocols in diverse surgical settings.

Keywords: ERAS protocols, tailored anesthesia, patient outcomes, postoperative recovery, perioperative care.

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INTRODUCTION

Enhanced Recovery After Surgery (ERAS) protocols represent a paradigm shift in perioperative care, designed to optimize surgical outcomes and accelerate patient recovery. These evidence-based multidisciplinary approaches encompass various strategies, including preoperative optimization, intraoperative management, and postoperative care, aimed at minimizing the physiological and psychological stress associated with surgery. The core principles of ERAS focus on reducing surgical trauma, preserving organ function, and promoting early recovery through a combination of standardization and individualized care.[1]Surgical procedures inherently subject the body to significant physiological stress, potentially resulting in complications, prolonged hospital stays, and delayed return to normal function. Traditional perioperative care approaches, often characterized by prolonged fasting, delayed mobilization, and over-reliance on opioids for pain management, have been linked to suboptimal recovery and increased risks of morbidity. ERAS protocols challenge these conventions by integrating practices such as carbohydrate loading, multimodal analgesia, early mobilization, and goal-directed fluid therapy, which collectively enhance

recovery and improve patient outcomes.[2]The role of anesthesia in ERAS is crucial, as it directly influences intraoperative stability, postoperative pain control, and recovery trajectories. Tailored anesthesia plans are an integral component of ERAS, focusing on personalized perioperative care to meet the unique needs of each patient. These plans emphasize minimizing the use of opioids, employing regional anesthesia techniques when appropriate, and optimizing hemodynamic stability through careful fluid management. By aligning anesthesia practices with ERAS principles, patients benefit from reduced pain, fewer complications, and faster recovery.[3]A growing body of evidence supports the implementation of ERAS protocols across various surgical specialties, including colorectal, orthopedic, gynecological, and bariatric procedures. The protocols have demonstrated significant reductions in postoperative complications, hospital length of stay, and healthcare costs, while also improving patient satisfaction and overall outcomes. Despite these promising results, the adoption and adherence to ERAS protocols vary widely across institutions and regions. Barriers such as lack of awareness, inadequate training, and resistance to change among healthcare providers can limit the effectiveness of ERAS programs.[4]Tailored anesthesia plans play a pivotal role in addressing these challenges by integrating evidence-based practices with individualized care. Preoperative assessments enable anesthesiologists to identify patient-specific risks and optimize strategies accordingly, such as adjusting for comorbidities, body weight, and surgical complexity. Intraoperatively, the use of regional anesthesia techniques, such as nerve blocks, not only reduces the reliance on systemic opioids but also contributes to superior pain control and faster recovery. Postoperative care, including effective pain management and early mobilization, is further enhanced through careful coordination between anesthesia and surgical teams.[5]This study focuses on evaluating the combined impact of ERAS protocols and tailored anesthesia plans on patient outcomes. It investigates critical metrics such as postoperative complications, length of hospital stay, recovery time, pain control, and patient satisfaction, offering insights into the synergistic benefits of integrating these approaches. By examining the effects of this combined strategy, the study aims to highlight areas for improvement and provide recommendations for optimizing ERAS programs across diverse healthcare settings.[6]One of the key objectives of this research is to explore the factors influencing adherence to ERAS protocols. High adherence rates are crucial for maximizing the benefits of ERAS, as partial implementation can dilute its impact on recovery and outcomes. Tailored anesthesia plans have the potential to drive adherence by providing a framework for standardizing care while allowing flexibility to address individual patient needs. By identifying and addressing barriers to adherence, this study seeks to promote wider implementation of ERAS protocols and foster a culture of continuous improvement in perioperative care.[7]Another important aspect of this study is the evaluation of patient satisfaction, which serves as a critical measure of the overall success of ERAS programs. Patient satisfaction reflects not only the clinical outcomes but also the quality of care, communication, and support provided throughout the surgical journey. Tailored anesthesia plans, by addressing patient-specific concerns and minimizing discomfort, are expected to contribute significantly to higher satisfaction rates.The integration of ERAS protocols with tailored anesthesia plans represents a holistic approach to perioperative care that has the potential to redefine surgical outcomes. As healthcare systems worldwide face increasing pressures to improve efficiency and reduce costs, the adoption of ERAS programs offers a compelling solution. By emphasizing multidisciplinary collaboration, evidence-based practices, and patient-centered care, ERAS protocols provide a framework for enhancing the safety, efficiency, and quality of surgical care.

MATERIAL AND METHODS

This prospective cohort study was conducted to evaluate the effect of Enhanced Recovery After Surgery (ERAS) protocols combined with tailored anesthesia plans on patient outcomes. A total of 110 patients scheduled for elective surgeries across various specialties were enrolled. Inclusion criteria included adult patients aged 18–80 years with an American Society of Anesthesiologists (ASA) classification of I–III, undergoing surgeries expected to last more than 90 minutes. Exclusion criteria encompassed patients with significant comorbidities such as advanced cardiac or pulmonary diseases, emergency surgeries, or those unable to provide informed consent.

All patients were managed according to ERAS protocols tailored to their specific surgical procedures. The ERAS framework included preoperative optimization, intraoperative management, and postoperative care strategies. Preoperative measures involved nutritional optimization, smoking cessation counseling, and administration of carbohydrate loading beverages up to 2 hours before surgery. Intraoperative management included patient-specific anesthesia plans developed based on preoperative assessments. Multimodal analgesia was emphasized, utilizing regional anesthesia techniques where appropriate, in conjunction with opioid-sparing strategies. Fluid management adhered to goal-directed therapy principles to maintain euvolemia and optimize hemodynamic stability. Postoperatively, patients were encouraged to ambulate early, resume oral intake as tolerated, and participate in physical therapy programs. Data were collected prospectively, including patient demographics, comorbidities, surgical characteristics, anesthesia methods, and

adherence to ERAS protocols. Primary outcomes assessed included postoperative complications, length of hospital stay, and time to return to normal function. Secondary outcomes evaluated patient satisfaction, pain scores, and rates of readmission within 30 days. Statistical analyses were performed using appropriate univariate and multivariate methods to determine the association between the ERAS and anesthesia protocols and patient outcomes. Ethical approval was obtained from the institutional review board, and all participants provided written informed consent prior to enrollment.

RESULTS

The study included 110 patients, with a balanced representation of age groups. The majority of patients were aged 41–60 years (45.45%), followed by 18–40 years (31.82%) and 61–80 years (22.73%). Male participants accounted for 56.36% of the cohort, while females constituted 43.64%. Regarding ASA classification, half of the patients (50.00%) were ASA II, indicating moderate systemic disease. A notable proportion (31.82%) were classified as ASA III, reflecting severe systemic disease, while the remaining 18.18% were classified as ASA I, representing healthy individuals. This demographic and clinical distribution provided a representative sample for evaluating ERAS protocols. Abdominal surgeries were the most common type of procedure (45.45%), followed by orthopedic (27.27%) and gynecological surgeries (18.18%). Other types of surgeries constituted 9.09% of cases. General anesthesia was the predominant technique used in 54.55% of cases, while regional anesthesia accounted for 31.82%. Combined anesthesia techniques were employed in 13.64% of cases. Adherence to ERAS protocols was high, with 86.36% of patients achieving complete adherence, highlighting successful protocol implementation. However, partial adherence was observed in 13.64% of patients, underscoring areas for improvement in compliance. Postoperative complications were minimal, with 81.82% of patients experiencing no complications. Minor complications, such as nausea, were observed in 13.64% of patients, while major complications, including infections, were rare (4.55%). The majority of patients (72.73%) had a hospital stay of $\leq$3 days, demonstrating the effectiveness of ERAS protocols in reducing hospitalization. Only 4.55% had stays exceeding 7 days. Similarly, 77.27% of patients returned to normal function within 7 days, further emphasizing the positive impact of ERAS protocols on recovery timelines. Patient satisfaction was high, with 68.18% of patients reporting being very satisfied and 22.73% reporting satisfaction. Neutral responses accounted for 9.09%. Pain control was effective, with the proportion of patients reporting moderate to severe pain (NRS $\geq$4) decreasing over time: 18.18% on Day 1, 9.09% on Day 3, and 4.55% on Day 7. Additionally, the 30-day readmission rate was low, with only 9.09% of patients readmitted, while 90.91% had no readmissions, reflecting the safety and effectiveness of the protocols. Adherence to ERAS protocols was significantly associated with preoperative counseling and tailored anesthesia plans. Among patients with complete adherence, 94.74% received preoperative counseling compared to 66.67% in the non-adherent group ($p < 0.01$). Tailored anesthesia plans were provided to 89.47% of adherent patients versus 66.67% of non-adherent patients ($p < 0.05$). Postoperative mobilization showed a trend toward higher adherence (92.63% vs. 80.00%) but was not statistically significant ($p = 0.12$). These findings suggest that effective preoperative preparation and anesthesia customization are key drivers of adherence to ERAS protocols.

Table 1. Demographics and Baseline Characteristics of Patients (n = 110)

Characteristic	Value (n)	Percentage (%)
Age (years)		
18–40	35	31.82
41–60	50	45.45
61–80	25	22.73
Gender		
Male	62	56.36
Female	48	43.64
ASA Classification		
I	20	18.18
II	55	50.00
III	35	31.82

Table 2. Surgical and Anesthesia Characteristics

Parameter	Value (n)	Percentage (%)
Type of Surgery		
Abdominal	50	45.45
Orthopedic	30	27.27
Gynecological	20	18.18

Other	10	9.09
Anesthesia Type		
General Anesthesia	60	54.55
Regional Anesthesia	35	31.82
Combined Techniques	15	13.64
Adherence to ERAS Protocols		
Complete Adherence	95	86.36
Partial Adherence	15	13.64

Table 3. Primary Outcomes

Outcome	Value (n)	Percentage (%)
Postoperative Complications		
None	90	81.82
Minor (e.g., nausea)	15	13.64
Major (e.g., infection)	5	4.55
Length of Hospital Stay		
≤3 Days	80	72.73
4–7 Days	25	22.73
>7 Days	5	4.55
Return to Normal Function		
≤7 Days	85	77.27
>7 Days	25	22.73

Table 4. Secondary Outcomes

Outcome	Value (n)	Percentage (%)
Patient Satisfaction		
Very Satisfied	75	68.18
Satisfied	25	22.73
Neutral	10	9.09
Pain Scores (NRS ≥4)		
Day 1 Postoperative	20	18.18
Day 3 Postoperative	10	9.09
Day 7 Postoperative	5	4.55
30-Day Readmission		
None	100	90.91
Readmitted	10	9.09

Table 5. Factors Influencing Adherence to ERAS Protocols

Factor	Adherent (n = 95)	Non-Adherent (n = 15)	p-value
Preoperative Counseling	90 (94.74%)	10 (66.67%)	<0.01
Anesthesia Tailoring	85 (89.47%)	10 (66.67%)	<0.05
Postoperative Mobilization	88 (92.63%)	12 (80.00%)	0.12

DISCUSSION

This study demonstrated the effectiveness of Enhanced Recovery After Surgery (ERAS) protocols combined with tailored anesthesia plans in improving postoperative outcomes. The distribution of age, gender, and ASA classifications in this study reflects a balanced and diverse cohort. The predominance of ASA II patients (50.00%) is consistent with previous studies that evaluated ERAS protocols. For instance, Gustafsson et al. (2012) reported a similar distribution of ASA classifications in their analysis of colorectal surgery patients, where ASA II patients constituted 48%, with ASA III patients making up 35%, aligning closely with the 31.82% in this study.[8]The majority of patients underwent abdominal surgeries (45.45%), a finding similar to that reported by Greco et al. (2014), who observed a 46% prevalence of abdominal procedures in a review of ERAS implementation.[9] The preference for general anesthesia (54.55%) and the use of regional anesthesia in 31.82% of cases also aligns with findings from previous studies, such as the work by Kehlet (2013), which highlighted the importance of multimodal anesthesia in ERAS protocols. However, our study's use of combined techniques (13.64%) was slightly higher compared to the 8–10% reported in prior research, suggesting an increased emphasis on tailored anesthesia plans.[10]Adherence to ERAS protocols was 86.36%, which is higher than the 75–80% adherence rates reported by Lassen et al. (2009). This may be

attributed to the integration of tailored anesthesia plans and enhanced preoperative counseling in our study, emphasizing the importance of personalized care in achieving high compliance rates.[11]The low rate of postoperative complications (18.18% overall, with 13.64% minor and 4.55% major) aligns with findings from previous studies. For example, Wind et al. (2013) reported a 20% complication rate in ERAS-managed patients undergoing colorectal surgery, slightly higher than the rate observed in this study. This difference may reflect the benefit of tailored anesthesia plans in further minimizing risk.[12]The hospital stay of ≤3 days in 72.73% of patients is consistent with findings by Vlug et al. (2011), who reported a median length of stay of 3 days in ERAS cohorts. Notably, only 4.55% of patients in our study had stays exceeding 7 days, compared to 7–10% in earlier studies, indicating improved efficiency in recovery processes.[13]The return to normal function within 7 days for 77.27% of patients in this study also compares favorably with prior data. According to a study by Zhuang et al. (2013), early recovery rates were reported at 70–75%, suggesting that the addition of tailored anesthesia in our study contributed to slightly better outcomes.[14]Patient satisfaction was high, with 68.18% reporting being very satisfied and 22.73% satisfied. These figures are comparable to results reported by Thiele et al. (2015), where overall satisfaction rates exceeded 85%.[15] The decreasing trend in pain scores over time—18.18% (Day 1), 9.09% (Day 3), and 4.55% (Day 7)—demonstrates effective pain management strategies, consistent with Kehlet (2013), who emphasized the role of multimodal analgesia in reducing postoperative pain.[10]The 30-day readmission rate of 9.09% in this study is lower than the 12–15% reported by previous studies, such as a systematic review by Lee et al. (2014). This improvement may be attributed to comprehensive preoperative counseling and enhanced postoperative care.[16]Adherence to ERAS protocols was significantly influenced by preoperative counseling and tailored anesthesia plans. Patients receiving preoperative counseling had a higher adherence rate (94.74%) compared to those without (66.67%), a finding that aligns with Gustafsson et al. (2012), who emphasized the role of patient education in improving compliance.8 Similarly, anesthesia tailoring significantly improved adherence (89.47% vs. 66.67%, $p < 0.05$), highlighting the importance of individualizing care plans, as supported by Kehlet (2013).[10]

CONCLUSION

This study demonstrates that the integration of Enhanced Recovery After Surgery (ERAS) protocols with tailored anesthesia plans significantly improves patient outcomes. High adherence rates (86.36%) were associated with reduced postoperative complications (18.18%), shorter hospital stays (72.73% ≤3 days), and faster recovery (77.27% within 7 days). Tailored anesthesia plans effectively enhanced pain control and patient satisfaction, with 68.18% reporting being very satisfied. These findings underscore the importance of personalized perioperative care and multidisciplinary collaboration in optimizing surgical outcomes and recovery. The study highlights the need for broader implementation of ERAS protocols across diverse surgical settings.

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