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Effects of compliance of enhanced recovery protocols in cesarean delivery: a pilot study

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Abstract

Objective: The present study examines the effectiveness of ERAS CD in improving postoperative recovery, patient satisfaction, and overall quality of life. By integrating the principles of ERAS into caesarean delivery care, the research aims to provide a comprehensive framework that healthcare providers can adopt to enhance surgical outcomes.

Materials and methods: The present interim analysis is based on a cohort of a prospective study that is being presently carried out in a tertiary university hospital. Eligible women where those that delivered at term (gestational age greater than 37+0 weeks) with planned or emergent cesarean delivery. The progression of implementation of ERAS guidelines through time was considered the primary endpoint of this interim analysis.

Results: Overall, 100 patients were included in this pilot study that involves a proportion of a larger cohort that aims to recruit 600 patients. Among recruited patients a significant proportion achieved the pre-requisite of successful completion of at least 80% of the components of ERAS CD according to current guidelines. Following sub-grouping of our cohort in 4 distinct periods that included 25 women each to evaluate the integration of ERAS CD we observed a transitional increase in the proportion of patients undergoing ERAS, that did not, however, reach statistical significance (p=.188). Nevertheless, the proportion of patients that achieved optimal ERAS CD coverage doubled between the first and fourth period, indicating positive results. Significantly, less complications were noted in the ERAS CD group, compared to controls (4/50 vs 19/50 complications, p=.002). The interval to postoperative flatus and stool significantly differed, favoring again the ERAS CD group.

Conclusion: Our research augments the growing global evidence that ERAC protocols improve maternal recovery by promoting earlier gastrointestinal function, mitigating postoperative discomfort, and reducing minor complications, all while ensuring safety.

Keywords: ERAS, enhanced recover, cesarean delivery, complications

Introduction

Over the past few decades, significant advancements have been made in perioperative care, aiming to improve surgical outcomes and fasten recovery times [1, 2]. These advancements emerged in response to the need for better surgical methods and more efficient recovery protocols. Effective management of postoperative pain with traditional methods often failed to provide adequate pain relief, leading to extended recovery times 3. This has driven the development of multimodal pain relief strategies that combine various analgesic techniques to enhance patient comfort and speed up recovery [3, 4].

Caesarean delivery, one of the most common surgical procedures worldwide, presents unique challenges in postoperative recovery [5-7]. The postoperative quality of life for mothers following caesarean delivery is often compromised by pain, immobility, and delayed return to daily activities [8-10]. With the prevalence of caesarean deliveries ranging from 10% to 40% of live births, and countries like Brazil reporting rates as high as 60% [11-13], it underscores the importance of standardized protocols that ensure the physical well being and emotional health of the women pro-,intra- and post-operatively.

The impact of perioperative management on surgical outcomes cannot be overstated. Proper perioperative care can significantly reduce complications, shorten hospital stays, and improve patient satisfaction. Enhanced Recovery After Surgery (ERAS) pathways, specifically tailored for caesarean delivery, aim to address these issues by implementing evidence-based practices throughout the preoperative, intraoperative, and postoperative phases [14].

The ERAS pathway for caesarean delivery includes preoperative counseling, carbohydrate loading, optimized anesthesia, minimally invasive surgical techniques, and early mobilization [15-17]. These components collectively contribute to reducing surgical stress, enhancing pain management, and promoting quicker recovery. The primary purpose of the ERAS pathway is to standardize care, minimize variations in practice, and ultimately improve maternal and neonatal outcomes.

This study focuses on the application of the ERAS pathway specifically for caesarean deliveries (ERAS CD). The study examines the effectiveness of ERAS CD in improving postoperative recovery, patient satisfaction, and overall quality of life. By integrating the principles of ERAS into caesarean delivery care, the research aims to provide a comprehensive framework that healthcare providers can adopt to enhance surgical outcomes.

Methods

The present cohort of women is based on a preliminary report of a prospective study that is being presently carried out in a tertiary university of hospital in Greece. Prior to enrollment in the study patients are informed about the benefits of implementing ERAS protocol in cesarean delivery and sign the appropriate consent form. Eligible women where those that delivered at term (gestational age greater than 37^{+0} weeks) with planned or emergent cesarean delivery. Cases with significant antenatal or perinatal pathology (including placenta accreta/percreta, ruptured uterus or severe preeclampsia) that could prolong their hospital stay were omitted from the study. The study was designed accordance with the declaration of Helsinki for medical research involving human subjects and the institutional review board of our hospital approved this study prior to its onset (IRB approval number: 750/24). The study is under consideration for registration in clinicaltrials.gov (Unique protocol ID: 59945).

Definitions

Current guidelines concerning the implementation of ERAS in the antenatal, preoperative, intraoperative

Table 1. Patient and intraoperative characteristics

	ERAS CD	Controls	p-value
Maternal age	31 (26-35)	29 (25-34)	.437
BMI	29 (22-34)	28 (22-33)	.236
Elective surgery	41/50	43/50	.781
Estimated blood loss (ml)	150 (100-300)	150 (100-400)	.812

and postoperative care of women were addressed in women with the aim to implement in their complete form. These briefly include preadmission education and preoperative measures to help decrease perioperative morbidity, intraoperative elements that considerably enhance the postoperative recovery and postoperative measures that help mobilize patients and diminish hospitalization [15-17]. The goal to implement at least 80% of the reported variables was set and patients were categorized in two groups; those that fulfilled the goal and those that had ERAS implemented in lower scores.

The progression of implementation of ERAS guidelines through time was considered the primary endpoint of this interim analysis. We also analyzed primary end goals of our study which is expected to be completed at the end of 2025 or with the enrollment of 600 cesarean deliveries. Variables considered are time since first flatus and stool, incidence of postoperative complications, postoperative infectious diseases, and pain scores during ambulation, at day 0, day 1 and day 2 of hospitalization. Overall quality of life, readmission data as well as pain at breastfeeding were also documented. Duration of hospitalization was not considered as almost all women that deliver with cesarean section in our institution remain until the completion of 72 hours to evaluate the course of their offspring.

Statistical analysis

Statistical analysis was performed using the SPSS 20.0 program (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Evaluation of the normality of distributions was performed with graphical methods and the Kolmogorov-Smirnoff analysis. The differences of continuous variables were assessed using the Mann-Whitney and Kruskal-Wallis test (due to the abnormal distribution that was observed during the evaluation of normality) whereas dichotomous variables were analyzed with the chi-square test. Fisher's exact test was applied wherever the number of observations was lower than five in the case of dichotomous variables. The level of significance for all analyses was set to $p<.05$.

Results

Overall, 100 patients were included in this pilot study that involves a proportion of a larger cohort that aims to recruit 600 patients. Among recruited patients a significant proportion achieved the pre-requisite of successful completion of at least 80% of the components of ERAS CD according to current guidelines. We sub-grouped our cohort in 4 distinct periods that included 25 women each to evaluate the integration of ERAS CD and observed a transitional increase in the proportion of patients undergoing ERAS that did not, however, reach statistical significance (presumably due to the relatively small sample size) (Period 1 8/25 women, Period 2 11/25 women, Period 3 11/25 women and period 4 16/25 women, p=.188). It should be noted, however, that the proportion of patients that achieved optimal ERAS CD coverage doubled between the first and fourth period, indicating positive results. Patient and surgical intraoperative characteristics are presented in Table 1. Briefly, differences in maternal age, body mass index, gestational age at delivery, surgical setting, operative duration and estimated blood loss did not significantly differ among participants.

Table 2. Postoperative outcomes

	ERAS CD	Controls	p-value
Pain at ambulation	6 (6-7)	7 (6-7)	.211
Pain 0 day	5 (4-6)	6 (4.5-7)	.037
Pain 1st postoperative day	3 (2-4)	4 (2.5-6)	.005
Pain 2nd postoperative day	2 (2-3)	3 (2-4)	<.001
Pain during breastfeeding 0 day	4 (2-6)	5 (3-6)	.496
Pain during breastfeeding 1st day	3 (2-5)	4 (2-5)	.934
Pain during breastfeeding 2nd day	3 (2-5)	3 (2-5)	.730
Overall quality of life	6 (6-7)	6 (6-7)	.25

Differences in pain outcomes and overall quality of life among patients that were treated with ERAS CD and controls. Values are depicted as median (interquartile range).

The majority of recorded complications referred to Clavien-Dindo class I complications (19 complications) whereas 4 recorded Clavien-Dindo class II complications were noted. The latter involved 3 cases that required postoperative transfusion due to persistent anemia as well as 1 case that involved a surgical site infection. Significantly, less complications were noted in the ERAS CD group, compared to controls (4/50 vs 19/50 complications, p=.002) indicating the importance of integrating enhanced recovery protocols in diminishing minor postoperative complications.

The interval to postoperative flatus and stool significantly differed, favoring again the ERAS CD group (p<.001 in both cases) (Figure 1)

Patient during postoperative ambulation was comparable among the two groups (p=.211); however, pain during the immediate postoperative period (day of operation) as well as at postoperative days 1 and 2 was significantly less prominent is the ERAS CD group (Table 2). On the other hand, the integration of ERAS

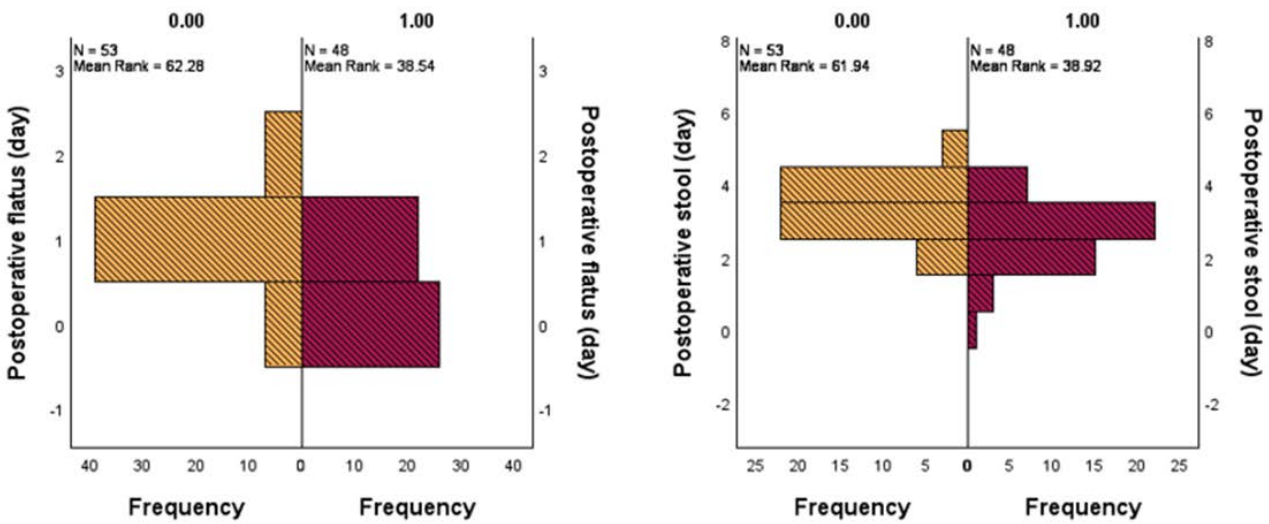

Figure 1. Time to postoperative flatus and stool (days) among ERAS patients (0.00 group) and controls (1.00 group). The x axis represents the number of patients in each group and the y axis the postoperative day at which either of the reported outcomes was observed.

did not exert significant effects in the actual incidence of pain or discomfort during breastfeeding (Table 2). Differences in the overall quality of life at discharge day indicated comparable outcomes.

Discussion

Our research highlighted that the implementation of enhanced healing after caesarean delivery regimen resulted in expedited gastrointestinal healing, reduced postoperative discomfort in the initial days, and a decrease in minor complications. It did not exacerbate discomfort during mobility or nursing, nor did it diminish quality of life at discharge. The findings were observed despite only partial compliance with ERAC components, suggesting that even incremental clinical benefits. The incremental increase in protocol compliance during the study period indicates that cultural and logistical adaptation to ERAC is attainable in a tertiary obstetric facility, albeit the improvement did not reach statistical significance. These benefits were observed within a framework of known postpartum hospitalization criteria, which limited our capacity to evaluate one of the most commonly reported ERAC outcomes, lengh of stay (LOS). Nevertheless, the observed improvements in physiological recovery and patient comfort highlight the practical and therapeutic importance of using ERAC in diverse healthcare environments.

Our findings correspond with a growing body of research supporting ERAC procedures as a safe and effective approach for improving recovery after caesarean delivery. Multiple studies have demonstrated comparable improvements in a gastrointestinal function, recognized as a sensitive measure of the quality of postoperative recovery. Uyaniklar et al. [18] showed in their research that the time to first flatus was markedly reduced in the ERAV group (10 hours) compared to the conventional treatment group (18 hours). Postoperative pain leves were greatly reduced, and no additional problems were seen. Tamang et al. [19] indicated that in a resource-constrained environment, initiating catheter removal, resulted in expendited bowel function recovery, earlier ambulation, and reduced hospital duration, without an increase in readmissions, postoperative nausea and vomiting, urinary tract infections, or wound complications. These enhancements correspond with the physiological explanation that early feeding stimulated gut motility, reduces the danger of ileus, and increases nutrition availability diminishes thromboembolic risk. Our findings suggest that certain elements of ERAC, particularly early enteral feeding and mobilization, may offer substantial benefits to postoperative physiology and should be prioritized in gradual implementation schemes.

The analgesic advantages observed in our cohort align with extensive literature indicating that ERAC might diminish opioid need without causing patient discomfort. Kleiman et al. performed a matched analysis demonstrating a substantional reduction in inpatient opioid consumption (46.1 ± 37.0 vs. 28.4 ± 24.1 morphine milligramme equivalents (MME) and daily usage (15.1 ± 10.3 vs. 10.9 ± 8.7 MME), alongside diminished peak pain scores and a decreased length of stay (LOS) [20]. Grasch et al. noted similar reductions in inpatient morphine milligramme equivalents (MME) during the first 24 hours (21.3 ± 14.1 vs. 9.4 ± 12.7) and the following 24–48 hours (25.7 ± 14.9 vs. 14.1 ± 14.9), along with a 50% decrease in outpatient opioid pill usage (median 20 vs 10 pills), while pain scored and satisfaction levels remained consistent [21].

Comprehensive initiatives, such as the 15-hospital implementation of the Kaiser Permanente network reported by Hedderson et al. [22] and the multicenter project by Combs et al. [23], corroborated these findings across varied patient populations, illustrating that structured multimodal analgesia can simultaneously improve pain management and reduce

opioid exposure. Although we did not explicitly quantify opioid consumption, the consistent reductions in pain scores across our ERAC group and the sustained functional recovery metrics strongly indicate that opioids may be less necessary. This aligns with the mechanistic advantage of the multimodal method, which employs planned acetaminophen, NSAIDs, neuraxial morphine, and local infiltration to address several pain pathways and diminish the reliance on systematic opioids.

The evidence regarding the reduction of length of stay (LOS) following the implementation of ERAS is mixed, with variations often ascribed to baseline practices and institutional release criteria rather than clinical preparedness for discharge. Mangala et al. stated that the average length of stay decreased fro 77.7 hours to 53.9 hours in India. This was primarly due to patients being fed, relocated, and having their catheters removed sooner [24]. Tamang et al. reported a similar decrease in duration of stay (about 21 hours) within a Bhutanese context, defined by traditional care practices such as prolonged fasting and delayed ambulation [19]. Birchall et al. [25] and Hedderson et al. [22] in their research observed no alteration in length stay, despite improvements in pain scores, mobilization timing, and opioid consumption. They stated this was due to stringent postpartum monitoring protocols. Teigen et al. performed a randomized controlled trial that yielded a slight decrease of roughly 2 hours in median length of stay [26]. Nonetheless, they noted elevated breastfeeding rates at release, suggesting that specific patient-centered advantages may occur regardless of discharge schedule. Our work indicates that the difficulty quantifying LOS due to rigid 72-hour postpartum stay restrictions corroborates findings from future research, highlighting the need to consider institutional constraints when LOS-related ERAC targets.

Besides maternal recovery, research suggests that ERAC may confer neonatal benefits, particularly in situations where maternal recovery fosters early and lasting mother-infant bonding. Chiao et al. noted a reduction in composite newborn problems (from 47.4% to 33.0%) with the introduction of ERAC, linked to significant decreases in hypoglycemia (12.6% to 4.8%) and jaundice (31.1% to 20.7%), as well as an increase in exclusive breastfeeding rates (67.4% to 80.2%) [27]. Teigen et al. discovered that the ERAC group exhibited a superior breastfeeding rate at discharge (67.2% vs to 48.3%) [26]. The results are likely affected be several components incorporated into ERAC protocols: preoperative carbohydrate loading to stabilize maternal and fetal glucose levels, optimized fluid balance to reduce maternal breast oedema, early mobilization to assist breastfeeding positioning, and improved maternal pain management to promote prolonged skin-to-skin contact. Although our study did not analyze neonatal outcomes, the substantial evidence supporting the indirect advantages of ERAC for neonates underscores the necessity of including these measures in future evaluations, especially in contexts where maternal-neonatal dyad care is critical.

The merits of our study include its prospective design, systematic monitoring of adherence to ERAC elements, and the evaluation of many recovery domains-pain, gastrointestinal function, functional mobility, and complications-enabling a comprehensive assessment of protocol impact. The incorporation of both elective and emergency caesarean births improves generalizability as the majority of previous studies have concentrated on elective procedures. By documenting incremental advantages in ERAC compliance, we could elucidate the feasibility and rapidity of its implementation in a practical tertiary care environment. However, it is essential to acknowledge the constraints. The single-center design and limited sample size hinder the attainment of statistically meaningful results, particularly in subgroup analysis. The lack of opioid intake data obstructs direct com-

parisons with several ERAC trials where opioid-sparing is a primary outcome. Third, the static institutional policy regarding postpartum hospitalization rendered it infeasible to assess length of stay, a critical metric in several ERAC reviews. Fourth, we did not assess patient-reported outcomes post discharge or include neonatal endpoints hence neglecting potentially critical dimensions of ERAC's influence. Ultimately, we cannot ascertain the long-term functional recovery or the sustainability of advantages beyond the initial days post-surgery due to insufficient follow-up duration.

Conclusion

Our research augments the growing global evidence that ERAC protocols improve maternal recovery by promoting earlier gastrointestinal function, mitigating postoperative discomfort, and reducing minor complications, all while ensuring safety. These improvements are feasible despite partial protocol compliance, supporting the practical implementation of ERAC components in various clinical settings. Future study should incorporate standardized opioid consumption indicators, neonatal outcomes, and long-term patient-reported measures, while also examining which specific ERAC components provide the most substantial advantages, to improve and optimize route design for maximum efficacy.

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Informed Consent Statement

Informed consent was taken from patients included in the present study, following thorough counseling, prior to their inclusion.

Institutional Review Board

The present study was approved by the IRB of our center (IRB approval number: 750/24).

Data Availability Statement

Data will become available upon reasonable request

Conflicts of Interest

The authors have no relevant financial or non-financial interests to disclose.

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