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Original Research Article

Enhanced Recovery after Surgery (ERAS) and Patient-Related Outcomes in Lower Segment Cesarean Section: A Prospective, Controlled Clinical Observational Study

Kachhara AG[1], Bhatt HA[2], Nahar A[3], Singh N[4], Sharma R[5], Kollareddy BSNR[6]

[1,2]Assistant Professor, Department of Anaesthesiology and Critical Care, American International Institute of Medical Sciences (AIIMS), Udaipur, Rajasthan, India

[3]Professor, Department of Anaesthesiology and Critical Care, American International Institute of Medical Sciences (AIIMS), Udaipur, Rajasthan, India

[4]Consultant Anesthesia, NHS Hospital, Jalandhar, Punjab, India

[5]Professor and Dean, Department of Anaesthesiology and Critical Care, American International Institute of Medical Sciences (AIIMS), Udaipur, Rajasthan, India

[6]Postgraduate Student, Department of Anaesthesiology and Critical Care, American International Institute of Medical Sciences (AIIMS), Udaipur, Rajasthan, India

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Corresponding author: Dr. Apeksha G. Kachhara

Conflict of interest: Nil

Abstract

Background: Cesarean section is one of the most commonly performed surgical procedures in obstetric practice. Conventional perioperative care frequently involves prolonged fasting, intraoperative hemodynamic fluctuations, suboptimal pain relief, delayed urinary catheter removal, and extended immobilization. Enhanced Recovery after Cesarean protocols integrate multidisciplinary, evidence-based practices across the preoperative, intraoperative, and postoperative periods to optimize maternal physiological function and accelerate recovery.

Aim and Objectives: This study aimed to evaluate the impact of an Enhanced Recovery after Cesarean protocol compared with conventional perioperative management on maternal readiness for hospital discharge, postoperative pain scores, rescue analgesic consumption, intraoperative hemodynamic stability, and functional recovery milestones in women undergoing elective lower segment cesarean section under spinal anesthesia.

Materials and Methods: This prospective, controlled clinical observational study enrolled 200 healthy pregnant women aged 18 to 40 years classified as physical status I or II scheduled for elective cesarean delivery. Patients were allocated into two equal groups of 100 each: the Enhanced Recovery group, which received preoperative counseling, shortened fasting with oral carbohydrate loading, prophylactic phenylephrine infusion, active warming, multimodal analgesia, early oral intake, early urinary catheter removal, and early ambulation; and the Traditional Care group, which received standard institutional perioperative care.

Results: Baseline demographic and spinal block characteristics were comparable between groups. The Enhanced Recovery group experienced significantly fewer episodes of intraoperative hypotension (10% versus 40%, $p < 0.001$), lower Visual Analogue Scale pain scores during the first 8 postoperative hours ($p < 0.0001$), lower Numerical Pain Rating scores throughout 24 hours ($p < 0.0001$), and reduced rescue tramadol requirement (14% versus 40%, $p < 0.0001$). Time to liquid intake (4.31 ± 0.42 versus 15.89 ± 1.18 hours), decatheterization (6.56 ± 1.00 versus 62.68 ± 9.71 hours), ambulation (7.73 ± 1.80 versus 63.63 ± 6.76 hours), and readiness for discharge (2.85 ± 0.50 versus 5.25 ± 0.61 days) were significantly reduced ($p < 0.0001$).

Conclusion: Implementing an Enhanced Recovery after Cesarean protocol significantly improves intraoperative hemodynamic stability, reduces postoperative pain and opioid consumption, accelerates functional recovery, and shortens hospital stay without increasing maternal morbidity.

Keywords: Cesarean Section, Enhanced Recovery After Surgery, Multimodal Analgesia, Phenylephrine Infusion, Postoperative Pain, and Spinal Anesthesia.

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Introduction

Cesarean delivery (CD) is one of the most frequently performed major abdominal surgical procedures in obstetric practice, with approximately 18.5 million procedures conducted

globally each year [1,2]. In India, institutional deliveries expanded substantially over a decade (2008–2009 to 2018–2019) from 96,54,924 to 197,27,034, accompanied by a sharp rise in the overall cesarean section rate from 8.9% to 20%, representing an estimated annual excess of 18 lakh cesarean births between 2010 and 2019 [3]. This rising surgical volume places considerable strain on tertiary healthcare infrastructure, increasing inpatient bed occupancy and healthcare expenditure for both families and medical institutions.

Postoperative discomfort following lower segment cesarean section (LSCS), compounded by surgical tissue trauma, neuroendocrine and metabolic stress-induced catabolism, suboptimal analgesia, delayed restoration of gastrointestinal motility, and prolonged immobilization, contributes to extended hospital length of stay (LOS), persistent maternal fatigue, delayed maternal-neonatal bonding, and heightened risk of thromboembolic or infectious morbidity. Because the vast majority of parturients undergoing scheduled cesarean delivery are young and otherwise healthy, they possess strong physiological reserve for rapid functional recovery when supported by structured perioperative pathways.

The concept of Enhanced Recovery After Surgery (ERAS) was pioneered by Henrik Kehlet in 1997 for colorectal surgery to attenuate the surgical stress response and preserve organ function through multimodal perioperative care [4,5]. The National Institute for Health and Care Excellence (NICE) guidelines subsequently recommended that women recovering satisfactorily, remaining apyrexial, and experiencing no surgical or obstetric complications following cesarean delivery should be offered early hospital discharge after 24 hours with structured home follow-up, as early discharge does not increase maternal or neonatal readmission rates [6].

In 2018 and 2019, the ERAS Society published comprehensive, three-part evidence-based guidelines covering antenatal/preoperative, intraoperative, and postoperative care in cesarean delivery [7–9], while the Society for Obstetric Anesthesia and Perinatology (SOAP) and the American College of Obstetricians and Gynecologists (ACOG) established consensus recommendations for Enhanced Recovery after Cesarean (ERAC) [10–12].

The ERAC pathway integrates coordinated interventions across the anesthesiology, obstetrics, neonatology, and nursing teams. Preoperative elements focus on structured patient counseling, anxiety reduction, limiting solid food fasting to 6–8 hours and clear liquids to 2 hours before anesthesia, non-particulate carbohydrate loading in non-diabetic mothers, preemptive analgesia, antimicrobial prophylaxis, and chlorhexidine skin preparation [7,10]. Intraoperative elements emphasize neuraxial anesthesia, prevention of spinal anesthesia-induced hypotension via prophylactic phenylephrine infusion and crystalloid co-loading, active maternal warming to maintain normothermia, dual-class antiemetic prophylaxis, and immediate skin-to-skin contact [8,10,13]. Postoperative elements prioritize early oral hydration and feeding, scheduled opioid-sparing multimodal analgesia, early urinary catheter removal (within 6–12 hours), early ambulation once motor block regresses, lactation support, and timely discharge planning [9,10].

Despite robust international endorsement, translating full ERAC protocols into clinical practice in developing countries such as India faces practical barriers, including lower maternal health literacy, rural demographics, staffing constraints, and institutional reluctance to modify longstanding fasting and immobilization routines [14,15]. Therefore, the present prospective, controlled clinical observational study was designed to implement an 11-component ERAC protocol in parturients undergoing elective LSCS at a tertiary care academic hospital in Rajasthan, India, and compare its effectiveness against traditional perioperative care with respect to maternal readiness for discharge, postoperative pain and rescue opioid requirement, intraoperative hemodynamic stability, and functional recovery milestones.

Materials and Methods

Study Design, Setting, and Ethical Considerations: This prospective, controlled clinical observational study was conducted in the Department of Anaesthesiology and Critical Care at the American International Institute of Medical Sciences (AIIMS), Udaipur, Rajasthan, India, between 2022 and 2025. Prior to participant enrollment, the study protocol was reviewed and approved by the Institutional Ethics Committee (Certificate Reference No.: AIIMSUDR/2023/4489, dated February 20, 2023). The study was conducted in strict accordance with the ethical principles of the Declaration of Helsinki and the Indian Council of Medical Research (ICMR) guidelines for biomedical research involving human participants. Written informed consent was obtained from all participating women in their native language (Hindi or English) after explaining the nature, purpose, potential risks, and benefits of the study.

Sample Size Calculation: Based on a pilot clinical observation of 20 parturients under identical selection criteria demonstrating a reduction in mean hospital stay (readiness for discharge) from 5.5 days (standard deviation [SD] = 0.52) in the conventional care pathway to 2.5 days (SD = 1.08)

in the ERAC pathway, the required sample size was calculated using the standard two-group comparison formula for continuous outcomes at a 95% confidence level (two-tailed α error = 5%, Z = 1.96) and 80% statistical power (β error = 20%, Z = 0.846) with an allocation ratio (r) of 1:1:

$$n > [(Z_{1-\alpha/2} + Z_{1-\beta})^2 \times (\sigma_1^2 + \sigma_2^2 / r)] / (\mu_1 - \mu_2)^2$$

To ensure robust statistical power across all secondary endpoints and account for potential exclusions, a total of 200 parturients were enrolled and allocated into two groups of 100 patients each: Group A (ERAC Protocol, n = 100) and Group B (Traditional Protocol, n = 100). The flow of participants through each stage of the study is illustrated in Figure 1.

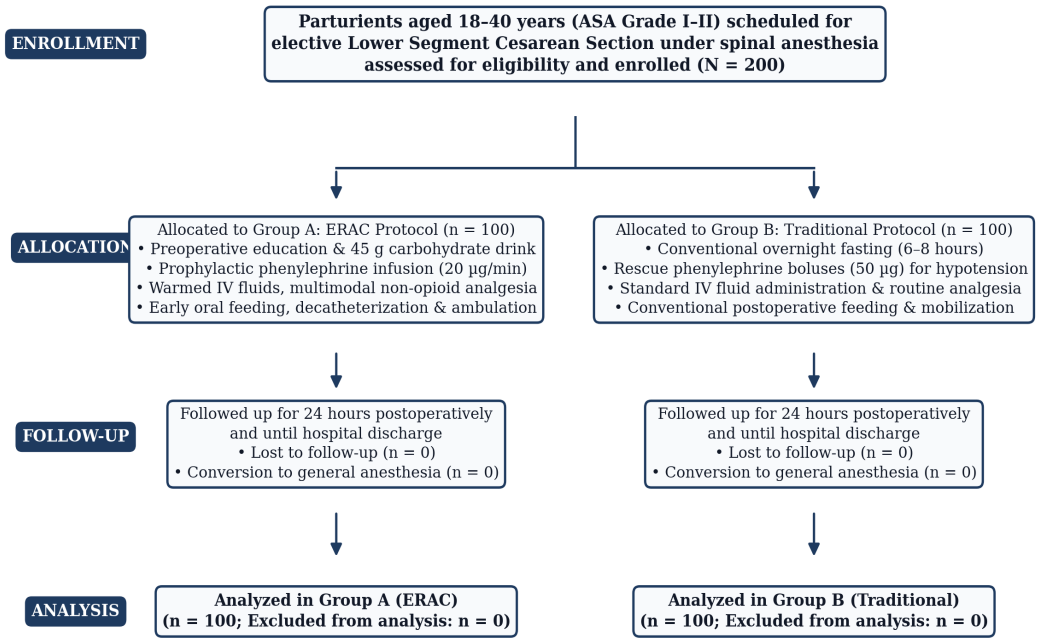


Fig. 1: CONSORT Flow Diagram of Participant Enrollment, Allocation, Follow-up, and Analysis

Inclusion and Exclusion Criteria

Inclusion Criteria: Pregnant women of childbearing age (18–40 years) with singleton term gestation, classified as American Society of Anesthesiologists (ASA) physical status Grade I or II, scheduled for elective lower segment cesarean section under subarachnoid block (spinal anesthesia).

Exclusion Criteria: Patients with pre-existing or gestational diabetes mellitus, autoimmune disorders, severe or uncontrolled pregnancy-induced or chronic hypertension, pre-existing cardiac disease, Rh-negative incompatibility, psychiatric or neurological disorders, severe uncontrolled hypothyroidism or hyperthyroidism, abnormal placentation (placenta previa or morbidly adherent placenta), or refusal to provide informed consent.

Contraindications to Spinal Anesthesia: Local infection at the lumbar puncture site, coagulopathy or bleeding diathesis, severe hypovolemia, anticipated major hemorrhage, or severe spinal deformity.

Perioperative Interventions: ERAC Protocol (Group A) versus Traditional Protocol (Group B)

All enrolled patients underwent a comprehensive Pre-Anesthetic Checkup (PAC) one day prior to surgery, including complete blood count (hemoglobin), bleeding and clotting time, prothrombin time/international normalized ratio (PT/INR), renal function tests (serum urea and creatinine), random blood sugar (RBS), and blood grouping. Preoperative anxiety and information need were evaluated using the 6-item Amsterdam Preoperative Anxiety and Information Scale (APAIS), graded on a 5-point Likert scale (1 = not at all to 5 = extremely) [16].

Preoperative Phase in Group A (ERAC): Patients received structured preoperative counseling regarding spinal anesthesia, postoperative pain assessment, early skin-to-skin contact, and early breastfeeding. Fasting was limited to 6–8 hours for solid food and 2 hours for clear liquids. Non-diabetic parturients received an oral non-particulate carbohydrate drink (100 g

glucose in 800 mL water on the night prior to surgery and 45–50 g carbohydrate in 200 mL water 2 hours prior to surgery). Morning doses of antihypertensive or thyroxine medications were administered with sips of water where applicable. Surgical site preparation was performed using chlorhexidine-alcohol along with povidone-iodine vaginal cleansing. An 18-gauge intravenous (IV) cannula was secured 1 hour before surgery, random blood glucose was recorded, dual-class IV antiemetic prophylaxis (ondansetron 4 mg IV and dexamethasone 8 mg IV) and antibiotic prophylaxis were administered prior to skin incision, aseptic urinary catheterization was performed, and a preemptive rectal suppository (paracetamol/diclofenac sodium) was inserted immediately following spinal anesthesia.

Intraoperative Phase in Group A (ERAC): Patients received co-loading with prewarmed Ringer's lactate at 20 mL/kg/h (limiting total routine IV fluids to < 3 L), active maternal warming using an inline IV fluid warmer and forced-air warming blanket with operating room ambient temperature maintained above 23 °C (72 °F), and a prophylactic IV phenylephrine infusion initiated at 20 µg/min immediately after spinal positioning to prevent spinal anesthesia-induced hypotension. Following delivery, the lowest effective dose of uterotonic (5 IU oxytocin IV slow bolus followed by 10 IU in a running infusion) was administered, and immediate skin-to-skin contact was encouraged.

Postoperative Phase in Group A (ERAC): Oral intake was initiated early with lozenges/ice chips and sips of water within 1–2 hours, clear liquids within 2–4 hours, and a semisolid/regular diet within 4–8 hours postoperatively.

The IV cannula was converted to a heparin/saline lock once oxytocin infusion was completed and oral fluids were tolerated. Scheduled opioid-sparing multimodal analgesia was maintained using IV diclofenac sodium 75 mg every 12 hours and oral paracetamol (acetaminophen) 650 mg every 6 hours. The urinary catheter was removed between 6 and 12 hours postoperatively, and assisted ambulation was initiated as soon as motor blockade regressed (Bromage 0), progressing from bedside sitting to supported walking 3–4 times daily.

Traditional Protocol in Group B (Control): Patients followed conventional institutional care, including overnight fasting (nil per os for 6–8 hours for both solids and fluids without preoperative carbohydrate loading), conventional fluid administration without routine forced-air warming, reactive treatment of spinal hypotension using intermittent IV phenylephrine 50 µg boluses rather than prophylactic continuous infusion, delayed initiation of oral liquids and solids until bowel sounds or flatus returned, routine urinary catheter retention and immobilization until 48–72 hours postoperatively, and conventional on-demand analgesic management.

Anesthetic Technique and Outcome Assessments: Upon arrival in the operating room, standard multiparameter monitoring—automated non-invasive blood pressure (NIBP), electrocardiography (ECG), pulse oximetry (SpO_2), heart rate (HR), and temperature—was established and baseline readings were recorded in the supine position. Under strict aseptic precautions, subarachnoid block (SAB) was performed at the L3–L4 (or L2–L3/L4–L5) intervertebral space in the sitting or lateral decubitus position using a 25-gauge Quincke spinal needle. Hyperbaric 0.5% bupivacaine heavy (2.0–2.2 mL; 1.5 mL hyperbaric bupivacaine + 0.5 mL [25 µg] fentanyl) was injected intrathecally after confirming free flow of cerebrospinal fluid, and the patient was immediately placed supine with left uterine displacement.

Sensory blockade was assessed bilaterally along the mid-clavicular line every 2 minutes for the first 10 minutes and every 5 minutes thereafter using a sterile 25-gauge blunt pinprick needle to record time to onset at the T10 dermatome, time to reach maximal sensory block height (T4–T6), and time to two-segment sensory regression. Motor blockade was evaluated using the Modified Bromage Scale (0 = no motor block; 1 = inability to raise extended leg; 2 = inability to flex knee; 3 = complete motor block with inability to flex ankle) every 2 minutes until Bromage 3 was achieved and postoperatively until complete motor recovery (Bromage 0). Intraoperative HR, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and SpO_2 were recorded at baseline (0 min) and at 2, 4, 6, 8, 10, 15, 20, 25, 30, 35, and 40 minutes. Hypotension was defined as a decrease in MAP > 20% below baseline and was treated with IV phenylephrine 50 µg boluses (or titrated noradrenaline infusion if refractory). Bradycardia was defined as HR < 55 beats/min and treated with IV atropine 0.6 mg.

Postoperatively, patients were monitored in the Post-Anesthesia Care Unit (PACU) for 20 minutes before transfer to the obstetric ward. Postoperative pain intensity was evaluated at 1, 2, 3, 4, 8, 12, 16, and 24 hours using both the Visual Analogue Scale (VAS; 0–10 cm) and the 11-point Numerical Pain Rating Scale (NRS/NPR; 0 = no pain, 1–3 = mild pain, 4–6 = moderate pain, 7–10 = severe pain). Intravenous tramadol 100 mg was administered as rescue analgesia for breakthrough pain (VAS ≥ 4), and total rescue analgesic doses consumed in 24 hours were recorded. Time to first oral intake (lozenges, clear liquids, semisolids), time to urinary catheter removal, need for recatheterization, time to

first ambulation, perioperative blood glucose (1 hour preoperatively and postoperatively), adverse events, and postoperative day (POD) of maternal readiness for discharge were documented.

Statistical Analysis: Data were compiled in Microsoft Excel and analyzed using standard statistical software. Continuous variables were expressed as mean ± standard deviation (SD) and median where applicable, and intergroup comparisons were performed using the unpaired Student's t-test or Mann-Whitney U test.

Categorical variables were expressed as frequencies and percentages (n, %) and compared using the Chi-square (χ^2) test or Fisher's exact test. A two-tailed p-value < 0.05 was considered statistically significant, and $p < 0.0001$ was considered highly significant.

Results

All 200 enrolled parturients (100 in Group A [ERAC] and 100 in Group B [Traditional]) completed the study protocol without conversion to general anesthesia or loss to follow-up. As shown in Table 1, both groups were statistically comparable with respect to maternal age (30.33 ± 3.29 vs. 30.39 ± 3.85 years, p = 0.91), body weight (71.35 ± 10.85 vs. 72.09 ± 13.84 kg, p = 0.83), height (156.07 ± 3.91 vs. 156.01 ± 3.78 cm, p = 0.91), gestational age (37.78 ± 0.72 vs. 37.81 ± 0.87 weeks, p = 0.90), and total duration of surgery (35.35 ± 3.82 vs. 35.50 ± 0.98 minutes, p = 0.70). Similarly, subarachnoid block characteristics—including time to sensory onset at T10 (p = 0.43), time to reach maximal sensory block height (p = 0.89), time to two-segment sensory regression (p = 0.68), and time to complete motor recovery to Bromage 0 (p = 0.89)—did not differ significantly between the two groups (Table 1).

Table 1: Comparison of Baseline Demographic Profile and Subarachnoid Block (SAB) Characteristics between Groups

Parameter	Group A: ERAC (n = 100)	Group B: Traditional (n = 100)	p-value
Demographic and Surgical Parameters			
Age (years), Mean ± SD	30.33 ± 3.29	30.39 ± 3.85	0.91 (NS)
Weight (kg), Mean ± SD	71.35 ± 10.85	72.09 ± 13.84	0.83 (NS)
Height (cm), Mean ± SD	156.07 ± 3.91	156.01 ± 3.78	0.91 (NS)
Gestational Age (weeks), Mean ± SD [Median]	37.78 ± 0.72 [38]	37.81 ± 0.87 [38]	0.90 (NS)
Duration of Surgery (min), Mean ± SD	35.35 ± 3.82	35.50 ± 0.98	0.70 (NS)
Subarachnoid Block (SAB) Characteristics			
Time to Onset of Sensory Block at T10 (min)	2.59 ± 0.78	2.62 ± 1.01	0.43 (NS)
Time to Reach Maximal Sensory Block Height (min)	4.78 ± 1.23	4.81 ± 1.04	0.89 (NS)
Time to Two-Segment Sensory Regression (hours)	1.16 ± 0.46	1.14 ± 0.19	0.68 (NS)
Time to Reach Modified Bromage Scale 0 (hours)	2.81 ± 0.56	2.84 ± 0.52	0.89 (NS)

Data are presented as Mean ± Standard Deviation (SD) or Median. SAB: Subarachnoid block; ERAC: Enhanced Recovery after Cesarean; NS: Not statistically significant (p > 0.05).

Intraoperative hemodynamic trends are detailed in Table 2 and illustrated in Figure 2. Baseline heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were comparable between the two groups ($p > 0.05$).

Following spinal anesthesia, patients in Group A (ERAC) receiving prophylactic phenylephrine infusion exhibited a modest, physiologically stable baroreceptor-mediated lower heart rate compared with Group B between 15 and 35 minutes intraoperatively ($p \leq 0.05$). Crucially, Group B (Traditional) experienced a marked drop in arterial blood pressure following spinal blockade, whereas Group A maintained superior hemodynamic stability: SBP was significantly higher in Group A at 4 minutes (113.96 ± 13.43 vs. 108.78 ± 12.46 mmHg, p = 0.005), 6 minutes (114.42 ± 14.92 vs. 101.23 ± 14.20 mmHg, $p < 0.0001$), 8 minutes (118.12 ± 17.40 vs. 105.97 ± 15.76 mmHg, $p < 0.0001$), and 10 minutes (117.31 ± 15.44 vs. 111.63 ± 16.86 mmHg, p = 0.01).

Similarly, DBP and MAP were significantly better preserved in Group A at 6 minutes (MAP: 84.00 ± 2.44 vs. 75.54 ± 8.92 mmHg, $p < 0.0001$) and 8 minutes (MAP: 85.80 ± 13.78 vs. 79.08 ± 10.58 mmHg, p = 0.0001) after spinal anesthesia (Table 2, Figure 2).

Table 2: Comparison of Intraoperative Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, and Mean Arterial Pressure at Different Time Intervals

Time Interval	HR (beats/min) Group A vs. Group B (p-value)	SBP (mmHg) Group A vs. Group B (p-value)	DBP (mmHg) Group A vs. Group B (p-value)	MAP (mmHg) Group A vs. Group B (p-value)
Baseline	96.53±15.19 vs 95.45±16.41 (p = 0.57)	122.44±11.26 vs 123.91±12.65 (p = 0.33)	74.83±10.61 vs 75.69±8.79 (p = 0.53)	90.66±9.75 vs 91.02±9.42 (p = 0.79)
2 min	98.59±16.11 vs 96.21±17.14 (p = 0.29)	117.84±13.41 vs 122.96±13.21 (p = 0.003*)	71.76±10.93 vs 74.15±7.94 (p = 0.07)	87.12±0.85 vs 90.65±9.11 (p = 0.01*)
4 min	97.58±18.06 vs 94.00±18.74 (p = 0.17)	113.96±13.43 vs 108.78±12.46 (p = 0.005*)	68.52±10.08 vs 66.59±7.18 (p = 0.12)	83.67±0.04 vs 80.65±8.01 (p = 0.01*)
6 min	91.82±16.74 vs 93.03±17.74 (p = 0.62)	114.42±14.92 vs 101.23±14.20 (p < 0.0001**)	68.79±12.32 vs 62.70±7.38 (p < 0.0001**)	84.00±2.44 vs 75.54±8.92 (p < 0.0001**)
8 min	87.37±16.65 vs 90.73±18.94 (p = 0.18)	118.12±17.40 vs 105.97±15.76 (p < 0.0001**)	69.64±13.59 vs 65.64±8.99 (p = 0.01*)	85.80±13.78 vs 79.08±10.58 (p = 0.0001**)
10 min	87.65±18.35 vs 91.90±18.80 (p = 0.10)	117.31±15.44 vs 111.63±16.86 (p = 0.01*)	69.34±12.62 vs 68.08±9.06 (p = 0.41)	85.33±12.31 vs 82.60±0.86 (p = 0.09)
15 min	86.52±18.53 vs 91.65±19.71 (p = 0.05*)	117.67±14.31 vs 115.78±14.27 (p = 0.21)	68.88±10.83 vs 69.00±7.02 (p = 0.92)	85.22±10.70 vs 84.46±8.72 (p = 0.58)
20 min	86.75±18.72 vs 92.80±19.56 (p = 0.02*)	117.19±11.11 vs 116.15±11.33 (p = 0.55)	68.03±9.13 vs 68.41±6.63 (p = 0.73)	84.38±8.40 vs 84.32±7.25 (p = 0.95)
25 min	86.15±18.41 vs 91.41±18.08 (p = 0.04*)	118.49±10.68 vs 118.89±10.22 (p = 0.94)	69.25±9.01 vs 68.35±6.29 (p = 0.41)	85.66±8.05 vs 85.10±6.65 (p = 0.59)
30 min	85.63±15.94 vs 90.49±16.34 (p = 0.05*)	119.26±9.62 vs 119.96±9.17 (p = 0.59)	69.04±9.34 vs 68.95±6.25 (p = 0.93)	85.78±7.88 vs 85.95±6.49 (p = 0.86)
35 min	87.33±15.43 vs 98.92±15.14 (p = 0.005*)	119.33±11.59 vs 120.12±9.26 (p = 0.73)	71.81±13.43 vs 70.03±5.64 (p = 0.32)	87.97±11.55 vs 86.73±6.03 (p = 0.47)
40 min	88.14±15.24 vs 93.98±14.24 (p = 0.20)	125.18±13.90 vs 120.36±9.26 (p = 0.06)	76.55±18.56 vs 76.80±5.13 (p = 0.99)	93.09±15.90 vs 92.33±5.36 (p = 0.70)

Values are expressed as Mean ± SD. At 30, 35, and 40 min, sample sizes reflect ongoing surgeries (Group A: n = 99, 21, and 11; Group B: n = 100, 100, and 96, respectively). HR: Heart Rate; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; MAP: Mean Arterial Pressure. *p < 0.05 (Significant); **p < 0.0001 (Highly significant).

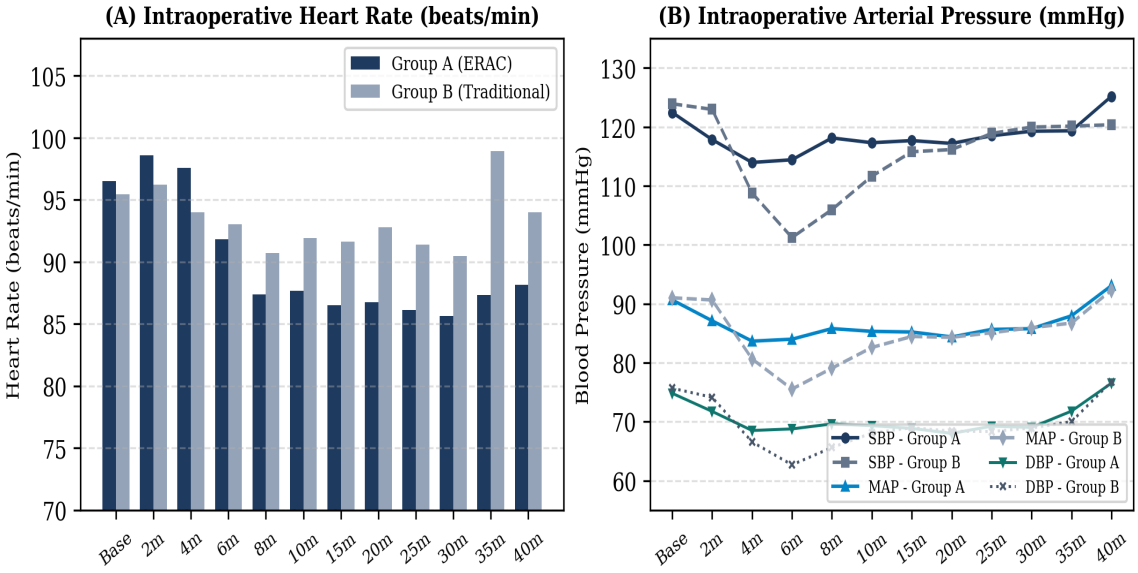


Fig. 2: Intraoperative Comparison of (A) Heart Rate and (B) Systolic, Diastolic, and Mean Arterial Blood Pressure between Group A (ERAC) and Group B (Traditional)

As shown in Table 3, the incidence of intraoperative hypotensive episodes was fourfold higher in the Traditional group compared with the ERAC group (40% [40/100] vs. 10% [10/100], $p < 0.001$). Consequently, the total number of rescue 50 µg phenylephrine boluses required was significantly higher in Group B than in Group A (90 boluses [4500 µg total; mean bolus dose 115.24 ± 28.91 µg] vs. 14 boluses [700 µg total; mean bolus dose 70.00 ± 25.82 µg], $p < 0.001$ and $p = 0.0123$, respectively). Because Group A received a continuous prophylactic phenylephrine infusion throughout surgery (mean infusion dose 714.25 ± 171.34 µg), cumulative phenylephrine exposure was higher in Group A (721.25 ± 163.62 vs. 112.50 ± 30.22 µg, $p < 0.0001$), which effectively prevented spinal hypotension. The incidence of intraoperative bradycardia was lower in Group A (4% vs. 8%), though the difference did not reach statistical significance ($p = 0.234$). No cases of postpartum hemorrhage (PPH) or blood transfusion occurred in either group.

Table 3: Comparison of Intraoperative Hypotension, Bradycardia, and Vasopressor (Phenylephrine) Dose Requirements

Parameter	Group A: ERAC (n = 100)	Group B: Traditional (n = 100)	p-value
Incidence of Hypotension, n (%)	10 / 100 (10%)	40 / 100 (40%)	< 0.001*
Incidence of Bradycardia, n (%)	4 / 100 (4%)	8 / 100 (8%)	0.234 (NS)
Total Number of 50 µg Phenylephrine Boluses	14	90	< 0.001*
Cumulative Bolus Dose of Phenylephrine (µg)	700 µg	4500 µg	< 0.001*
Mean Bolus Dose of Phenylephrine (µg), Mean ± SD	70.00 ± 25.82	115.24 ± 28.91	0.0123*
Total Prophylactic Infusion Dose (TID, µg), Mean ± SD	714.25 ± 171.34	Not Applicable	—
Total Phenylephrine Dose Required (µg), Mean ± SD	721.25 ± 163.62	112.50 ± 30.22	< 0.0001**

***p < 0.05 (Significant); **p < 0.0001 (Highly significant); NS: Not significant.**

Postoperative pain scores and rescue analgesic consumption over the first 24 hours are presented in Table 4 and Figure 3. Patients managed under the ERAC protocol reported significantly lower mean Visual Analogue Scale (VAS) scores at 1 hour (1.22 ± 0.43 vs. 1.84 ± 0.78), 2 hours (1.90 ± 0.88 vs. 2.54 ± 0.79), 3 hours (2.08 ± 0.93 vs. 3.34 ± 0.86), 4 hours (2.67 ± 1.17 vs. 4.19 ± 1.59), and 8 hours (2.63 ± 0.98 vs. 3.80 ± 1.58) postoperatively compared with the Traditional group (all $p < 0.0001$), whereas VAS scores at 12, 16, and 24 hours were comparable ($p > 0.05$) once scheduled ward analgesics took effect in both cohorts. Furthermore, when evaluated using the 11-point Numerical Pain Rating (NPR) scale, Group A exhibited highly significant reductions in pain

intensity across all time points from 1 hour to 24 hours postoperatively (all $p < 0.0001$).

Consequently, the proportion of patients requiring IV tramadol (100 mg) rescue analgesia in the first 24 hours was significantly lower in Group A (14% [14/100] vs. 40% [40/100], $p < 0.0001$), accompanied by a marked reduction in total rescue analgesic doses administered (15–16 doses vs. 57–58 doses, $p < 0.0001$) and mean 24-hour tramadol dose among recipients (113.27 ± 36.21 mg vs. 161.12 ± 49.32 mg, $p < 0.0001$; Table 4).

Table 4: Comparison of Postoperative Visual Analogue Scale (VAS) Scores, Numerical Pain Rating (NPR) Scores, and Rescue Analgesic (Tramadol) Requirement in the First 24 Hours

Postoperative Time / Parameter	Group A: ERAC (n = 100)	Group B: Traditional (n = 100)	p-value
Visual Analogue Scale (VAS) Score (0–10), Mean ± SD			
1 hour	1.22 ± 0.43	1.84 ± 0.78	< 0.0001**
2 hours	1.90 ± 0.88	2.54 ± 0.79	< 0.0001**
3 hours	2.08 ± 0.93	3.34 ± 0.86	< 0.0001**
4 hours	2.67 ± 1.17	4.19 ± 1.59	< 0.0001**
8 hours	2.63 ± 0.98	3.80 ± 1.58	< 0.0001**
12 hours	2.29 ± 0.89	2.17 ± 0.86	0.08 (NS)
16 hours	1.84 ± 0.69	2.04 ± 0.97	0.08 (NS)
24 hours	1.67 ± 0.84	1.83 ± 0.70	0.14 (NS)
Numerical Pain Rating (NPR) Score (0–10), Mean ± SD			
1 hour	3.22 ± 0.43	7.84 ± 0.78	< 0.0001**
2 hours	2.90 ± 0.88	5.54 ± 0.79	< 0.0001**
3 hours	2.08 ± 0.93	5.34 ± 0.86	< 0.0001**
4 hours	2.67 ± 1.17	5.19 ± 1.59	< 0.0001**
8 hours	1.63 ± 0.98	4.80 ± 1.58	< 0.0001**
12 hours	1.29 ± 0.89	5.17 ± 0.86	< 0.0001**
16 hours	0.84 ± 0.69	5.04 ± 0.97	< 0.0001**
24 hours	0.67 ± 0.84	5.83 ± 0.70	< 0.0001**
Postoperative Rescue Analgesic (IV Tramadol 100 mg) in 24 Hours			
Patients Requiring Rescue Analgesic, n (%)	14 / 100 (14%)	40 / 100 (40%)	< 0.0001**
Total Number of Rescue Doses Administered	15 (16 in master chart)	57 (58 in master chart)	< 0.0001**
Cumulative Rescue Tramadol Dose in 24 Hours (mg)	1600–2000 mg	5600–5800 mg	< 0.0001**
Mean Rescue Tramadol Dose per Recipient (mg), Mean ± SD	113.27 ± 36.21	161.12 ± 49.32	< 0.0001**

****p < 0.0001 (Highly significant); NS: Not significant (p > 0.05). Cumulative tramadol dose reflects 100 mg per rescue bolus.**

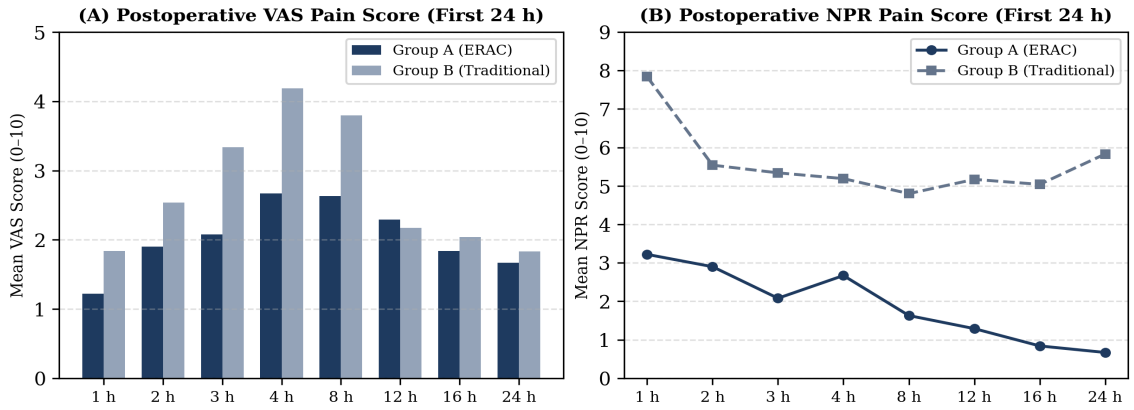


Fig. 3: Comparison of Postoperative (A) Visual Analogue Scale (VAS) and (B) Numerical Pain Rating (NPR) Scores during the First 24 Hours

Compliance with postoperative ERAC elements and functional recovery outcomes are summarized in Table 5 and Figure 4. Within the ERAC cohort, early oral feeding (within 2–4 hours) was successfully implemented in 100% (100/100) of parturients, early urinary catheter removal (within 6–10 hours) in 97% (97/100; 98% within 10 hours), and early ambulation (within 6–10 hours) in 91% (91/100; 92% within 10 hours).

Compared with Group B, Group A achieved a highly significant reduction in time to first oral liquid intake (4.31 ± 0.42 vs. 15.89 ± 1.18 hours, $p < 0.0001$), semisolid diet resumption (7.88 ± 0.81 vs. 33.12 ± 5.02 hours, $p < 0.0001$), urinary catheter removal (6.56 ± 1.00 vs. 62.68 ± 9.71 hours, $p < 0.0001$), and independent ambulation (7.73 ± 1.80 vs. 63.63 ± 6.76 hours, $p < 0.0001$), with zero cases of urinary retention or recatheterization in either group. Preoperative random blood glucose measured 1 hour before surgery was significantly higher in Group A than in Group B (114.23 ± 12.77 vs. 94.72 ± 9.41 mg/dL, $p < 0.0001$), reflecting the preoperative oral carbohydrate load, whereas postoperative blood glucose levels were normoglycemic and statistically comparable between the two groups (111.85 ± 11.09 vs. 109.37 ± 11.86 mg/dL, $p = 0.128$; Table 5).

Finally, maternal readiness for hospital discharge occurred nearly 2.4 days earlier in the ERAC group compared with the Traditional group (2.85 ± 0.50 vs. 5.25 ± 0.61 days, $p < 0.0001$). In Group A, 20% of patients met discharge readiness criteria on POD 2 and 76% on POD 3 (96% by POD 3), whereas in Group B, 0% were ready for discharge in the first 3 postoperative days, with 72% achieving readiness only on POD 5 and 24% on POD 6–7 (Table 5, Figure 4).

Table 5: Implementation of ERAC Components, Postoperative Recovery Milestones, Perioperative Blood Glucose Levels, and Maternal Readiness for Discharge

Outcome Parameter	Group A: ERAC (n = 100)	Group B: Traditional (n = 100)	p-value
ERAC Protocol Implementation Compliance in Group A, n (%)			
Early Oral Feeding (2–4 hours) vs. Delayed (> 4 hours)	100 (100%) Early / 0 Delayed	Conventional delayed regimen	—
Early Decatheterization (6–10 hours) vs. Delayed (> 10 hours)	97 (97%) Early / 3 (3%) Delayed	Conventional delayed regimen	—
Early Ambulation (6–10 hours) vs. Delayed (> 10 hours)	91 (91%) Early / 9 (9%) Delayed	Conventional delayed regimen	—
Postoperative Functional Recovery Milestones (Hours), Mean ± SD			
Time to Oral Lozenges (hours)	2.41 ± 0.51	Not Administered (0)	—
Time to First Clear Liquid Intake (hours)	4.31 ± 0.42	15.89 ± 1.18	< 0.0001**
Time to First Semisolid Diet Intake (hours)	7.88 ± 0.81	33.12 ± 5.02	< 0.0001**
Time to Urinary Catheter Removal (hours)	6.56 ± 1.00	62.68 ± 9.71	< 0.0001**
Time to First Postoperative Ambulation (hours)	7.73 ± 1.80	63.63 ± 6.76	< 0.0001**
Urinary Retention / Need for Recatheterization, n (%)	0 (0%)	0 (0%)	1.00 (NS)
Perioperative Capillary/Venous Blood Glucose (mg/dL), Mean ± SD			
Preoperative Blood Sugar (1 hour before surgery)	114.23 ± 12.77	94.72 ± 9.41	< 0.0001**
Postoperative Blood Sugar	111.85 ± 11.09	109.37 ± 11.86	0.128 (NS)
Maternal Readiness for Hospital Discharge by Postoperative Day (POD), n (%)			
POD 2	20 (20%)	0 (0%)	—
POD 3	76 (76%)	0 (0%)	—
POD 4	3 (3%)	4 (4%)	—
POD 5	1 (1%)	72 (72%)	—
POD 6	0 (0%)	19 (19%)	—
POD 7	0 (0%)	5 (5%)	—
Mean Day of Readiness for Discharge (days), Mean ± SD	2.85 ± 0.50	5.25 ± 0.61	< 0.0001**

****p < 0.0001 (Highly significant); NS: Not significant. POD: Postoperative day.**

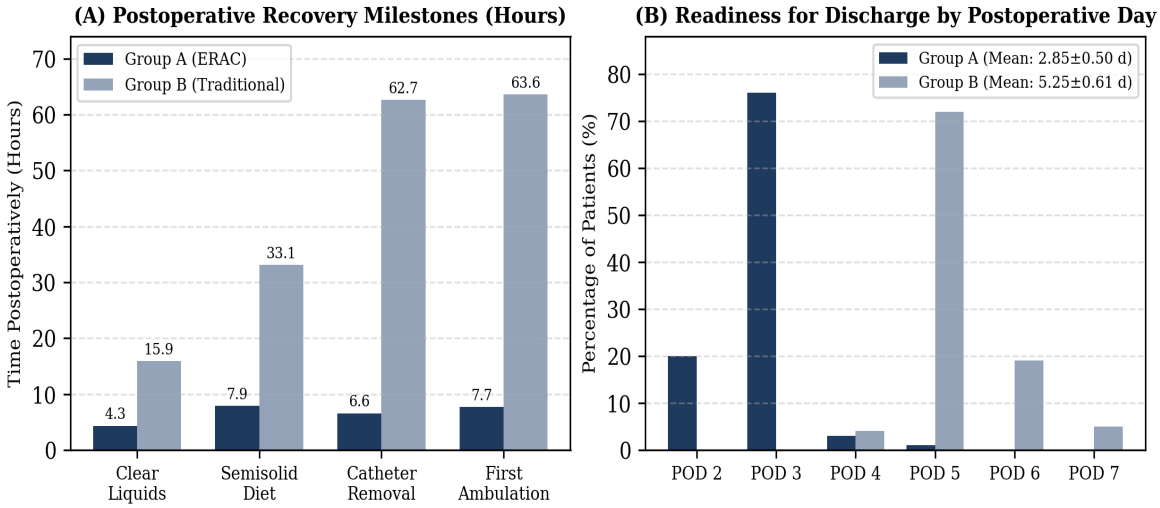


Fig. 4: Comparison of (A) Postoperative Functional Recovery Milestones (Hours) and (B) Maternal Readiness for Discharge by Postoperative Day

Discussion

Standardized Enhanced Recovery after Cesarean (ERAC) pathways synthesize evidence-based perioperative interventions to attenuate surgical stress, preserve maternal physiological homeostasis, and accelerate functional recovery. While the 2019 SOAP consensus statement outlines 19 core ERAC elements [10] and the ERAS Society guidelines span 25 recommendations across three phases7–9, clinical studies worldwide vary in the number of elements adopted depending on institutional feasibility. Lester et al. [17] and Mullman et al. [18] implemented 8 and 10 SOAP components, respectively, whereas Kleiman et al. [19] utilized [12] components. In the present study, we successfully implemented 11 key ERAC elements across the preoperative, intraoperative, and postoperative periods. In an umbrella review of clinical pathways, Corso et al. [20] identified that three core postoperative components—early oral intake, early mobilization, and early urinary catheter removal—were universally shared across all published ERAC protocols, and Sultan et al. [14] confirmed that patient education, abbreviated fasting, and multimodal analgesia form the backbone of successful ERAC programs.

Both cohorts in our study were well matched in baseline demographics and subarachnoid block characteristics, mirroring the comparability reported by Tamang et al. [21] and Lester et al. [17]. A major intraoperative finding of our study was the fourfold reduction in spinal anesthesia-induced hypotension in the ERAC group (10% vs. 40%, $p < 0.001$) achieved by combining prophylactic phenylephrine infusion (20 µg/min) with prewarmed Ringer's lactate co-loading (20 mL/kg/h). This aligns closely with the double-blind randomized controlled trial by George et al. [13], who demonstrated that prophylactic phenylephrine infusion significantly reduced hypotension and intraoperative nausea and vomiting (46% vs. 75%; relative risk 0.61, $p < 0.001$) compared with intermittent bolus dosing, as well as the Indian observational study by Gupta et al.22, who likewise documented significantly fewer hypotensive episodes and rescue vasopressor boluses in their ERAC cohort ($p < 0.0001$).

Abbreviated preoperative fasting (2 hours for clear liquids) combined with a non-particulate carbohydrate drink (45–50 g) 2 hours before surgery is a cornerstone of ERAC [7,10,15]. Prolonged overnight fasting depletes hepatic glycogen reserves, exacerbates maternal thirst, hunger, and preoperative anxiety, and induces postoperative insulin resistance [15,23]. In our study, oral carbohydrate loading significantly elevated preoperative blood glucose 1 hour prior to surgery (114.23 ± 12.77 vs. 94.72 ± 9.41 mg/dL, $p < 0.0001$), preventing fasting hypoglycemia while maintaining normal postoperative glycemic levels (111.85 ± 11.09 vs. 109.37 ± 11.86 mg/dL, $p = 0.128$) without any episodes of regurgitation or aspiration. Kleiman et al. [19], Lester et al. [17], Mullman et al. [18], and Tamang et al. [21] similarly demonstrated safe administration of clear carbohydrate beverages up to 2 hours preoperatively.

Effective multimodal analgesia is vital after cesarean delivery to facilitate early maternal mobility and newborn care while minimizing opioid-related adverse effects [11,15,23]. Using preemptive rectal paracetamol/diclofenac supplementation followed by scheduled IV diclofenac (75 mg 12-hourly) and oral acetaminophen (650 mg 6-hourly), our ERAC group achieved highly significant reductions in VAS pain scores through the first 8 postoperative hours ($p < 0.0001$) and lower NPR pain scores

across the entire 24-hour observation window ($p < 0.0001$). Consequently, only 14% of ERAC patients required rescue IV tramadol compared with 40% in the Traditional group ($p < 0.0001$), with a 72% reduction in total rescue doses administered (15–16 vs. 57–58 doses). These findings corroborate large-scale studies by Hedderson et al. [24] (who observed a reduction in daily inpatient morphine equivalents from 10.7 to 5.4 as multimodal analgesia adherence rose from 9.7% to 88%), Kleiman et al. [19] (38% reduction in postoperative opioid consumption, 27.8 ± 23.6 vs. 44.7 ± 35.4 MMEQ, $p < 0.001$), Mullman et al.18 (OR 16.8 for opioid reduction, $p < 0.001$), and the meta-analyses by Meng et al. [25] (WMD −1.23 for pain score; SMD −0.46 for opioid consumption, $p < 0.00001$) and Pinho et al. [26] (SMD −0.91 for opioid consumption across 19,001 women, $p = 0.003$).

Early resumption of oral feeding, early urinary catheter removal, and early mobilization act synergistically to restore normal physiology. In our ERAC cohort, 100% of women initiated oral liquids within 2–4 hours (mean 4.31 ± 0.42 vs. 15.89 ± 1.18 hours, $p < 0.0001$) and semisolids at 7.88 ± 0.81 vs. 33.12 ± 5.02 hours ($p < 0.0001$) without any increase in postoperative nausea, vomiting, or paralytic ileus. These results mirror the randomized controlled trials by Teoh et al. [27] and Izbizky et al. [28], as well as observational studies by Cattin et al. [29] and Lester et al.17. Similarly, removing the urinary catheter at 6.56 ± 1.00 hours (vs. 62.68 ± 9.71 hours, $p < 0.0001$) and initiating ambulation at 7.73 ± 1.80 hours (vs. 63.63 ± 6.76 hours, $p < 0.0001$) caused zero cases of urinary retention or recatheterization, consistent with the randomized trial by El-Mazny et al. [30] and cohorts reported by Rousseau et al. [31] and Lester et al. [17] (ambulation at 9.8 vs. 32.9 hours; decatheterization at 11.3 vs. 21.2 hours, $p < 0.001$). Ultimately, the cumulative benefit of these multimodal interventions translated into a highly significant reduction in maternal readiness for hospital discharge from 5.25 ± 0.61 days in the Traditional group to 2.85 ± 0.50 days in the ERAC group ($p < 0.0001$), with 96% of ERAC parturients ready for discharge by POD 3.

We evaluated maternal readiness for discharge rather than actual physical departure because neonatal observation policies and government maternity benefit schemes frequently delayed physical discharge despite complete maternal surgical recovery—an observation also highlighted by Teigen et al. [32] and Lester et al. [17]. Our reduction in hospital stay aligns closely with Indian and international studies by Gupta et al. [22], Jakhetiya et al. [33] (68.8 ± 1.9 vs. 105.4 ± 25.7 hours, $p < 0.001$), Mundhra et al. [34] (53.87 ± 15.02 vs. 73.92 ± 8.96 hours, $p < 0.0001$), Darwish et al. [35], Bowden et al. [36], and Laronche et al. [37].

Limitations of the Study

This study had certain limitations. First, it was a single-center observational study in which the ERAC and traditional cohorts were evaluated across sequential timeframes, which may introduce selection or performance bias. Second, because of limited coordination with the neonatology team regarding immediate operating-room handover of the newborn and institutional discharge policies under government health schemes, we could not evaluate 1-hour breastfeeding initiation rates, long-term neonatal outcomes, or 30-day post-discharge readmission rates. Third, due to a limited number of forced-air warming units across operating suites, continuous active warming could not be maintained throughout the entire duration of surgery in every case. Future multicenter randomized controlled trials incorporating formal obstetric Quality of Recovery (QoR-11) scoring and cost-effectiveness analyses are warranted.

Conclusion

The implementation of a standardized, multidisciplinary Enhanced Recovery After Cesarean (ERAC) protocol in parturients undergoing elective lower segment cesarean section under spinal anesthesia significantly improves intraoperative hemodynamic stability, provides superior postoperative pain relief, reduces rescue opioid consumption, accelerates oral feeding, urinary catheter removal, and ambulation, and shortens maternal readiness for hospital discharge by more than two days without increasing maternal morbidity. Even in resource-constrained settings, core ERAC elements can be safely and effectively integrated into routine obstetric anesthesia practice.

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References

1. Gibbons L, Belizan JM, Lauer JA, Betran AP, Merialdi M, Althabe F. The global numbers

and costs of additionally needed and unnecessary caesarean sections performed per year: overuse as a barrier to universal coverage. World Health Report 2010; 30:1-31.
2. Betran AP, Ye J, Moller A, Souza JP, Zhang J. Trends and projections of caesarean section rates: global and regional estimates. BMJ Glob Health 2021; 6(6):e005671.
3. Kumar M. Development of National and Sub-national Electronic Health Records to Enable Health Data Exchange for Improved Maternal Health Service Delivery and Program: The Case of a Tertiary Care State Government Hospital in India. Doctoral dissertation, University of North Carolina at Chapel Hill, 2021.
4. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth 1997; 78(5):606-617.
5. Steenhagen E. Enhanced recovery after surgery: it's time to change practice! Nutr Clin Pract 2016; 31(1):18-29.
6. National Institute for Health and Care Excellence (NICE). Caesarean birth: Clinical guideline [CG132]. NICE, London, 2011.
7. Wilson RD, Caughey AB, Wood SL, Macones GA, Wrench IJ, Huang J, et al. Guidelines for antenatal and preoperative care in cesarean delivery: Enhanced Recovery After Surgery Society recommendations (part 1). Am J Obstet Gynecol 2018; 219(6):523.e1-523.e15.
8. Caughey AB, Wood SL, Macones GA, Wrench IJ, Huang J, Norman M, et al. Guidelines for intraoperative care in cesarean delivery: Enhanced Recovery After Surgery Society recommendations (part 2). Am J Obstet Gynecol 2018; 219(6):533-544.
9. Macones GA, Caughey AB, Wood SL, Wrench IJ, Huang J, Norman M, et al. Guidelines for postoperative care in cesarean delivery: Enhanced Recovery After Surgery (ERAS) Society recommendations (part 3). Am J Obstet Gynecol 2019; 221(3):247.e1-247.e9.
10. Bollag L, Lim G, Sultan P, Habib AS, Landau R, Zakowski M, et al. Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean. Anesth Analg 2021; 132(5):1362-1377.
11. American College of Obstetricians and Gynecologists. ACOG Committee Opinion No. 742: Postpartum pain management. Obstet Gynecol 2018; 132(1):e35-e43.
12. American College of Obstetricians and Gynecologists. ACOG Committee Opinion No. 750: Perioperative pathways: enhanced recovery after surgery. Obstet Gynecol 2018; 132(3):e120-e130.
13. George RB, McKeen DM, Dominguez JE, Allen TK, Doyle PA, Habib AS. A randomized trial of phenylephrine infusion versus bolus dosing for nausea and vomiting during Cesarean delivery in obese women. Can J Anaesth 2018; 65(3):254-262.
14. Sultan P, Sharawi N, Blake L, Carvalho B. Enhanced recovery after caesarean delivery versus standard care studies: a systematic review of interventions and outcomes. Int J Obstet Anesth 2020; 43:72-86.
15. Ituk U, Habib AS. Enhanced recovery after cesarean delivery. F1000Research 2018; 7:513.
16. Moerman N, van Dam FS, Muller MJ, Oosting H. The Amsterdam Preoperative Anxiety and Information Scale (APAIS). Anesth Analg 1996; 82(3):445-451.
17. Lester SA, Kim B, Tubinis MD, Morgan CJ, Powell MF. Impact of an enhanced recovery program for cesarean delivery on postoperative opioid use. Int J Obstet Anesth 2020; 43:47-55.
18. Mullman L, Hilden P, Goral J, Gwacham N, Tauro C, Spinola K, et al. Improved outcomes with an enhanced recovery approach to cesarean delivery. Obstet Gynecol 2020; 136(4):685-691.
19. Kleiman AM, Chisholm CA, Dixon AJ, Sariosek BM, Thiele RH, Hedrick TL, et al. Evaluation of the impact of enhanced recovery after surgery protocol implementation on maternal outcomes following elective cesarean delivery. Int J Obstet Anesth 2020; 43:39-46.
20. Corso E, Hind D, Beever D, Fuller G, Wilson MJ, Wrench IJ, et al. Enhanced recovery after elective caesarean: a rapid review of clinical protocols, and an umbrella review of systematic reviews. BMC Pregnancy Childbirth 2017; 17(1):91.
21. Tamang T, Wangchuk T, Zangmo C, Wangmo T, Tshomo K. The successful implementation of the Enhanced Recovery After Surgery (ERAS) program among caesarean deliveries in Bhutan to reduce the postoperative length of hospital stay. BMC Pregnancy Childbirth 2021; 21(1):637.
22. Gupta S, Gupta A, Baghel AS, Sharma K, Choudhary S, Choudhary V. Enhanced recovery after cesarean protocol versus traditional protocol in elective cesarean section: a prospective observational study. J Obstet Anaesth Crit Care 2022; 12(1):28-33.
23. Patel K, Zakowski M. Enhanced recovery after cesarean: current and emerging trends. Curr Anesthesiol Rep 2021; 11(2):136-144.
24. Hedderson M, Lee D, Hunt E, Lee K, Xu F, Mustille A, et al. Enhanced recovery after surgery to change process measures and reduce opioid use after cesarean delivery: a quality improvement initiative. Obstet Gynecol 2019; 134(3):511-519.

25. Meng X, Chen K, Yang C, Li H, Wang X. The clinical efficacy and safety of enhanced recovery after surgery for cesarean section: a systematic review and meta-analysis of randomized controlled trials and observational studies. Front Med (Lausanne) 2021; 8:694385.
26. Pinho B, Costa A, Silva R. Impact of enhanced recovery after surgery (ERAS) guidelines implementation in cesarean delivery: a systematic review and meta-analysis. Eur J Obstet Gynecol Reprod Biol 2024; 292:102-110.
27. Teoh WH, Shah MK, Mah CL. A randomised controlled trial on beneficial effects of early feeding post-caesarean delivery under regional anaesthesia. Singapore Med J 2007; 48(2):152-157.
28. Izbizky GH, Minig L, Sebastiani MA, Otaño L. The effect of early versus delayed postcaesarean feeding on women's satisfaction: a randomised controlled trial. BJOG 2008; 115(3):332-338.
29. Cattin A, De Baene A, Achon E, Bersot Y, Destoop Q, Pelissier A, et al. Evaluation of enhanced recovery for elective cesarean section. Gynecol Obstet Fertil Senol 2017; 45(4):202-209.
30. El-Mazny A, El-Sharkawy M, Hassan A. A prospective randomized clinical trial comparing immediate versus delayed removal of urinary catheter following elective cesarean section. Eur J Obstet Gynecol Reprod Biol 2014; 181:111-114.
31. Rousseau A, Sadoun M, Aimé I, Leguen M, Carbonnel M, Ayoubi JM. Comparative study about enhanced recovery after cesarean section: what benefits, what risks? Gynecol Obstet Fertil Senol 2017; 45(7-8):387-392.
32. Teigen NC, Sahasrabudhe N, Doulaveris G, Xie X, Negassa A, Bernstein J, et al. Enhanced recovery after surgery at cesarean delivery to reduce postoperative length of stay: a randomized controlled trial. Am J Obstet Gynecol 2020; 222(4):372.e1-372.e10.
33. Jakhetiya B, Sharma A, Verma R. Clinical outcome in patient undergoing LSCS via ERAS pathway versus traditional pathway: a prospective observational study. Indian J Obstet Gynecol Res 2023; 10(2):145-150.
34. Mundhra R, Gupta M, Bahadur A. Effect of Enhanced Recovery after Surgery (ERAS) protocol on maternal outcomes following emergency caesarean delivery: a randomized controlled trial. Int J Gynaecol Obstet 2024; 164(2):580-587.
35. Darwish AM, Zahran KM, Bedaiwy MA. Enhanced recovery after cesarean section (CS) versus conventional care in a lower middle-income country: a randomized controlled trial. J Matern Fetal Neonatal Med 2022; 35(25):8912-8918.
36. Bowden SJ, Dooley W, Hanrahan J, Kanu C, Halder S, Cormack C, et al. Fast-track pathway for elective caesarean section: a quality improvement initiative to promote day 1 discharge. BMJ Open Qual 2019; 8(2):e000465.
37. Laronche A, Popescu L, Benhamou D. An enhanced recovery programme after caesarean delivery increases maternal satisfaction and improves maternal-neonatal bonding: a case control study. Eur J Obstet Gynecol Reprod Biol 2017; 210:212-216.