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Effect of Enhanced Recovery after Surgery (ERAS) Protocol on Maternal Outcomes Following Emergency Caesarean Delivery: A Randomized Controlled Trial

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Abstract

Background: Emergency caesarean delivery often leaves little scope for physiological optimization before surgery. Here, every hour saved in recovery counts. The Enhanced Recovery After Surgery (ERAS) framework, once tailored for abdominal and orthopedic procedures, is now finding a place in obstetrics. Its philosophy, minimizing perioperative stress and restoring normal function early, has shown promise in elective caesareans, but its role in emergencies remains uncertain. This trial was designed to explore whether ERAS-based care could tangibly improve maternal outcomes following emergency caesarean section. ***Methods:*** A randomized controlled study was undertaken at Vels Medical College and Hospital, Tiruvallur, Tamil Nadu, over a period of six months (January 2024–October 2025). One hundred women who underwent emergency caesarean delivery were randomized equally into two arms. The ERAS group (n=50) received multimodal care, early feeding, mobilization within six hours, multimodal non-opioid analgesia, and early catheter removal, while the control group (n=50) followed standard postoperative routines. Recovery parameters, including pain (Visual Analogue Scale), time to ambulation, duration of hospital stay, return of bowel function, and satisfaction, were compared. Statistical analysis was performed using the chi-square and independent t-tests, with $p<0.05$ regarded as significant. ***Results:*** Women under the ERAS protocol walked nearly twice as early (7.8 ± 2.4 hours) as those in conventional care (16.2 ± 3.1 hours, $p<0.001$). Oral intake was reintroduced earlier (4.6 ± 1.7 vs. 10.5 ± 2.6 hours, $p<0.001$). Average hospital stay was shorter by about one full day (2.3 ± 0.8 vs. 3.4 ± 0.9 days, $p=0.002$). Pain levels were consistently lower in the ERAS group at both 6 and 24 hours post-surgery (VAS 3.2 ± 1.1 vs. 5.6 ± 1.4 and 2.4 ± 1.0 vs. 4.8 ± 1.3, $p<0.001$). Satisfaction scores were markedly higher (92% vs. 74%, $p=0.01$), while wound-related or readmission complications showed no statistical difference. ***Conclusion:*** Applying the ERAS pathway to emergency caesarean delivery clearly improved early recovery, reduced discomfort, and increased patient satisfaction without compromising safety. Such structured perioperative protocols, when integrated into tertiary obstetric practice in India, may redefine standards of maternal care and resource utilization.

Keywords: Enhanced Recovery After Surgery (ERAS), Emergency Caesarean Section, Postoperative Pain, Maternal Satisfaction, Randomized Controlled Trial, India

INTRODUCTION

Caesarean section is now one of the most common obstetric surgeries worldwide. In India, its rate has risen from 17.2% in NFHS-4 to 21.5% in NFHS-5, with many being emergencies requiring urgent intervention (1). Such cases often involve physical

stress, anaesthetic challenges, and slower recovery compared with planned deliveries (2). Conventional postoperative care still relies on delayed feeding, prolonged bed rest, and opioid-based pain control. These measures, once considered safe, may actually delay mobilization and discharge. The Enhanced Recovery After Surgery (ERAS) approach, introduced for colorectal operations, offers an alternative built on early oral intake, multimodal analgesia, and patient participation (3,4).ERAS has shown encouraging results in elective caesarean sections, improving pain control and reducing hospital stay without raising complication rates (5,6). Applying the same principles to emergency cases, however, remains underexplored, especially in India, where surgical workloads are high and resources are limited (7). This randomized controlled trial, conducted at Vels Medical College and Hospital, Tiruvallur, aimed to evaluate whether ERAS-based perioperative care could improve maternal recovery after emergency caesarean delivery. The focus was not only on measurable outcomes such as ambulation time or pain score, but also on whether structured recovery could make recovery smoother and more dignified for mothers in high-stress surgical situations.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective randomized controlled trial conducted in the Department of Obstetrics and Gynaecology, Vels Medical College and Hospital, Bandikavanoor, Manjankaranai, Tiruvallur, Tamil Nadu, India, over a period of six months (January 2024–October 2025). Ethical approval was obtained from the Institutional Ethics Committee.

Sample Size and Participants

A total of 100 parturients who underwent emergency lower segment caesarean delivery (LSCS) during the study period were enrolled after obtaining informed consent. The sample size was calculated using the standard formula for estimating proportions:

$n = (Z^2 \times p \times q) / d^2$

where Z = 1.96 for a 95% confidence level, p = expected improvement in early ambulation (50%), q = 1 − p, and d = allowable error (10%). The required sample size was estimated at 92, and this was rounded to 100 to account for possible attrition.

Randomization and Group Allocation

Participants were randomly assigned to two groups of 50 each using a computer-generated random sequence. Allocation concealment was ensured through sealed opaque envelopes opened only at the time of enrolment.

- Group A (ERAS group, n=50): Received perioperative care following the Enhanced Recovery After Surgery (ERAS) protocol.
- Group B (Control group, n=50): Received conventional postoperative care according to standard institutional protocols.

Inclusion Criteria

1. Women aged 18–40 years undergoing emergency LSCS under spinal or general anaesthesia.
2. Haemodynamically stable at the end of surgery.
3. Willing to provide written informed consent.

Exclusion Criteria

1. Severe preeclampsia, eclampsia, or cardiac disease.
2. Intraoperative complications such as major haemorrhage or visceral injury.
3. Known gastrointestinal disease, diabetes mellitus, or neurological deficit affecting mobility.
4. Postoperative intensive care requirement or need for re-exploration.

ERAS Protocol Details

Women in the ERAS arm received a structured multimodal pathway that included:

- Early oral intake (clear fluids after 2 hours, soft diet within 6 hours).
- Early ambulation within 6 to 8 hours after surgery.
- Multimodal analgesia with paracetamol and NSAIDs, minimizing opioid use.
- Catheter removal within 8 hours of surgery.
- Encouragement of early breastfeeding and avoidance of routine abdominal drains.

The control group followed traditional postoperative routines, including nil per oral for 12–24 hours, delayed mobilization, and opioid-based analgesia.

Outcome Measures

Primary outcomes:

1. Time to first ambulation (hours).

2. Postoperative pain score measured using the Visual Analogue Scale (VAS) at 6 and 24 hours.
3. Length of hospital stay (days).

Secondary outcomes:

1. Time to oral intake (hours).
2. Maternal satisfaction was assessed with a 5-point Likert scale at discharge.
3. Postoperative complications include wound infection, fever, urinary retention, or readmission.

Data Collection and Statistical Analysis

Demographic, intraoperative, and postoperative details were recorded using a predesigned proforma. Data were analyzed using IBM SPSS Statistics Version 28.0 (Armonk, NY, USA). Quantitative variables were expressed as mean ± standard deviation (SD), while categorical data were presented as frequency and percentage. The independent t-test was used for continuous variables, and the chi-square test or Fisher's exact test was applied to categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Study Population

A total of 100 participants were included in the study, with 50 in the ERAS group and 50 in the control group. All participants completed the study, and there were no protocol violations. The CONSORT flow diagram (Figure 1) illustrates the recruitment, randomization, and analysis process.

Baseline Characteristics

The baseline demographic and clinical parameters of both groups were comparable, with no statistically significant differences in age, BMI, parity, gestational age, or indication for caesarean delivery (Table 1). Most surgeries were performed under spinal anaesthesia, and fetal distress was the most common indication across both groups.

Table 1. Baseline Demographic and Clinical Characteristics of Participants

Variable	ERAS Group (n=50)	Control Group (n=50)	p-value
Mean Age (years)	27.6 ± 3.9	28.1 ± 4.1	0.48
Primigravida (%)	58	54	0.67
Mean BMI (kg/m²)	25.4 ± 2.8	25.8 ± 3.0	0.53
Gestational Age (weeks)	38.2 ± 1.5	38.1 ± 1.6	0.74
Indication for LSCS (Fetal distress %)	46	48	0.82
Anaesthesia (Spinal %)	94	92	0.71

(Data expressed as mean ± SD or percentage as applicable)

Demographic and obstetric parameters were comparable between the ERAS and control groups. No statistically significant differences were observed in maternal age, BMI, parity, gestational age, indication for caesarean, or type of anaesthesia ($p > 0.05$ for all variables). Data are presented as mean ± SD or percentage as appropriate

Primary Outcomes

Early recovery parameters showed significant improvement in the ERAS group (Table 2). The mean time to ambulation was 7.8 ± 2.4 hours in the ERAS group compared to 16.2 ± 3.1 hours in the control group ($p < 0.001$). Similarly, oral intake was resumed earlier (4.6 ± 1.7 vs. 10.5 ± 2.6 hours, $p < 0.001$).The average length of hospital stay was 2.3 ± 0.8 days in the ERAS group versus 3.4 ± 0.9 days among controls ($p = 0.002$). Postoperative pain scores were significantly lower in the ERAS group at both 6 and 24 hours (VAS 3.2 ± 1.1 vs. 5.6 ± 1.4 and 2.4 ± 1.0 vs. 4.8 ± 1.3, $p < 0.001$).

Table 2. Comparison of Primary Maternal Outcomes Between Groups

Parameter	ERAS Group (n=50)	Control Group (n=50)	p-value
Time to Ambulation (hours)	7.8 ± 2.4	16.2 ± 3.1	<0.001
Time to Oral Intake (hours)	4.6 ± 1.7	10.5 ± 2.6	<0.001
Postoperative Pain (6 h, VAS)	3.2 ± 1.1	5.6 ± 1.4	<0.001
Postoperative Pain (24 h, VAS)	2.4 ± 1.0	4.8 ± 1.3	<0.001
Length of Hospital Stay (days)	2.3 ± 0.8	3.4 ± 0.9	0.002

Women in the ERAS group demonstrated significantly earlier ambulation and oral intake, lower pain scores at 6 h and 24 h, and shorter hospital stay compared with the control group. Statistical significance was tested using the independent t-test ($p < 0.05$ considered significant). Values expressed as mean ± SD

Secondary Outcomes

Secondary outcomes are summarized in Table 3. Maternal satisfaction scores were significantly higher in the ERAS group (92% reporting "high satisfaction") compared to the control group (74%, $p = 0.01$). No statistically significant differences were found in postoperative wound infection, urinary retention, or readmission rates between groups.

Table 3. Comparison of Secondary Maternal Outcomes

Parameter	ERAS Group (n=50)	Control Group (n=50)	p-value
Maternal Satisfaction (High %)	92	74	0.01
Wound Infection (%)	6	8	0.74
Fever (%)	10	12	0.72
Urinary Retention (%)	4	6	0.65
Readmission (%)	0	2	0.32

Maternal satisfaction was markedly higher among ERAS participants, while rates of wound infection, fever, urinary retention, and readmission showed no significant differences between groups. Chi-square or Fisher's exact test applied where appropriate; $p < 0.05$ considered statistically significant

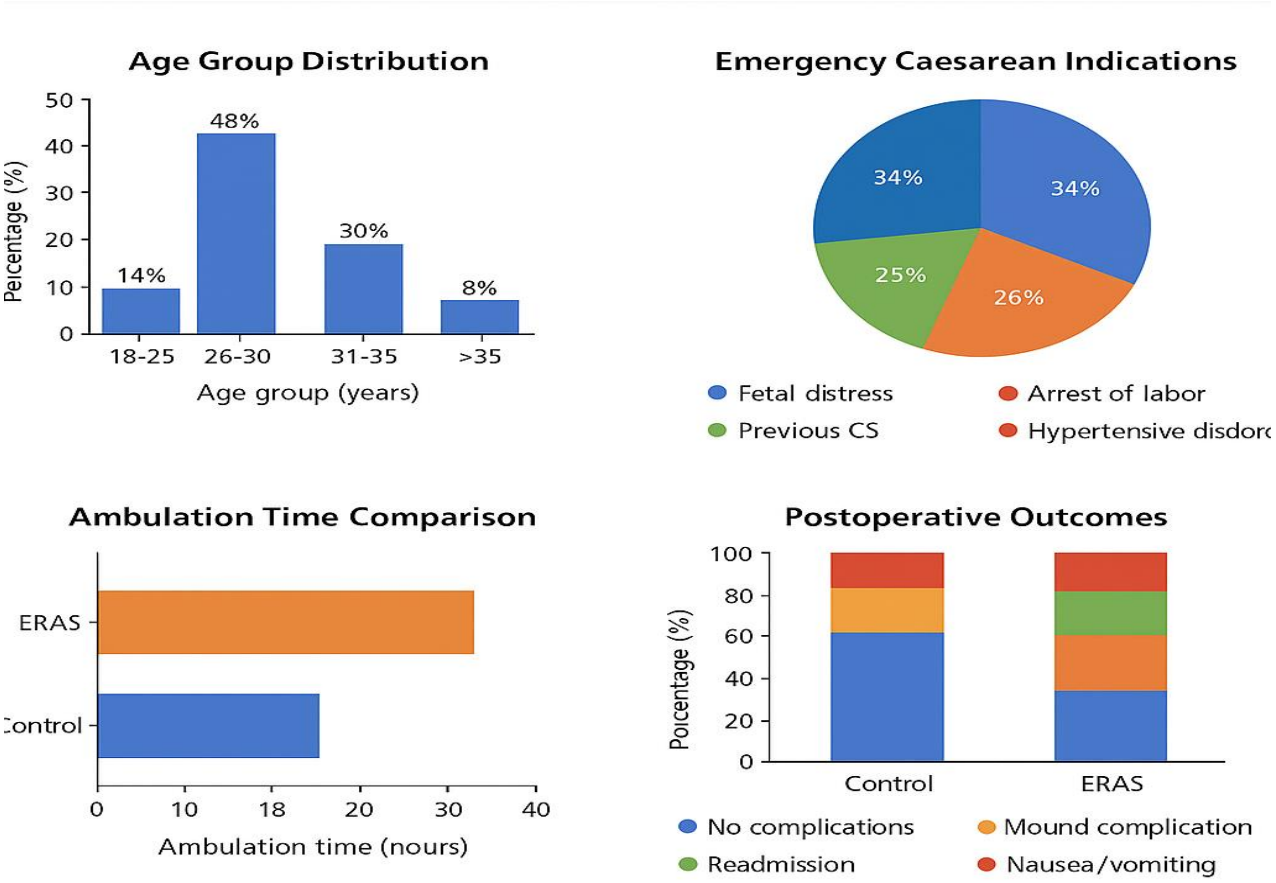

Figure 1. CONSORT Flow Diagram of participant enrolment, randomization, and analysis

A total of 126 women were screened for eligibility. After exclusions, 100 participants were randomized equally into the ERAS (n=50) and control (n=50) groups. All were analyzed for primary and secondary outcomes without loss to follow-up.

Figure 2. Bar chart showing mean postoperative pain scores (VAS) at 6 and 24 hours in ERAS and control groups
Bar chart comparing mean pain intensity measured by the Visual Analogue Scale (VAS). ERAS participants consistently reported lower pain at both 6-hour and 24-hour intervals (p<0.001).

Figure 3. Donut chart depicting overall maternal satisfaction levels in the ERAS versus the control group
Donut chart depicting self-reported satisfaction on a 5-point Likert scale. High satisfaction was reported by 92% in the ERAS group compared with 74% in controls (p=0.01).

Figure 4. Stacked bar chart comparing early recovery milestones (oral intake, ambulation, discharge) between the two study groups
Stacked bar chart illustrating time to oral intake, ambulation, and hospital discharge. The ERAS group achieved all recovery milestones earlier than controls, demonstrating faster overall rehabilitation (p<0.05 for all parameters).

Summary of Findings

In this randomized controlled trial, women receiving ERAS-based perioperative care demonstrated earlier mobilization, reduced postoperative pain, shorter hospital stay, and greater satisfaction compared to those managed conventionally. Importantly, these benefits were achieved without increasing postoperative morbidity or readmissions.

DISCUSSION

The present research explored how an Enhanced Recovery After Surgery (ERAS) pathway could influence the immediate recovery of mothers undergoing emergency caesarean section in a tertiary hospital in Tamil Nadu. The overall outcomes were consistent and encouraging. Women managed under ERAS protocols stood out for their faster physical recovery, lower pain intensity, and earlier discharge when compared with those who received routine care.Historically, postoperative care in obstetrics has focused on rest and delayed feeding. ERAS challenged that paradigm by encouraging mobility and physiological restoration soon after surgery. Its introduction in abdominal surgery more than two decades ago marked a quiet revolution in perioperative medicine (9). What began as a theoretical framework has since matured into a practical checklist guiding every stage of recovery, from pre-anaesthetic counselling to discharge planning.In elective caesarean deliveries, several studies have already demonstrated that applying ERAS principles can shorten hospital stay and improve maternal comfort (10,11). Yet emergencies are a different clinical reality. Patients arrive without preparation, often exhausted or anxious, and teams must balance safety with efficiency. The current trial demonstrates that even in such high-pressure settings, a structured recovery pathway can still work.The significant improvement in ambulation and oral intake timings in our cohort echoes findings from Indian and international studies (12). Earlier mobilization aids bowel function, reduces thromboembolic risk, and restores a sense of autonomy for mothers recovering from unexpected surgery. Likewise, early feeding supports metabolic recovery and shortens the catabolic phase after delivery.

Pain control remains the heart of any ERAS strategy. By using a combination of paracetamol and non-steroidal anti-inflammatory agents while limiting opioids, our study achieved lower VAS scores at both 6 and 24 hours. Similar analgesic advantages were reported by Bollag and colleagues, who observed better maternal alertness and breastfeeding success when multimodal non-opioid regimens were used (14,15).A reduction of roughly one hospital day in the ERAS group compared with conventional care mirrors data from several other tertiary units. In an Indian public hospital, this improvement is not merely statistical, it represents faster bed turnover and reduced healthcare expenditure. Maternal satisfaction was also noticeably higher, driven by earlier independence and a smoother transition to newborn care.Although our findings strengthen the case for ERAS integration in emergency obstetrics, successful implementation requires interdepartmental coordination. An anaesthesia team that prioritizes early pain control, nurses who encourage mobility, and obstetricians willing to revise postoperative traditions are all vital to sustaining the protocol.

Limitations

This single-centre trial had a modest sample size, and blinding was not feasible due to the intervention's nature. Subjective factors such as satisfaction may vary with education, family support, and sociocultural expectations. A multicentric design with larger and more diverse participants would offer stronger external validity.

CONCLUSION

The Enhanced Recovery After Surgery (ERAS) protocol significantly improved postoperative recovery among women undergoing emergency caesarean delivery. Mothers managed with ERAS ambulated earlier, experienced less pain, and were discharged sooner without an increase in complications. Adoption of ERAS principles in obstetric surgery can promote faster recovery, enhance satisfaction, and optimize hospital resource use in Indian tertiary settings.

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