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ORIGINAL ARTICLE

Empowering Mothers Through Enhanced Recovery after Cesarean Section (ERACS): A Comparative Study on Recovery Quality and Patient Satisfaction

Haidy Salah Mansour, Marwa Abdelrehim Mohamed, Ibrahim Abbas Youssef, Tarek Abdelmenem Abdelzaher

Anesthesiology and Intensive Care Department, Faculty of Medicine, Minia University, Minia, Egypt.

Correspondence to *Marwa Abdelrehim Mohamed, Assistant Lecturer of Anesthesiology and Intensive Care Department, Faculty of Medicine, Minia University, Minia, Egypt.*
E-mail: Marwa.Attia@mu.edu.eg

Objective Enhanced Recovery After Cesarean Section (ERACS) is a fast post-cesarean recovery approach consisting of three stages; preoperative, intraoperative, and postoperative stages. The study aimed to determine whether the ERACS protocol, which promotes faster recovery following elective cesarean sections, improves final patient results.

Methods This prospective randomized controlled open label study was carried out on 106 pregnant females with elective cesarean section were classified into 2 equal groups: Group A (ERACS protocol): perioperative enhanced recovery after surgery recommendations and Group B (traditional anesthetic and surgical techniques): conventional process of cesarean delivery. The primary outcome was the Obstetric Quality of Recovery -11 (ObsQoR-11) at the time of discharge. The secondary outcomes were assessment of postoperative visual analogue scale (VAS), postoperative nausea and vomiting (PONV) impact score, total postoperative opioid consumption, presence of ileus, time needed to reach criteria of discharge and overall patient satisfaction.

Results Subjects in group A reported significantly higher levels compared to those in group B on the ObsQoR-11 scale (P<0.001). Regarding VAS, a significant reduction in the pain assessment between group A and group B (p<0.01) postoperatively was detected. The POVN impact sore at 0, 6 and time of discharge were significantly reduced in group A in comparison with group B (p<0.01). There was a significant decrease in group A than B in opioid consumption, ileus incidence and time to reach criteria of discharge. Overall patient satisfaction significantly increased in group A compared to group B.

Conclusions Implementing ERACS significantly had positive maternal outcomes evidenced by higher total ObsQoR-11, lower pain score, PONV, lower opioid consumption, less ileus, and time of discharge, as well as averall patient satisfaction.

Keywords Enhanced Recovery After Caesarean Section, Postoperative Patient Satisfaction, Recovery Quality.
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INTRODUCTION

Globally, cesarean section (CS) is a very commonly performed surgery, playing a critical role in reducing maternal and neonatal mortality. Over the last few decades, the rate of CS has risen significantly all over the world with the World Health Organization estimating that cesarean deliveries now account for approximately 21% of all births, and this figure is projected to increase to 29% by 2030 [1,2].

Traditionally, post-cesarean care protocols have followed conservative approaches such as delayed oral feeding, extended catheterization, and late ambulation,

based on the assumption that these practices minimize postoperative complications. However, such methods may contribute to slower recovery, increased risk of ileus, and prolonged hospitalization, all of which might have a negative effect on patient satisfaction and hospital efficiency. Wit+h the majority of cesarean patients being young and otherwise healthy, there is an opportunity to revise conventional perioperative care in favor of more evidence-based practices that promote faster recovery and better outcomes [3].

The protocol of ERACS has been successfully adopted across various surgical disciplines, including urology, gynecology, and orthopedics, demonstrating consistent benefits in terms of decreased morbidity, earlier mobilization, and reduced healthcare costs. Enhanced Recovery after C-section (ERAS) is a technique that applies the principles of CS to pregnant patients in a way that is unique to their needs. Better outcomes following caesarean sections (ERACS) are becoming more popular [4].

Preoperative counseling, carbohydrate loading, minimum fasting, early eating, effective multimodal analgesia, early catheter removal, and timely movement are all part of the ERACS protocol's suite of perioperative techniques. Without raising complications or readmission rates, studies have demonstrated that ERACS can considerably decrease hospital stays, postoperative pain, narcotic intake, and overall treatment costs. Institutions implementing ERACS have reported improved maternal outcomes and greater patient satisfaction compared to traditional protocols [5,6].

This research aimed at evaluating elective CS patients' experience with the ERACS protocol in comparison to those with more traditional approaches as regards primary outcome which is quality of recovery and secondary outcome including postoperative VAS, postoperatiove nausea and vomiting, amount of postoperative opioid utilization, duration of hospitalization, presence of ileus and overall patient satisfaction.

PATIENTS AND METHODS

The prospective randomized controlled open label study was done in Minia University Hospitals between March 2024 and December 2024 on pregnant females with elective CS. Our work was approved by the Ethical Committee of Minia University (NO 383/08/2022) and registered at clinicaltrials.gov (ID: NCT06225557).

The study included 106 pregnant females aged 18-40y with body mass index (BMI) less than 30kg/m^2 for elective CS.

Patients were excluded from the study if they suffer from any of the following conditions: recent history of opioid use, severe cardiac disease, cardiac arrhythmia, myocardial injury, uncontrolled diabetes, severe liver and kidney disease, coagulation defect, severe anemia, severe anxiety, pre-eclampsia, or complicated CSs (such as wound infection, re-exploration, or caesarean hysterectomies).

Consent was obtained in writing from every patient. Each patient was randomly assigned to one of two groups: Group A 53 patients (ERACS protocol) and Group B 53 patients (traditional anesthetic and surgical techniques).

Each patient underwent a thorough evaluation that included taking their medical history, taking their vital signs, and running a battery of tests in the lab, including CBC, liver & renal function tests, blood grouping, Rh typing, radiological studies, and a dating scan to confirm the gestational age.

Group (A) ERACS protocol patients

According to ERAS society guidelines (https://erassociety.org) [7].

Perioperative ERACS

Preadmission information, patient education and counselling:

Before anesthesia, oral 10 milliliters of Maalox (combination of magnesium hydroxide and aluminum hydroxide) and 20 milligrams of Famotidine (an Antodine product)—a H2 receptor antagonist. drink plenty of clear fluids for two hours before the procedure, have a small meal for six hours before the procedure, and take 200 milliliters of any carbohydrate supplement by mouth for two hours before the surgery.

Antiemetics (infusion of 8mg of dexamethasone 90min before the induction of anesthesia and 8mg of ondansetron 20-30min before conclusion of the approach), skin preparation with chlorhexidine-alcohol and a povidone-iodine solution for the vagina, antibiotics administered intravenously (IV) 30 minutes prior to skin incision, and so on.

A 20G line was used for medication infusion, and an was insertion of 18G cannula in the other forearm was done to secure the IV line. Prior to spinal anesthesia, intravenous fifteen milliliters per kilogram of warmed ringer lactate solution was given as a preload.

Regional anesthesia in the form of (intrathecal block + bilateral TAP for postoperative analgesia).

The patient was positioned in a sitting position for spinal anesthesia. A 25G Quincke's needle was implanted in the L2-3/L3-4 vertebral interspace after 2% xylocaine was infiltrated into the skin. Then, 2.0-2.2ml of hyperbaric Inject 10-12mg of 0.5 percent bupivacaine intrathecally. After that, they rolled the patients over onto their backs with a slight inclination to the left. The pinprick test was used to assess the block height till T5 level was reached, and the patients received a 500ml to 1 litre bolus of the crystalloid solution before beginning an infusion at a rate of 40ml/h with a syringe infusion pump (Mindray SK-500II). Via transparent facemask, oxygen at a flow rate of 3–5 liters per minute was supplied. The patient's systolic blood pressure (SBP) was monitored at 2-minute intervals for the first 20 minutes, or until delivery, and then every 5 minutes until the surgery was completed. A titrated dosage of ephedrine was given in case of intraoperative hypotension occurred when the maternal SBP fell 20% of the baseline value or below 100mmHg. When the heart rate was less than 50 beats/minute, injection of 0.2mg of atropine was administered. The patient was slowly given five international units of oxytocin as an intravenous bolus injection after birth.

Postoperative TAPB was administered on both sides of the body. Towards the end of the procedure, injection of 20ml of 0.25% bupivacaine into the plane between the internal oblique and transverse abdominis muscles on each side was done, with ultrasound guidance.

Using warm IV fluids and monitoring temperature can help to avoid intraoperative hypothermia.

Postoperatively: gum chewing, nauseousness avoidance, antiemetics (8mg of ondansetron intravenously as a rescue antiemetic), NSAIDs and paracetamol as analgesics, 30mg of ketorolac or 1g of acetaminophen intravenously every six hours. When the visual analogue scale (VAS) is equal to or more than 4/10 at any one time, a dose of 5-10mg of nalbuphine (20mg/1ml) can be administered to alleviate breakthrough pain. A regular diet started within two hours, pneumatic compression stoking, avoiding routine heparin usage, mobilization immediately following cesarean section, and prompt removal of the urinary catheter following delivery.

Group (B) Traditional anesthetic and surgical techniques patients

Nil per oral for 6 hours before surgery, no betadine vaginal pessary and prophylactic antibiotics were given 30-60 minutes before the skin incision.

Intraoperative management was the same as of group (A) regarding level and dose of spinal anesthesia except in group (B) there was adding fentanyl 15µg intrathecally with the spinal anesthesia and TAPB was not performed.

In post-operative care, allowed sips of water after the appearance of bowel sounds, patients used to ambulate after recovery from spinal anesthesia and catheter removal used to be done at the time of discharge.

Assessment

Demographic data

Patient age, body mass index, gestation age and duration of surgery.

Primary outcome

The postpartum recovery of the inpatients using the Obstetric Quality of Recovery 11 score (ObsQoR-11) when they are discharged (Table 1) [8].

Table 1: Inpatient postpartum recovery quality using ObsQoR-11 at time of discharge [8]:

Quality Of Recovery Score following elective Caesarean Delivery (obsQoR-11)		**(0 to 10, where: 0= very poor and 10= excellent)**										
		Strongly disagree ←----------→ strongly agree										
1-	I have had moderate pain	10	9	8	7	6	5	4	3	2	1	0
2-	I have had severe pain	10	9	8	7	6	5	4	3	2	1	0
3-	I have had nausea or vomiting	10	9	8	7	6	5	4	3	2	1	0
4-	I have been feeling dizzy	10	9	8	7	6	5	4	3	2	1	0
5-	I have had shivering	10	9	8	7	6	5	4	3	2	1	0
6-	I have been comfortable	0	1	2	3	4	5	6	7	8	9	10
7-	I am able to mobilise independently	0	1	2	3	4	5	6	7	8	9	10
8-	I can hold baby without assistance	0	1	2	3	4	5	6	7	8	9	10
9-	I can feed/nurse my baby without assistance	0	1	2	3	4	5	6	7	8	9	10
10-	I can look after my personal hygiene/toilet	0	1	2	3	4	5	6	7	8	9	10
11-	I feel in control	0	1	2	3	4	5	6	7	8	9	10
Total score ≥10= Good recovery												

We used an Arabic translated form of (ObsQoR 11) [9].

This is a tool used to assess the recovery of women after obstetric surgery, such as CSs, and other childbirth-related procedures at time of discharge. The score evaluates physical and emotional recovery, providing valuable insights into the well-being of women post-surgery. It is made up of an 11-point numerical Likert scale, where 0 indicates a highly negative opinion and 10 a very positive one, with 110 being the highest possible score.

Secondary outcomes

- Visual analog scale for postoperative pain to evaluate the need for postoperative rescue analgesia at 0, 2, 4, 6, 8, 12 hours and at time of discharge. On the visual analog scale, 0 symbolizes "no pain" and 10 "the worst pain imaginable" were included.

- POVN through the simplified POVN impact scale score at 0, 6, 24hr, or earlier time of release (Table 2) [10].

It used the vomiting count to determine the severity of vomiting, scored as the number of vomitus (0-2, or 3 if ≥3 vomits). To estimate the PONV Impact Scale Score, addition of the numerical response to questions 1 and 2. A PONV Impact Scale Score of five or greater means clinically significant POVN.

Table 2: The simplified POVN impact scale score [9]:

Q1. Have you vomited or had dry- retching?
0. No
1. Once
2. Twice
3. ≥ 3
Q2. Have you felt nauseous (a queasy stomach and a mild urge to vomit)? If so, has this nausea affected your ability to carry out daily tasks—like getting out of bed, moving around in bed, walking as usual, or eating and drinking
0. Not at all
1. Sometimes
2. Often or most of the time
3. All the time

* Count distinct episodes: Many vomits or retching events that occur over a short time frame, say 5 minutes. should be counted as one vomiting/dry-retching episodes; multiple episodes necessitate distinct time periods without vomiting/dry- retching.

- The presence of post-cesarean ileus, the total amount of opioid consumption until the time of discharge, the length of time spent in the hospital to meet discharge criteria, and overall patient satisfaction.

Sample size calculation

Before the study, the number of patients required in each group was determined after a power calculation according to data obtained Pilot study (6 patients within each group). In this study, mean (ObsQoR-11) in ERACS group was (72±17.1) and in non-ERACS group was (63.1±15) to provide effect size 0.55. A sample size of 53 patients in each group was determined to provide 80% power for independent test at the level of 0.05 significance using G Power 3.1.9.2 software.

Statistical analysis

The statistical study was carried out using SPSS v27, which was developed by IBM at their Armonk, NY, USA factory. The data distribution was checked for normality via the Shapiro-Wilks test and histograms. Mean and SD were used to provide quantitative parametric data that were examined via the unpaired student *t*-test. We utilized The median and IQR to present quantitative non-parametric data that were assessed via the Mann Whitney-test. When applicable, the Chi-square test or Fisher's exact test were used to assess the qualitative variables, which were given as percentages and reported as frequency. It was referred to be statistically significant if the two-tailed *P* value was ≤0.05.

RESULTS

According to the CONSORT diagram of enrolment of this study, 106 cases were incorporated in the final analysis of 150 cases initially assessed for eligibility. 18 patients refused to participate, and 26 patients were excluded from the study (Figure 1).

Demographic data:

Regarding the mean age, BMI, gestation age and duration of surgery. The comparison between the two groups that were analyzed did not reveal any significant differences (Table 3).

The Obstetric Quality of Recovery 11 score (ObsQoR-11), postoperative visual analogue score (VAS) and simplified PONV impact scale score

PONV, dizziness, shivering, discomfort, ability to move around on one's own, holding and nursing a baby

without help, personal hygiene, and a sense of control were all significantly reduced according to ObsQoR-11. A greater number of ERACS group (A) than non ERACS group (B). When comparing the two groups' postoperative pain assessments at 0, 2, 4, 6, 8, 12, and time of discharge after surgery, there was a significant reduction in pain for group (A) ERACS. Regarding PONV there was a significant decrease in the incidence of postoperative nausea and vomiting in group A compared to group B. This decrease started postoperatively at 0hr, 6 hr, 24hr or at time of discharge (Table 4).

Total opioid required postoperative, presence of ileus, first mealtime and discharge time

Regarding postoperative opioid consumption, there is significant decrease in total opioid consumption, ileus incidence and time needed to reach criteria of discharge in group (A) than group (B) (Table 5).

Overall patient satisfaction

When we compared overall patient satisfaction, in group A (ERACS) there were 43 patients who were satisfied, however 30 patients were satisfied in group B (Non `ERACS) (Table 6).

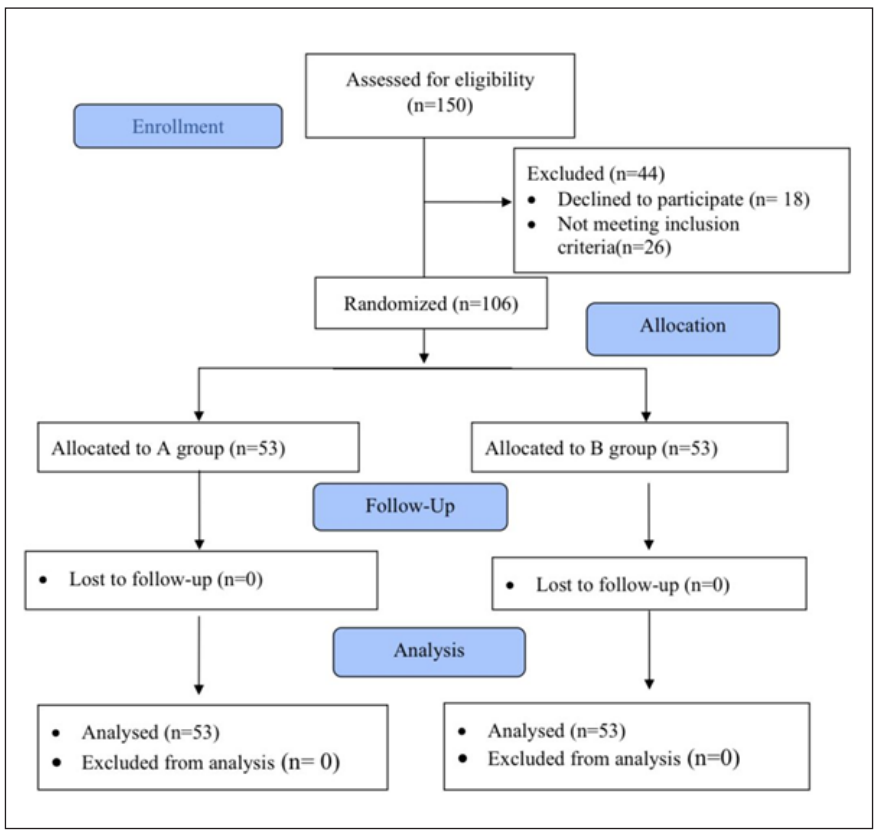

Figure 1: Consert diagram of the study.

Table 3: Demographic data of the studied groups:

Variable	Group A ERACS (*n*= 53)	Group B Non ERACS (*n*= 53)	*P*-value
Age (years)	27.05±5.8	27.1±5.7	0.964
BMI (kg/m^2)	23.35±2.2	23.5±2.3	0.723
Gestation (week)	(38) 37.91±0.72	(38)37.89±0.87	0.9
Duration of surgery (minutes)	31.35±3.82	31.50±0.98	0.7

Data are presented as mean±SD; *P*>0.05= Nonsignificant; BMI: Body mass index; ERACS: Enhanced recovery after caesarean section.

Table 4: The ObsQoR-11, VAS and simplified PONV of the studied groups:

	Group A ERACS (*n*= 53)	Group B Non ERACS (*n*= 53)	*P*-value
ObsQoR-11			
Moderate pain	7(5 -8)	5(3-6)	0.001*
Sever pain	8(5-10)	3(2-5)	0.001*
Nausea or vomiting	10(10-10)	7(5-8)	0.001*
Feeling dizzy	10(8-10)	6(5-7)	0.001*
shivering	10(9-10)	5(4-5)	0.001*
Comfortable	8(7-9)	6(5-8)	0.001*
Able to mobilize independently	8(8-9)	5(3.5-5)	0.001*
Can hold baby without assistance	8(7-9.5)	5(4-5)	0.001*
Can feed/nurse baby without assistance	8(7-9)	5(4-7)	0.001*
Can look after personal hygiene/toilet	8(7-9)	5(4-5)	0.001*
Feeling in control	9(8-9)	5(4-5)	0.001*
Total	92(83.5-101.5)	56(52-61.5)	0.001*
VAS			
VAS at 0h	3(2-6)	6(5-7)	0.001*
VAS at 2h	3(3-4)	5(4-7)	0.001*
VAS at 4h	2(1-4)	4(2-5)	0.012*
VAS at 6h	2(2-3)	4(2-5)	0.001*
VAS at 8h	1(0-2)	3(0-5)	0.001*
VAS at 12h	1(0-2)	2(1-3)	0.001*
VAS at time of discharge	1(1-2)	1(0-1)	0.001*
Simplified PONV			
At 0 hours	0(0-0)	0(0-1.5)	0.001*
At 6 hours	0(0-0)	0(0-0)	0.018*
At 24 hours	0(0-0)	0(0-1)	0.017*

Data is presented as median (IQR); Q: Quartile; *: Significant as *p* value <0.05. Mann Whitney test used to compare quantitative data between two group; ERACS: Enhanced recovery after caesarean section; ObsQoR-11: Obstetric quality of recovery-11; VAS: Visual analogue scale; PONV: Postoperative nausea and vomiting.

Table 5: Total opioid required postoperative, presence of ileus, first mealtime and discharge time:

Variable	Group A ERACS (*n*= 53)	Group B Non ERACS (*n*= 53)	*P*-value
Opioid (mg)	1.98±2.02	7.56±3.7	0.001*
Ileus	0(0.0%)	9 (17.0%)	0.003*
Time of discharge (hours)	8.75±3.2	15.01±5.13	0.001*

Data is presented as mean±SD, number and %; *: Significant as *p* value <0.05; ERACS: Enhanced recovery after the caesarean section. Independent *t* test was used to compare quantitative data between two groups and Fisher Exact test was used to compare qualitative data between two groups.

Table 6: Overall patient satisfaction:

Patient Satisfaction	Group A ERACS (*n*= 53)	Group B Non ERACS (*n*= 53)	*P*-value
Satisfied	43(81.1)	30(56.6)	0.006
Not-Satisfied	10(18.9)	23(43.4)	

Data is presented as mean±SD, number and %; *: Significant as *p* value <0.05. Data were analysed using chi square test; ERACS: Enhanced recovery after the caesarean section.

DISCUSSION

The ERACS is a fast post-cesarean recovery method consisting of preoperative, intraoperative, and postoperative stages [11]. The ERACS method is a development of the ERACS protocol, which was originally applied to digestive surgery operations. This ERACS protocol has been shown to reduce complications during surgery, decrease the duration of hospitalization, and increase patient satisfaction. Then this ERACS protocol is applied in obstetric surgery.

Both groups reported higher levels of moderate to severe pain, nausea or vomiting, dizziness, shivering, comfort, capability of moving around on their own, holding the baby without help, feeding or nursing the baby without help, personal hygiene/toilet care, and feeling in control on the ObsQoR-11. The total ObsQoR-11 was much greater in the first group in comparison with the second. People in group A ate less at their first lunchtime compared to those in group B.

This was consistent with Kielty *et al.,* [12] who shown that administering ERACS improved the ObsQoR-11 score. Similarly, Lashin *et al.,* [2] noted that ERACS protocols' incorporation into C-section procedures constitutes a major step forward in gynecological treatment since it considerably improves patients' overall experience with recovery. Also, Niekerk *et al.,* [13] found that the ObsQoR-10 scores significantly improved after the ERACS treatment. Moreover, Mundhra *et al.,* [14] demonstrated that the ERAS group showed remarkable improvement in mobility, self-care, typical activity, and pain/discomfort than the traditional group. Additionally, the ERACS group had a noticeably lower first mealtime. In addition, Pravina and Tewary *et al.,* [14] showed that postoperative mobilization was significantly earlier in ERAS than controls.

Compared to the non-ERACS group, the ERACS group had a significantly reduced VAS pain score at 0h, 2h, 4h, 6h, 8h, 12h, and at time of discharge.

This was in line with the finding of Mundhra *et al.,* [15] discovered that the ERACS group's VAS score was much lower in comparison with the non-ERACS group. The ERACS group also reported considerably alleviate pain scores both while moving and at rest compared to the control group, as did Utami and Maria *et al.,* [16]. According to Altahrawy *et al.,* [17] the pain scores were dramatically decreased in the ERACS protocol group than the control group. Furthermore, when compared to conventional protocol, Gupta *et al.,* [18] found that ERACS considerably improved pain alleviation. On the other hand, lester *et al.,* [19] discovered that the average pain scores of the pre- and post-enhanced recovery groups were not significantly different. This discrepancy with our results could be explained by the diverse study locations, populations, and study designs.

Group A had significantly decreased PONV at 0, 6, and 24 hours compared to group B in the current investigation. Lashin *et al.,* [20] demonstrated that PONV was substantially lower in the ERACS group than controls, which was in alignment with our findings. Similarly, Lu *et al.,* [21] found that ERACS methods improve outcomes, including lower PONV, across many surgical specialties. The ERACS group had a much decreased PONV compared to the control group, as pointed out by Ali *et al.,* [22]. Additionally, there was no increase in the incidence of nausea/vomiting or other GIT complications, such as abdominal distention, among patients in the ERACS protocol group, according to Gupta *et al.,* [18]. In addition, Gohar *et al.,* [23] found that ERACS group participants had substantially decreased PONV compared to control group participants. In addition, the ERACS technique considerably reduced PONV in elective caesarean sections in comparison with the control group, based on Altahrawy *et al.,* [17].

Our findings showed that compared to group B, group A had much reduced rates of opioid use, ileus, and time to discharge.

In agreement with our findings, Paripurna *et al.,* [24] shown that the ERAS group had a substantially reduced hospitalization duration than non-ERAS group. When comparing the ERACS technique to a control group, Altahrawy *et al.,* [17] found that it considerably reduced painkiller usage and hospital stay in elective caesarean sections. Furthermore, a study conducted by Tamang *et al.,* [25]. there was significant reduction in postoperative hospital stay, enhancing patient recovery and resource utilization.

Following a cesarean section, Gupta *et al.,* [18] found that patients needed fewer opioids after surgery, and their hospital stays were significantly shorter, thanks to ERACS. Additionally, Grasch *et al.,* [26] proposed that ERACS protocol application during cesarean birth considerably decreased opioid use in the first 48h postoperatively than the group that did not execute the procedure. Mundhra *et al.,* [15] also found that than the traditional group, the ERACS group had a substantially shorter total hospitalization duration. The use of opioids in the hours following surgery decreased significantly with the implementation of the ERACS procedure, according to Niekerk *et al.,* [13].

Group A scored considerably higher than group B on measures of overall patient satisfaction of the surgery. In the same line, Gohar *et al.,* [23] noted that ERAS significantly improved the level of maternal satisfaction. Similarly, Altahrawy *et al.,* [17] discovered that, when compared to a control group, the ERACS approach considerably increased satisfaction scores for elective caesarean sections.

However, Grasch *et al.,* [26] found no statistically significant change in the total satisfaction score following the use of the ERACS protocol for caesarean birth. Differences in operator experience and population variables may account for the contradictory findings.

Moreover, in a study done by Putri *et al.,* [27] they found through bibliometric and visual analysis that global research interest in Enhanced Recovery After Caesarean Surgery (ERACS) has significantly increased over the past decade, focusing on key areas such as pain management, maternal outcomes, and recovery protocols. This growing trend reflects the rising global recognition of ERACS as an effective, evidence-based approach to improving postoperative care in cesarean deliveries.

LIMITATIONS

The limitations of this study were a single center study that may result in different findings than elsewhere, small sample sizes that may produce insignificant results.

CONCLUSION

Implementing ERAS significantly had positive maternal outcomes evidenced by lower pain score, opioid, first mealtime, ileus, time of discharge and PONV, higher total ObsQoR-11, as well as improving the level of maternal comfort and staff performance with the intervention.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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