



THE EFFECTIVE OF ERAC PROGRAM FOR EARLY RECOVERY AFTER CESAREAN SECTION CAN THO UNIVERSITY OF MEDICINE AND PHARMACY HOSPITAL AND CAN THO CENTRAL GENERAL HOSPITAL

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<p>Keywords</p> <p><i>ERAC, Caesarean section, Early recovery after surgery</i></p>	<p>Abstract</p> <p>Background: The ERAC program for early recovery after cesarean section helps women reduce complications, postoperative pain, hospital stay and costs by speeding up the recovery process early in the postoperative period. Objective: Evaluate the results of ERAC (Enhanced Recovery After Cesarean) at Can Tho University of Medicine and Pharmacy Hospital and Can Tho Central General Hospital. Methods: descriptive cross-sectional design with controlled survey of 368 women with indications for caesarean section, randomly selected with the consent of the women. Result: 198/368 (53.8%) applied the ERAC program. The mean age was 29.6 ± 6.1 years old. The mean time to sit up when applying ERAC was 6.83 ± 1.35h compared with 7.52 ± 1.9 hours ($p < 0.001$). The time to walk after surgery was 11.18 ± 2.4h compared with 13.36 ± 4.1h ($p < 0.001$); Normal urination time 10.49 ± 2.3h compared with 11.32 ± 3.3h ($p < 0.01$), normal travel time 35.67 ± 9.7h compared with 39.86 hours ± 4.5 ($p < 0.001$). Pain level after surgery with VAS 4.01 ± 0.7 compared with 4.18 ± 0.7 ($p < 0.001$). Conclusion: The ERAC effective in accelerating the recovery process after cesarean section.</p>
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I. BACKGROUND

In recent times, the rate of cesarean section surgery has been increasing globally. In China, the cesarean section rate is 41.5% [1], while in Australia it is 35.7% [2]. In Vietnam, according to a study by Pham Thi Be Lan, the cesarean section rate is 53.6% [3]. However, the post-operative care after a cesarean section faces many challenges and requires more effective care methods.



Therefore, providing care to help mothers recover quickly after a cesarean section is crucial. In the 1990s and early 2000s, scientists developed the Enhanced Recovery After Surgery (ERAS) program, focusing on early recovery after colorectal surgery. ERAS is a multi-modal postoperative patient care approach designed to promote early recovery after surgery. Today, ERAS is widely applied in various surgical fields, including obstetrics and gynecology.

In obstetrics, the Enhanced Recovery After Cesarean (ERAC) program is implemented to help mothers recover quickly after a cesarean section [4]. This is a care approach for mothers before, during, and after cesarean surgery, incorporating evidence-based practices to optimize and enhance the recovery process. The goal of ERAC is to help reduce complication rates, post-operative pain, hospital stay duration, and treatment costs by maintaining organ function before surgery, reducing stress during surgery, and accelerating the recovery of function and physiological processes in the post-operative phase. The role of applying ERAC in reducing hospital stay time, potential complications, recurrence rates, and financial burdens on healthcare systems has been well-documented [6], [7].

The ERAS program has been widely applied in surgery, particularly in colorectal surgeries. Regarding the ERAC program for cesarean sections, it has proven to be effective and is widely adopted worldwide. In Vietnam, although the rate of cesarean section is relatively high, the application of the ERAC program has not yet received full attention. Our study aims to thoroughly evaluate the application of the Enhanced Recovery After Cesarean (ERAC) program. Thus, we conduct this study to assess the results of early recovery care for mothers before, during, and after cesarean surgery at Can Tho University of Medicine and Pharmacy Hospital and Can Tho Central General Hospital.

II. MATERIALS AND METHODS

2.1. Research design: a cross-descriptive with a control group study.

2.2. Study population: Pregnant women aged 18 years and older with an indication for cesarean section, giving birth at the Department of Obstetrics - Can Tho University of Medicine and Pharmacy Hospital and Can Tho Central General Hospital.

2.2.1. Inclusion criteria

All pregnant women aged 18 years and older with an indication for cesarean section, giving birth at the Department of Obstetrics - Can Tho University of Medicine and Pharmacy Hospital and Can Tho Central General Hospital, who agree to fully participate in all 10 steps of the ERAC (Enhanced Recovery After Cesarean) protocol for preoperative, intraoperative, and postoperative care."

2.2.2. Exclusion criteria

- Women who are not legally capable, suffering from mental disorders, depression, etc."
- "Stillbirth in the uterus."
- "Insufficient information according to the study design."

2.3. Sampling size

$$n = Z^2 \frac{P(1-P)}{d^2}$$

Z: confidence coefficient (with $\alpha = 0.05$, $Z = 1.96$)

d: allowable error, selected as $d = 0.08$

p: the study chose $p = 0.763$, based on the research by Trương Thị Ánh Tuyết in 2020: the rate of early bowel motility recovery after cesarean section in the group with early exercise was 76.3%. The sample size (n) is calculated as: $n = 275$. To reduce sample loss by 10%, the study collected data from 305 women undergoing cesarean sections.

2.4. Research Content and Intervention Implementation Process

Information about the participants, including age, education level, occupation, number of pregnancies, labor and delivery process, intraoperative and postoperative information, and



hospitalization time, was collected. The ERAC process was conducted before, during, and after the cesarean section in the following sequential steps [7], [8], [9]:

Step 1: Provide Carbohydrates Before Surgery

Provide 50 grams of sugar dissolved in 200 ml of water for the patient to drink within 2 hours before surgery, provided the patient has no diabetes.

Step 2: Skin Preparation

Clean the abdominal skin and vaginal area with Povidone-iodine before the cesarean section.

Step 3: Limit Pre- and Intraoperative Sedation

Use regional anesthesia combined with opioids if there are no contraindications.

Step 4: Cesarean Section Technique

Perform a lower transverse uterine incision to minimize blood loss during surgery.

Step 5: Newborn Care

Delay cord clamping for more than 1 minute in full-term infants.

Delay cord clamping for more than 30 seconds in preterm infants.

Maintain neonatal body temperature at 36.5–37.5°C after birth.

Ensure immediate resuscitation space is available.

Facilitate skin-to-skin contact with the mother within the first 30 minutes after surgery.

Step 6: Early Breastfeeding

Encourage breastfeeding within 30 minutes after cesarean section.

Step 7: Early Feeding

Within 60 minutes after leaving the operating room: drink 50 ml of water.

6 hours after cesarean section: consume liquid food if tolerated well.

Step 8: Early Mobilization

Initiate early mobility once limb movement has returned to normal:

6–8 hours after surgery: Patient sits on the edge of the bed and moves from bed to chair.

8–24 hours after surgery: Patient leaves the bed and walks at least 1–2 times in the room.

24–48 hours after surgery: Patient walks at least 3–4 times in the room.

48 hours after surgery: Patient resumes normal ambulation.

Step 9: Early Removal of Urinary Catheter

Remove the urinary catheter 7 hours after surgery unless otherwise directed by the surgeon.

Step 10: Postoperative Pain Management

Employ multimodal pain relief, including long-acting low-dose opioids such as morphine and/or NSAIDs and/or paracetamol.

2.5. Data Processing and Statistical Analysis

Data were entered and analyzed using SPSS 20.0 statistical software. Chi-square tests were used to compare qualitative variables, while ANOVA tests assessed differences in postoperative complications, hospital stay duration, treatment costs, pain levels (VAS), and patient satisfaction compared to routine procedures.

2.6. Research Ethics

The research was approved by the Ethics Committee of Can Tho University of Medicine and Pharmacy for biomedical studies.

III. RESULTS

The study surveyed 368 women with indications for cesarean sections at two hospitals: Can Tho University of Medicine and Pharmacy Hospital and Can Tho Central General Hospital. Among these, 198/368 (53.8%) applied the ERAC (Enhanced Recovery After Cesarean) program for early recovery after cesarean surgery.

3.1. General Characteristics of the Study Population

Table 1. General Characteristics of the Study Population

Characteristic	Total (n=368, %)	Normal Care (n=170, %)	ERAC (n=198, %)	p-value
Age Group				
< 35	279 (75.8)	121 (71.2)	158 (79.8)	0.054
≥ 35	89 (24.2)	49 (28.2)	40 (20.2)	
Mean Age	29.6 ± 6.01	30.2 ± 6.1	29.2 ± 5.9	
Residence				
Urban	136 (36.9)	67 (39.4)	69 (34.8)	0.213
Rural	232 (63.1)	103 (60.6)	129 (65.2)	
Education Level				
< High School	101 (27.4)	50 (29.4)	51 (25.7)	0.230
High School	197 (53.5)	94 (55.3)	103 (52.1)	
> High School	70 (19.1)	26 (15.3)	44 (22.2)	
Parity				
First pregnancy	140 (38.1)	62 (36.5)	78 (39.4)	0.387
≥ Second pregnancy	228 (61.9)	108 (63.5)	120 (60.6)	

p: Chi-Square test

The average age was 29.6 ± 6.01 years. Women living in rural areas accounted for a higher proportion compared to urban areas (63.1% vs. 36.9%). Most participants had a high school education level (53.5%). Women with a second or subsequent pregnancy were more common than first-time mothers (61.9% vs. 38.1%). There was no significant difference between the normal care and ERAC groups.

3.2. Post-Cesarean Care Characteristics

Table 2. Characteristics of Post-Cesarean Care

Characteristic	Total (n=368, %)	Normal Care (n=170, %)	ERAC (n=198, %)	p-value
Prophylactic Antibiotics				
No	353 (95.9)	166 (97.6)	187 (94.4)	0.121
Yes	15 (4.1)	4 (2.4)	11 (5.6)	
Early Breastfeeding				
Yes	363 (98.6)	165 (97.1)	198 (100)	0.015
No	5 (1.4)	5 (2.9)	0	
Skin-to-Skin Contact				
Yes	359 (97.6)	161 (94.7)	198 (100)	0.002
No	8 (2.2)	8 (4.7)	0	
Pain Management				
Yes	361 (98.1)	166 (97.6)	196 (98.9)	0.307
No	6 (1.6)	4 (2.4)	2 (1.1)	
Antibiotics Post-Surgery				
No	2 (0.5)	1 (0.6)	1 (0.5)	0.711
Yes	366 (99.5)	169 (99.6)	197 (99.5)	

The rate of prophylactic antibiotic use was relatively low at 4.1%. Postoperative antibiotic use was very high at 99.5%. Pain management after surgery was utilized in 98.1% of



cases, mostly using Voltaren. There was no significant difference between the groups in these aspects. Skin-to-skin contact and early breastfeeding were achieved in 100% of ERAC participants ($p < 0.05$).

3.3. Post-Cesarean Recovery Times

Table 3. Recovery Times After Cesarean Surgery

Activity	Total (n=368)	Normal Care (n=170)	ERAC (n=198)	p-value
Drinking fluids or soft foods (hours)*	2.20 ± 0.5	2.42 ± 0.7	2.01 ± 0.1	<0.001
Eating solid foods (hours)*	6.28 ± 1.4	6.58 ± 1.9	6.02 ± 0.3	<0.001
Sitting up for the first time (hours)*	7.15 ± 1.6	7.52 ± 1.9	6.83 ± 1.3	<0.001
Walking for the first time (hours)*	12.17 ± 3.4	13.36 ± 4.1	11.18 ± 2.4	<0.001
Normal mobility (hours)*	37.53 ± 7.5	39.86 ± 9.7	35.67 ± 4.5	<0.001
First bowel movement (hours)*	22.34 ± 3.1	22.46 ± 3.2	22.23 ± 2.8	0.463
Normal urination (hours)*	10.86 ± 2.9	11.32 ± 3.3	10.49 ± 2.3	0.007
Catheter removal (hours)*	7.28 ± 1.3	7.63 ± 1.9	7.01 ± 0.1	<0.001

* Unit: hours

- ERAC participants had shorter recovery times compared to the normal care group in most categories ($p < 0.05$).

3.4. Early Recovery Outcomes

Table 4. Early Recovery Outcomes After Cesarean Surgery

Outcome	Total (n=368)	Normal Care (n=170)	ERAC (n=198)	p-value
Pain level (VAS score)	4.08 ± 0.5	4.18 ± 0.7	4.01 ± 0.7	0.000
Hospital stay (days)	5.28 ± 1.2	5.24 ± 1.1	5.32 ± 1.2	0.485
Patient satisfaction	4.91 ± 0.3	4.82 ± 0.4	4.99 ± 0.1	0.000

The ERAC group reported lower postoperative pain (VAS 4.01 ± 0.7 vs. 4.18 ± 0.7, $p < 0.01$) and higher satisfaction (4.99 ± 0.1 vs. 4.82 ± 0.4, $p < 0.001$). No significant difference in hospital stay duration was noted.

IV. DISCUSSION

4.1. General Characteristics of the Study Population

The postoperative care program was initiated by Professor Henrik Kehlet in the 1990s. The ERAS (Enhanced Recovery After Surgery) program, also known as ERP (Enhanced Recovery Program) or "fast-track" programs, has become a significant focus in perioperative management for colorectal surgery, vascular surgery, thoracic surgery, and more recently, radical cystectomy surgery. These programs aim to modify physiological and psychological responses to major surgeries and have been proven to reduce complications and hospital stays, improve cardiopulmonary and bowel function, and expedite the return to normal activities [10].

In Vietnam, the ERAS early recovery program is widely applied in general surgery, especially in colorectal surgeries. However, its application in obstetrics and gynecology remains limited and incomplete.



Our study surveyed 368 women with indications for cesarean sections at two hospitals: Can Tho University of Medicine and Pharmacy Hospital and Can Tho Central General Hospital. Of these, 198/368 (53.8%) applied the ERAC (Enhanced Recovery After Cesarean) program for early recovery after cesarean surgery. The results showed that the participants were of reproductive age, with a mean age of 29.6 ± 6.01 years. Women living in rural areas accounted for a higher proportion compared to those in urban areas (63.1% vs. 36.9%). Most participants had a high school education level (53.5%). Women with second or subsequent pregnancies outnumbered first-time mothers (61.9% vs. 38.1%). As the study was randomized, no significant differences were observed between the groups following normal care procedures and those following the ERAC program.

4.2. Characteristics of Postoperative Care and Recovery Activities After Cesarean Section

The rate of prophylactic antibiotic use was relatively low at 4.1%; therefore, the use of antibiotics for treatment after cesarean section reached 99.5%, with medical facilities primarily using antibiotics for therapeutic purposes. Postoperative pain management was administered to 98.1% of patients, mainly using Voltaren. No significant differences were observed between the two study groups in these aspects. However, skin-to-skin contact and early breastfeeding were achieved in 100% of the ERAC group ($p < 0.05$).

The average time for consuming the first liquid meal was 2.20 ± 0.5 hours, and the first solid meal was consumed at 6.28 ± 1.4 hours. Postoperative mobilization included sitting up for the first time, which occurred at an average of 6.28 ± 1.4 hours. Walking was initiated within 12.17 ± 3.4 hours. Our study recorded earlier feeding and mobilization in the ERAC group compared to the standard cesarean care group ($p < 0.05$). Specifically: The time to sit up for the first time in the ERAC group was 6.83 ± 1.3 hours compared to 7.52 ± 1.9 hours. The time to achieve normal ambulation for the first time was 35.67 ± 4.5 hours in the ERAC group compared to 39.86 ± 9.7 hours. Digestive function recovery, including the time of the first bowel movement, was 22.23 ± 2.8 hours in the ERAC group compared to 22.46 ± 3.2 hours. The time to achieve normal urination was 10.49 ± 2.3 hours in the ERAC group compared to 11.32 ± 3.3 hours. In most cases, recovery times in the ERAC group were shorter than those in the standard cesarean care group ($p < 0.05$).

4.3. Early Recovery Outcomes for Mothers After Cesarean Section

Postoperative pain levels measured by the VAS scale were lower in the ERAC group compared to the standard care group (4.01 ± 0.7 vs. 4.18 ± 0.7) ($p < 0.05$). These findings align with the study by Monique Hedderson [11], which showed better pain reduction in women applying ERAC compared to standard procedures, resulting in decreased use of pain medication.

Our study did not find any differences in hospital stay duration between the two groups. This may be due to hospital regulations and the fact that the ERAC program was newly implemented during the study period, which is also a limitation of this research. However, we observed that patient satisfaction was higher in the ERAC group compared to the standard care group (4.99 ± 0.1 vs. 4.82 ± 0.4).

From these results, we conclude that the initial application of the ERAC program for mothers before, during, and after cesarean section has shown promising success.

V. CONCLUSION

The results of applying ERAC showed that the pain level after surgery, measured by VAS, was 4.01 ± 0.7 in the ERAC group compared to 4.18 ± 0.7 in the standard procedure group ($p < 0.001$). The satisfaction level of patients in the ERAC group was higher than in the standard procedure group, with scores of 4.99 ± 0.1 compared to 4.82 ± 0.4 ($p < 0.001$). However, there was no significant difference in the length of hospital stay, with an average of 5.32 ± 1.2 days in the ERAC group and 5.24 ± 1.1 days in the standard procedure group ($p = 0.631$). The results of the study suggest that the full implementation of ERAC is effective in accelerating the recovery process after cesarean surgery. However, the application requires specific guidelines



tailored to the population, and implementation should involve thorough training to enhance the effectiveness of ERAC.

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REFERENCES

1. Ming Y, Li M, Dai F, et al (2019), Dissecting the current caesarean section rate in Shanghai, China., *Scientific reports*, 9(1):2080. doi:10.1038/s41598-019-38606-7
2. Mayne L, Liu C, Tanaka K, Amoako A (2022), Caesarean section rates: applying the modified ten-group Robson classification in an Australian tertiary hospital, *Journal of obstetrics and gynaecology : the journal of the Institute of Obstetrics and Gynaecology*. J, 42(1), pp. 61-66. doi:10.1080/01443615.2021.1873923
3. Pham Thi Be Lan. (2018), Current status of cesarean section and some related factors in Tra Vinh city, Tra Vinh province in 2018, *Ho Chi Minh City Journal of Medical*, 23(2), pp. 141 - 146.
4. Meng X, Chen K, Yang C, Li H, Wang X (2021), 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, *Frontiers in medicine*, 8:694385. doi:10.3389/fmed.2021.694385
5. Suharwardy S, Carvalho B (2020), Enhanced recovery after surgery for cesarean delivery. *Current opinion in obstetrics & gynecology*, 32(2), pp.113-120. doi:10.1097/gco.0000000000000616.
6. Truong Thi Anh Tuyet, Vu Thi Nhung (2020), Evaluation of the effectiveness of early exercise after cesarean section. *Vietnamese Journal of Obstetrics and Gynecology*, 18(4), pp. 28-32.
7. Bollag L, Lim G, Sultan P, et al (2021), Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean, *Anesthesia and analgesia*, 132(5), pp. 1362-1377. doi:10.1213/ane.0000000000005257
8. Nickolas C. Teigen, Nicole Sahasrabudhe, Georgios Doulaveris, et al (2020), Enhanced recovery after surgery at cesarean delivery to reduce postoperative length of stay: a randomized controlled trial, *American Journal of Obstetrics & Gynecology*, 222:372.e1-10.
9. Nguyen, T.V., Wantonoro, W., Nguyen, P.V., & Nguyen, L.T. (2022). Interventions strategy reducing postpartum fatigue: a literature review. *Journal of Health Studies*, 6(2), pp.11-26. DOI: 10.31101/jhes.2698
10. Vu Ngoc Anh Tuan, Vuong Thua Duc, Pham Thanh Viet, Do Ngoc Nghia (2020), Initial evaluation of the effectiveness of ERAS in laparoscopic surgery for colorectal cancer, *Scientific research project*, Binh Dan Hospital.
11. Melnyk M, Casey RG, Black P, Koupparis AJ (2011), Enhanced recovery after surgery (ERAS) protocols: Time to change practice? *Canadian Urological Association journal = Journal de l'Association des urologues du Canada*, 5(5), pp.342-8. doi:10.5489/cuaj.11002
12. Hedderson M, Lee D, Hunt E, et al (2019), Enhanced Recovery After Surgery to Change Process Measures and Reduce Opioid Use After Cesarean Delivery: A Quality Improvement Initiative. *Obstetrics and gynecology*, 134(3), pp. 511-519. doi:10.1097/aog.0000000000003406