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An Overview on Enhanced Recovery after Cesarean Section

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Abstract

The enhanced recovery after surgery society (ERAS) and the society for obstetric anesthesiology and perinatology (SOAP) have published recommendations that reflect the growing acceptance of improved recovery after cesarean birth (ERAC) utilization. Healthcare stakeholders are endorsing ERAC protocols more frequently because they can shorten hospital stays and related costs while also streamlining perioperative care pathways and improving patient experience. There is currently a dearth of high-quality research supporting the advantages of ERAC methods.

Keywords: Enhanced Recovery, Cesarean Section, ERAC.

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1. Introduction

The concept of perioperative care known as "Enhanced Recovery after Surgery" (ERAS) has been around since the 1990s and is relatively new to the field of obstetrics. It is embodied in the term "Enhanced Recovery after Caesarean Delivery" (ERACS). A multimodal-based perioperative care strategy called ERACS aims to improve the patient's condition right away. It lessens the stress reaction during surgery while preserving preoperative organ function. All parties involved in the process—anesthesiologists, obstetricians, pediatricians, nurses, pharmacists, patients, and hospital administration—are involved in ERAC's multidisciplinary approach. Thus, institutional backing, local infrastructure, and compliance of all supporting systems are necessary for the successful implementation of ERAC [1]. Numerous surgical specialties have integrated improved recovery routes. The use of these protocols in obstetrics for cesarean delivery is still in its infancy. Apart from adhering to nursing interventions and participating in them, patients are also free to make autonomous decisions and actions related to the enhanced recovery components of their care.

These include early postoperative intake and gum chewing to promote digestive system motility, preoperative oral intake decisions to reduce surgical stress response and minimize postoperative nausea and vomiting, and interventions to lower the risk of venous thromboembolism by donning sequential compression devices while in bed and engaging in early ambulation. Nurse interventions should be provided and assessed to support patient engagement and full participation in their recovery process, since these particular care elements are left up to the patient's discretion to complete on their own [2]. Among the many advantages of the ERACS are its ability to reduce worry and stress, decrease hospital stays, lower the risk of surgical infections, and quicken physical recovery. There are also fewer problems, a shorter hospital stay, and a quicker functional recovery. It can also lessen opioid exposure and dependence while enhancing the quality of patient treatment. By putting patient safety first, ERACS seeks to expedite the healing and care processes while also delivering a comfortable experience for patients. When using ERACS, preoperative, intraoperative, and postoperative care are essential [3].

2. Preoperative care

2.1. Preoperative Education

Preoperative care will include education, counseling, and pre-admission information. Patients need to be adequately informed about the surgical and anesthetic treatments they will be undergoing. The surgeon, anesthesiologist, and nurse should ideally meet with the patient and family to discuss the case. It can hasten the healing and release of the patient while lowering anxiety and dread. Psychological counseling furthermore seeks to lower tension in order to hasten the healing of wounds and post-operative recuperation. Patients receiving counseling services may be given informational materials, pamphlets, or multimedia. Enhancing patient participation in perioperative nutrition, mobilization, pain management, and physical therapy can be beneficial. Additionally, it lessens post-operative problems [4]. In general, counseling and education are required for the ERACS to be successful. Information regarding the surgery and what to anticipate in the operating room are covered in the education and counseling sessions.

Surgical planning, pain management programs, nutrition goals, and early mobilization are also included. The patient is also given information about nutrition for expectant

moms and nursing mothers, duration of their stay, and requirements for their discharge. This instruction was given by three medical professionals: nurses from Personal Surgical Office (PSO), anesthesiologists, and specialists in obstetrics and gynecology. To help patients learn about ERACS idea, it is crucial to provide educational materials that they can take home or access online [5]. In order to engage and empower patients to participate more fully in their plan of treatment, Enhanced Recovery after Cesarean Consensus adds patient education goals include setting patient expectations and reviewing enhanced recovery goals. To improve patient compliance and collaboration with healthcare team, an early focus on patient education regarding the rehabilitation process and discharge milestones is advised [6].

3. Preoperative Nutrition

3.1. Preoperative Oral Intake and Fasting

Preoperative, perioperative, and postoperative components are incorporated into ERAS protocols in order to reduce risk of postoperative nausea and vomiting. Reducing surgical stress and achieving early postoperative homeostasis are goals of enhanced recovery procedures, which also seek to lessen postoperative nausea and vomiting [7]. A primary component of ERAS protocols aimed at reducing postoperative nausea and vomiting (PONV) involves departing from conventional pre-operative fasting guidelines before surgery. Conventional "nothing by mouth" rule after midnight for cesarean delivery should be changed, according to several research. According to ERAS Society, a light meal can be consumed up to six hours before surgery, and clear liquids, ideally oral carbohydrate drinks (for women without diabetes), can be consumed up to two hours before procedure is planned to begin. These recommendations for fasting and oral intake are in agreement with the American Society of Anesthesiologists. These updated fasting guidelines have a strong recommendation grade and a high evidence level [8]. An earlier study debated the effects of postoperative nausea and vomiting on patients undergoing outpatient cholecystectomy who drank a beverage high in carbohydrates two hours prior to surgery versus those who fasted overnight.

When compared to standard nothing by mouth guidelines, their findings showed a lower incidence of PONV among the patients randomized to carbohydrate beverage group [9]. Clear liquid intake up to two hours before to surgery is indicative of a major shift in practice for many hospitals using ERAS guidelines. Before being admitted for a cesarean delivery, patient maintains control over their oral intake, which may lessen likelihood of postoperative nausea and vomiting. Patient has to fast prior to surgery in order to prevent postoperative nausea. Before undergoing anesthesia, it advised to fast for six to eight hours for solid foods and two hours for fluids heavy in calories. Two hours prior to surgery, consuming high-calorie beverages can help minimize feelings of hunger, thirst, and anxiety. Two hours before to surgery, capsules containing omeprazole or ranitidine will be provided [10]. Anesthesiologists have a great deal of concern about a patient's nil per oral (NPO) status, thus their involvement is crucial. Two hours prior to surgery, the ERAC and the Society of Obstetric Anesthesia and Perinatology (SOAP) recommend administering clear juice (16 ounces/500 ml). Limiting extended non-peroxide and complex carbohydrate (maltodextrin) loading with non-particulate drink night before and two to three hours before anesthesia can reduce protein breakdown, improve postoperative insulin resistance, and limit metabolic stress response [11].

3.2. Antibiotic Prophylaxis

Thirty to sixty minutes before to the ERACS treatment, a single dose of broad-spectrum prophylactic antibiotics is administered. In addition, non-steroidal anti-inflammatory medications (NSAIDs) and scheduled acetaminophen are supplied. It involves limiting amount of neuraxial opioids, or morphine, avoiding nausea and hypothermia, and promoting mother-toddler bonding. These days, multimodal analgesia is a crucial part of most surgeries and anesthesia. Procedures and drugs used in ERACS procedures go beyond standard surgical anesthetic. Analgesic medications can be started right away before surgery, continued during surgery, and prolonged afterward. In ERACS, non-opioid analgesics reduce the amount of opioids used [4]. Prophylactic antibiotic use can reduce risk of infection following cesarean section by 60% to 70%. Antibiotics should not be administered postoperatively but rather prior to clamping of umbilical cord. Clinical situation and patient's allergy status determine which antibiotic is best. Both gram-positive and gram-negative bacteria, as well as certain anaerobes, should be covered by antibiotics [12]. For women under 80 kg, a single intravenous dosage of cephazolin (1 g) is standard; for patients 80 kg or more, dose rises to 2 g.

To obtain appropriate tissue concentrations of antibiotic, cephazolin dosages up to 3 g are being considered for women weighing 120 kg or more. Patients who are not prescribed cephazolin, for example, due to a severe allergy, should be prophylactically treated with 900 mg of clindamycin and 5 mg/kg of aminoglycoside. If an allergy manifests as urticaria, respiratory distress, angioedema, or anaphylaxis, it should be given careful thought. In patients with a history of methicillin-resistant Staphylococcus aureus, adding a single dose of vancomycin is advised [13]. Infection risk is attributed to both skin and vaginal flora due to nature of cesarean sections. Risk of contracting vaginal bacteria is higher in women who have a cesarean section following labor or membrane rupture. According to more recent studies, giving these women 500 mg of azithromycin intravenously in addition to their usual antibiotic prophylactic helps lower their risk of infection. After cesarean sections, topical treatments have also used to reduce infection. It has discovered that topical povidone-iodine and chlorhexidine are both useful for prepping skin on abdomen. There is conflicting and mainly low-quality research, however there may be some indication that chlorhexidine reduces infection more effectively than povidone-iodine. Both approaches are seen as appropriate as data is ambiguous [14].

3.3. Euvolemia

Having perioperative euvolemia is crucial to getting the best possible results from a cesarean delivery. In addition to blood pressure, intravascular volume controls cardiac output and oxygen supply. In addition to preventing acidosis and optimizing fetal oxygenation, maintaining appropriate uterine perfusion also helps to remove waste materials from uterine myometrium and transport nutrients. Pregnant women who experience peri-operative fluid excess are more likely to experience pulmonary edema and increased cardiovascular workload. In first three days following delivery, weight loss

in newborns might be caused by maternal intrapartum fluid excess. Keeping fluid balance within normal limits is one of the fundamental tenets of ERAS. Goal-directed fluid treatment based on physiologic endpoints has demonstrated to shorten hospital stays and minimize perioperative complications in general surgical population [7].

3.4. Preoperative intravenous (IV) fluid therapy

Preoperative intravenous (IV) fluid therapy is a widely used procedure to maintain fluid balance and guarantee proper hydration before to surgery, including cesarean sections. Particular pace at which IV fluid is administered may change depending on patient's needs, health, and the evaluation of the surgical team. Nonetheless, 125 mL/hr is a generally accepted recommendation for IV hydration treatment prior to surgery. IV fluids given before to surgery to provide optimal hydration. Sustaining blood volume, supporting organ function, and averting dehydration-related consequences all depend on keeping adequate hydration. Preoperative IV fluids ensure that electrolytes and other necessary chemicals are available in right concentrations and assist maintain body's optimum fluid balance. Maintaining this balance is essential for proper physiological processes. Healthcare professionals continuously monitor the patient's fluid status, vital signs, and urine output during preoperative IV fluid treatment. Depending on patient's reaction and fluid balance, fluid rate may need to be adjusted [3].

3.5. Preoperative blood glucose monitoring

Preoperative blood glucose monitoring is a routine procedure used to evaluate a patient's blood sugar levels prior to surgery. An hour before to the surgery is usually the standard time point for this kind of examination. Preoperative blood glucose monitoring is primarily used to detect abnormal blood sugar levels prior to surgery. This is crucial because unchecked blood sugar levels, whether high or low, raise the possibility of issues both before and following the surgery [15]. Blood glucose monitoring prior to surgery is very crucial for diabetics. Prior to surgery, it assists the medical professionals in evaluating how well their diabetes is being managed and making any required changes to ensure ideal blood glucose control. Before surgery, blood glucose levels are carefully checked since they can affect how the body reacts to anesthesia and how the surgery turns out in general. Low blood glucose levels (hypoglycemia) might result in issues like the confusion, seizures, or trouble waking up from anesthesia. High blood glucose levels (hyperglycemia) can hinder wound healing and increase the risk of infection [9].

4. Intraoperative care

4.1. Technique of Anesthesia

For cesarean birth, the American Society of Anesthesiologists' practice guidelines and the ERAS guidelines both advocate central neuraxial procedures such as spinal, epidural, and combined spinal epidural. Since regional anesthesia is linked to a lower incidence of intraoperative discomfort, nausea, and vomiting, less blood loss, a lower stress reaction to surgery, and a shorter hospital stay, it is recommended over general anesthesia. Although the effects of epidural and spinal anesthesia are similar, spinal anesthesia has a quicker start and a lower rate of intraoperative pain. Patients get a single dose of spinal anesthesia by administering 2.5 mg of midazolam two to three minutes before to spinal anesthesia. Ephedrine infusion for the maintenance of anesthesia-induced hypotension [16].

4.2. Preoperative antimicrobial prophylaxis and skin preparation

Premature rupture of membranes and the absence of chorioamnionitis typically classify a cesarean delivery as clean (class I). However, a clean contaminated (class II) incision is typically used for a cesarean birth in event of a ruptured membrane, especially if rupture occurs during active phase, second stage, or chorioamnionitis of labor. One may argue that some of these later incisions are polluted (class III) wounds at very least. All have a higher chance of developing postoperative infections, nevertheless, and have shown to benefit from preventative antibiotics and other measures. Class II or class III wounds both have risk of skin flora in addition to risk of exposure from vaginal flora, even though class I incisions will primarily be at risk from abdominal skin flora. When thinking about preventive antibiotics, wound preparation, and vaginal preparation, these microbiological dangers are main concerns. Accepted practice for infection prevention during cesarean delivery prior to membrane rupture has to employ a first-generation cephalosporin with a rather restricted spectrum targets skin flora [17]. Preoperative prophylactic antibiotic recipients showed a substantial decrease in composite maternal infectious morbidity when compared to those who received prophylactic antibiotics at time of cord clamping. There is mounting evidence incidence of wound infections could be further decreased by expanding range of antibiotics prescribed before incision.

When compared to vaginal delivery, the risk of infection and the morbidity that follows is five to twenty times higher during cesarean delivery. Hospital readmissions and a notable extension of hospital stay are caused by infectious problems. Strong data suggests that all women having cesarean deliveries should get prophylactic antibiotics [18]. Because of the potential for antibiotic exposure in neonates, preventive medications have historically been delayed until cord clamping. Nonetheless, there is unambiguous proof that preventative antibiotics given 60 minutes or less before to skin incision considerably lower risk of postpartum infection in mothers as compared to when they are given after cord clamping [19]. Current recommendation is to give non-laboring patient a single dosage of a broad-spectrum antibiotic before making a skin incision. If at all possible, it is advised women take an antimicrobial shower before to being admitted to hospital for a planned cesarean delivery. Azithromycin significantly decreased infectious complications from 12.0% to 6.1% and wound infections from 6.6 to 2.4% when added to the regular cephalosporin regimen. In order to prepare the abdomen for surgery, Centers for Disease Control recommend using a chlorhexidine alcohol scrub instead of a povidone iodine solution. Evidence in context of cesarean deliveries is sparser, despite fact that there is a larger body of literature in other procedures [20].

4.3. Vaginal preparation

An antibacterial vaginal preparation using a povidone-iodine solution before to cesarean birth in women during labor or who have ruptured their membranes appears to lower the incidence of infection problems, according to a

growing body of research. According to reports, the endometritis risk dropped from 8.3 to 4.3%. This was true for women in labor as well as those with ruptured membranes in stratified analyses [21].

4.4. Management of Perioperative Hypotension

Under spinal anesthetic, women frequently experience hypotension during cesarean deliveries, which can be harmful to both mother and fetus. Hypotension can reduce uteroplacental blood flow, which affects fetal oxygenation, and cause intraoperative nausea and vomiting (IONV) in mother. It has proven possible to treat spinal anesthesia-induced hypotension using both fluids and vasopressors. Incidence of hypotension can only be somewhat reduced by fluid loading techniques alone [22]. Although neuraxial procedures are preferred method for treating CD, there are certain risks related to these treatments that can affect both mother and newborn. Most frequent adverse impact of sympatheticectomy brought on by neuraxial methods is vasodilation, which lowers blood pressure. Neuraxial block's onset pace and drug dosage both affect how severe hypotension is. Due to a decrease in uteroplacental perfusion, spinal induced hypotension can cause symptoms in women such as intraoperative nausea, vomiting, and dizziness. It can result in fetal acidosis [23]. Since peripheral vasodilatation is primary cause of spinal-induced hypotension, vasopressors are the cornerstone of hypotension treatment.

Because phenylephrine has a better fetal acid-base status than ephedrine and a lower incidence of IONV, it is presently vasopressor of choice for treating maternal hypotension brought on by neuraxial anesthesia [24]. Most widely advised method for treating spinal-induced hypotension is combination of vasopressors and hydration treatment. To a certain extent, preloading with crystalloid and colloid helps prevent maternal hypotension. Current agreement emphasizes crystalloid co-loading and colloid preloading more. It is still unknown, what constitutes ideal fluid regimen in terms of volume dosage and if crystalloid or colloid works better to prevent hypotension [25]. Vasopressor usage is advised as a routine preventative measure because it has demonstrated that it is beneficial in preventing spinal-induced hypotension. Because it can directly counteract vasodilation, phenylephrine—a pure alpha agonist—is preferred vasopressor. To justify use of medications like norepinephrine and metaraminol, which have weak beta agonist action, more research-based evidence from obstetric patients needed.

Effective dose of norepinephrine bolus (ED90) for parturients having elective CD indicated by scientists to prevent hypotension in 90% of cases. Researchers found that an estimated 100 mg of phenylephrine is equal to 8 micrograms of norepinephrine [26]. Compared to phenylephrine boluses for rescue of established hypotension, a prophylactic infusion is more successful in lowering the frequency of hypotensive events and the incidence of nausea and vomiting. Consequently, using a prophylactic phenylephrine infusion started at 50 mcg/minute in combination with a fast crystalloid colloid of up to 2 L would be the advised course of action as part of an the ERAS protocol. When treating hypotension following a cesarean delivery, a low-dose norepinephrine infusion has studied as a potential substitute for the phenylephrine. Research indicates that it is just as effective as the phenylephrine in preserving blood pressure while causing a greater heart rate and cardiac output [27].

4.5. Management of Spinal Anesthesia-Induced Intra and Postoperative Nausea and Vomiting

Possible causes of spinal anesthesia-induced intra- and the postoperative nausea and vomiting the (PONV) include activation of the vomiting center due to the hypotension-induced brain ischemia and the hyperactivation of the gastrointestinal system as a result of the sympathetic blockade. Furthermore, opioids and specific surgical techniques like as externalization of uterus and intra-abdominal saline irrigation may also have a role. Preventive vasopressor infusion and fluid loading reduce the risk of intraoperative nausea and vomiting while preserving the uteroplacental perfusion by maintaining the maternal blood pressure. Combining at least two intravenous antiemetics with the distinct mechanisms of action is advised. Combining the glucocorticoids, the D2 receptor antagonists, and 5HT3 antagonists is advised [28].

4.6. Prevention of Hypothermia

Effects of spinal anesthesia can disrupt thermoregulation for a few hours and quickly lower body temperature below 36°C. Perioperative hypothermia raises risk of coagulopathy, cardiac ischemia, infection rate, and decreased medication metabolism in mother, along with decreasing patient satisfaction due to shivering [29]. Fifty to eighty percent of patients undergoing spinal anesthesia for cesarean delivery may experience perioperative hypothermia. Numerous randomized control trials demonstrated that in non-pregnant patients, perioperative hypothermia is linked to problems. Surgical site infection, cardiac ischemia, changed medication metabolism, coagulopathy, prolonged hospital stay, shivering, decreased skin integrity, and low patient satisfaction have among these consequences. Neonatal hypothermia related to maternal hypothermia has associated with complications in newborns, including as hypoglycemia and respiratory distress syndrome. Preterm and extremely low birth weight babies have known to die from hypothermia [30]. The ERAS society advises utilizing warming equipment to prevent perioperative hypothermia. Thus, incidence of maternal and newborn hypothermia may be reduced by using warming devices for IV fluid administration in conjunction with air warming blankets and keeping operating room temperature at 22°C.

Patients who received active warming also experienced decreased newborn hypothermia and better umbilical artery cord pH, in addition to increased thermal comfort. Early mother-child bonding can also be facilitated by maintaining normothermia. It is unknown which active warming approach works best. The majority of techniques are ineffective when used alone. Instead, warmed intravenous fluids combined with forced air warming before and during surgery may be more beneficial, and this should be incorporated into all ERAS procedures [31]. Forced air warming and intravenous fluid warming were two of active warming techniques. Patients in the active warming group (forced air warming or intravenous fluid warming) experienced far less temperature fluctuation, fewer episodes of shivering, a higher body temperature at conclusion of surgery or upon arrival at post anesthetic care unit, and a higher PH in umbilical artery. It has shown that forcing air

warming in addition to fluid warming reduces risk of perioperative hypothermia and enhances maternal thermal comfort [32].

4.7. Care of the newborn infant

Birthing causes more stress than most other major life events, and there are major physiological changes that must be completed. The newborn's initial care is crucial for facilitating a safe and orderly transition from fetal to neonatal life. Fitness for service in every setting that performs cesarean birth entails having the necessary resources (people, equipment, and knowledge) and being ready to provide rapid newborn resuscitation if necessary [7]. Apgar scores are crucial performance and health markers that need to be evaluated and recorded at1, 5, and 10 minutes after delivery. Interventions in the operating room for the agitated baby include the best time to clip the umbilical cord, preventing hypothermia, helping the baby start breathing, and allowing the mother and newborn to touch each other's skin [33].

4.8. Delayed cord clamping

Delaying the cutting of the umbilical cord for a minimum of one minute following a full birth reduces infant anemia and enhances neurodevelopmental results. After a cesarean delivery, the baby may be held by the doctor or an assistant near the placenta until the umbilical cord is clamped, or it may be placed on the mother's legs or tummy. Systematic evaluations have indicated that delaying cord clamping for at least 30 seconds in preterm newborns reduces the incidence of necrotizing enterocolitis, intraventricular hemorrhage, and transfusion requirements [34]. Since it is linked to a lower risk of intraventricular hemorrhage, a higher hematocrit, and a decreased requirement for volume resuscitation, it was originally advised that premature neonates delay clamping the umbilical cord for at least 30 seconds. Current results, however, indicate that it might also be advantageous in term newborns if there is no proof of appreciable harm [35]. A greater probability of phototherapy-induced jaundice existed in newborns with postponed cord clamping. At least 30 to 60 seconds after birth, strong term and preterm children should have their cords clamped later, according to the ACOG's current guidance. Only babies who require emergency resuscitation or whose placental circulation is compromised should have their cords cut immediately [36].

4.9. Facilitating onset of breathing

In addition to preventing hypothermia, it's advised to help baby regain control of their body and gently stimulate them when they take their first breath or cry. About 85% of newborns delivered at term will start breathing on their own within 10 to 30 seconds of birth; 10% more will respond to stimulation drying, and other 5% require assisted breathing. It is best to avoid routinely suctioning airway or performing gastric aspiration; secretions should only be removed if they seem to be obstructing airway. If amniotic fluid contains meconium, a similar course of action advised [37].

4.10. Skin to skin contact

Early skin-to-skin contact has been shown to benefit both the mother and the infant. Early skin-to-skin contact has been linked to longer and higher breastfeeding rates as well as lower rates of postpartum depression and anxiety in mothers. It is important to take action to encourage breastfeeding to start as soon as possible. About ten years ago, the idea of a "natural or gentle" cesarean delivery was established. It aims to change certain features of the procedure so that the woman might have a "natural" experience that is similar to giving birth vaginally [38]. These adjustments include the use of a transparent surgical drape, letting the mother and her companion see the baby be born, and starting the breastfeeding and skin-to-skin contact process right away. The "natural" cesarean delivery group rated their birth experience substantially higher and engaged in more breastfeeding than the typical cesarean delivery group, according to a randomized trial [39].

4.11. Multimodal Techniques for Perioperative Pain Management

An essential part of ERAS protocols is provision of sufficient postoperative analgesia, and this is especially true for women having cesarean deliveries. Poor maternal bonding with newborn, breastfeeding difficulties, delayed mobilization, which may raise risk of thromboembolic consequences, delayed functional recovery, and an increased risk of postpartum depression and persistent pain are all linked to suboptimal analgesia [40]. Postoperative pain caused by a variety of intricate circumstances, and pain perception varies greatly between people. In order to maximize analgesia, reduce side effects, and provide opioid sparing, ERAS protocols suggest a multimodal analgesic regimen that combines medications with several mechanisms of action. It has demonstrated that multimodal approaches can alter body's physiological response to painful stimuli, opioid intake, and long-term opioid dependence. Together with intrathecal opioids, a multimodal analgesic regimen should be taken into consideration. This may involve regional methods and non-opioid analgesia [50]. Intraoperative breakthrough pain is minimized and postoperative analgesia improved by intrathecal opioid administration. For CD, neuraxial morphine dosage recommendations vary from 1 to 3 milligrams when administered via epidural technique or from 50 to 150 micrograms when administered intrathecally via spinal technique.

Scheduled non-steroidal anti-inflammatory medications and acetaminophen reduce need for opioids and their associated adverse effects by 30% to 50% following CD, unless there is a contraindication. It is advised to begin taking prescribed acetaminophen either before surgery or during the healing process. Following peritoneal closure, NSAIDs in the form of 30 mg of intravenous ketorolac can be given. Regular NSAIDS can then be given at prearranged intervals; for example, ketorolac can be prescribed at doses of 15 to 30 mg every six hours, ibuprofen at 600 mg every six hours, or naproxen at 500 mg every twelve hours. The highest amount of acetaminophen that can be taken in a 24-hour period is 4000 milligrams, as approved by the FDA [42]. The two methods of local anesthesia that advised are nerve blocks and wound infiltration. Transversus abdominis plane (TAP) block and quadratus lumborum block are two ultrasonography-guided nerve blocks that have demonstrated good analgesic impact. Research has demonstrated that TAP block is just as effective as 100 mg intrathecal morphine for CD in terms of perioperative outcomes, such as pain scores, need for rescue analgesics, side effect rates, and patient satisfaction. It has been discovered that the quadratus lumborum block is an efficient localized block for postoperative pain control following CD when utilized as part of multimodal analgesic

therapy. When neuraxial morphine is unavailable or impractical to administer, these nerve block methods are very helpful [43].

4.12. Oxytocin management

To stop postpartum bleeding, a precautionary low-dose oxytocin infusion (15U/hour) should be started. Adverse effects such hypotension and myocardial ischemia are less common at low doses [44]. As a first-line prophylactic uterotonic, carbetocin, a long-acting agonist of the oxytocin receptor, can be utilized in place of oxytocin [45].

5. Postoperative care

5.1. Promotion of Postoperative Gut Motility/Ileus Prevention

5.1.1. Early Nutrition

There are varying definitions for early feeding, ranging from 30 minutes to 8 hours following cesarean delivery. Largest trial on early feeding randomized patients to either conventional feeding after eight hours or early feeding after 2 hours. It showed improvements in ambulation, length of stay, and maternal satisfaction along with a decrease in thirst and hunger, but had no effect on readmissions, gastrointestinal symptoms, or infections. In order to enhance breastfeeding, post-operative diet should include higher amounts of milk, fruit, vegetables, and calories. Sufficient fiber in diet is necessary to avoid constipation [46]. Aspiration, dehydration, and a decline in nutritional status can result in respiratory, renal, and viral consequences from prolonged gastrointestinal tract dysfunction, which can be multifactorial in nature. The ERAS procedure, despite early oral intake linked to a reduced risk of paralytic ileus, a shorter recovery period for intestinal peristalsis and gas release, and a decreased risk of gastrointestinal problems [47]. The restoration of normal colon function is among most crucial elements in healing process following any surgical procedure.

A number of factors make this possible, including early oral (enteral) fluid intake on day of surgical intervention, preventing postoperative nausea and vomiting, mobilizing patients as soon as possible, reaching euvolemia, and using opioid-sparing analgesia in early postoperative phase to prevent side effects of opioid analgesics, such as nausea and vomiting [48]. Resuming oral fluid intake the day of surgery and incorporating a regular diet on the first postoperative day is known as early postoperative nutrition. Across surgical specialties, early oral intake is encouraged as part of an enhanced recovery pathway to encourage an early return of gut motility, improve insulin sensitivity, and reduce surgical stress response without raising risk of complications or nausea and vomiting during postoperative period [8]. Two hours after procedure, the ERAS recommendations for cesarean delivery advise returning to a regular diet. Recommendation grade for this civilization is strong, with a moderate level of evidence supporting it. After surgery patient will autonomously choose to begin early oral intake, and they will continue to be in charge of consuming both liquid and solid oral intake as long as they are ambulatory. The research provides unequivocal descriptions of advantages of early oral intake following cesarean delivery, and these benefits should be clarified as a component of self-care in a patient's recuperation process [49].

5.1.2. Gum Chewing

Numerous studies have suggested chewing gum during the recovery phase following surgery. Gum chewing is rated as low evidence with a weak recommendation in the ERAS guidelines for cesarean delivery and gynecologic/oncology surgery. This is mostly because studies have not used blinding techniques. Gum chewing, a form of sham eating, has shown to aid in early postoperative phase in the restoration of bowel function [50]. Postoperative gum chewing after cesarean delivery has shown to decrease postoperative ileus by shortening time between first flatus, first bowel sound, and first bowel movement. This promotes intestinal activity throughout the recovery phase. Gum chewing reported to be more acceptable for use following surgery when it is a cheap, low-risk, and straightforward technique. Gum chewing until bowel function returns is recommended by one guideline as high [51].

The patient can be given gum to chew, and if they choose, they can be encouraged to use it in between meals. By shortening the time between the patient's first flatus and first bowel movement following surgery, and by increasing the speed at which bowel function returns, an understanding of the reasons behind gum chewing in the early postoperative period may encourage the patient to continue chewing gum [52]. The gum chewing regimens used in the research varied greatly in terms of when they were started, from just after the procedure to as much as 12 hours later, how long each session lasted (15 to 60 minutes), and how many sessions there were per day (3 to >6). The investigations used traditional delayed feeding as a comparator group until digestive function was restored. In the early feeding trials, the time to report flatus was 5.9 hours, while in the traditional feeding trials, it was 7.8 hours. When compared to individuals who did not chew gum, there was a 7-hour improvement in time to flatus [53].

6. Venous Thromboembolism Prevention

6.1. Sequential Compression Devices

One of the main causes of obstetric morbidity and mortality is venous thromboembolism. In order to reduce the risk of thromboembolism, the National Partnership for Maternal Safety Consensus Bundle on Venous Thromboembolism suggests early ambulation and the standard use of mechanical thromboprophylaxis for all women having cesarean deliveries. The ERAS Society's 3-part series on guidelines for cesarean delivery mentions in Part 3 that patients are more susceptible to venous thromboembolism during the hypercoagulable condition that follows childbirth [54]. Sequential compression devices have been shown to reduce the death risk from pulmonary embolisms after becoming the standard of therapy after cesarean delivery. To lower the risk of thromboembolism in the postoperative state, it is important to assess the patient's comprehension of the advantages of wearing the sequential compression devices whenever they are in bed [55].

6.2. Early Mobilization

Medical discomfort, indwelling urine catheters, intravenous poles and fluids, and other obstacles to early mobilization notwithstanding, research from various medical specialties repeatedly document the advantages of early mobilization after surgery. Early mobilization and ambulation has been shown to reduce the risk of thrombosis and muscular atrophy, as well as have positive effects on the

lungs (mitigating atelectasis) and insulin resistance [56]. It has also been shown to shorten hospital stays. Guidelines for safe perioperative care are developed by incorporating comprehensive activity plans related to gynecologic surgery and obstetric anesthesia. Despite these advantages, several studies agreed that there is a dearth of data on relative merits of patient-chosen ad lib mobility versus mobilization tactics. Following neuraxial anesthesia, a patient's motor function will be recovered. Once the patient has shown stability, the patient will determine how much mobility and ambulation they wish to continue on their own initiative and at their own discretion. Learning about advantages of early and frequent ambulation after cesarean delivery may have an impact on patient's degree of participation in ambulation activities [57]. A key component of the ERAS protocol is early verticalization and mobilization for active monitoring around patient and in the operating area on the day of operation.

The patient must be well analgesic, in a euvolemic and euglycemic state, free of nausea and vomiting, and have resumed oral fluid intake in order for this crucial stage to occur [58]. Placing the patient on the edge of their bed is the first step in early mobility. Because the catheter was taken out no later than six hours after the treatment to prevent postoperative patients from developing urinary tract infections, the patient can go from their bed to the bathroom. Following the catheter's removal, the patient can nurse the child while sitting comfortably to ensure proper baby attachment. One day following the ERACS operations, or the second day of hospitalization, the patient may be released from the hospital. Patients who do not require additional anti-pain drugs, such as anti-pain patches or infusions, or who can tolerate pain are eligible for discharge [59]. An audit, active engagement from a member of the surgical team, and the earlier implementation of other ERAS protocol components—analgesia, prevention of nausea and vomiting, and early feeding (oral fluid intake)—are necessary for the use of these components. All of this demonstrates that the protocol, which involves a continuum of events, cannot be implemented in isolation for any one component. The avoidance of thromboembolic consequences, mainly with use of "mechanical prevention" (elastic bandages or stockings), is another crucial aspect of early mobilization [60].

6.3. Urinary catheter removal early

It is common practice to insert a urinary catheter during a cesarean section. Bladder drainage is typically thought to be able to quantify urine production, lessen damage to the urinary system, and lessen postoperative urinary retention. However, one of the most typical side effects following a cesarean delivery is a urinary tract infection [61]. Under ERAS standards, urinary catheters should be taken out within 24 hours. Data regarding the timing of urinary catheter removal in women undergoing spinal anesthesia after cesarean delivery are scarce. Urinary catheters were taken out 8 hours post-operation to allow for early ambulation in a published the ERAS protocol for cesarean delivery; no problems were noted [62]. Another prospective randomized clinical trial compared the incidence of post-operative bacteriuria, dysuria, burning during micturition, frequency and urgency of urination, time till first voiding, the mean postoperative ambulation time, and length of hospital stay between women undergoing the elective cesarean delivery and immediate vs. 12-hour urinary catheter removal [63].

6.4. Opioid-sparing analgesia

Postoperative analgesia is not the only outcome of opioid-sparing analgesia. Reduction and prevention of the symptoms of nausea, vomiting, gastric stasis, intestinal paresis, and paralytic ileus are the primary objectives of opioid-sparing analgesia, which will aid in the swift restoration of gastrointestinal tract function. Over the past ten years, new models in perioperative care, particularly in postoperative analgesia, as well as surgical and anesthetic procedures have been mainstreamed in an effort to reduce the abuse of opioid analgesics and the related side effects. Optimizing perioperative treatment and postoperative outcomes (complications, readmissions, and patient satisfaction) is goal of ERAS protocols [64]. The PROSPECT (PROcedure Specific Postoperative Pain ManagemenT) Working Group was established by anesthesiologists and surgeons. Based on evidence-based medicine, the PROSPECT program seeks to offer useful procedure-specific pain management guidelines for anesthesia for a range of surgical procedures. Recommendations for perioperative care in numerous surgical specialties have resulted in guidelines that have been helpful in lowering complications, opioid use, length of hospital stay, and cost.

Perioperative analgesia is based on multimodal opioid-sparing analgesia, as per ERAS protocols. This idea encompasses both local analgesic methods and different pharmaceutical drugs [65]. Acetaminophen (paracetamol) and NSAIDs are the two systemic pharmacological medicines that are most frequently employed. Because NSAIDs have a potent analgesic effect without the negative effects of opioids, such as nausea, vomiting, somnolence, and intestinal paralysis, they are often and extensively utilized in postoperative analgesia in ERAS programs. The risk of postoperative gastrointestinal bleeding and weakened anastomoses associated with nonselective NSAIDs has considerably decreased with development of selective COX-2 inhibitors, such as celecoxib. For purpose of providing analgesia during perioperative phase of several non-cardiac surgical procedures, such as spine and orthopedic surgery, these analgesics are advised [66]. ERAS procedures use liposomal bupivacaine infiltration into abdomen wall along laparotomy incision for postoperative analgesia, working in conjunction with NSAIDs and acetaminophen. In terms of pain management and opioid use, bupivacaine infiltration of abdominal wall functions similarly to an epidural catheter.

According to the findings of all the trials, bupivacaine infiltration and epidural anesthesia are equally effective, however patients who receive bupivacaine infiltration require more opioids. In addition to the analgesic impact and avoiding opioids, the length of hospital stay and associated expenditures are linked to concomitant problems (e.g., nausea, vomiting, paralytic ileus/sub ileus) and regional analgesia approaches [67]. For the most part, epidural analgesia works well in the managing pain following the laparotomies and high-volume procedures, which are also linked to more severe surgical trauma. Nevertheless, several articles note that this kind of analgesia causes infusion overload and urine retention in addition to delaying early release. Several methods of the postoperative analgesia are suggested in place of this kind of analgesia; these methods

can be combined in different ways. These include the NSAIDs, non-opioid analgesics, oral analgesics, spinal anesthetic, and abdominal wall infiltration with bupivacaine. The Acetaminophen, the celecoxib, and gabapentin are the drugs that can be given, under the guidelines of the ERAS society [68].

6.5. Prophylaxis of surgical site infections

Hospital expenditures, quality of life, and duration of stay are primarily impacted by surgical site infections and fever during the early postoperative phase. The latter is the outcome of a postponed discharge and higher consumable and medication use. A surgical incision can result in hematomas, seromas, dehiscence/events, and wound infections, among other consequences. Regardless of the kind of incision (Pfannenstiel or lower median laparotomy), these complications are common for open procedures, and part of the ERAS protocol's efforts are intended to reduce them. These are intricate procedures that require prophylactic antibiotic use, targeted infusion therapy, preventing postoperative hyperglycemia and insulin resistance by consuming carbohydrates before to surgery, and maintaining normothermia during the operation [69].

6.6. Normothermia

The length of the procedure under normothermia settings affects the risk of surgical site infections, the amount of blood lost during the procedure, and how quickly the patient recovers from general anesthesia. Surgical site infections are a major cause of nosocomial infections in surgical patients and a substantial risk factor in reporting postoperative outcomes. An independent and major risk factor, even mild hypothermia increases the likelihood of SSI six times. Even eight weeks following surgery, perioperative hypothermia is linked to a higher rate of infection complications [70]. SSIs caused by hypothermia have the potential to lengthen hospital stays and raise postoperative healthcare expenses. By lowering oxygen delivery, perioperative hypothermia weakens the immune system's defenses against several infections. Peripheral vasoconstriction is another impact of hypothermia that results in decreased tissue oxygenation of the surgical site and decreased blood flow. Tissue hypoxia can cause surgical wound dehiscence by changing protein metabolism, which interferes with the healing process [71].

6.7. Normothermia and intraoperative blood loss

An increased amount of blood loses during surgery is one of the effects of hypothermia. Because hypothermia interferes with enzyme activity, it can alter the pharmacokinetics of drugs. The body redistributes blood to the important organs from the bowels, extremities, kidneys, and liver when hypothermia sets in. As a result, the medications' plasma bioavailability is decreased. Apart from the aforementioned consequences, a drop in body temperature also results in an increase in blood saturation with carbon dioxide and a PH fall. Drugs become ionized when the pH shifts, which alters their bioavailability. In this manner, the metabolism is lowered and slowed down, which prolongs the effects of the medications used to induce and maintain anesthesia. Because there is less blood flow to liver when body temperature drops, propofol plasma concentration rises [72]. The activity of volatile anesthetics is impacted by perioperative hypothermia, which lowers the minimum alveolar concentration of isoflurane and sevoflurane by 5% for every degree that the body temperature drops.

Furthermore, hypothermia prolongs the time it takes for patients to recover from anesthesia by making volatile anesthetics more soluble in tissue. For every degree that body temperature drops, the concentration of fentanyl, an opioid analgesic frequently used during anesthesia, rises by 5%. Hypothermia modifies the bioavailability of muscle relaxants via altering their metabolism and excretion, respectively. A two-degree drop in body temperature can cause neuromuscular blockade to last twice as long. There is a correlation between delayed recovery from anesthesia and all of these perioperative hypothermia effects [30]. There are serious coagulation problems linked to hypothermia. Plasma coagulation factors need an ideal temperature to work properly, just as other enzymes. Because hypothermia lowers enzyme activity, coagulopathy results. The clotting factors are decreased by the related blood loss, which increases blood loss even more.

At temperatures below 36 0C, synthesis of thrombin and fibrinogen suppressed, an increased risk of bleeding. Hypothermia impacts platelet numbers and function in addition to plasma coagulation factors. Platelet sequestration occurs in spleen and liver, resulting in a reduction in quantity of platelets in peripheral circulation. This is cause of thrombocytopenia, is characterized by a maximal decrease in platelet count between 25 and 30 °C [73]. Rewarming body to normal temperature can reverse thrombocytopenia caused by hypothermia. Because thromboxane A2 is essential for platelet activation and aggregation, hypothermia inhibits its release, which results in a reversible abnormality in platelet aggregation. According to systematic review, mere 1-degree decrease in body temperature might result in a 16% rise in blood loss and 22% increase in risk of blood transfusion [74]. Evidence from another study shows preserving normothermia during surgery lowers likelihood of blood transfusion by forty percent. Similar to effects of disseminated intravascular coagulopathy occur in patients with septic shock, hypothermia may also be cause of hypercoagulability due to various coagulation and vasculature changes, such as increased viscosity, hemoconcentration, and activation of inflammatory cascade [29].

6.8. Infusion therapy

Preventing fluid excess is the foundation of balanced infusion therapy, also known as restricted or targeted infusion therapy. The two main negative effects of infusion overload are the delayed return of intestinal function and the difficulty in healing surgical incisions. Disorders involving the immune system's suppression of lymphocyte function and quantity are linked to surgery. In addition to treating these conditions, targeted infusion therapy helps to prevent SSIs. The ERAS protocol's infusion of up to one liter of saline solutions during the initial twenty-four hours of surgery has been adhered to. Early feeding is a possibility, which supports this [75].

6.9. The Benefits of ERACS

The remarkable clinical outcomes of ERACS can be attributed to multiple factors. Reducing psychological stress and enhancing patient adherence can be achieved through preoperative education and comprehensive psychological therapy regarding the ERACS procedure. Second, following surgery, the ERACS treatment lowers insulin resistance,

decreases food loss, boosts carbohydrate intake, and relieves stress. Third, in order to lower the risk of venous thromboembolism and postoperative urinary tract infections, the ERACS protocol suggests expediting the removal of urinary catheters and mobilization. Fourth, postoperative infection risks, including urinary tract infections, lung infections, and postoperative wound infections, reduced by conventional nursing practice, broad-spectrum prophylactic antibiotics, and early mobilization using ERACS protocol. Fifth, intraoperative care and multimodal analgesia can improve patient comfort during surgery.

Finally, early oral feeding following surgery is essential for promoting body homeostasis and hastening healing so patients can resume their regular activities [1]. The patients' length of stay was shorter, according to ERACS. The fundamental idea is to significantly reduce pain using multimodal analgesia such that following surgery, patients can move around for two hours and stay active for six hours. Length of stay (LOS) is one metric used to evaluate the quality of hospitals. A patient's duration of stay in the hospital is measured from the moment of admission when the patient is registered until the hospital publishes a discharge plan or planning document. In the medical record, this information is crucial for accounting for patient expenses. The number of patient days or LOS must be taken into account to estimate the management of hospital expenses and funding, as the hospital spending budget is the largest contributor to state budget expenditures [8].

6.10. Discharge counselling

According to active surveillance of complications following cesarean delivery, 10% of patients experience surgical site infections, of which >80% develop after discharge. This suggests that women should be given comprehensive information on the normal discharge course, infection signs and symptoms, activity restrictions, and when to seek medical attention. Therefore, before the patient is released, it is necessary to make sure that they have a way to get in touch with the labor and delivery unit, are provided with the number to call, and are aware of who to get in touch with if they have any questions. After discharge, the patient has to be contacted 24 hours later to discuss any questions or concerns and to find out how mother and baby are doing [76]. Depending on specific conditions and hospital standards, the duration of hospital stay following an elective cesarean section might vary and could begin as soon as eight hours after the procedure. Improved Recuperation The goal of after-surgery protocols is to maximize recuperation and hasten hospital departure; nevertheless, the precise time frame is contingent upon several elements, such as the patient's state and the evaluation of the healthcare provider. If certain requirements satisfied, such as stable vital signs, sufficient pain management, regular bowel function, satisfactory incision healing, and a supportive home environment, early discharge under an ERAS protocol may be appropriate. It's crucial to remember that choice to discharge a patient should be decided individually, taking into account their level of overall health and suitability for home care [76].

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