

Research article

Basic principles of anesthesia and postoperative analgesia in patients operated within an enhanced recovery after surgery (ERAS) protocol

Stanislav Slavchev^{1,2}, Angel Yordanov^{3*}¹Department of Obstetrics and Gynaecology, Faculty of Medicine, Medical University "Prof. Dr Paraskev Stoyanov" – Varna, Bulgaria²Obstetrics and Gynaecology Clinic, St. Anna University Hospital - Varna, Bulgaria³Department of Gynaecologic Oncology, Medical University Pleven, Pleven, Bulgaria**ABSTRACT**

The Enhanced Recovery After Surgery (ERAS) system is a collection of preoperative, intraoperative, and early postoperative measures. The primary goal of gynecological surgery is a rapid and uneventful recovery from oncological and standard procedures, particularly in patients over the age of 65. The goal is to achieve comparable results to those obtained with minimally invasive procedures. Certain features of the ERAS system are similar to those of standard surgical procedures. These are the measures taken to prevent thromboembolism and to promote early postoperative mobility. Anesthesia and postoperative analgesia are critical components of achieving the ERAS system's objectives. The ERAS protocol requires multimodal non-opioid postoperative analgesia, infiltration of the surgical wound with a local anesthetic, and avoidance of opioid analgesics. We discuss current data on patient management according to the ERAS protocol for anesthesia and analgesia in order to minimize the body's stress reactions, promote early mobility, and reduce postoperative complications. ERAS protocol has gained popularity in recent years in a number of centers, primarily in the United States and Europe, due to its direct impact on hospital stay length, healthcare costs, and benefits for patients, their relatives, and caregivers.

Keywords: ERAS protocol; multimodal opioid-sparing analgesia; local infiltration anesthesia

Received - 18-02-2021, Accepted- 19-04-2022

***Correspondence:** Angel Yordanov ✉ angel.yordanov@gmail.com

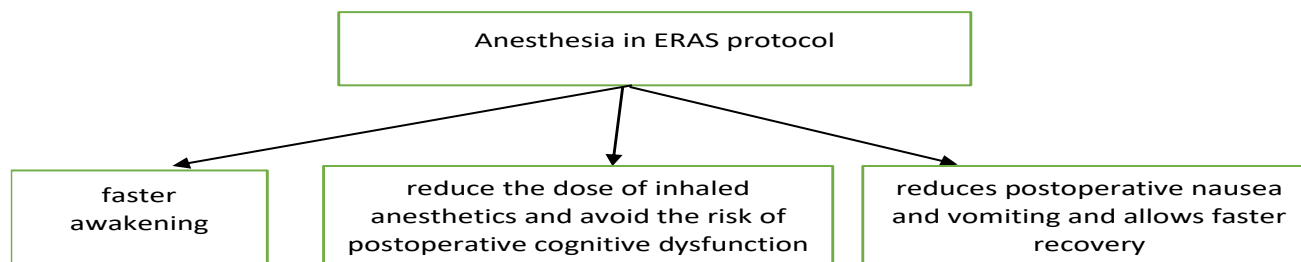
Department of Gynecologic Oncology, Medical University Pleven, Pleven Bulgaria.

INTRODUCTION

Surgical intervention puts the body and its organ systems under strain. In recent years, the Enhanced Recovery after Surgery (ERAS) system of perioperative measures was introduced and established in practice. It is intended to alleviate the stress placed on organs and body systems during surgery, allowing patients to recover

more quickly and without complications while also shortening their hospital stay. Anesthesia during surgery and postoperative analgesia, based on opioid-sparing analgesia, are crucial elements in the ERAS protocol.

The benefits of anesthesia in ERAS protocol are shown in figure 1.

Figure 1: The benefits of anesthesia in ERAS protocol**Anesthesia as part of an ERAS protocol**

Anesthesiologists face numerous challenges during an operation, including inducing anesthesia, providing pain relief during the procedure, and optimizing hemodynamics and oxygen supply to the tissues. Propofol has become the standard agent for general

anesthesia induction due to its rapid onset of action, favorable antiemetic properties, and rapid recovery following administration. General anesthesia can be administered through inhalation or intravenously, and short-acting inhalants are recommended, such as

sevoflurane or desflurane. Additionally, a prolonged controlled propofol infusion reduces postoperative nausea and vomiting [1, 2]. Numerous intravenous anesthetics, including dexmedetomidine, ketamine, and lidocaine, can be combined with propofol to achieve adequate general intravenous anesthesia. Apart from its direct sedative and analgesic effects, dexmedetomidine decreases the need for opioids and the alveolar concentrations of inhaled anesthetics [3–6]. Ketamine does not alleviate prolonged postoperative pain, but the optimal duration and dosage for various types of surgery are uncertain [7, 8]. Intravenous lidocaine infusion during the perioperative period decreases the need for anesthetics during surgery and improves intestinal function restoration, resulting in a shorter hospital stay [9]. Additionally, there is evidence that ketamine, lidocaine, propofol, and the avoidance of inhaled anesthetics may help cancer patients avoid relapses [10]. Numerous factors influence recurrence and survival rates in gynecologic diseases, and no specific recommendations can be made at this time [10, 11].

To minimize the postoperative side effects of opioids, high doses and long-acting opioids should be avoided. Remifentanyl and other short-acting opioid analgesics promote rapid recovery but may cause hyperalgesia. Nitric oxide is an analgesic agent with a low alveolar concentration associated with an increased risk of postoperative nausea and vomiting [12]. Avoiding nitric oxide during laparoscopic gynecologic surgery is recommended to prevent postoperative vomiting. Antiemetic prophylaxis with at least two antiemetic medications should be used [13].

Neuromuscular blockers cause muscle relaxation, which aids in open surgery. During laparoscopic surgery, muscle relaxation is maintained to achieve low intra-abdominal pressures [14]. Peripheral nervous system stimulants should be used to ensure complete reversibility of the neuromuscular block and to minimize the risk of residual muscle weakness, which is a significant risk factor for postoperative respiratory complications [15].

By utilizing a bispectral index to determine the depth of anesthesia, the anesthetic dose can be reduced, enabling a faster awakening [16]. The bispectral index especially relevant for elderly patients to reduce the dose of inhaled anesthetics and avoid the risk of postoperative cognitive dysfunction and delirium [17, 18].

Regional anesthesia techniques comprise a significant portion of the perioperative activities implemented as part of the ERAS program to reduce stress responses and the use of anesthetics and opioids. Regional anesthetic techniques include peripheral nervous system neuraxial (spinal) blockade and infiltration anesthesia in the operative field [19]. Multimodal non-opioid analgesia reduces postoperative nausea and vomiting and allows faster recovery [20, 21].

Recent studies have demonstrated a decrease in respiratory

complications in patients undergoing open abdominal surgery when a low-tidal-volume ventilation strategy is used (air volume of 6–8 ml/kg and positive expiratory pressure of 6–8 cm H₂O) [22]. According to randomized controlled trials, low tidal volumes and high expiratory pressure are protective for the lungs during surgery [23].

Opioid-sparing multimodal postoperative analgesia

Postoperative pain following gynecologic surgery has a significant impact on the patient's quality of life and has been linked to an increased risk of complications, prolonged hospital stays, more rehospitalizations, and increased hospital costs [24, 25]. When patients rely exclusively on opioids for postoperative analgesia, nausea, sedation, and fatigue occur, addiction risk increases, and financial and social losses occur [26–28]. Avoiding opioid use following surgery by implementing multimodal postoperative analgesia algorithms that prioritize non-opioid medications improves patients' functional recovery [29]. Nonsteroidal anti-inflammatory drugs, acetaminophen, gabapentin, and dexamethasone are all non-opioid alternatives. Preoperative training should emphasize using non-opioid medications as the first option for postoperative pain control.

When analgesics and NSAIDs are combined, they have a synergistic effect, which is the basis of the ERAS protocols for postoperative pain control [30]. To minimize opioid requirements, preoperative oral acetaminophen, celecoxib, and gabapentin are recommended [31]. Intravenous acetaminophen should not be used routinely, as its oral equivalent has the same efficacy and is significantly less expensive. Generally, oral administration of all postoperative medications is preferred over intravenous administration. Intravenous analgesics should be used in less than 5% of patients undergoing laparotomy. When administered correctly, abdominal wall infiltration with bupivacaine or liposomal bupivacaine during laparotomy has been shown to have no systemic adverse effects and should be included in all ERAS protocols as part of multimodal analgesia [32].

The use of thoracic epidural analgesia and transverse abdominis plane block may be considered in patients undergoing major abdominal surgery as an alternative to local anesthesia. Although thoracic epidural analgesia has been shown to effectively reduce postoperative pain and stress [33, 34], it does have some disadvantages, including a 30% failure rate [35], hypotension requiring vasopressors [36], and incapacity for early mobility [37]. The transverse abdominal muscles are blocked by injecting a local anesthetic between the muscular layers of the chest under ultrasound guidance. This procedure has been shown to significantly reduce postoperative pain and the need for opioids [38]. Although no comparison of thoracic epidural analgesia, transverse abdominal muscle blockade, and bupivacaine incisional injection during laparotomy has been conducted, the literature has established the latter's superiority to the

first two pain control methods. A study found that patients who received liposomal bupivacaine topically experienced less pain and used fewer opioids than those who received transverse abdominal muscle blockade following abdominal hysterectomy [39]. Additional studies in laparoscopic surgery have demonstrated an effect of transverse abdominal muscle blockade [40–43]. A randomized trial compared epidural analgesia with transabdominal plane block. It demonstrated a 0.5-day reduction in hospital stay with transverse abdominis plane block administration, most likely due to the slow transition from thoracic epidural analgesia to oral analgesics [44]. The available evidence suggests that bupivacaine injection into the incision area is more effective than transverse abdominis plane block or thoracic epidural analgesia.

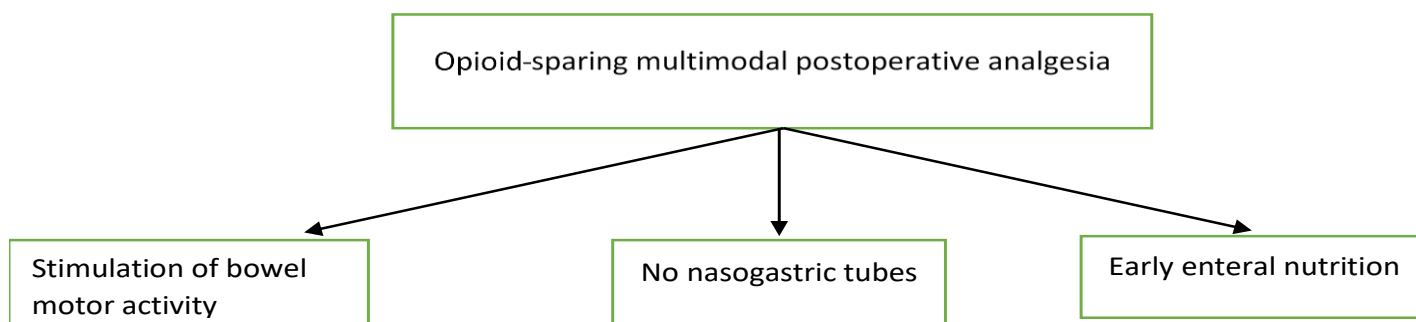
Significant differences in patients' responses to medications, including opioids, have been established due to hereditary factors [45]. Pharmacogenomics is a branch of personalized

medicine investigating genetic variations in enzymes, mediators, and receptors that may account for individual differences in drug efficacy and toxicity [46]. This information is becoming increasingly important in the postoperative management of opioid use, with one study demonstrating a 50% reduction in opioid use and excellent analgesia when targeted pharmacogenetic information was used [47].

A multimodal postoperative analgesic protocol, as recommended by ERAS, successfully reduces opioid use during the hospital stay and after discharge. It is accomplished by combining bupivacaine injection at the laparotomy incision with non-opioid oral medications (NSAIDs and acetaminophen) during the early postoperative period and after discharge. The ERAS protocol does not recommend thoracic epidural analgesia or transverse abdominis plane block.

The usage of opioid-sparing multimodal postoperative analgesia leads to the following benefits for the patients (fig.2):

Figure2: Patients benefits from opioid-sparing multimodal postoperative analgesia



CONCLUSIONS

The multimodal postoperative analgesic protocol (acetaminophen and nonsteroidal anti-inflammatory drugs) achieves complete analgesia and successfully avoids the use of opioids in the early postoperative period. The protocol's primary activity is a local infiltration anesthesia with bupivacaine in the surgical wound area.

REFERENCES

1. Sneyd JR, Carr A, Byrom WD, et al, 1998. A meta-analysis of nausea and vomiting following maintenance of anaesthesia with propofol or inhalational agents. *Eur J Anaesthesiol* 15(4), Pages- 433–445.
2. Tramèr M, Moore A, McQuay H, 1997. Propofol anaesthesia and postoperative nausea and vomiting: quantitative systematic review of randomized controlled studies. *Br J Anaesth* 78(3), Pages- 247–255.
3. Blandszun G, Lysakowski C, Elia N, et al. 2012. Effect of perioperative systemic α_2 agonists on postoperative morphine consumption and pain intensity: systematic review and meta-analysis of randomized controlled trials. *Anesthesiology*; 116(6), Pages - 1312–1322.
4. Le Bot A, Michelet D, Hilly J, et al, 2015. Efficacy of intraoperative dexmedetomidine compared with placebo for surgery in adults: a meta-analysis of published studies. *Minerva Anesthesiol* 81(10), Pages- 1105–1117.
5. Bellon M, Le Bot A, Michelet D, et al, 2016. Efficacy of intraoperative dexmedetomidine compared with placebo for postoperative pain management: a meta-analysis of published studies. *Pain Ther* 5(1), Pages- 63–80.
6. Fragen RJ, Fitzgerald PC, 1999. Effect of dexmedetomidine on the minimum alveolar concentration (MAC) of sevoflurane in adult's age 55 to 70 years. *J Clin Anesth* 11 (6), Pages- 466–470.
7. Elia N, Tramèr MR, 2005. Ketamine and postoperative pain--a quantitative systematic review of randomised trials. *Pain* 113(1-2), Pages- 61–70.
8. Reddi D, 2016. Preventing chronic postoperative pain. *Anaesthesia* 71(Suppl 1), Pages- 64–71.
9. Weibel S, Jelting Y, Pace NL, et al 2018. Continuous intravenous perioperative lidocaine infusion for postoperative pain and recovery in adults. *Cochrane anaesthesia, critical and emergency care Group*, ED. *Cochrane Database SystRev*6(6):CD009642
10. Missair A, Cata JP, Votta-Velis G, et al, 2019. Impact of perioperative pain management on cancer recurrence: an ASRA/ESRA special article. *Reg Anesth Pain Med* 44(1), Pages- 13–28.
11. Wigmore TJ, Mohammed K, Jhanji S, 2016. Long-term survival for patients undergoing volatile versus IV anesthesia for cancer surgery: a retrospective analysis. *Anesthesiology* 124(1), Pages- 69–79.

12. Tramèr M, Moore A, McQuay H, 1996. Omitting nitrous oxide in general anaesthesia: meta-analysis of intraoperative awareness and postoperative emesis in randomized controlled trials. *Br J Anaesth* 76(2), Pages- 186–193.
13. Gan TJ, Diemunsch P, Habib AS, et al, 2014. Consensus guidelines for the management of postoperative nausea and vomiting. *Anesth Analg* 118(1), Pages- 85–113.
14. Brintjens MH, van Helden EV, Braat AE, et al, 2017. Deep neuromuscular block to optimize surgical space conditions during laparoscopic surgery: a systematic review and meta-analysis. *Br J Anaesth* 118(6), Pages- 834–842.
15. McLean DJ, Diaz-Gil D, Farhan HN, et al, 2015. Dose-dependent association between intermediate-acting neuromuscular-blocking agents and postoperative respiratory complications. *Anesthesiology* 122(6), Pages- 1201–1213.
16. Punjasawadwong Y, Phongchiewboon A, Bunchungmongkol N, 2014. Bispectral index for improving anaesthetic delivery and postoperative recovery. *Cochrane anaesthesia, critical and emergency care Group, ED. Cochrane Database Syst Rev; 2014(6):CD003843*
17. Chan MTV, Cheng BCP, Lee TMC, et al, 2013. BIS-guided anesthesia decreases postoperative delirium and cognitive decline. *J NeurosurgAnesthesiol* 25(1), Pages- 33–42.
18. Wildes TS, Mickle AM, Ben Abdallah A, et al, 2019. Effect of Electroencephalography-Guided anesthetic administration on postoperative delirium among older adults undergoing major surgery: the engages randomized clinical trial. *JAMA* 321(5), Pages- 473–483.
19. Wick EC, Grant MC, Wu CL, 2017. Postoperative multimodal analgesia pain management with nonopioid analgesics and techniques: a review. *JAMA Surg* 152(7), Pages- 691–697.
20. Carey ET, Moulder JK, 2018. Perioperative management and implementation of enhanced recovery programs in gynecologic surgery for benign indications. *ObstetGynecol* 132(1), Pages- 137–146.
21. Carter-Brooks CM, Du AL, Ruppert KM, et al, 2018. Implementation of a urogynecology-specific enhanced recovery after surgery (ERAS) pathway. *Am J ObstetGynecol* 219(5), 495.e1– 495.e10.
22. Futier E, Constantin J-M, Paugam-Burtz C, et al, 2013. A trial of intraoperative low-tidal-volume ventilation in abdominal surgery. *N Engl J Med* 369(5), Pages- 428–437.
23. Güldner A, Kiss T, SerpaNeto A, et al, 2015. Intraoperative protective mechanical ventilation for prevention of postoperative pulmonary complications: a comprehensive review of the role of tidal volume, positive end-expiratory pressure, and lung recruitment maneuvers. *Anesthesiology* 123(3), Pages- 692–713.
24. Wells N, Pasero C, McCaffery M, 2008. Improving the quality of care through pain assessment and management. In: Hughes RG (1st ed). *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Agency for Healthcare Research and Quality, Rockville, pp. 1-41
25. Massicotte L, Chalaoui KD, Beaulieu D, et al, 2009. Comparison of spinal anesthesia with general anesthesia on morphine requirement after abdominal hysterectomy. *Acta Anaesthesiol Scand* 53(5), Pages- 641–647.
26. Florence CS, Zhou C, Luo F, et al, 2013. The economic burden of prescription opioid overdose, abuse, and dependence in the United States. *Med Care* 54(10), Pages- 901–906.
27. Woodhouse A, Mather LE, 1998. The effect of duration of dose delivery with patient-controlled analgesia on the incidence of nausea and vomiting after hysterectomy. *Br J Clin Pharmacol* 45(1), Pages- 57–62.
28. Dolin SJ, Cashman JN, 2005. Tolerability of acute postoperative pain management: nausea, vomiting, sedation, pruritus, and urinary retention. Evidence from published data. *Br J Anaesth* 95(5), Pages- 584–591.
29. Meyer LA, Lasala J, Iniesta MD, et al, 2018. Effect of an enhanced recovery after surgery program on opioid use and patient-reported outcomes. *Obstet Gynecol* 132(2), Pages-281–190.
30. Buvanendran A, Kroin JS, 2009. Multimodal analgesia for controlling acute postoperative pain. *Curr OpinAnaesthesiol*; 22(5), Pages- 588–593.
31. Ong CKS, Seymour RA, Lirk P, et al, 2010. Combining Paracetamol (acetaminophen) with nonsteroidal antiinflammatory drugs: a qualitative systematic review of analgesic efficacy for acute postoperative pain. *Anesth Analg* 110(4), Pages-1170–1179.
32. Kalogera E, Bakkum-Gamez JN, Weaver AL, et al, 2016. Abdominal incision injection of liposomal bupivacaine and opioid use after laparotomy for gynecologic malignancies. *Obstet Gynecol* 128(5), Pages- 1009–1017.
33. Wu CL, Cohen SR, Richman JM, et al, 2005. Efficacy of postoperative patient-controlled and continuous infusion epidural analgesia versus intravenous patient-controlled analgesia with opioids: a meta-analysis. *Anesthesiology* 103, Pages- 1079–1088.
34. Carli F, Mayo N, Klubien K, et al, 2002. Epidural analgesia enhances functional exercise capacity and health-related quality of life after colonic surgery: results of a randomized trial. *Anesthesiology* 97(3), Pages- 540–549.
35. Ready LB, 1999. Acute pain: lessons learned from 25,000 patients. *Reg Anesth Pain Med* 24(6), Pages- 499–505.
36. Hübner M, Blanc C, Roulin D, et al, 2015. Randomized clinical trial on epidural versus patient-controlled analgesia for laparoscopic colorectal surgery within an enhanced recovery pathway. *Ann Surg*; 261(4), Pages- 648–653.
37. Chen L-M, Weinberg VK, Chen C, et al, 2009. Perioperative outcomes comparing patient controlled epidural versus intravenous analgesia in gynecologic oncology surgery. *Gynecol Oncol* 115(3), Pages- 357–361.
38. Champaneria R, Shah L, Geoghegan J, et al, 2013. Analgesic effectiveness of transversus abdominis plane blocks after hysterectomy: a meta-analysis. *Eur J ObstetGynecolReprod Biol* 166(1), Pages- 1–9.
39. Gasanova I, Alexander J, Ogunnaike B, et al, 2015. Transversus abdominis plane block versus surgical site infiltration for pain management after open total abdominal hysterectomy. *Anesth Analg* 121(5), Pages- 1383–1388.
40. Levy BF, Scott MJ, Fawcett W, et al, 2011. Randomized clinical trial of epidural, spinal or patient-controlled analgesia for patients undergoing laparoscopic colorectal surgery. *Br J Surg* 98(8), Pages- 1068–1078.
41. Calle GA, López CC, Sánchez E, et al, 2014. Transversus abdominis plane block after ambulatory total laparoscopic hysterectomy: randomized controlled trial. *Acta Obstet GynecolScand* 93(4), Pages- 345–350.
42. Kane SM, Garcia-Tomas V, Alejandro-Rodriguez M, et al, 2012. Randomized trial of transversus abdominis plane block at

- total laparoscopic hysterectomy: effect of regional analgesia on quality of recovery. *Am J Obstet Gynecol*; 207 (5) Pages- 419.e1-5.
43. El Hachem L, Small E, Chung P, et al, 2015. Randomized controlled double-blind trial of transversus abdominis plane block versus trocar site infiltration in gynecologic laparoscopy. *Am J ObstetGynecol*; 212 (2), Pages- 182.e1–182.e9.
 44. Torgeson M, Kileny J, Pfeifer C, et al, 2018. Conventional epidural vs transversus abdominis plane block with liposomal bupivacaine: a randomized trial in colorectal surgery. *J Am Coll Surg* 227(1), Pages- 78–83.
 45. Evans WE, Relling MV, 1999. Pharmacogenomics: translating functional genomics into rational therapeutics. *Science* 286(5439), Pages- 487–491.
 46. Relling MV, Evans WE, 2015. Pharmacogenomics in the clinic. *Nature* 526(7573), Pages- 343–350.
 47. Senagore AJ, Champagne BJ, Dosokey E, et al, 2017. Pharmacogenetics-guided analgesics in major abdominal surgery: further benefits within an enhanced recovery protocol. *Am J Surg*; 213(3), Pages- 467–472.

How to cite this article

Stanislav Slavchev, Angel Yordanov, 2022. Basic principles of anaesthesia and postoperative analgesia in patients operated within an enhanced recovery after surgery (ERAS) protocol. *J. Med. P'ceutical Allied Sci.* V 11 - I 2, Pages - 4752 - 4756
doi: 10.55522/jmpas.V11I2.3088.