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PERSONAL EXPERIENCE OF IMPLEMENTING  
THE ENHANCED RECOVERY  
AFTER SURGERY (ERAS) SOCIETY  
RECOMMENDATIONS IN NEONATAL  
SURGICAL PATHOLOGY

### Summary

*This paper presents our own experience of implementing the Enhanced Recovery After Surgery (ERAS) International Protocol in neonatal surgical pathology from 2023. The results demonstrate the efficacy of this approach in the context of the current situation, which is characterized by an increased workload in neonatal departments due to the destruction of medical facilities as a consequence of the Russian Federation's military actions.*

**Aim.** *To analyze, assess and discuss the experience and details of implementing the ERAS International Protocol in neonatal surgical pathology.*

**Materials and methods.** *The objective of this study was to conduct a retrospective analysis of the experience in using the ERAS International Protocol in a Neonatal Intensive Care Unit with a neonatal mobile team from the CE «Regional Medical Center of Family Health» DRC. A retrospective analysis of the experience of implementing the ERAS International Protocol was conducted in a Neonatal Intensive Care Unit with a neonatal mobile team from the CE «Regional Medical Center of Family Health» DRC.*

**Results.** *The article elucidates the principal stages of utilizing the ERAS International Protocol in the care of paediatric patients with surgical pathology in the Neonatal Intensive Care Unit with the neonatal mobile team of the CE «Regional Medical Center of Family Health» DRC. This hospital has become the second largest children's hospital in Ukraine, offering a comprehensive range of medical services. The influx of patients has considerably increased the workload on the department, necessitating an optimization of anaesthetic and surgical care provision to newborns.*

**Conclusions.** *Compliance with the ERAS Protocol allows to reduce hospital length of stay in children as well as significantly bring down the treatment costs of postoperative complications and is expedient for implementation.*

**Key words:** *ERAS Protocol; Newborns; Intraoperative Anesthetic Management; Enhanced Recovery After Surgery; Recommendations.*

### Introduction

The full-scale invasion of Ukraine by the Russian Federation has resulted in a significant burden on the national health care system, with the destruction of numerous medical facilities. This has led to the necessity of reorganizing hospitals, despite the challenges related to the ongoing war. The implementation of the Enhanced Recovery After Surgery (ERAS) International Protocol in neonatal surgical pathology is an illustrative example of the necessary actions to be taken in the present era. If implemented with due diligence, ERAS represents an evidence-based, multidisciplinary approach to postoperative care and surgical quality improvement. It has been demonstrated to reduce postoperative complication rates, shorten hospital length of stay, reduce medical costs, and encourage patient mobilization. Furthermore, it encompasses numerous aspects of preoperative, intraoperative, and postoperative patient care. It is used by an interdisciplinary care team with an explicit time frame for implementation [1-4]. It is anticipated that elective neonatal surgery will have every chance of fully implementing this protocol. In the case of urgent surgery, it is recommended that the largest possible number of protocol components be used.

The ERAS guidelines represent a novel approach to surgical care that differs from existing evidence-based strategies in several ways. Firstly, they are designed to be more tailored to the specific needs of a multidisciplinary

team working at all stages of treatment. Secondly, they emphasise the importance of active parental involvement. However, it is important to note that this approach is not in direct opposition to current protocols.

Despite the substantial benefits demonstrated by ERAS, its successful implementation is hindered by several challenges, including a labor shortage and a lack of political commitment, poor communication and cooperation between anesthesiological, surgical, and other teams, and resistance to moving away from outdated practices, as discussed in published literature [7-9].

In the wake of the initiative spearheaded by First Lady Olena Zelenska at the Summit of First Ladies and Gentlemen, the Regional Medical Center of Family Health has entered into a memorandum of understanding with the Massachusetts General Hospital in the United States of America. The latter is regarded as one of the most prominent medical institutions globally and is affiliated with Harvard Medical School. This development was made possible by the efforts of Gennadiy Fuzaylov, who has been assisting hospitals in the treatment and rehabilitation of Ukrainian children for an extended period. As a result of this collaboration, the Regional Medical Center of Family Health has already implemented the ERAS Protocol (a multimodal, multidisciplinary, evidence-based approach to the care of surgical patients) within the Medical Guarantee Program «Surgeries for adults and children in a one-day hospital stay» [3].

The implementation of the enhanced ERAS Protocol in the surgical neonatal intensive care unit for newborns with a mobile neonatology team was driven by the expertise and enthusiasm of specialists, as well as the imperative to optimize care and reduce financial costs for patients.

The search for effective methods of preoperative, intraoperative, and postoperative management of these patients is of great importance in order to reduce complication and mortality rates. This is because surgical procedures do not completely resolve all pathophysiological changes associated with underlying pathology or its combination with developmental abnormalities, immaturity, infection, and other factors. The implementation of comprehensive guidelines, developed via evidence-based medicine, has been shown to improve outcomes and shorten treatment duration. A review of the literature reveals that neonatal patients who require surgical intervention are at a high risk of postoperative wound infection. The observed incidence rate is 4 % in aseptic surgeries and 19 % in septic ones, which often results in a prolonged length of hospital stay [1].

**Aim.** To analyze, assess and discuss the experience and details of implementing the ERAS International Protocol in neonatal surgical pathology.

**Materials and methods.** A retrospective analysis of the experience in using the ERAS International Protocol was conducted based on a Neonatal Intensive Care Unit with a neonatal mobile team of the CE «Regional Medical Center of Family Health» DRC».

### Results and discussion

The Department of Intensive Care for newborns with the neonatal mobile team of the CE «Regional Medical Center of Family Health» DRC provides a comprehensive range of surgical procedures, encompassing both minor one-day operations and major reconstructive abdominal surgeries.

In the case of minor surgeries, the protocol allows for the performance of procedures in the shortest possible time and, in the majority of cases, for these to be one-day interventions. Consequently, there has been a notable reduction in bed occupancy rates, along with a decline in complications associated with hospitalization, including those of a psychological and infectious nature.

The mean postoperative period was reduced to one day for minimally invasive operations and 3.2 days for major ones when the ERAS Protocol was implemented.

The primary objective of the ERAS Protocol implementation is to adopt a stage-by-stage approach. The stages are standardised and are used to categorise all surgical procedures into three distinct phases: preoperative, intraoperative and postoperative.

The initial stage, along with all subsequent stages, entails the involvement of a multidisciplinary team comprising an anesthesiologist, surgeon, neonatologist, nurses, and consultants from specialized departments. The team is always structured in a manner that ensures each

specialist is able to exercise their authority while ensuring the mandatory documentation of all recommendations is carried out using an electronic medical record system. Furthermore, regular briefings are held for all team members, with particular emphasis placed on the nurses. The expert panel's reports serve as a reference for the daily medication administration records and diaries, providing a checklist of essential information.

The subsequent item on the agenda is the resolution of the issue of antibiotic prophylaxis. In accordance with the established protocol, an antibiotic should be administered parenterally at least one hour prior to the commencement of surgical procedures. In the case of minor surgical procedures, such as aseptic ophthalmological interventions, including the correction of retinopathy and nasolacrimal duct dilation, the use of systemic antibiotics is not indicated. Instead, local prophylaxis is preferred. In the case of major surgical procedures, a group of inhibitor-protected penicillins and cephalosporins are administered systemically at doses that are standard for the age of the patient.

One of the preparatory steps for surgical intervention is the monitoring of the patient's hemoglobin levels, which is typically conducted by a neonatologist or an anesthesiologist. In accordance with the established protocol, the preoperative hemoglobin value for children should be greater than 90 g/l, and for those who require supplemental oxygen, it should be greater than 100 g/l. This is particularly pertinent in the case of premature infants. Given that premature newborns are prone to developing early infantile anemia, the prevention of this condition represents a primary objective for neonatologists who provide care to infants. The department's standard protocol is to administer 200 IU/kg of recombinant human erythropoietin intramuscularly three times per week. In cases where anemia is refractory, a hemotransfusion should be performed prior to surgery.

A meticulous surgical intervention plan is devised, and all activities throughout the various stages of an operation are meticulously documented and discussed.

The preoperative preparation for abdominal surgeries typically entails the administration of acetaminophen (15 mg/kg) and tranexamic acid (15 mg/kg) intravenously one hour prior to a surgical incision. In cases where predicted blood loss is anticipated, fresh frozen plasma is employed at a dose of 20 ml/kg perioperatively. Additionally, it is imperative to prepare antigen-matched erythrocytes that are compatible with the patient's blood type prior to the surgical procedure.

Monitoring encompasses a range of vital signs and physiological parameters, including electrocardiography, capnometry, blood pressure and saturation measurements, esophageal temperature management, and anesthetic gas correction. The maintenance of normothermia during surgery involves the use of a resuscitation table as an operating table with a gel support surface and the application of heat at both the lower and upper levels. Additionally, a medical device known as the Biegler model BW 685 (Austria) is employed for the warming of infusions.



**Fig. 1. An operating room (windows are blacked out for a period of wartime).**

Furthermore, an intraoperative strategy encompasses the participation of a multidisciplinary team, the formulation of a step-by-step operation plan, and the utilization of a checklist comprising the anesthetic card and operation protocol.

In abdominal surgeries, we employ a prolonged analgesedation regimen that includes myorelaxation. All drugs are administered via prolonged infusion, thereby ensuring profound and smooth anesthesia. In the context of intestinal surgeries, the decision regarding the formation of a primary anastomosis is made collectively by medical councils.

For induction, sevoflurane at a minimal alveolar concentration (MAC) of 1.0 (2.8-3.3 vol%) and/or fentanyl at a dose of 3-5  $\mu\text{g}/\text{kg}$  are administered intravenously prior to intubation. For intubation, 0.5 mg/kg atracurium is administered intravenously, followed by a continuous infusion at a rate of 0.5 mg/kg/h intraoperatively.

The basic analgesedation is achieved through the administration of a combination of sevoflurane 0.3-0.4 MAC + propofol (5 mg/kg/h) or 20 % sodium oxybutyrate (25 mcg/kg/h) and fentanyl 0.5 % via continuous infusions at a rate of 10 mcg/kg/h. Additionally, fentanyl boluses are administered at doses of 5  $\mu\text{g}/\text{kg}$  before a surgical incision and/or in cases where adequate analgesia is required (in cases where there is an increased pulse rate or blood pressure parameters). Additionally, 0.5 % midazolam at a rate of 0.3-0.5 mg/kg/h in conjunction with fentanyl at 10  $\mu\text{g}/\text{kg}/\text{h}$  is administered via continuous intravenous infusion for the purpose of providing analgesedation.

To maintain normovolemia, infusions of crystalloids at a rate of 10 ml/kg/h, fresh frozen plasma, and 10 % glucose with electrolytes are administered. A strategy of perioperative infusion therapy is based on a restrictive fluid

regimen, which aims to achieve a 30 % volume reduction of the total infusate.

Ventilation is monitored continuously according to capnometry, blood gases, hemoglobin, electrolytes, blood glucose, lactate, and diuresis, with additional examinations conducted every hour during surgical procedures.

In the case of minor surgical procedures, such as nasolacrimal duct dilation in newborns, short-term inhalation anesthesia with sevoflurane 1.0 MAC (2.8-3.3 vol%) is employed. In instances where laser coagulation of the retina is required, an infusion of propofol at a dose of 10  $\mu\text{g}/\text{kg}/\text{h}$  is administered, or alternatively, inhalation sevoflurane anesthesia at 1.0 MAC (2.8-3.3 vol%) is utilized in conjunction with non-invasive ventilation through a laryngeal mask or nasal oxygen cannula.

In the event of pyloric stenosis, a combination of inhalation sevoflurane anesthesia at 1.0 MAC (2.8-3.3 vol%) and 15 mg/kg acetaminophen administered intravenously on non-invasive ventilation through the laryngeal mask is employed.

In the case of excising inguinal hernias, a combination of inhalation sevoflurane anesthesia at 1.0 MAC (2.8-3.3 vol%) with acetaminophen is employed, or alternatively, an intravenous 10 mg/kg/h propofol infusion combined with 15 mg/kg acetaminophen intravenously on non-invasive ventilation through the laryngeal mask or iGel placement.

A postoperative strategy is of equal importance and, in certain cases, may present greater challenges.

Analgesia and sedation are provided for up to three days following major surgical procedures, with midazolam administered at a rate of 0.3  $\mu\text{g}/\text{kg}/\text{h}$  and fentanyl at a rate of 3-5  $\mu\text{g}/\text{kg}/\text{h}$  via prolonged infusions. Acetaminophen is also administered intravenously at a dose of 15  $\mu\text{g}/\text{kg}$  every six hours.

The administration of lingual sucrose or dextrose is not employed in the provision of analgesia for surgical procedures.

The protocol suggests the early cessation of antibiotic therapy. This strategy has been demonstrated to be effective for minor surgical procedures and aseptic surgeries. Nevertheless, the decision to continue or discontinue antibiotics is always made on an individual basis in the context of open abdominal surgeries, with consideration given to the results of blood tests and the levels of inflammatory markers (C-reactive protein and procalcitonin).

Postoperative nutritional care facilitates the early introduction of enteral nutrition. In the case of minor and aseptic surgeries, there are no issues regarding the resumption of breast milk or milk formula feeding, which can typically occur within a period of 6-12 hours following the procedure. It is imperative that a collective decision be made concerning the readiness of a child for enteral feeding following intestinal surgery. The council of physicians is comprised of anesthesiologists, neonatologists, surgeons, and consultants from various departments. If parents or nurses are involved in the care of the child, observational data may be obtained from them. The subject of breastfeeding is inevitably raised.

Following extubation, when a child regains consciousness, it is beneficial for parents to be involved in the care as soon as possible. This significantly reduces the care burden on nurses, who are responsible for ensuring the implementation of aseptic and antiseptic techniques and for monitoring the interactions between parents

and children. Furthermore, it has been observed that in the majority of cases, parents demonstrated proficiency in assisting with the care of children, and following a brief training course, they adhered meticulously to the prescribed recommendations. Partnerships at the stage of care and parental understanding of an overall strategy developed by a multidisciplinary team facilitate communication with them and reduce emotional stress in the team. These issues are of primary importance and are a significant source of distress within the medical community.

The economic feasibility of implementing this protocol is contingent upon the reduction of hospital stay costs by up to 30 %. This is achieved by lowering the costs of equipment depreciation, bed days, and workloads on medical personnel.

**Conclusions.** A critical analysis and evaluation of the experience in implementing the ERAS International Protocol in neonatal surgical pathology has demonstrated that this strategy represents the optimal approach for enhancing the quality of medical care. It is anticipated that elective neonatal surgery will have the opportunity to fully implement this protocol, and that urgent surgery will utilize the greatest possible number of its components.

The work in this area is in progress.

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**ВЛАСНИЙ ДОСВІД ВПРОВАДЖЕННЯ РЕКОМЕНДАЦІЙ ТОВАРИСТВА ЩОДО ПРИСКОРЕНОГО ВІДНОВЛЕННЯ ПІСЛЯ ОПЕРАЦІЇ (ERAS) ПРИ НЕОНАТАЛЬНІЙ ХІРУРГІЧНІЙ ПАТОЛОГІЇ**

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**Резюме.**

У статті наведено власний досвід впровадження міжнародного протоколу прискореного відновлення після операції (ERAS) при неонатальній хірургічній патології з 2023 року. Висвітлені дані щодо ефективності цього кроку на тлі особливостей сьогодення у вигляді підвищення навантаження на неонатальні відділення у зв'язку з руйнуваннями об'єктів медичних закладів внаслідок російської агресії.

**Мета.** Здійснення аналізу, оцінки, обговорення досвіду і нюансів впровадження міжнародного протоколу прискореного відновлення після операції (ERAS) при неонатальній хірургічній патології.

**Матеріали і методи дослідження.** Проведено ретроспективний аналіз досвіду використання міжнародного протоколу прискореного відновлення після операції (ERAS) на базі відділення інтенсивної терапії новонароджених з виїзною неонатальною бригадою КП «Регіональний медичний центр родинного здоров'я» ДОР».

**Результати дослідження.** У статті наведено основні кроки досвіду використання міжнародного протоколу прискореного відновлення після операції (ERAS) при наданні допомоги дітям з хірургічною патологією у відділенні інтенсивної терапії новонароджених з виїзною неонатальною бригадою КП «Регіональний медичний центр родинного здоров'я» ДОР», який за своїм набором медичних послуг і розміром став другою дитячою лікарнею в Україні, що значно збільшило навантаження на відділення і потребувало оптимізації надання анестезіологічної та хірургічної допомоги новонародженим.

**Висновки.** Дотримання протоколу прискореного відновлення після операції (ERAS) дозволяє скоротити час перебування дитини у відділенні та значно знизити затрати на лікування постопераційних ускладнень і є доцільним у впровадженні.

**Ключові слова:** протокол ERAS; новонароджені; інтраопераційне анестезіологічне забезпечення; прискорене відновлення після хірургічних втручань; рекомендації.

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