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Optimizing Quality of Recovery in Adolescent Idiopathic Scoliosis Surgery: A Nursing-Led Enhanced Recovery Approach

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Abstract

Adolescent Idiopathic Scoliosis (AIS) surgery, primarily spinal fusion, is a major procedure with potential for significant postoperative pain and complications. Enhanced Recovery After Surgery (ERAS) protocols, initially developed for adult surgery, are increasingly applied in pediatric settings to optimize outcomes and accelerate recovery. This review article explores the current evidence on optimizing the quality of recovery in AIS surgery through a nursing-led ERAS approach. It details the specific components of ERAS across preoperative, intraoperative, and postoperative phases, highlighting critical nursing interventions such as comprehensive patient education, multimodal pain management, and early mobilization. The implementation of nursing-led ERAS in AIS surgery has demonstrated significant benefits, including reduced length of hospital stay, decreased opioid consumption, improved pain control, lower complication rates, and enhanced patient satisfaction. This review article concludes by emphasizing the pivotal role of nurses in ERAS success and suggests future directions for research, including standardization of protocols, long-term outcome evaluation, and integration of patient-reported outcomes and technology.

Key words Adolescent Idiopathic Scoliosis. Enhanced Recovery. Nursing. Quality of Recovery.

Introduction

Adolescent Idiopathic Scoliosis (AIS) is a complex three-dimensional spinal deformity affecting approximately 2-3% of adolescents worldwide [1]. While conservative management is often the first line of treatment, surgical intervention, primarily spinal fusion, is indicated for curves exceeding 40-45 degrees in skeletally immature patients or for progressive curves [2]. Spinal fusion surgery for AIS is a major procedure associated with significant postoperative pain, prolonged hospitalization, and potential complications such as surgical site infection, neurological deficits, and implant-related issues [3, 4].

Enhanced Recovery After Surgery (ERAS) protocols are multimodal, evidence-based perioperative care pathways designed to optimize patient outcomes, reduce complications, and accelerate recovery [5]. Initially developed for adult colorectal surgery, ERAS principles have been successfully adapted and implemented across various surgical specialties, including pediatric surgery [6, 7]. The core tenets of ERAS involve preoperative patient education and counseling, optimization of medical conditions, standardized anesthetic techniques, multimodal pain management, early mobilization, and early enteral nutrition [8].

While the benefits of ERAS in adult surgical populations are well-established, its application in pediatric surgery, particularly in complex procedures like AIS spinal fusion, is gaining increasing attention [9]. The unique physiological and psychological characteristics of adolescents necessitate a tailored approach to ERAS implementation. Furthermore, the pivotal role of nursing in the successful execution of ERAS protocols cannot be overstated. Nurses are at the forefront of patient education, pain assessment and management, early mobilization, and overall coordination of care, making their contribution integral to achieving optimal quality of recovery [10].

This review article aims to explore the current evidence on optimizing the quality of recovery in adolescent idiopathic scoliosis surgery through a nursing-led enhanced recovery approach. It will delve into the specific components of ERAS relevant to AIS patients, highlight the critical nursing interventions at each stage of the perioperative journey, and discuss the impact of such an approach on patient outcomes, including pain management, length of hospital stay, complication rates, and overall patient satisfaction. By synthesizing existing literature, this article seeks to provide a comprehensive overview and practical insights for healthcare professionals involved in the care of adolescents undergoing scoliosis surgery.

Components of ERAS in AIS Surgery

ERAS protocols are designed to optimize patient physiology and minimize surgical stress through a multidisciplinary approach. For adolescent idiopathic scoliosis surgery, the ERAS pathway can be broadly categorized into three phases: preoperative, intraoperative, and postoperative. Each phase incorporates specific evidence-based interventions aimed at improving recovery and reducing complications.

Preoperative Phase

The preoperative phase of ERAS for AIS surgery focuses on patient and family education, nutritional optimization, psychological preparation, and pain management planning. Comprehensive patient and family education is paramount, as it empowers adolescents and their caregivers with knowledge about the surgical process, expected recovery trajectory, and their active role in the ERAS pathway [11]. This includes detailed discussions about pain management strategies, early mobilization, and nutritional goals. Nurses play a crucial role in delivering this education, addressing concerns, and setting realistic expectations.

Nutritional screening and optimization are vital to prevent postoperative complications. Malnutrition can impair wound healing and immune function, increasing the risk of infection. Preoperative carbohydrate loading, where appropriate, can reduce insulin resistance and improve patient comfort [12]. Psychological preparation, including anxiety reduction techniques and counseling, can significantly impact pain perception and recovery. Identifying and addressing preoperative anxiety and fear can lead to better postoperative outcomes [13]. Furthermore, a clear plan for multimodal pain management, including opioid-sparing strategies, should be established during this phase.

Intraoperative Phase

During the intraoperative phase, ERAS principles aim to minimize surgical trauma, optimize fluid management, and ensure effective pain control. The use of minimally invasive surgical techniques, where feasible, can reduce tissue damage and blood loss, contributing to faster recovery [14]. However, for complex AIS corrections, traditional open approaches are often necessary. Regardless of the surgical technique, meticulous surgical hemostasis is crucial to minimize blood transfusions, which can be associated with increased complications.

Anesthetic management is a cornerstone of intraoperative ERAS. Goal-directed fluid therapy helps maintain euvolemia and prevent fluid overload or dehydration, both of which can negatively impact recovery [15]. Multimodal analgesia, incorporating regional anesthesia techniques (e.g., epidural analgesia, paravertebral blocks) and non-opioid medications (e.g., NSAIDs, acetaminophen), is essential for effective pain control while minimizing opioid-related side effects such as nausea, vomiting, and respiratory depression [16]. Hypothermia prevention through active warming measures is also critical, as it can reduce surgical site infections and improve coagulation [17].

Postoperative Phase

The postoperative phase is critical for accelerating recovery and preventing complications. Early mobilization is a key component, encouraging patients to sit up, stand, and walk as soon as safely possible after surgery [18]. This helps prevent complications such as deep vein thrombosis, pulmonary atelectasis, and muscle deconditioning. Nurses are instrumental in facilitating early mobilization, providing assistance, and ensuring patient safety.

Aggressive multimodal pain management continues in the postoperative period, with a focus on opioid reduction. Regular pain assessments and timely administration of analgesics are crucial. Early enteral nutrition, often initiated within hours of surgery, promotes gut function, reduces ileus, and provides necessary nutrients for healing [19]. Removal of urinary catheters and drains as early as possible reduces the risk of infection and encourages patient mobility. Close monitoring for complications, such as surgical site infections, neurological changes, and respiratory compromise, is also a continuous nursing responsibility. Patient and family engagement in the recovery process, including active participation in physical therapy and adherence to discharge instructions, is vital for a successful transition home and sustained quality of recovery.

Nursing-Led Interventions in ERAS for AIS

Nurses play a pivotal and multifaceted role in the successful implementation of ERAS protocols for adolescent idiopathic scoliosis surgery. Their involvement spans the entire perioperative continuum, from initial patient contact to post-discharge follow-up. Nursing-led interventions are crucial for patient education, symptom management, early mobilization, and overall care coordination, directly contributing to an optimized quality of recovery.

Preoperative Nursing Interventions

In the preoperative phase, nurses are key educators and advocates. They conduct comprehensive assessments to identify potential risks and tailor education to the adolescent's developmental stage and learning style. This includes explaining the surgical procedure, the ERAS pathway, pain management expectations, and the importance of early mobilization [10]. Nurses can utilize various educational tools, such as brochures, videos, and interactive sessions, to enhance understanding and retention. Addressing patient and family anxieties through empathetic communication and psychological support is also a critical nursing responsibility. Nurses can teach relaxation techniques, guided imagery, and coping strategies to reduce preoperative stress, which has been shown to positively impact postoperative pain and recovery [13]. Furthermore, nurses ensure that nutritional optimization strategies, such as carbohydrate loading, are understood and adhered to by the patient.

Intraoperative Nursing Interventions

While the intraoperative phase is primarily surgeon and anesthesiologist-led, circulating and scrub nurses contribute significantly to ERAS principles. They ensure a sterile environment, meticulous instrument counts, and assist in maintaining normothermia through active warming devices. Nurses also play a role in advocating for appropriate patient positioning to prevent pressure injuries and nerve damage. In the recovery room (Post-Anesthesia Care Unit - PACU), nurses are responsible for vigilant monitoring of vital signs, early detection of complications, and initial pain assessment and management. They initiate multimodal analgesia as prescribed and ensure the patient is comfortable before transfer to the surgical ward.

Postoperative Nursing Interventions

The postoperative phase is where nursing interventions have the most direct and profound impact on quality of recovery. Nurses are responsible for continuous pain assessment using age-appropriate scales and administering analgesics, including non-opioid options, to achieve optimal pain control while minimizing side effects [16]. They educate patients on patient-controlled analgesia (PCA) devices and encourage their effective use. Early mobilization is a cornerstone of postoperative ERAS, and nurses are instrumental in facilitating this. They assist patients with turning, sitting up, dangling legs, and ambulating as soon as medically cleared, often within hours of surgery Implement ERAS pathway for Surgical Correction of Adolescent Idiopathic Scoliosis and evaluate its

effect on postoperative functional recovery, length of stay, patient satisfaction, patient outcome as well as complication and readmission rates [17].

This requires careful assessment of patient readiness, pain levels, and potential orthostatic hypotension. Nurses also monitor for and manage common postoperative complications such as nausea, vomiting, and urinary retention, often employing non-pharmacological interventions first.

Nutritional support is another critical nursing responsibility. Nurses encourage early oral intake, starting with clear liquids and progressing to a regular diet as tolerated. They monitor for signs of ileus and ensure adequate hydration. Bowel management protocols, including early ambulation and laxatives, are implemented to prevent constipation. Nurses also manage surgical drains and catheters, ensuring their timely removal to reduce infection risk and facilitate mobility. Throughout the postoperative period, nurses provide ongoing patient and family education, reinforcing discharge instructions, and preparing them for home care. This includes teaching wound care, medication administration, activity restrictions, and signs of complications to watch for. The continuous presence and holistic care provided by nurses are indispensable for a smooth and accelerated recovery after AIS surgery.

Outcomes and Benefits of ERAS in AIS Surgery

The implementation of Enhanced Recovery After Surgery (ERAS) protocols in adolescent idiopathic scoliosis (AIS) surgery has demonstrated significant improvements in various patient outcomes, contributing to an enhanced quality of recovery. These benefits extend across multiple domains, including reduced length of hospital stay (LOS), decreased opioid consumption, improved pain management, lower complication rates, and increased patient satisfaction.

Reduced Length of Hospital Stay (LOS)

One of the most consistently reported benefits of ERAS protocols in AIS surgery is a significant reduction in LOS [10, 20]. By optimizing perioperative care, facilitating early mobilization, and promoting rapid return of bowel function, ERAS pathways enable patients to be discharged sooner without compromising safety or increasing readmission rates. This not only benefits patients by allowing them to recover in the comfort of their homes but also has economic advantages for healthcare systems by reducing healthcare costs and increasing bed availability.

Decreased Opioid Consumption and Improved Pain Management

ERAS protocols emphasize multimodal analgesia, which combines various pain-relieving strategies to achieve effective pain control while minimizing reliance on opioids [16]. This approach, heavily supported by nursing interventions, leads to a substantial reduction in postoperative opioid consumption. Lower opioid use translates to fewer opioid-related side effects such as nausea, vomiting, constipation, and respiratory depression, thereby improving patient comfort and accelerating recovery. Patients on ERAS pathways often report better pain control and a more positive pain experience overall.

Lower Complication Rates

By standardizing care processes, optimizing patient physiology, and promoting early recovery milestones, ERAS protocols contribute to a reduction in postoperative complications. This includes a decrease in surgical site infections, pulmonary complications (e.g., atelectasis, pneumonia), and thromboembolic events [21]. The proactive management of potential risks and the emphasis on early intervention within the ERAS framework help to mitigate adverse events, leading to safer surgical outcomes for AIS patients.

Enhanced Quality of Recovery and Patient Satisfaction

Beyond objective clinical measures, ERAS significantly improves the subjective quality of recovery for adolescents undergoing scoliosis surgery. Patients experience less pain, faster return to normal activities, and a more positive overall surgical experience. The comprehensive preoperative education and active involvement of patients and families in their care journey foster a sense of empowerment and control, leading to higher patient

and family satisfaction [10]. The focus on early ambulation and nutrition also contributes to a quicker return to baseline functional status, allowing adolescents to resume their daily lives and school activities sooner.

Economic Benefits

While the primary focus of ERAS is patient-centered outcomes, the reduction in LOS and complication rates also translates into significant economic benefits for healthcare institutions. Shorter hospital stays mean lower bed-day costs, and reduced complications lead to fewer readmissions and less need for additional interventions. These cost savings can be substantial, making ERAS an attractive model for both clinical and financial sustainability in surgical care.

Conclusion and Future Directions

Adolescent idiopathic scoliosis surgery is a complex procedure, and optimizing the quality of recovery is paramount for the well-being of young patients. Enhanced Recovery After Surgery (ERAS) protocols, particularly when led by nursing interventions, offer a robust framework to achieve this goal. This review has highlighted how a nursing-led ERAS approach, encompassing comprehensive preoperative education, meticulous intraoperative support, and aggressive postoperative management, can significantly improve outcomes such as reduced length of hospital stay, decreased opioid consumption, better pain control, and lower complication rates. The holistic and continuous care provided by nurses is central to empowering patients and families, fostering early mobilization, and ensuring a smoother, more positive recovery journey.

Despite the growing evidence supporting ERAS in pediatric surgery, there are still areas for further research and development in the context of AIS. Future directions should focus on:

- **Standardization of ERAS Protocols:** While general principles exist, specific, evidence-based ERAS protocols tailored for AIS surgery need further refinement and widespread adoption across institutions. This includes developing clear guidelines for each perioperative phase, considering the unique needs of the adolescent population.
- **Long-term Outcomes:** More research is needed to evaluate the long-term impact of ERAS on the quality of life, functional outcomes, and patient satisfaction in adolescents who have undergone scoliosis surgery. This would provide a more comprehensive understanding of the sustained benefits of these pathways.
- **Patient-Reported Outcomes (PROs):** Incorporating and validating PRO measures into ERAS pathways for AIS can provide valuable insights into the patient's perspective on their recovery, pain experience, and overall satisfaction. This will allow for a more patient-centered evaluation of ERAS effectiveness.
- **Cost-Effectiveness Analysis:** While ERAS has shown economic benefits, detailed cost-effectiveness analyses specific to AIS surgery are needed to further support its widespread implementation and demonstrate its value to healthcare systems.
- **Technological Integration:** Exploring the use of digital health technologies, such as mobile applications for patient education, remote monitoring, and virtual rehabilitation, can further enhance the reach and effectiveness of nursing-led ERAS programs.

In conclusion, a nursing-led enhanced recovery approach in adolescent idiopathic scoliosis surgery represents a significant advancement in perioperative care. By leveraging the expertise and continuous presence of nurses, healthcare teams can optimize patient recovery, enhance satisfaction, and improve overall outcomes, ultimately leading to a better quality of life for adolescents undergoing this transformative surgery.

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