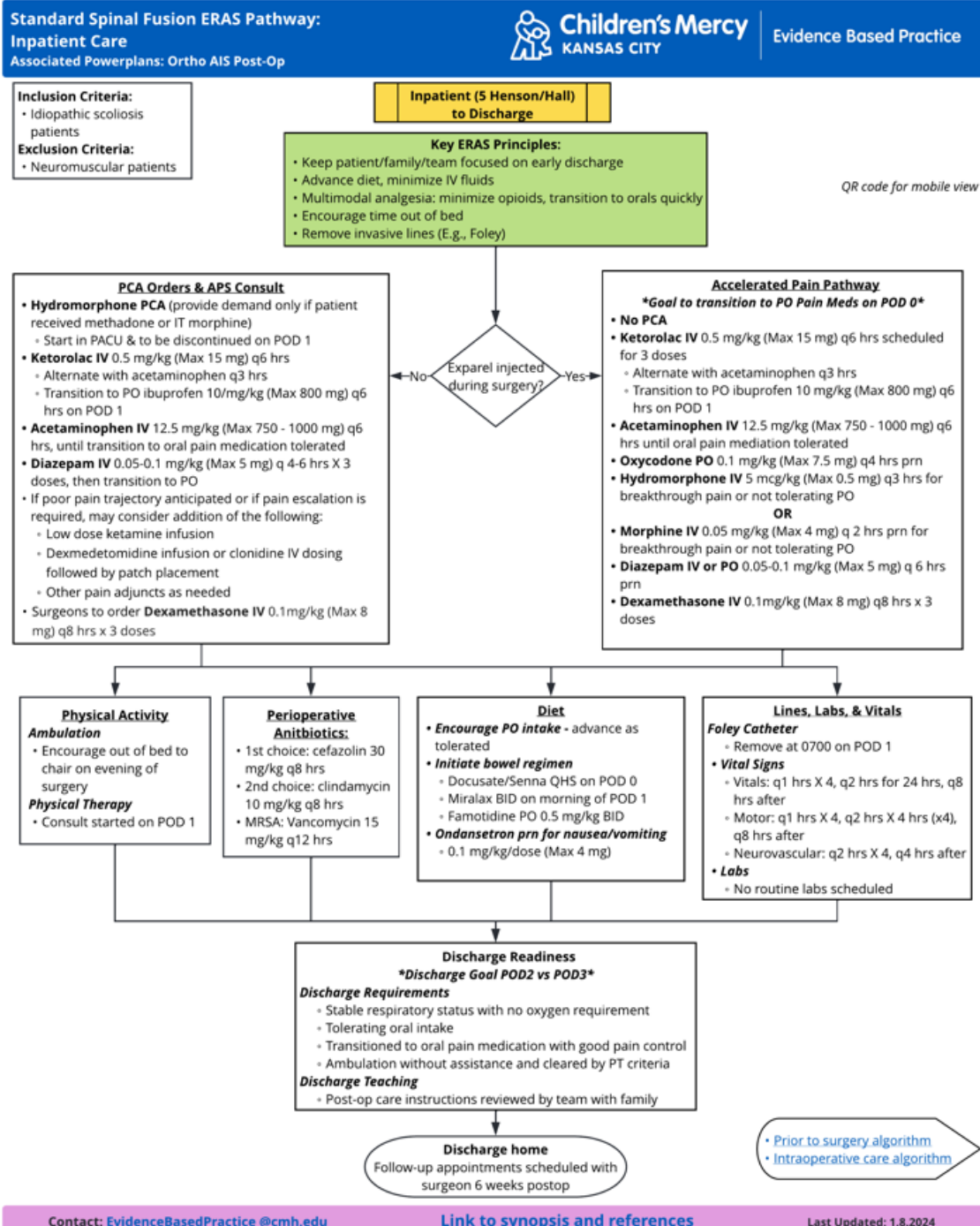


## Posterior Spinal Fusion Enhanced Recovery After Surgery



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### Standard Spinal Fusion ERAS Pathway Intraoperative Care



QR code for mobile view

**Inclusion Criteria:**

- Idiopathic scoliosis patients

**Exclusion Criteria:**

- Neuromuscular patients

#### Preoperative Care in SDS

**Preoperative Care**

- Carbohydrate-rich drink up to 2 hours before surgery
- Consider IV placement in SDS
- Anxiolysis: Midazolam IV vs PO per anesthesia team

**Prior to surgery patient/family meets**

- Pre-op nurse
- Anesthesiologist
- Surgeon
- Child Life Specialists

#### Case Setup & Induction

**Equipment:**

- Infusion pumps
- Hotline with blood tubing
- Prone pillow
- Bite blocks
- Tegaderm/ointment for eye protection
- Esophageal temp probe

**Vascular Access:**

- Have ultrasound (US) in room and order anesthesia US to capture image
- 2-3 large bore IVs (avoid antecubital location if possible)
- Arterial line

**Induction:**

- Consider the avoidance of non-depolarizing NMBs for intubation
- May give succinylcholine if appropriate

#### Intraoperative Care

**Maintenance of TIVA:**

- Propofol gtt: 50-150 mcg/kg/min
  - Higher dose may decrease NM signals
- Remifentanyl gtt: 0.2-0.5 mcg/kg/min
- Avoidance of inhaled anesthetics
- Avoidance of dexmedetomidine gtt

**PONV Prophylaxis:**

- Dexamethasone 0.1 mg/kg (Max 8 mg)
- Ondansetron 0.15 mg/kg (Max 8 mg) at end of case

**Antibiotics:**

- Cefazolin 30 mg/kg prior to incision and every 3 hours

**Coagulation:**

- Tranexamic acid (TXA)
  - Loading Dose: 30 mg/kg (max 2 grams)
- Infusion: 10 mg/kg/hour

**Muscle Relaxants:**

- Surgeons may ask for NMB to be given for exposure following completion of baseline neuromonitoring

**Multimodal Analgesia:**

- Methadone 0.15 mg/kg (max 15 mg)
  - Administered at beginning of case
- Ketamine gtt: 5 mcg/kg/min
- Acetaminophen: 12.5 mg/kg (max 1000 mg)
  - Administered at beginning of case and q6 hrs
- Ketorolac 0.5 mg/kg (max 15 mg)
  - Administered at end of case (confirm with surgeon)
- Consider avoiding long-acting opioids (morphine and hydromorphone), may give fentanyl boluses PRN
- Surgeon may inject local anesthetic at incision site

**Phases of Surgery & MAP Goals: \*Always Confirm w/ Surgery\***

- Phases 1 & 2:
  - Decortication of vertebral laminae, destruction of facet joints and removal of spinous processes
  - Placement of pedicle screws
- MAP goal ~65 mmHg (If < 10 yrs old, normal age based MAP)
- Phase 3: Distraction of spinal cord
  - MAP goal 75-85 mmHg (If < 10 yrs old increase to 25% above normal)

**MAP Management:**

- Have phenylephrine or dopamine gtt in line
- Ephedrine prn
- MAP goals vary by **phase of surgery**

**Fluid Management/Blood Transfusion:**

- Utilize cell saver

**Temperature Management:**

- Maintain normothermia (36 to 38 C) utilizing upper & lower Bair Hugger

**Change or Loss of Neuromuscular Signals:**

- Make sure surgeon stops operating
- Verify change or loss w/ neuromonitoring team and ask for characterization (change vs loss; diffuse vs focal)
- Verify correct probe placements and patient positioning
- Increase MAP
  - Age > 15: 85-95 mmHg
  - Age 10-14: 80-90 mmHg
  - Age 5-9: 75-85 mmHg
  - Age 1-4: 70-80 mmHg
- Hypoventilate >45 mmHg
- Confirm current medications, including infusions
- Optimize ABG and O<sup>2</sup> carrying capacity (transfuse as needed)
- Consider lidocaine IV 1-2 mg/kg to treat possible vasospasm
- Prepare for possible wake-up test
- Coordinate postop plans w/ surgeon

#### Emergence & PACU Orders

**Emergence:**

- Upon completion of final neuromonitoring test:
  - Discontinue ketamine gtt
  - If preferred, may discontinue propofol infusion and start inhalational anesthetic
- Continue remifentanyl infusion until closing skin
- Continue TXA until closing of skin
- If clinically indicated or transferring to PICU, check final ABG
- Administer ondansetron, ketorolac, & acetaminophen if have not already
- Ok to extubate patient deep if clinically indicated



**\*APS Consult & PCA Orders only if Exparel NOT Injected\***

**PACU Orders:**

- Fentanyl 0.5 mcg/kg q5 min PRN pain
- Hydromorphone 5 mcg/kg q5 min PRN pain
- Diazepam 0.05 - 0.1 mg/kg (max 5 mg) IV x 1 PRN muscle spasm

• Prior to surgery algorithm  
• Inpatient care algorithm

This ERAS pathway is meant as a guide for physicians and healthcare providers. It does not establish a standard of care, and is not a substitute for medical judgment which should be applied based upon the individual circumstances and clinical condition of the patient. Printing of Clinical Pathways is not recommended as these documents are updated regularly. Copyright © The Children's Mercy Hospital 2023. All rights reserved.

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Standard Spinal Fusion ERAS Pathway  
Preoperative Care



- Inclusion Criteria:**
- Idiopathic scoliosis patients
- Exclusion Criteria:**
- Neuromuscular patients

Prior to surgery day

Patient scheduled for spine surgery

QR code for mobile view

- Pre-Admission Testing (PAT) Evaluation:**
- Appointment typically occurs approximately 2 weeks prior to surgery on the same day H&P and consent are completed in Ortho clinic
  - Introduction to ERAS principles, e.g., multimodal analgesia, encouraging PO intake, etc
  - Carbohydrate-rich drink up to 2 hours prior to surgery
  - Discuss anesthesia risks and plan (including mitigation of pre-op anxiety)
  - ERAS Handout ([Link to Handout](#))

- Orthopedics Clinic:**
- Surgical consent completed with patient/family
  - Preoperative bathing instructions
  - Discussion about anticipated postoperative course & pain management

- 1st Set Labs (ordered by Ortho Team):**
- CBC with differential
  - BMP
  - LFTs
  - PT/PTT/INR
  - ABO

- Preoperative Testing (ordered by Ortho Team):**
- PFTs
  - ECHO & ECG
    - Typically for pts w/ thoracic curves > 80 degrees

- 2nd Set Labs (ordered by Ortho Team):**
- \*Day Before Surgery\***
- CBC with differential
  - Type and screen
  - HCG qualitative (> 10 years old)

Instruct caregivers/parents to call Ortho Clinic or PAT if they have any questions prior to surgery

- [Intraoperative algorithm](#)
- [Inpatient algorithm](#)

Contact: [EvidenceBasedPractice@cmh.edu](mailto:EvidenceBasedPractice@cmh.edu)      [Link to synopsis and references](#)      Last Updated: 11.27.2023

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### **Objective of ERAS Clinical Pathway**

The Spinal Fusion Enhanced Recovery After Surgery (ERAS) pathway aims to minimize the variation of care for the patient undergoing posterior spinal fusion for idiopathic scoliosis, starting with the surgical visit through hospital discharge. This includes optimizing pre-operative nutrition/metabolism, decreasing adverse medication side effects, promoting earlier return of bowel function, improving wound and anastomotic healing, and reducing overall hospitalization length of stay. In the last several decades the application of ERAS principles has shown significant improvements in various surgeries regarding length of stay, opioid use, pain control, and return to diet (Liu 2017).

### **Target Users**

- Anesthesiologists
- Pediatric Spine Surgeons
- Nurse practitioners
- Nurses (Operating Room, Inpatient)

### **Target Population**

#### **ERAS Inclusion Criteria**

- Patients presenting for a posterior spinal fusion procedure for idiopathic scoliosis

#### **ERAS Exclusionary Criteria**

- Neuromuscular patients

### **Core Principles of ERAS**

- Pre-operative education of patients and family with an introduction to ERAS
- Reduced pre-operative fasting, with clear liquid oral carbohydrate loading until 2 hours prior to surgery
- Goal-directed strict intra-operative intravenous fluid therapy guidelines to avoid hypo- or hypervolemia
- Avoidance of pre-operative mechanical bowel preparation
- Avoidance of routine nasogastric tube use
- Minimizing long-acting opioid analgesia, in favor of regional anesthesia with epidural and/or local anesthesia for intra-operative and post-operative pain control when appropriate and using alternative non-opioid medications when appropriate (e.g., non-steroidal anti-inflammatories or acetaminophen)
- Early post-operative mobilization
- Early post-operative enteral feeding

### **ERAS Management Recommendations:**

#### **Preoperative Care**

- The beginning of this ERAS pathway begins well before the surgical date. The concept of ERAS is presented to the patient/family at the initial surgical appointment and reinforced pre-operatively.
- The patient and family are provided with educational items at the initial surgical appointment, including pre-op diet restrictions, risks of anesthesia, and pain management strategies.
- At Pre-Admission Testing (PAT) clinic the core concepts of ERAS are introduced to the patient/families, including the emphasis on early post-op PO intake and a multimodal pain management approach. Expectation management is crucial in the pre-operative phase. An ERAS handout is also given to the family.
- On the morning of surgery, the patient drinks carbohydrate-rich clear fluids up to two hours before procedure start time.
- Anxiolysis is determined by the anesthesia team and midazolam is used as needed.

#### **Intraoperative Care**

The principal goals during the intraoperative care of these patients are:

- Multimodal approach to pain management
- Blood loss mitigation strategies
- Post-operative nausea and vomiting prophylaxis with dexamethasone and ondansetron
- Fluid management goal of euvolemia
- Ensure that antibiotics are administered prior to surgical incision
- Maintain normothermia throughout the entire procedure
- Long-acting local anesthetic injection performed by the surgical team

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**Postoperative Care**

The principal goals during the postoperative care of these patients are:

- Transition from IV to oral medications as soon as possible
- Encouraging oral intake
- Multimodal pain control
- Prevention of nausea
- Postoperative bowel regimen
- Getting out of bed to bedside chair evening after surgery
- Remove foley catheter evening after surgery or morning post operative day one
- Focus on early discharge from hospital with individualized home instructions.

**Additional Questions Posed by the ERAS Pathway Committee**

No clinical questions were posed by this committee.

**Key Metrics To Be Monitored:**

Preop	Intraop	Postop
Carbohydrate-rich drink	IV acetaminophen	PACU PONV score
	PONV prophylaxis	Average pain score
	ABX prior to incision	Long-acting opioids
	Liposomal Bupivacaine	IV Dexamethasone
	Ketorolac	Diazepam
	Ketamine	NSAID
	Normothermia	Length of stay

**Value Implications**

The following potential improvements may reduce costs and resource utilization for healthcare facilities and reduce healthcare costs and non-monetary costs (e.g., missed school/work, loss of wages, stress) for patients and families.

- Decreased inpatient length of stay
- Decreased unwarranted variation in care

**Potential Organizational Barriers and Facilitators**

**Potential Barriers**

- Challenges with follow-up faced by some families

**Potential Facilitators**

- Collaborative engagement across care continuum settings during ERAS development
- High rate of use of ERAS pathways within the hospital setting

**Power Plans**

- Ortho AIS Post-Op

**Associated Policies**

There are no associated policies with this ERAS pathway.

**ERAS Pathway Preparation**

This ERAS pathway was prepared by the Department of Evidence Based Practice (EBP) in collaboration with content experts at Children's Mercy Kansas City. Development of this ERAS pathway supports the Division of Quality Excellence and Safety's initiative to promote care standardization that is evidenced by measured outcomes. If a conflict of interest is identified the conflict will be disclosed next to the committee member's name.

**Implementation & Follow-Up**

- Once approved, this ERAS pathway was presented to appropriate care teams and implemented.
- Care measurements will be assessed and shared with appropriate care teams to determine if changes need

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to occur.

- This ERAS pathway is scheduled to be reviewed by all teams yearly.

**Idiopathic Scoliosis ERAS Committee Members and Representation**

- Trent Sims, DO, MS | Anesthesiology | Co-Committee Chair
- Emily Weisberg, MD, FASA | Anesthesiology | Co-Committee Chair
- Nichole Doyle, MD, FASA | Anesthesiology | Committee Member
- John Anderson, MD | Orthopaedic Surgery | Committee Member
- Aaron Shaw, DO, FAAOS | Orthopaedic Surgery | Committee Member
- Michael Benvenuti, MD | Orthopaedic Surgery | Committee Member
- Anne Stuedemann, MSN, RN, CPNP | Orthopaedic Surgery | Committee Member
- Heather Sambol, RN, APRN | Anesthesiology | Committee Member
- Azita Roberson, FNP-C | Anesthesiology | Committee Member

**EBP Committee Members**

- Todd Glenski, MD, MSHA, FASA | Anesthesiology, Evidence Based Practice
- Jarrod Dusin, MS, RD, LD, CPHQ | Evidence Based Practice

**Additional Review & Feedback**

- The ERAS pathway was presented to each division or department represented on the ERAS committee as well as other appropriate stakeholders. Feedback was incorporated into the final product.

**ERAS Development Funding**

The development of this guideline was underwritten by the EBP, Anesthesiology, and Surgery Departments.

**Approval Obtained**

Department/Unit	Date Approved
Anesthesiology	January 2024
Surgery	January 2024
Evidence Based Practice	January 2024

**Version History**

Date	Comments
January 2024	Version 1

**Disclaimer**

When evidence is lacking or inconclusive, options in care are provided in the ERAS algorithm(s) and the power plans that accompany the guideline. This ERAS pathway does not establish a standard of care to be followed in every case. It is recognized that each case is different, and those individuals involved in providing health care are expected to use their judgment in determining what is in the best interests of the patient based on the circumstances existing at the time. Accordingly, this ERAS pathway should guide care with the understanding that departures from the pathway may be required at times

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Appendix A  
ERAS Pathway Overview

ERAS

Pectus Excavatum Repair with Bar  
Placement Enhanced Recovery After  
Surgery Pathway



Children's Mercy  
KANSAS CITY

Pectus Center

BEFORE SURGERY	<ul style="list-style-type: none"> <li>✓ Attend preop visit on the diagnosis, treatment and management of pectus excavatum (<a href="http://www.childrensmercy.org/pectus">www.childrensmercy.org/pectus</a>)</li> <li>✓ Sign up for the patient portal</li> <li>✓ Perform daily pectus exercises</li> <li>✓ Take 1 capful of MiraLAX once daily starting 3 days prior to surgery</li> <li>✓ Bathe or shower the night before or morning of surgery. No lotions, oils, powders, or creams after the bath/shower</li> </ul>	PECTUS CLINIC   HOME
DAY OF SURGERY	<ul style="list-style-type: none"> <li>✓ Do not eat solid food six hours before surgery</li> <li>✓ Finish drinking a carbohydrate-rich drink 2-3 hours before surgery – you must not eat or drink anything a full 2 hours before surgery</li> <li>✓ Take pre-operative medication for anxiety, if needed</li> </ul>	 PRE-SURGICAL AREA
DURING SURGERY	<ul style="list-style-type: none"> <li>✓ Cryoablation will be performed to freeze the intercostal nerves on each side prior to placing the bar. This will temporarily decrease pain transmission through these nerves.</li> <li>✓ Multiple approaches to treat pain and reduce opioid need</li> <li>✓ Prevention of post-operative nausea</li> </ul>	 OPERATING ROOM
AFTER SURGERY	<ul style="list-style-type: none"> <li>✓ Transition from IV to oral medications as soon as possible</li> <li>✓ Combination of medications to treat pain</li> <li>✓ Prevention of nausea and tolerate oral intake of food</li> <li>✓ Getting out of bed as soon as possible after surgery</li> <li>✓ Achieve good pain control</li> <li>✓ Review postoperative instructions including recommended pain and bowel medication regimen</li> </ul>	 OBSERVATION UNIT
FOLLOW UP	<ul style="list-style-type: none"> <li>✓ Monitor recovery and appearance of incisions</li> <li>✓ Follow recommended medications and methods for pain control</li> <li>✓ Complete the satisfaction survey</li> <li>✓ Attend follow-up clinic visit in approximately 2 weeks after surgery</li> </ul>	 HOME

Developed by Departments of Surgery and Evidence Based Practice  
9.10.22

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