Pectus Excavatum Repair with Bar Placement
Enhanced Recovery After Surgery

Pectus Excavatum Repair with Bar Placement ERAS Algorithm

Abbreviations (laboratory and radiology studies excluded):
3W - three west floor
PACU- post anesthesia care unit
PO - by mouth
PRN - as needed
PTX - pneumothorax
TIVA - total intravenous anesthesia

Preoperative Care

Preoperative Care:
- Scopolamine Patch (1 mg transdermal), ordered in SDS
- Carbohydrate-rich drink up to 2 hours before surgery
- Anxiolysis - midazolam per anesthesia team

Intraoperative Care

Maintenance of Anesthesia:
- ***Volatile*** or TIVA at discretion of anesthesiologist
- ***Normothermia:***
  - Utilize Bair Hugger
  - Goal intraoperative temperature 36° - 38° C
- ***Euvolemia:***
  - Goal directed management with target euvolemia and avoidance of unnecessary over-administration
    - Isotonic fluids at 3-7 ml/kg/hr

Intraoperative Pain Management Protocol:
- ***Cryoablation of intercostal nerves performed by surgeon***
  - Pain lowering effects of cryoablation may be delayed in the immediate post-operative period
- ***Multimodal Analgesia:***
  - IV acetaminophen 10 -15 mg/kg at beginning of case
  - Ketamine 0.5 mg/kg - 1 mg/kg bolus at beginning of case
  - Dexmedetomidine infusion 0.5 mcg/kg/hr
  - Fentanyl prn during procedure
  - Ketorolac 0.5 mg/kg (max 15 mg) at end of case
  - Hydromorphone 10 mcg/kg X 1 at end of case

- ***Antibiotics:***
  - Discuss at huddle
  - Administer before incision
- ***Antiemetics:***
  - Dexamethasone 0.1mg/kg (max 8mg) ***and*** ondansetron 0.15 mg/kg (max 4mg)

PACU - 3 West

PACU Pain Medications:
- 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

Chest x-ray to confirm correct bar placement position

Discharge Criteria from 3W
Following a 6-Hour observation time, medical staff to determine patient's discharge status based on:
- Pain well controlled
- Able to tolerate clears
- Stable respiratory status (Patients at risk for PTX)

Does patient meet discharge criteria from 3W?

No → Admit for overnight stay

Yes

Discharge home with post-operative follow up visit in two weeks

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Objective of ERAS Model

The Pectus Excavatum Repair with Bar Placement Enhanced Recovery After Surgery (ERAS) pathway aims to minimize the variation of care for the patient undergoing pectus excavatum repair with bar placement surgery, starting with the Center for Pectus Excavatum and Pectus Carinatum Clinic 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).

Background

Pectus excavatum is the most common pediatric chest wall deformity and can become visible anytime from infancy through puberty. It occurs in approximately 1/1,000 children and is four times more common in males versus females. Options for surgically correcting this deformity began in the early 1900s with development of a less invasive approach in the 1980s. Children's Mercy Kansas City (CMKC) modified the procedure further with a central incision for the passage of a steel bar across the chest. The bar assists with reshaping the child's chest as they grow. As this surgery continues to evolve, Children's Mercy has adopted the use of the Enhanced Recovery After Surgery pathway, which was developed to standardize perioperative care to accelerate recovery for pectus excavatum surgery patients.

Target Users

- Anesthesiologists
- Pediatric surgeons
- Nurse practitioners
- OR nurses

Target Population

ERAS Inclusion Criteria

- Patients presenting for pectus excavatum repair with bar placement surgery

Core Principles of ERAS (Melnyk et al., 2011)

- 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.
- Also discussed are some of the core concepts of ERAS, including the emphasis on early post-op PO intake and a multimodal pain management approach. Expectation management is crucial in the pre-operative phase. A handout (Appendix A), approved by CMKC's Health Literacy Committee, is given to the family prior to departing their pre-surgery appointment. The ERAS overview handout is available in Spanish as well (Appendix B).

- Patients and families are provided contacts for the Pectus Clinic to answer any questions they may have prior to the procedure.
- On the morning of surgery, the patient drinks carbohydrate-rich clear fluids up to two hours before procedure start time.
- A 1 mg transdermal scopolamine patch is ordered and applied in same day surgery
- 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
  - IV acetaminophen at beginning of case
  - IV ketamine bolus X 1 at beginning of case
  - IV ketorolac at end of case
  - IV hydromorphone X 1 at end of case
  - Cryoablation of intercostal nerves performed by surgical team
- 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
- Cryoablation of nerves by the surgical team

Postoperative Care

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

- Transition from IV to oral medications as soon as possible
- Achieve good pain control utilizing a combination of medications to treat pain
- Prevention of nausea
- Getting out of bed as soon as possible after surgery
- Tolerate oral intake
- Review postoperative instructions including recommended pain and bowel medication regimen
- Stable respiratory status; no oxygen requirement
- Focus on early discharge from hospital with individualized home instructions.

Additional Questions Posed by the CPM 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
	Ketorolac	Length of stay
	Ketamine	
	Normothermia	

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

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Potential Facilitators

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

Power Plans

- General Surgery Post Op Pectus Excavatum Repair
- General Surgery Same Day Pectus Excavatum

Associated Policies

There are no associated policies with this ERAS pathway.

ERAS Model Preparation

This care process was prepared by the Department of Evidence Based Practice (EBP) in collaboration with content experts at Children's Mercy Kansas City. Development of this care process 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 to occur. This ERAS pathway is scheduled for revision in January 2023.

Pectus Excavatum Repair with Bar Placement ERAS Committee Members and Representation

- Tolulope Oyetunji, MD, MPH | Surgery | Committee Co-Chair
- Emily Weisberg, MD, FASA | Anesthesiology | Committee Co-Chair
- Christian Taylor, MD | Anesthesiology | Committee Member
- Amy Pierce, MSN, APRN, PPCNP-BC | Surgery | Committee Member
- Beth Orrick, APRN, FNP-BC | Surgery | Committee Member
- Diane Rash, MSN, RN, CPNP-AC, PC | Surgery | Committee Member
- Azita Roberson, MSN, RN, CPN, APRN, FNP-C | Department of Anesthesiology | Committee Member

EBP Committee Members

- Todd Glenski, MD, MSHA, FASA | Anesthesiology, Evidence Based Practice
- Andrea Melanson, OTD, OTR/L | Evidence Based Practice
- Megan Gripka, MT (ASCP) SM | 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	August 2022
Surgery	August 2022
Evidence Based Practice	August 2022

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Version History

Date	Comments
September 12, 2022	Initial version
January 12, 2023	Updates to pre-operative care discussed and approved by committee – incorporated into documents with webpage updated

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.

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References

Liu, V.X., Rosas, E., Hwang, J., Cain, E., Foss-Durant, A., Clopp, M., et al. (2017). Enhanced recovery after surgery program implementation in 2 surgical populations in an integrated health care delivery system. *JAMA Surg, 152,* e171032. https://doi.org/10.1001/jamasurg.2017.1032

Melnyk, M., Casey, R. G., Black, P., & Koupparis, A. J. (2011). Enhanced recovery after surgery (ERAS) protocols: time to change practice? *Canadian Urological Association Journal = Journal de l'Association des urologues du Canada*, *5*(5), 342–348. https://doi.org/10.5489/cuaj.11002

Appendix A
Pectus ERAS Pathway Overview

ERAS

Pectus Excavatum Repair with Bar Placement Enhanced Recovery After Surgery Pathway

Children's Mercy KANSAS CITY

Pectus Center

BEFORE SURGERY	✓ Attend preop visit on the diagnosis, treatment and management of pectus excavatum (www.childrensmercy.org/pectus) ✓ Sign up for the patient portal ✓ Perform daily pectus exercises ✓ Take 1 capful of MiraLAX once daily starting 3 days prior to surgery ✓ Bathe or shower the night before or morning of surgery. No lotions, oils, powders, or creams after the bath/shower	PECTUS CLINIC HOME
DAY OF SURGERY	✓ Do not eat solid food six hours before surgery ✓ Finish drinking a carbohydrate-rich drink 2-3 hours before surgery – you must not eat or drink anything a full 2 hours before surgery ✓ Take pre-operative medication for anxiety, if needed	PRE-SURGICAL AREA
DURING SURGERY	✓ 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. ✓ Multiple approaches to treat pain and reduce opioid need ✓ Prevention of post-operative nausea	OPERATING ROOM
AFTER SURGERY	✓ Transition from IV to oral medications as soon as possible ✓ Combination of medications to treat pain ✓ Prevention of nausea and tolerate oral intake of food ✓ Getting out of bed as soon as possible after surgery ✓ Achieve good pain control ✓ Review postoperative instructions including recommended pain and bowel medication regimen	OBSERVATION UNIT
FOLLOW UP	✓ Monitor recovery and appearance of incisions ✓ Follow recommended medications and methods for pain control ✓ Complete the satisfaction survey ✓ Attend follow-up clinic visit in approximately 2 weeks after surgery	HOME

Developed by Departments of Surgery and Evidence Based Practice
9.10.22

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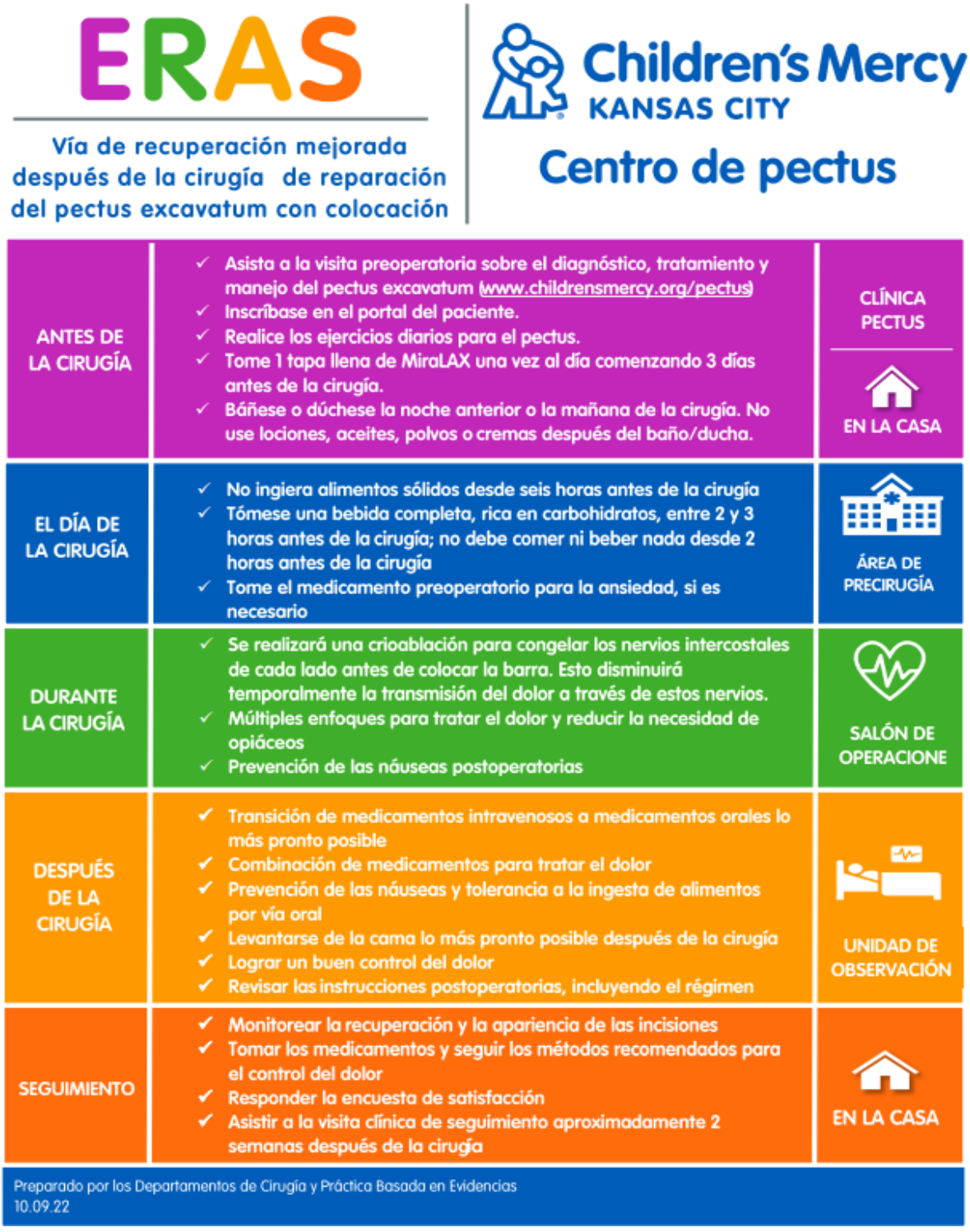
Appendix B
Pectus ERAS Pathway Overview – Spanish



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