Date Finalized: February 2025

Amputation Enhanced Recovery After Surgery Pathway Synopsis

Amputation ERAS Algorithm

Inclusion criteria:

- Amputation of a major extremity **Exclusion criteria:**
- · Finger/toe amputation

Preoperative Care

Pre-Operative Medications

- Gabapentin* 5 mg/kg PO (max dose 300 mg)
- Celecoxib 50 mg PO (10 25 kg), 100 mg PO (> 25 kg)
- Vitamin C 500 mg PO
- Dextromethorphan (long acting) 15 mg PO (ages 4 5 years), 30 mg PO (ages 6 - 11 years), 30 - 60 mg PO (ages 12 years and up)
- *Pregabalin 1 mg/kg (Max dose 75 mg) as alternative if pt has had side effects from gabapentin

Pre-operative Consults & Goals

Consults

- Pain Psychology
- Child Life

Pain education

Provide reassurance, discuss expectations, planned analgesic regimen, and anticipated

Multimodal Analgesia

- · Acetaminophen 10 -15 mg/kg IV at beginning of case and q6 hrs
- Ketamine infusion 5 mcg/kg/min vs intermittent dosing
- Methadone 0.15 mg/kg IV
- (max dose 15 mg) at beginning of case
- Dexmedetomidine infusion 0.5 mcg/kg/hr vs intermittent dosing
- Calcitonin 200 mcg IM or subQ at beginning of case
- Fentanvi PRN
- Hydromorphone PRN
 - Ketorolac **SHOULD NOT** be given intra-operatively*

Regional Anesthesia

Intraoperative Care

Please Consult APS Physician

Discuss regional anesthesia with surgeon at huddle

- · Peripheral nerve catheter preferable over single-shot nerve block
- For lower extremity amputations, consider epidural placement as an equivalent alternative to nerve catheter

Nerve Block Considerations

- For fascial plane block, consider lower concentrations of local anesthetic with high volume
- Be mindful of toxic local anesthetic dosages when multiple blocks are performed

Adiuncts

Consider clonidine or dexmedetomidine and preservative-free dexamethasone to prolong block

Intraoperative Medications

- Antibiotics: Discuss at huddle
 - Administer before incision

Antiemetics:

- Dexamethasone 0.1 mg/kg IV (max 8 mg)
- Ondansetron 0.15 mg/kg IV (max 4 mg)

Inpatient to Discharge

Main Goals of Inpatient of Care

Postoperative Care:

Bowel Regimen & Diet

- Daily bowel regimen
- · Avoidance of placing NG tube
- · Advance diet on POD 0
- Antiemetics
 - Ondansetron PRN
 - Diphenhydramine PRN

Peripheral Nerve Catheters or Epidural likely to remain in place 5 - 7 days postoperatively



QR code for mobile view

Initial Postoperative Pain Management

- *APS to be consulted on all cases and write all pain orders*
- Calcitonin 200 mcg IM or subQ daily, max of 5 total doses (inclusive of intra-op dose)
- Dextromethorphan (long acting) 15 mg PO BID (ages 4 5 years), 30 mg PO BID (ages 6 - 11 years), 30 - 60 mg PO BID (ages 12 years and up)
- Vitamin C 500 mg PO daily
- Continue gabapentin 5 mg/kg PO TID or pregabalin 1 mg/kg PO BID
- Methadone 0.05 0.1 mg/kg/dose IV X 1 dose, given 8 -12 hrs after intra-op dose
 - Consider scheduling methadone if nerve catheter/epidural + non-opioid adjuncts are not providing adequate analgesia
- Oxycodone 0.1 mg/kg PO q4hrs PRN once tolerating clears
- Hydromorphone 5 10 mcg/kg or morphine 0.05 0.1 mg/kg IV q4 hrs PRN severe
- *Diazepam* 0.05 0.1 mg/kg q4 6 hrs PRN
- Convert to PO when tolerating regular diet
- Acetaminophen 12.5 mg/kg IV (max 1000 mg) q6 hrs scheduled Convert to PO when appropriate
- Celecoxib 50 mg PO (10 25 kg), 100 mg PO (> 25 kg) BID
- Consider ketamine infusion 0.1 0.3 mg/kg/hr
- Consider dexmedetomidine infusion 0.1 0.3 mcg/kg/min

Prior to discharge, ensure follow-up is in place with: Orthopedic surgeon, PT or OT, & Complex Pain Clinic

Consults

*If poor pain trajectory, consider MPS consult

- PT or OT on POD 1
- Pain psychology
- continued involvement
- Child Life
- continued involvement

Can consider:

- Massage therapy
- · Pet therapy

Abbreviations:

APS - Acute Pain Service MPS - Medical Pain Service OT - Occupational Therapy

PT - Physical Therapy

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Date Finalized: February 2025

2

Table of Contents

Amputation ERAS Algorithm	. 1
Objective of ERAS Pathway	. 3
Background	. 3
Target Users	. 3
Target Population	. 3
Core Principles of ERAS	. 3
ERAS Management Recommendations:	. 3
Additional Questions Posed by the ERAS Committee	. 4
Key Metrics to be Monitored:	. 4
Value Implications	. 5
Organizational Barriers and Facilitators	. 5
Power Plans	
ERAS Pathway Preparation	. 5
Amputation ERAS Committee Members and Representation	. 5
ERAS Development Funding	. 5
Approval Process	
Implementation & Follow-Up	. 6
Disclaimer	6
References	

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Date Finalized: February 2025

3

Objective of ERAS Pathway

To minimize the variation of care for patients undergoing amputation surgery while improving outcomes, starting with pre-operative care through hospital discharge. The Amputation Enhanced Recovery After Surgery (ERAS) pathway assists the surgical team with a standardized approach to surgical care and promotes optimal patient outcomes.

Background

Pediatric limb amputation is a significant surgical procedure often necessitated by trauma, congenital anomalies, or severe infections (Rafeeqi & Pearson, 2021). The Amputation ERAS pathway is a multimodal perioperative care approach designed to improve surgical outcomes and expedite recovery. ERAS protocols encompass preoperative, intraoperative, and postoperative strategies, including optimized pain management, early mobilization, and nutritional support. Implementing ERAS in pediatric limb amputation aims to minimize surgical stress, reduce postoperative complications, and enhance overall recovery. By integrating evidence-based practices, ERAS pathways have been shown to improve patient and family satisfaction, decrease hospital stays, and promote faster return to daily activities (Rafeeqi & Pearson, 2021; Roberts et al., 2020; Liu, 2017). The Amputation ERAS committee seeks to implement a comprehensive pain management strategy, incorporating regional anesthesia and nerve blocks, to enhance wound healing and expedite patient recovery.

Target Users

- Pediatric Anesthesiologists
- Pediatric Orthopedic Surgeons
- Fellows
- Residents
- Advanced Practice Nurses
- Nurses (Operating Room, Inpatient)

Target Population

Inclusion Criteria

• Amputation of a major extremity

Exclusion Criteria

• Finger/toe amputation

Core Principles of ERAS

- Preoperative education of patients and families with an introduction to ERAS (in non-urgent situations).
- Reduced pre-operative fasting, with clear liquid oral carbohydrate loading until 2 hours prior to surgery (in non-urgent situations).
- Goal-directed strict intraoperative 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 postoperative pain control when appropriate and using alternative non-opioid
 medications when appropriate (e.g., non-steroidal anti-inflammatories or acetaminophen)
- Early postoperative mobilization
- Early postoperative enteral feeding

ERAS Management Recommendations:

Pre-Operative Care

- In the Amputation ERAS protocol, the need for limb amputation can be urgent, so no pre-admission testing is conducted. When feasible, the ERAS protocol will be introduced to the patient and their family during surgery preparation.
- Key concepts of ERAS, such as early post-operative oral intake and a multimodal pain management approach, will be discussed when possible. Managing expectations is crucial in the preoperative phase.

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- Depending on the urgency and type of amputation, the patient will consume a carbohydrate-rich and clear fluid up to three hours before the procedure begins.
- Anxiolytics are provided in this population pre-operatively to help calm the patient

Intra-Operative Care

The primary goals during intraoperative care of these patients include:

- Multimodal approach to pain management
 - Discuss regional anesthesia options with the surgeon at huddle, including options for peripheral nerve catheter and/or epidural placement for lower extremity amputations
 - o Minimize the use of long-acting opioids
- Prophylaxis for postoperative nausea and vomiting should be administered using dexamethasone and ondansetron
- Fluid management goals of clinical euvolemia and antibiotics must be given before the surgical incision
- Maintenance of normothermia throughout the entire procedure
- Discontinuation of urinary catheter prior to transfer to PACU
- No administration of Ketorolac intra-operatively

Post-Operative Care

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

- Move toward oral intake as early as possible and avoid NG tube placement
- Advance diet on postoperative day zero
- Prevent/treat postoperative nausea and vomiting with diphenhydramine and ondansetron as needed
- Multimodal pain control- Consult acute pain service on all cases and write all pain orders on postoperative day zero
 - o Ketamine infusion
 - Gabapentin
 - Calcitonin
 - Methadone
 - o Dexmedetomidine infusion
 - Dextromethorphan
 - o Diazepam
 - o IV acetaminophen
 - Oxycodone prn once patient tolerates clears
 - o IV hydromorphone or morphine prn for severe breakthrough pain or if not tolerating PO intake
- Consultation with Physical or Occupational Therapy
- Consider collaboration with Child Life, Massage Therapy, and Pet Therapy
- If there is a poor pain trajectory, a consult with the medical pain service can be written

Additional Questions Posed by the ERAS Committee

No clinical questions were posed for this review.

Key Metrics to be Monitored:

Pre-Op	Intra-Op	Post-Op
Carbohydrate-rich drink	IV acetaminophen	Average pain score
Midazolam	Ketamine infusion	NSAID
Gabapentin	ABX prior to incision	Long-acting opioids
Pregabalin	Regional pain anesthesia	IV Dexamethasone
Celecoxib	Methadone	Diazepam
	Dexmedetomidine infusion	Length of stay
	Calcitonin	
	Fentanyl	
	Hydromorphone	
	Dexamethasone	
	Ondansetron	

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Value Implications

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

- Decreased inpatient length of stay
- Decreased unwarranted variation in care
- Improved communication between patients and the care team throughout the perioperative period
- Improved post-operative pain control

Organizational Barriers and Facilitators

Potential Barriers

- Variability of acceptable level of risk among providers
- 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 pathway

Power Plans

There are no associated power plans with this surgical pathway

Associated Policies

There are no associated policies with this surgical pathway

ERAS Pathway Preparation

This ERAS pathway was prepared by the Department of Evidence Based Practice (EBP) in collaboration with the Amputation ERAS committee composed of content experts at Children's Mercy Kansas City. If a conflict of interest is identified, the conflict will be disclosed next to the committee member's name.

Amputation ERAS Committee Members and Representation

- Emily Weisberg, MD | Anesthesiology | Committee Co-Chair
- Erin Adams, MD | Anesthesiology | Committee Co-Chair
- Nicole Dolye, MD, FASA, FAAP | Anesthesiology | Committee Co-Chair
- Armand Morel, MD | Anesthesiology | Committee Member
- Kathryn Keeler, MD | Orthopedic Surgery | Committee Member

EBP Committee Members

- Todd Glenski, MD, MSHA, FASA | Anesthesiology, Evidence Based Practice
- Andrea Melanson, OTD, OTR/L | Evidence Based Practice

ERAS Development Funding

The development of this ERAS pathway was underwritten by the following departments/divisions: Anesthesiology, Orthopedic Surgery, and Evidence Based Practice.

Conflict of Interest

The contributors to the Amputation ERAS have no conflicts of interest to disclose related to the subject matter or materials discussed.

Approval Process

- This product was reviewed and approved by the Amputation ERAS Committee, content experts from departments/divisions, and the EBP Department.
- Pathways are reviewed and updated as necessary every 3 years within the EBP Department at CMKC. Content expert teams are involved with every review and update.

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Date Finalized: February 2025

5

Review Requested

Department/Unit	Date Obtained
Anesthesiology	February 2025
Orthopedic Surgery	February 2025
Evidence Based Practice	February 2025

Version History

Date	Comments
February 2025	Version one – Development of algorithm and synopsis

Date for Next Review:

February 2028

Implementation & Follow-Up

- Once approved, the ERAS pathway was presented to appropriate care teams and implemented.
- Key metrics will be assessed and shared with the appropriate care teams to determine if changes are needed.
- Education tools for patients and families were created for pre-surgery visits to provide an overview of the ERAS pathway. Health literacy reviewed the tool.
- Education was provided to all stakeholders:

Departments of Anesthesiology and Orthopedic Surgery Resident physicians

Disclaimer

When evidence is lacking or inconclusive, care options are provided in the supporting documents that accompany the ERAS pathway.

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7

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
- Rafeeqi, T. & Pearson, E.G. (2021, July). Enhanced recovery after surgery in children. *Translational Gastroenterology* and Hepatology, 6, 1-9. doi: 10.21037/tgh-20-188
- Roberts, K., Brindle, M., & McLuckie, D. (2020, July). Enhanced recovery after surgery in pediatrics: A review of the literature. *British Journal of Anesthesia*, 20(7), 235–241. doi.org/10.1016/j.bjae.2020.03.004.
- Taylor, C.M., Weisberg, E.L., Doyle, N.M., & Glenski, T.A. (2024). Error traps in developing a pediatric enhanced recovery after surgery (ERAS) program. *Pediatric Anesthesia*, 0, 1-8. doi.org/10.1111/pan.15042

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