Neuromuscular Patients Undergoing Major Orthopedic Surgery
Enhanced Recovery After Surgery

Abbreviations (laboratory and radiology studies excluded):
NPO - Nothing by mouth
PAT - Pre-Admission Testing
SDS - Same Day Surgery

Inclusion criteria:
- Neuromuscular patients undergoing major lower extremity orthopedic procedures

Exclusion criteria:
- Neurotypically developed patients
- Neuromuscular patients undergoing soft tissue work only
- Neuromuscular patients undergoing hardware removal only

Medication/diet instructions received at PAT:
- ***Medication*:**
  - Patient takes all normal daily medications morning of surgery unless specifically instructed to stop
- ***Diet:***
  - Standard NPO guidelines
  - Carbohydrate-rich drink (Gatorade, Powerade, or Pedialyte) encouraged when NPO until 2 hours prior to procedure time
- ***Arrival time/location***

Prior to surgery day

Patient scheduled for surgery

Patient seen in **Orthopedic Surgery Clinic and PAT** for pre-surgery evaluation to review the following:
- Introduction to ERAS
- Pain management and regional anesthesia
  - Anesthesia APRNs to chart review Orthopedic clinic notes for regional anesthesia recommendation
- Polyethylene glycol BID for 3 days prior to surgery
- Medication and diet instructions
- Discuss anesthesia risks and plan (including mitigation of pre-op anxiety)
- Pre-op Ortho ERAS checklist
- Ortho Surgery ERAS pathway

2 days prior to surgery date, SDS calls caregiver

Intraoperative to discharge algorithm

Abbreviations (laboratory and radiology studies excluded):
SDS - Same Day Surgery
APS - Acute Pain Service
PENG - Pericapsular nerve group block
NG - Nasogastric
PO - By mouth
POD - Post-operative day
PONV - Post-operative nausea and vomiting
P.T. - Physical Therapy
TIVA - Total intravenous anesthesia
PACU - Post-Anesthesia Care Unit

Preoperative Care

- Active warming of patient in SDS
- Anxiolysis: midazolam per anesthesia team

Nerve Block Considerations

- Consider lower concentrations of local with high volume if fascial plane block
- Be mindful of toxic local anesthetic dosages when multiple blocks are performed
- If unable to perform peripheral nerve blocks consider epidural placement
- **Adjuncts:** Consider clonidine or dexmedetomidine and preservative free dexamethasone to prolong block

Intraoperative Care

Intraoperative Medication Bundle

- ***Antibiotics:***
  - Discuss at huddle
  - Administer before incision
- ***Antiemetics:***
  - Dexamethasone 0.1 mg/kg (max 8 mg)
  - Ondansetron 0.15 mg/kg (max 4 mg)
- ***Multimodal Analgesia:***
  - IV acetaminophen 12.5 mg/kg (max 1000 mg) at start of case
  - Ketorolac 0.5 mg/kg (max 15 mg) at closure
  - Consider dexmedetomidine bolus/infusion
  - Consider ketamine infusion
- ***Limit IV opioids:***
  - Fentanyl prn
  - Minimize long-acting opioids

Regional Anesthesia

Please Consult APS Physician

- **Discuss nerve blocks with surgeon at huddle**
  - ***If Proximal femoral osteotomy only:***
    - Femoral nerve block plus lateral femoral cutaneous nerve block **OR**
    - Suprainguinal fascia iliaca block **+/-** PENG block **OR**
    - PENG block + lateral femoral cutaneous nerve block
  - ***If Acetabuloplasty:***
    - Suprainguinal fascia iliaca block **+/-** PENG block **OR**
    - Quadratus lumborum block
  - ***If Tibial involvement:***
    - Popliteal nerve block with saphenous nerve block **OR**
    - Popliteal nerve block with adductor canal block
  - ***If Distal femur involvement:***
    - Femoral nerve block **OR**
    - Adductor canal block

Maintenance of Anesthesia

- ***Volatile*** or TIVA maintenance at discretion of anesthesiologist
- ***Normothermia:***
  - Patients with cerebral palsy are at high risk for hypothermia
    - Room temperature set to 70° F
    - Utilize Bair Hugger
    - Goal intraoperative temperature 36° - 38° C
- ***Euvolemia:***
  - Goal is clinical **euvolemia** (zero fluid balance, no net weight gain on POD #1)
  - **Isotonic fluids at 3-7 ml/kg/hr** (additional as clinically indicated)

Prior to Transfer to PACU

- Discontinue urinary catheter

Postoperative Care: Inpatient to discharge

Main Inpatient Goals of Care

Bowel regimen & Diet

- Daily bowel regimen
- Avoidance of NG tube
- Advance diet on POD 0
- Antiemetics: ondansetron and diphenhydramine prn

Postoperative Pain Management

- **APS to be consulted on <u>all</u> cases and write <u>all</u> pain orders on POD 0**
  - Dexmedetomidine infusion 0.1 - 0.3 mcg/kg/min
    - May adjust depending on baseline neurological function
  - PO diazepam 0.1 mg/kg q6 hrs scheduled (unless otherwise discussed with surgeon)
  - IV acetaminophen 12.5 mg/kg (max 1000 mg) q6 hrs scheduled
    - Change to PO on POD 1
  - IV ketorolac 0.5 mg/kg (max 15 mg) q6 hrs alternating q3 hrs with acetaminophen
  - Oxycodone 0.1 mg/kg q 4hrs prn once tolerating clears
  - IV hydromorphone 5-10 mcg/kg or morphine 0.05-0.1 mg/kg q4 hrs prn severe breakthrough pain or if not tolerating PO intake

Physical Therapy

- P.T. consulted on POD 1

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

Prior to surgery algorithm

Objective of ERAS Model

This Enhanced Recovery After Surgery (ERAS) pathway aims to standardize perioperative care and accelerate recovery for neuromuscular patients undergoing major orthopedic surgery starting preoperatively with a bowel regimen, carbohydrate rich fluid intake on the day of surgery, and preoperative warming. The pathway includes a multimodal pain management regimen utilizing single shot peripheral nerve blocks that aims to reduce opioid utilization, decrease adverse drug related side effects, expedite the resumption of oral intake, and promote the return of bowel function.

Background

Patients with cerebral palsy and those with other neuromuscular diagnoses often require multiple, orthopedic surgical procedures. These procedures require specialized pain management strategies secondary to increased muscle tone and spasticity, which can be worsened by inadequate pain control. In addition, they have multiple medical comorbidities that can be worsened by traditional pain management with opioids.

Traditionally pain control for these surgeries have required epidural catheters but there are many patients in this population (those with a baclofen pump, dorsal rhizotomy, prior spinal fusion) that are not candidates for epidural catheters. Replacing an indwelling epidural catheter with single-shot peripheral nerve blocks at the beginning of the surgery may allow for earlier patient mobilization, earlier discharge from physical therapy, and will facilitate the removal of the foley catheter at completion of the case. This patient population is at risk for many perioperative difficulties in addition to pain control which includes intraoperative hypothermia and delayed return of bowel function (Doyle et al., 2022).

Target Users

- Pediatric surgeons
- Nurse practitioners
- OR nurses
- Anesthesiologists

Target Population

ERAS Inclusion Criteria

Neuromuscular patients undergoing major lower extremity orthopedic procedures.

ERAS Exclusion Criteria

- Neurotypically developed patients
- Neuromuscular patients undergoing only soft tissue work
- Neuromuscular patients undergoing hardware removal only

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

- Preoperative education of patients and family with an introduction to ERAS
- Reduced preoperative fasting, with clear liquid oral carbohydrate loading 2 hours prior to surgery
- Goal-directed strict intraoperative intravenous fluid therapy guidelines to avoid hypo-or hypervolemia
- Avoidance of preoperative 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 intraoperative 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:

Preoperative Care

- The beginning of this ERAS protocol begins well before the surgical date. The concept of ERAS is presented to the patient/family at the initial surgical appointment and reinforced preoperatively.
- The patient and family are provided with educational items at the initial surgical appointment, including preoperative diet restrictions, risks of anesthesia, and pain management.
- 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 preoperative phase. Two

handouts (Appendices A and B), approved by CM's Health Literacy Committee, are given to the family prior to departing their pre-surgery appointment.
- Patients and families are provided with contacts for Dr. Keeler's nurse 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.

Intraoperative Care

The principal goals during the intraoperative care of these patients are:
- Multimodal approach to pain management
  - Discuss peripheral nerve blocks with surgeon at huddle
  - Minimize the use of long-acting opioids
- Postoperative nausea and vomiting prophylaxis with dexamethasone and ondansetron
- Fluid management goal of clinical euvolemia
- Ensure that antibiotics are administered prior to surgical incision
- Maintain normothermia throughout the entire procedure
- Discontinue urinary catheter prior to transfer to PACU

Postoperative Care

The principal goals during the postoperative care of these patients are:
- Move toward PO intake as early as possible and avoid NG tube placement
- Advance diet on postoperative day 0
- Prevent/treat postoperative nausea and vomiting with dexamethasone and ondansetron prn
- Multimodal pain control- Consult acute pain service on all cases and write all pain orders on postoperative day 0
  - Dexmedetomidine infusion
  - PO diazepam
  - IV acetaminophen
  - IV ketorolac
  - Oxycodone prn once patient tolerates clears
  - IV hydromorphone or morphine prn for severe breakthrough pain or if not tolerating PO intake
- Physical therapy (PT) Consult

Additional Questions Posed by the ERAS Committee

No clinical questions were posed by this committee.

Key Metrics To Be Monitored:

Preoperative	Intraoperative	Postoperative
Carbohydrate-rich drink	IV acetaminophen	PACU PONV score
	PONV prophylaxis	Average pain score
	ABX prior to incision	Long-acting opioids
	Ketorolac	Diazepam
	Normothermia	Length of stay
	Euvolemia	Dexmedetomidine infusion
	Nerve blocks/neuraxial anesthesia	
	Long-acting opioids	

Potential Cost 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

- 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

Power Plans

There are no Power Plans associated with this ERAS pathway.

Associated Policies

- There are no Associated Policies with this ERAS pathway.

ERAS Model Preparation

This care process was prepared by the Evidence Based Practice Department (EBP) in collaboration with content experts at Children's Mercy Kansas City. Development of this care process supports the Department of Quality Excellence and Safety's initiative to promote care standardization that builds a culture of quality and safety 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 shared with appropriate care teams and implemented. New handouts for patients and families were created for pre-surgery visits including a preparation checklist and an overview of the ERAS pathway. Key metrics will be assessed and shared with the appropriate care teams to determine if changes need to occur. This ERAS pathway is scheduled for revision in March 2023.

Neuromuscular Patients Undergoing Major Orthopedic Surgery ERAS Committee Members and Representation

- Nichole Doyle, MD, FASA | Anesthesiology | Committee Co-Chair
- Emily Weisberg, MD, FASA | Anesthesiology | Committee Co-Chair
- Kathryn Keeler, MD | Orthopedic Surgery | Committee Member
- Azita Roberson, MSN, RN, CPN, APRN, FNP-C | Anesthesiology | Committee Member

EBP Committee Members

- Todd Glenski, MD, MSHA, FASA | Anesthesiology, Evidence Based Practice
- Megan Gripka, MT (ASCP) SM | Evidence Based Practice
- Andrea Melanson, OTD, OTR/L | 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 ERAS pathway was underwritten by the Departments of Evidence Based Practice, Anesthesiology, and Orthopedic Surgery.

Approval Obtained:

Department/Unit	Date Approved
Anesthesiology	August 2022
Orthopedic Surgery	September 2022
Evidence Based Practice	September 2022

Version History

Date	Comments
October 2022	Initial version

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.

References

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Neuromuscular Patients Undergoing Major Orthopedic Surgery
Enhanced Recovery After Surgery
Appendix A

ERAS

Enhanced Recovery After Surgery

Patient Pre-Operative Checklist

ERAS program helps to:

- Promote overall healing from surgery
- Decrease opioid pain medicine use and side effects by using regional anesthesia
- Advance diet faster and speed up return of bowel function
- Decrease length of hospitalization

SURGERY	My child's orthopedic surgery starts at _____ on _____. You will receive a call 2 business days before surgery with more instructions on eating and drinking, when to arrive, and where to go for surgery.	☐
BOWEL ROUTINE	Do your child's normal bowel routine the day before surgery. They should eat regular, healthy meals the day before surgery. They must stop eating at least 6 hours before surgery starts.	☐
CLEAR CARB	Choose a clear, carbohydrate-rich drink like Gatorade or Pedialyte for your child to drink 2-3 hours before surgery. Try to have them drink about _____ oz. before surgery. They must finish drinking it no later than 2 hours before the surgery time.	☐
QUESTIONS	We are here to help with your questions before surgery. For surgery questions, call Orthopedic Surgery: (816) 234-3693 For anesthesia questions, call the PAT Clinic: (816) 802-1238	☐

Developed by Anesthesiology and Evidence Based Practice
11.22.22

Children's Mercy KANSAS CITY

Appendix B

ERAS

Neuromuscular Patients Undergoing Major Orthopedic Surgery Recovery After Surgery Pathway

Children's Mercy KANSAS CITY

ORTHOPEDIC SURGERY

BEFORE SURGERY	✓ Education ✓ Medical management of your child's orthopedic condition ✓ Pre-operative surgery appointments	HOME ORTHOPEDIC SURGERY
DAY OF SURGERY	✓ No solid food six hours before surgery ✓ *Carbohydrate-rich drink two hours before surgery* ✓ Pre-operative medication for anxiety if needed	PRE-SURGICAL AREA
DURING SURGERY	✓ Minimize blood transfusions ✓ Multiple approaches to treat pain and reduce opioid need ✓ Prevention of post-operative nausea ✓ Prevention of post-operative delirium ✓ Avoidance of hypothermia or hyperthermia	OPERATING ROOM
AFTER SURGERY	✓ Early removal of catheters, lines, and tubes ✓ Transition from IV to oral medications as soon as possible ✓ Combination of medications to treat pain ✓ Prevention of nausea ✓ Getting out of bed as soon as possible after surgery ✓ Faster return to a normal diet ✓ Continuous updates and communication from orthopedic nurse practitioner, including daily rounds with team	INPATIENT UNIT
FOLLOW UP	✓ Monitor recovery ✓ Satisfaction survey	HOME

Developed by Departments of Anesthesiology and Evidence Based Practice
8.22.22