

# Clinical Pathways

## Post-Operative Tethered Cord Patients

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# What is a Clinical Pathway?

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- An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective and consistent patient care.

# Objectives of Pathway

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- To improve and standardize post-operative care of the patient undergoing tethered cord surgery
- To eliminate variability and establish a standard of care for these patients

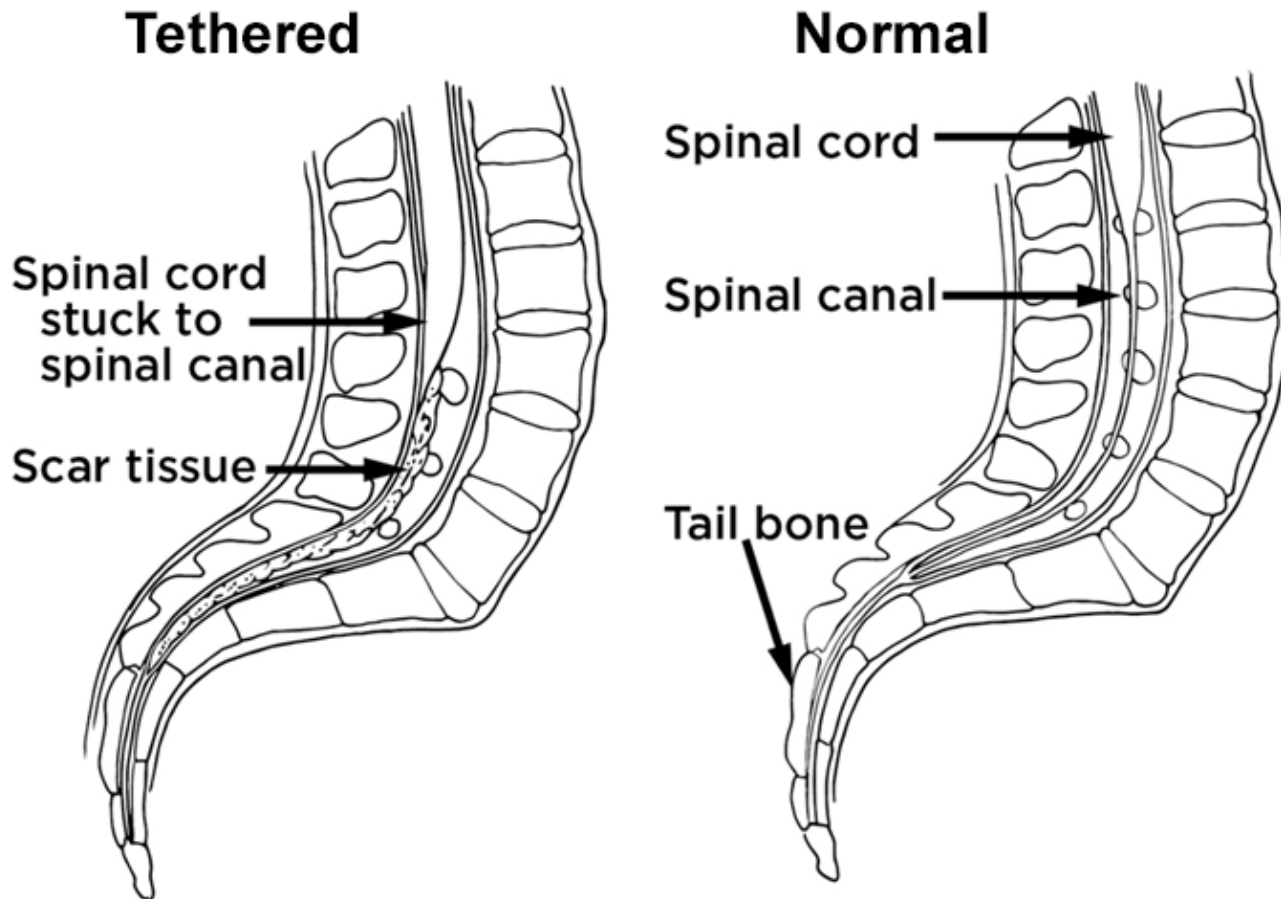
# Why do we need this pathway?

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- To change practice for post operative care of these select group of patients
- To guide care for these children
- To ensure standard of care is successfully implemented for the safety of the patient

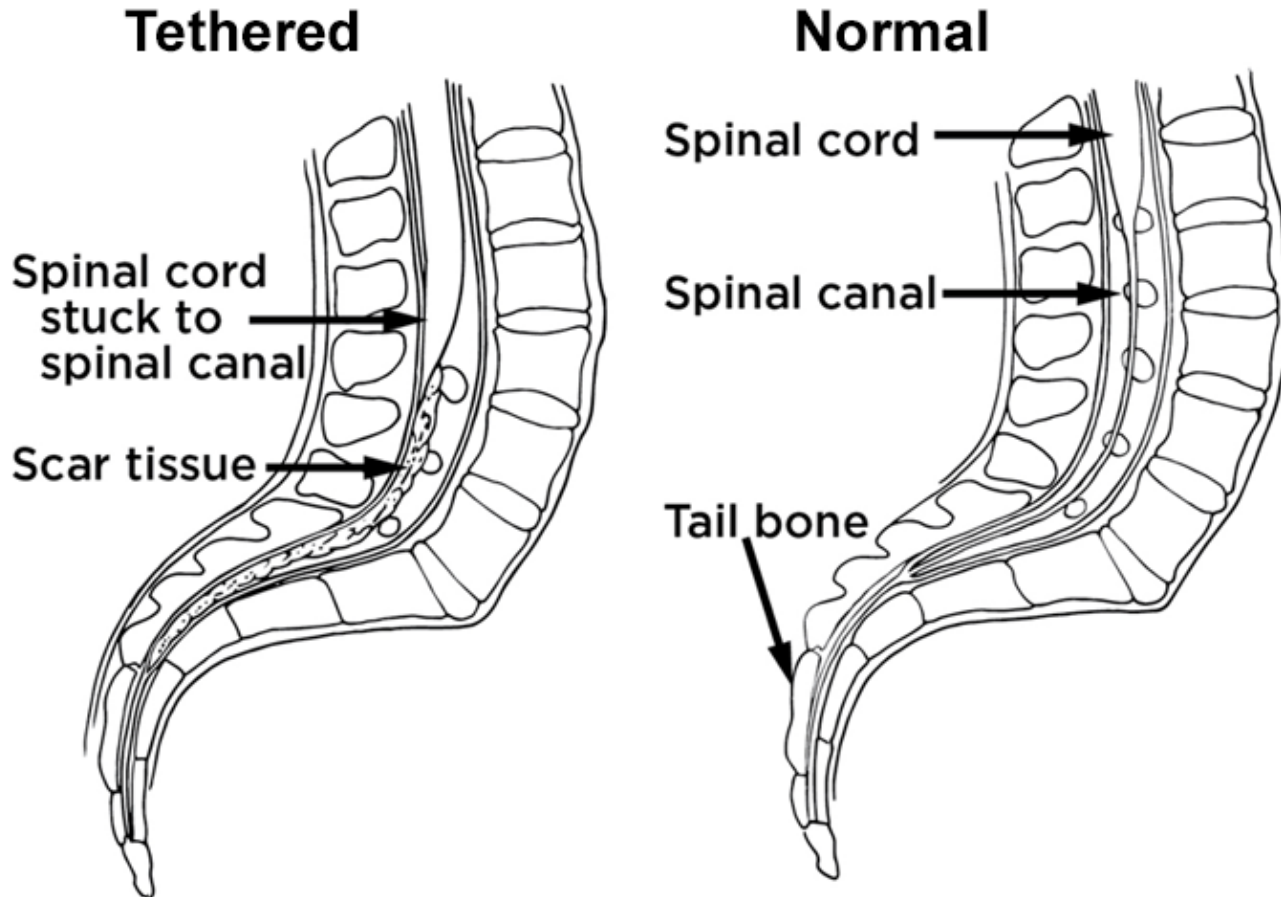
# What is Tethered Cord?



- Tethered cord occurs when the spinal cord is attached to tissues around the spine, most commonly at the base of the spine.
  - The attached tissue limits the movement of the spinal cord within the spinal column and causes an abnormal stretching of the spinal cord and impairment of blood flow to the nerve tissue.
  - Can be closely associated with spina bifida
- OR
- Can occur as an independent entity related to disorders of secondary neurulation and some tumors.

Image courtesy of: <https://www.seattlechildrens.org/conditions/brain-nervous-system-mental-conditions/tethered-spinal-cord/>

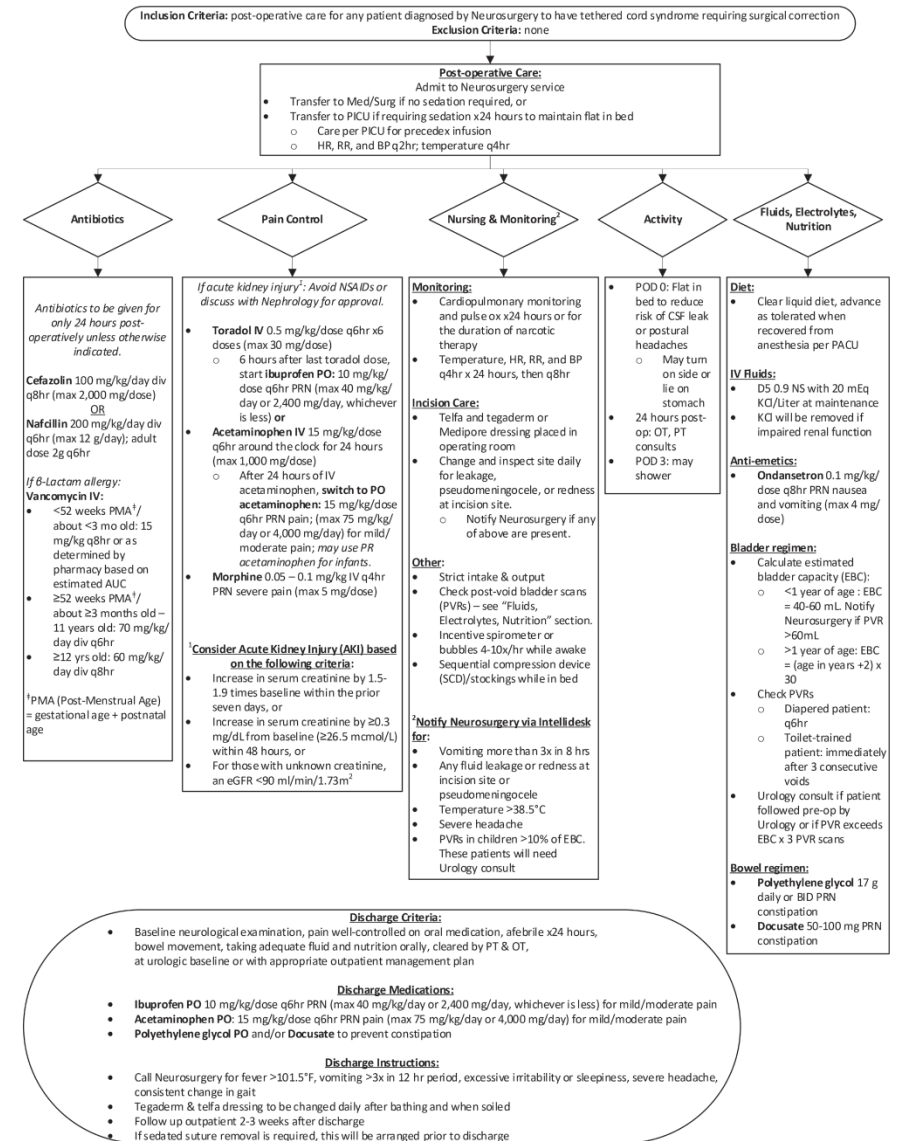
# What is Tethered Cord?



- The lower tip of the spinal cord (conus medullaris) is normally located opposite the disc between the first and second lumbar vertebrae.
- With tethered cord, the conus medullaris may be located below the interspace between the second and third lumbar vertebrae, and/or there may be radiographic evidence of abnormal points of attachment (i.e. thickened filum terminale, intraspinal mass, spinal cord adjacent to thecal sack in a fixed position).

# CLINICAL PATHWAY: Post-Operative Tethered Cord

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
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JUDGMENT.



This is the Post Operative Tethered Cord Clinical Pathway.

We will be reviewing each component in the following slides.

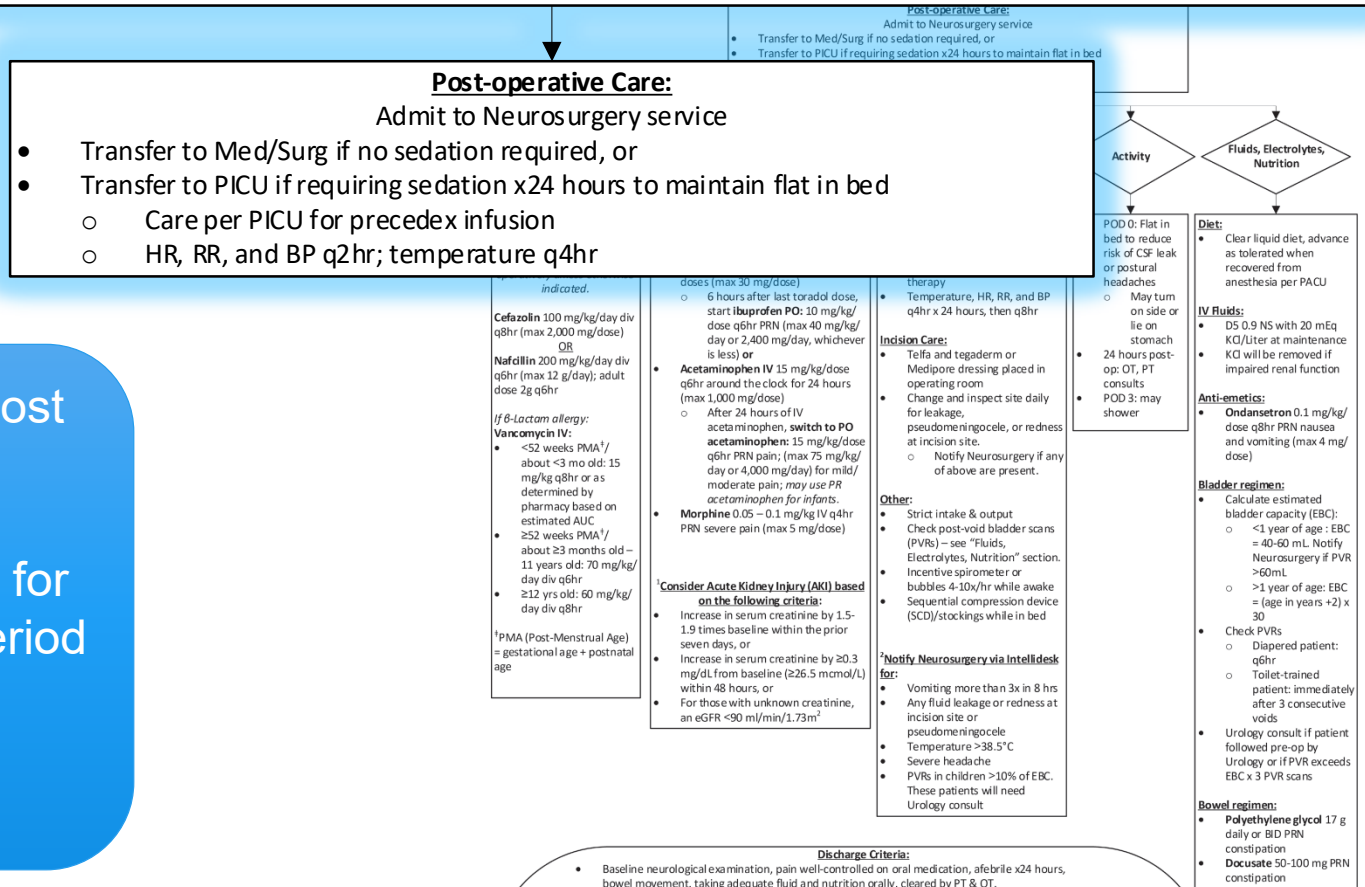
**CLINICAL PATHWAY:**  
**Post-Operative Tethered Cord**

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

This pathway is specifically for patients who have tethered cord that required surgical correction.

**Inclusion Criteria:** post-operative care for any patient diagnosed by Neurosurgery to have tethered cord syndrome requiring surgical correction

**Exclusion Criteria:** none



Patients need to be flat in bed for 24 hours post procedure.

- Some patients will require PICU admission for sedation with precedex during this initial period of recovery.
- Most children can then transfer to the Med/Surg unit after 24 hours.

**Discharge Criteria:**

- Baseline neurological examination, pain well-controlled on oral medication, afebrile x24 hours, bowel movement, taking adequate fluid and nutrition orally, cleared by PT & OT, at urologic baseline or with appropriate outpatient management plan

**Discharge Medications:**

- Ibuprofen PO 10 mg/kg/dose q6hr PRN (max 40 mg/kg/day or 2,400 mg/day, whichever is less)
- Acetaminophen PO: 15 mg/kg/dose q6hr PRN pain (max 75 mg/kg/day or 4,000 mg/day) for mild/moderate pain
- Polyethylene glycol PO and/or Docusate to prevent constipation

**Discharge Instructions:**

- Call Neurosurgery for fever >101.5°F, vomiting >3x in 12 hr period, excessive irritability or sleepiness, severe headache, consistent change in gait
- Tegaderm & telfa dressing to be changed daily after bathing and when soiled
- Follow up outpatient 2-3 weeks after discharge
- If sedated suture removal is required, this will be arranged prior to discharge

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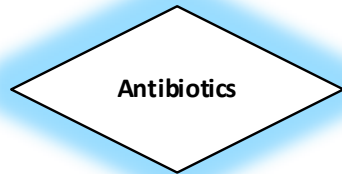
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# CLINICAL PATHWAY: Post-Operative Tethered Cord

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**Inclusion Criteria:** post-operative care for any patient diagnosed with Neurosurgery to have tethered cord syndrome requiring surgical correction  
**Exclusion Criteria:** none

**Post-operative Care:**  
Admit to Neurosurgery service  
• Transfer to Med/Surg if no sedation required, or  
• Transfer to PICU if requiring sedation x24 hours to maintain flat in bed  
○ Care per PICU for prececdex infusion  
HR, RR, and BP q2hr; temperature q4hr

## Activity

**Antibiotics**

Antibiotics to be given for only 24 hours post-operatively unless otherwise indicated.

**Cefazolin** 100 mg/kg/day div q8hr (max 2,000 mg/dose)  
OR  
**Nafclillin** 200 mg/kg/day div q6hr (max 12 g/day); adult dose 2g q6hr

**If  $\beta$ -Lactam allergy:**  
**Vancocycin IV:**  
• <52 weeks PMA<sup>1</sup>/ about <3 mo old: 15 mg/kg q8hr or as determined by pharmacy based on estimated AUC  
•  $\geq$ 52 weeks PMA<sup>1</sup>/ about  $\geq$ 3 months old – 11 years old: 70 mg/kg/day div q6hr  
•  $\geq$ 12 yrs old: 60 mg/kg/day div q8hr

<sup>1</sup>PMA (Post-Menstrual Age) = gestational age + postnatal age

**If acute pain, avoid NSAIDs or discuss with neurology for approval.**

- Toradol N** 0.5 mg/kg/dose q6hr x6 doses (max 30 mg/dose)
  - 6 hours after last toradol dose, start **ibuprofen PO**: 10 mg/kg/dose q6hr PRN (max 40 mg/kg/day or 2,400 mg/day, whichever is less) or
- Acetaminophen IV** 15 mg/kg/dose q6hr around the clock for 24 hours (max 1,000 mg/dose)
  - After 24 hours of IV acetaminophen, switch to **PO acetaminophen**: 15 mg/kg/dose q6hr PRN pain; (max 75 mg/kg/day or 4,000 mg/day) for mild/moderate pain; may use PR acetaminophen for infants.
- Morphine** 0.05 – 0.1 mg/kg IV q4hr PRN severe pain (max 5 mg/dose)

**Consider Acute Kidney Injury (AKI) based on the following criteria:**

- Increase in serum creatinine by 1.5-1.9 times baseline within the prior seven days, or
- Increase in serum creatinine by  $\geq$ 0.3 mg/dL from baseline ( $\geq$ 26.5 mcmol/L) within 48 hours, or
- For those with unknown creatinine, an eGFR <90 ml/min/1.73m<sup>2</sup>

## Fluids, Electrolytes, Nutrition

**Monitoring:**

- Cardiopulmonary monitoring and pulse ox x24 hours or for the duration of narcotic therapy
- Temperature, HR, RR, and BP q4hr x 24 hours, then q8hr

**Incision Care:**

- Telfa and tegaderm or Medipore dressing placed in operating room
- Change and inspect site daily for leakage, pseudomeningocele, or redness at incision site.
  - Notify Neurosurgery if any of above are present.

**Other:**

- Strict intake & output
- Check post-void bladder scans (PVR) – see “Fluids, Electrolytes, Nutrition” section.
- Incentive spirometer or bubbles 4-10x/hr while awake
- Sequential compression device (SCD)/stockings while in bed

**Notify Neurosurgery via Intellidesk for:**

- Vomiting more than 3x in 8 hrs
- Any fluid leakage or redness at incision site or pseudomeningocele
- Temperature >38.5°C
- Severe headache
- PVRs in children >10% of EBC. These patients will need Urology consult

**Diet:**

- Clear liquid diet, advance as tolerated when recovered from anesthesia per PACU

**IV Fluids:**

- D5 0.9 NS with 20 mEq KCl/Liter at maintenance
- KCl will be removed if impaired renal function

**Anti-emetics:**

- Ondansetron 0.1 mg/kg/dose q8hr PRN nausea and vomiting (max 4 mg/dose)

**Bladder regimen:**

- Calculate estimated bladder capacity (EBC):
  - <1 year of age: EBC = 40-60 mL. Notify Neurosurgery if PVR >60mL.
  - >1 year of age: EBC = (age in years + 2) x 30
- Check PVRs
  - Diapered patient: q6hr
  - Toilet-trained patient: immediately after 3 consecutive voids
- Urology consult if patient followed pre-op by Urology or if PVR exceeds EBC x 3 PVR scans

**Bowel regimen:**

- Polyethylene glycol 17 g daily or BD PRN constipation
- Docusate 50-100 mg PRN constipation

### Discharge Criteria:

- Baseline neurological examination, pain well-controlled on oral medication, afebrile x24 hours, bowel movement, taking adequate fluid and nutrition orally, cleared by PT & OT, at urologic baseline or with appropriate outpatient management plan

### Discharge Medications:

- **Ibuprofen PO** 10 mg/kg/dose q6hr PRN (max 40 mg/kg/day or 2,400 mg/day, whichever is less) for mild/moderate pain
- **Acetaminophen PO**: 15 mg/kg/dose q6hr PRN pain (max 75 mg/kg/day or 4,000 mg/day) for mild/moderate pain
- **Polyethylene glycol PO** and/or **Docusate** to prevent constipation

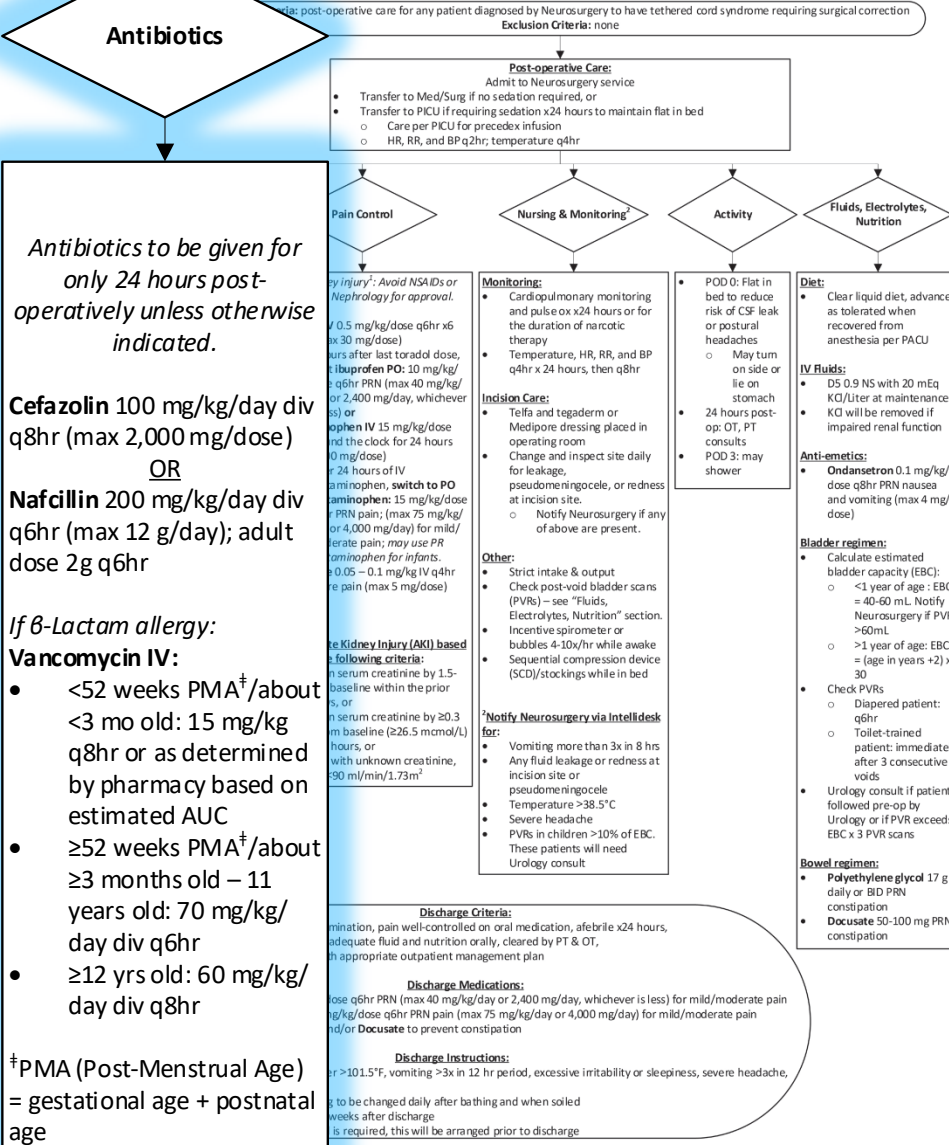
### Discharge Instructions:

- Call Neurosurgery for fever >101.5°F, vomiting >3x in 12 hr period, excessive irritability or sleepiness, severe headache, consistent change in gait
- Tegaderm & telfa dressing to be changed daily after bathing and when soiled
- Follow up outpatient 2-3 weeks after discharge
- If sedated suture removal is required, this will be arranged prior to discharge

Standardized care for these patients includes five different categories.

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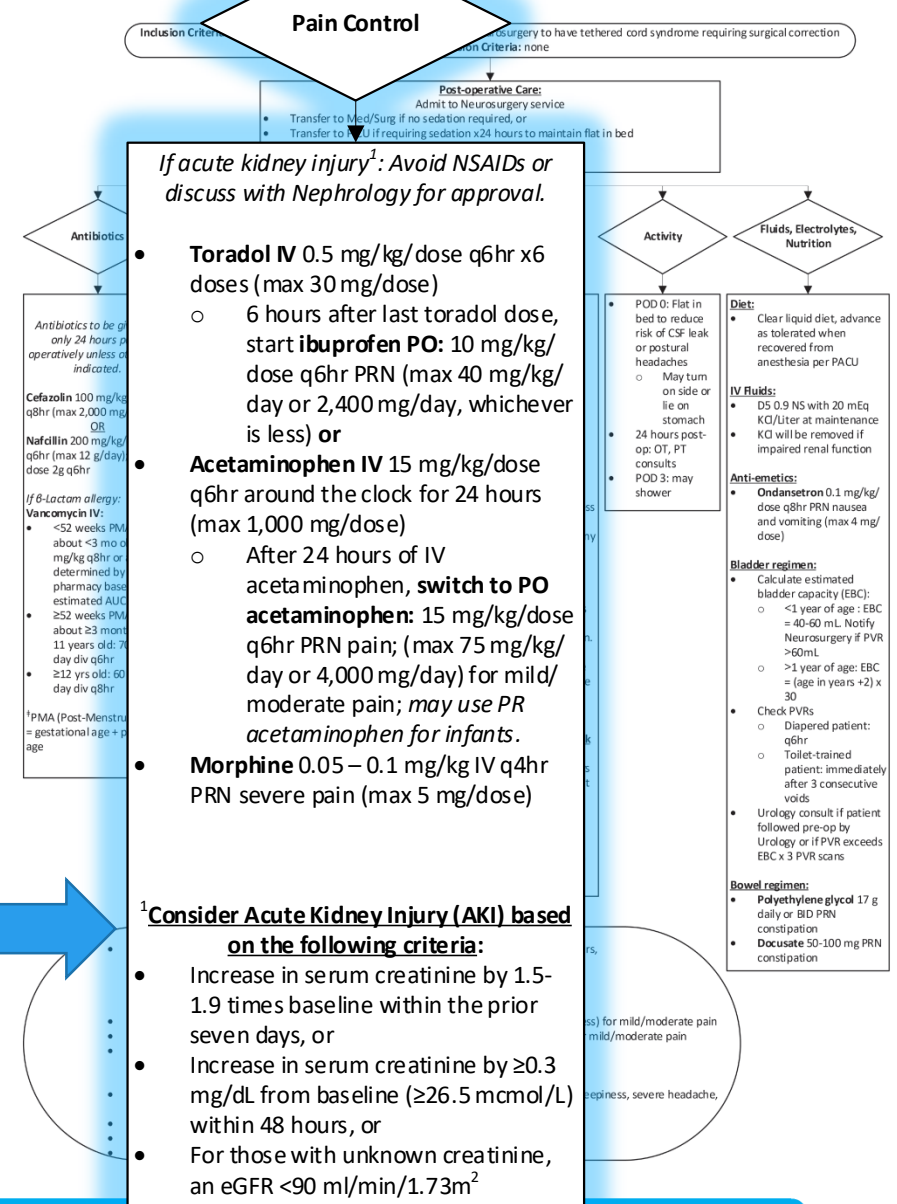
All children will receive antibiotics for the first 24 hours post procedure.

- There is no indication for routine administration of antibiotics beyond 24 hours.

NSAIDs, such as Toradol, are an important part of post operative pain management.

- Children with known renal impairment should only get NSAIDs after discussion with Nephrology

Note: the definition of AKI has been updated and is available at the bottom of the box.



**Nursing & Monitoring<sup>2</sup>**

Post-operative care for any patient diagnosed by Neurosurgery to have tethered cord syndrome requiring surgical correction  
**Exclusion Criteria:** none

**Monitoring:**

- Cardiopulmonary monitoring and pulse ox x24 hours or for the duration of narcotic therapy
- Temperature, HR, RR, and BP q4hr x 24 hours, then q8hr

**Incision Care:**

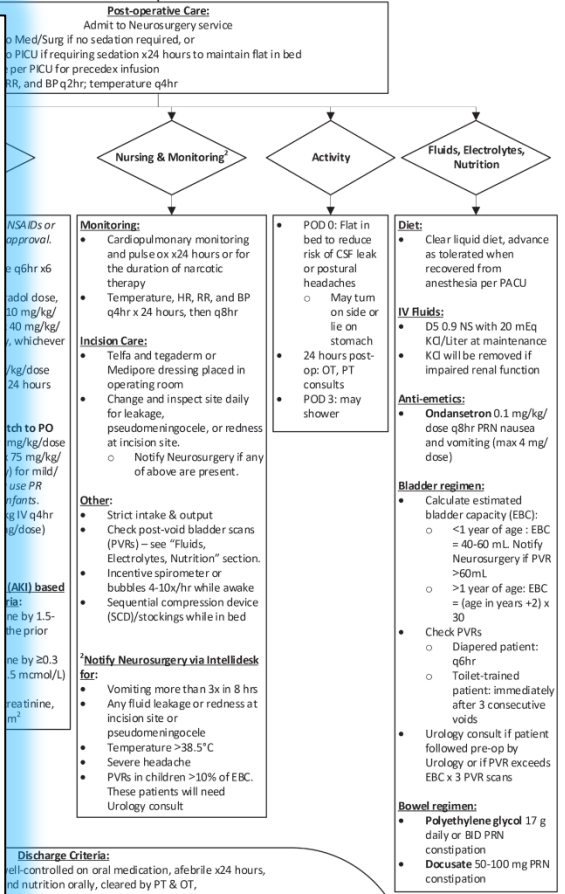
- Telfa and tegaderm or Medipore dressing placed in operating room
- Change and inspect site daily for leakage, pseudomeningocele, or redness at incision site.
  - Notify Neurosurgery if any of above are present.

**Other:**

- Strict intake & output
- Check post-void bladder scans (PVRs) – see “Fluids, Electrolytes, Nutrition” section.
- Incentive spirometer or bubbles 4-10x/hr while awake
- Sequential compression device (SCD)/stockings while in bed

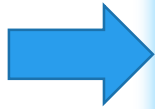
**<sup>2</sup>Notify Neurosurgery via Intellidesk for:**

- Vomiting more than 3x in 8 hrs
- Any fluid leakage or redness at incision site or pseudomeningocele
- Temperature >38.5°C
- Severe headache
- PVRs in children >10% of EBC. These patients will need Urology consult



Nursing care includes both routine vital sign monitoring, incentive spirometry, and venous thrombo-embolism (VTE) prevention.  
The surgical incision should be closely monitored.

**\*\*Neurosurgery should be notified of any fluid leakage from the incision\*\***



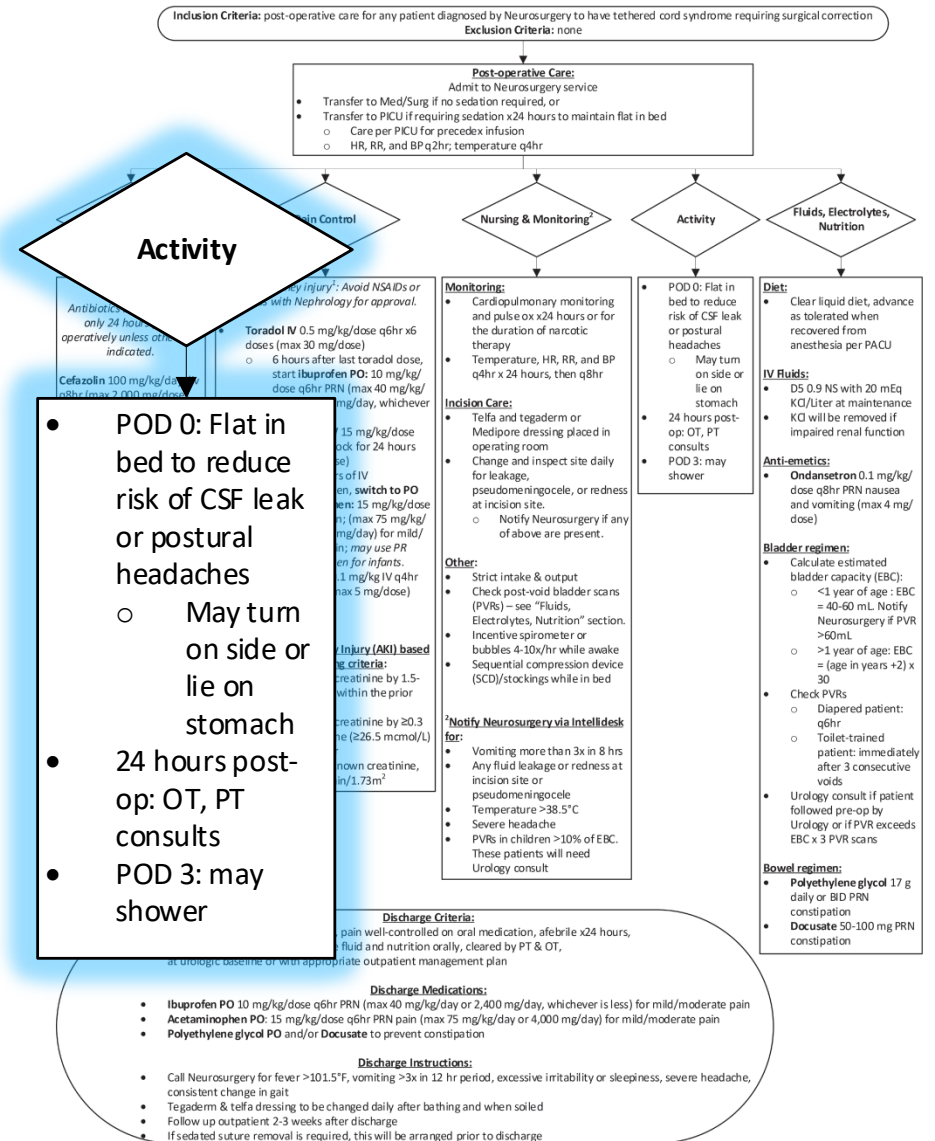
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Patients will be on bedrest with the bed flat for the first 24 hours after surgery.

- Once patient is allowed to sit up, RN should evaluate for headaches. If a patient experiences a severe headache, they should return to having the head of bed (HOB) flat then gradually increase the HOB over several hours.

Early PT and OT consults are important to help reduce the risk of complications that may result from immobility.



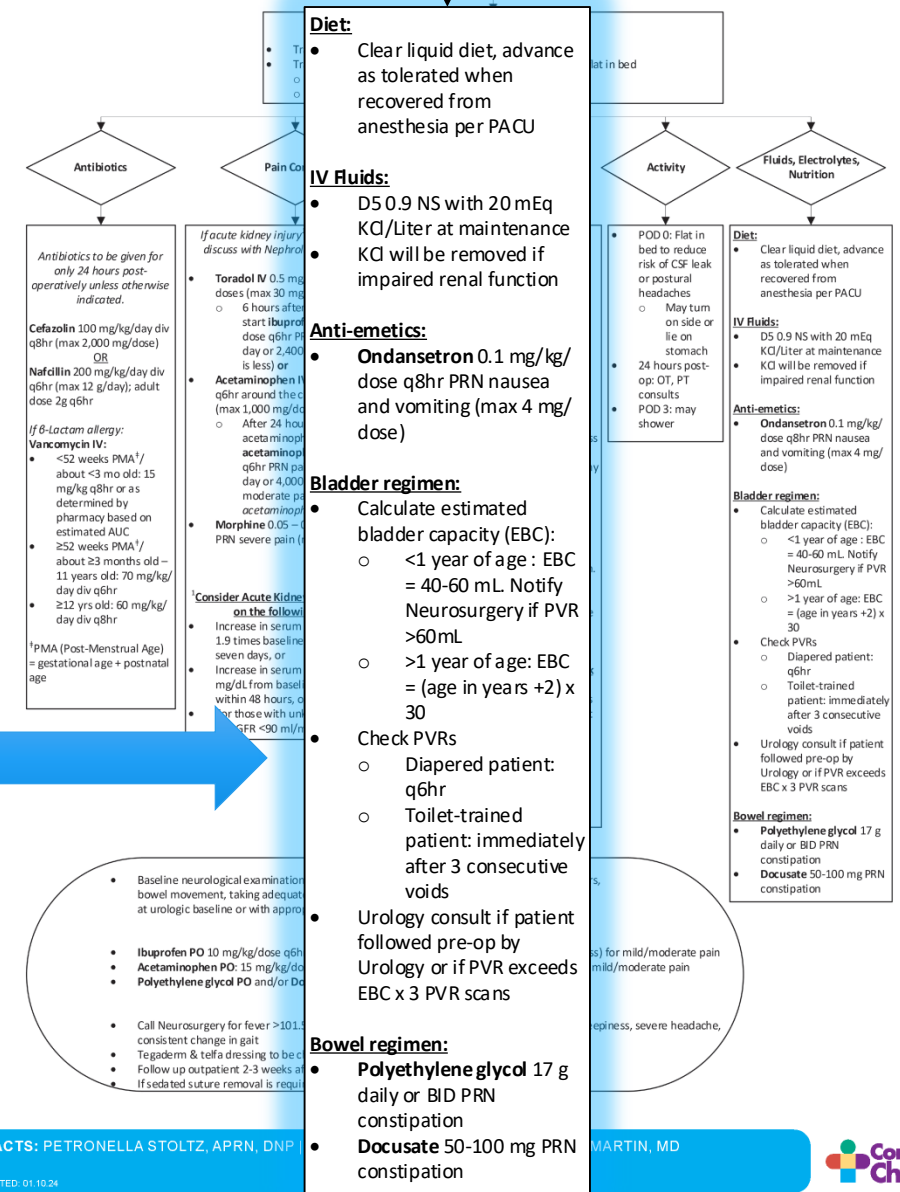
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Fluids, Electrolytes, Nutrition

Inclusion Criteria: post-operative care for any patient diagnosed with Tethered Cord Syndrome requiring surgical correction  
 Exclusion Criteria: none



Children will come out of the OR with a foley catheter in place. Once the foley catheter is removed, post void residuals (PVR) need to be checked and documented in the medical record.

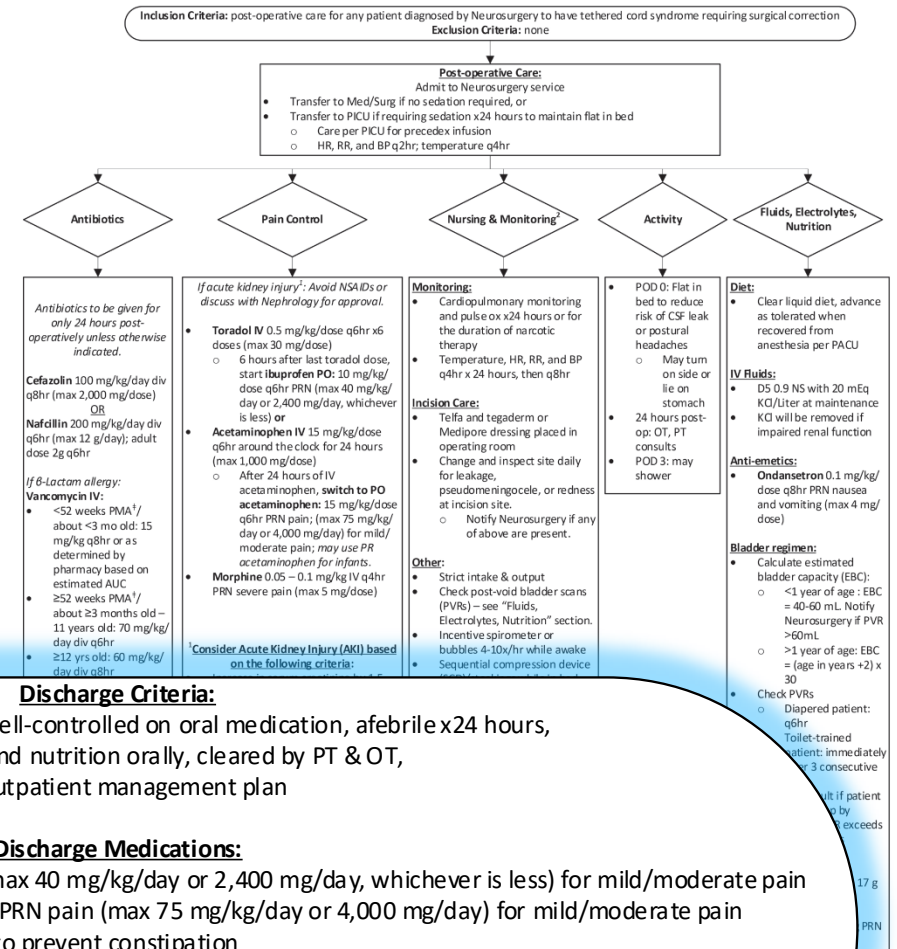
- Patients with PVR greater than 10% of their estimated bladder capacity will need a urology consult
- Urology is also consulted for patients with preexisting bladder dysfunction

Other things to note related to Fluids, Nutrition, and Electrolytes:

- Bowel regimen is initiated immediately post op

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Children criteria, medications and instructions (including when to call neurosurgery once discharged) are clearly outlined.

- Baseline neurological examination, pain well-controlled on oral medication, afebrile x24 hours, bowel movement, taking adequate fluid and nutrition orally, cleared by PT & OT, at urologic baseline or with appropriate outpatient management plan

### Discharge Medications:

- Ibuprofen PO** 10 mg/kg/dose q6hr PRN (max 40 mg/kg/day or 2,400 mg/day, whichever is less) for mild/moderate pain
- Acetaminophen PO:** 15 mg/kg/dose q6hr PRN pain (max 75 mg/kg/day or 4,000 mg/day) for mild/moderate pain
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# Review of Key Points

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- If patient requires Precedex then patient requires admission to PICU
- No BLOOD WORK required for patient post operatively unless unstable
- Pain Control
- Antibiotics x 24 hours
- Notify NS attending for any bleeding, instability or wound drainage immediately
- PVR are essential once foley is out
- If PVR are significant (see algorithm in pathway) Urology consult is indicated



# Use of Order Set

Order Sets

Orders

Order Sets

Admit to MS - Post Op Tethered Cord Personalize

General

ADT

- Transfer patient- Different Level of Care/Different Floor
- Return To Bed - Same Level of Care/Same Room  
Effective Immediately

Pathway

- Initiate Clinical Pathway: Tethered Cord  
Until discontinued, starting today at 1409, Until Specified  
Post-op, Sign & Hold

Nursing

Vital Signs

- Vital signs-TPR, BP and O2 sats  
Routine, Every 4 hours, First occurrence today at 1600, Until Specified  
Post-op, Sign & Hold
- Vital signs-TPR, BP and O2 sats  
Every 2 hours, Post-op
- Cardiorespiratory monitoring  
Routine, Continuous, starting today at 1409, Until Specified  
Post-op, Sign & Hold
- Pulse oximetry  
Routine, Continuous, starting today at 1409, Until Specified  
Post-op, Sign & Hold

Activity

- Activity, strict bed rest  
Until discontinued, starting today at 1409, Until Specified  
Post-op, Sign & Hold
- Head of bed flat x 24 hours  
Until discontinued, starting today at 1409, Until Specified  
Post-op, Sign & Hold

The Post-Op Tethered Cord Order set should be used for all patients who are post procedure. It will help ensure that all pathway elements are ordered correctly.

Order sets also help track pathway usage and pathway metrics.

\*NOTE: This order set is not to be used for PICU patients. Patients going to the PICU post operatively should use the PICU – Neurosurgery Order Set instead

# Quality Metrics

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- Percentage of patients with pathway order set usage
- Percentage of patients with deep wound infections
- Percentage of patients with superficial skin infections (SSI)
- Number of patients with organ space infection within 30 days of principal operative procedure
- Readmission within 30 days
- Return to the OR within 30 days

# Pathway Contacts

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- Petronella Stotlz, APRN, DNP
  - Department of Pediatric Neurosurgery
- Marcus Bookland, MD
  - Department of Pediatric Neurosurgery
- Jonathan Martin, MD
  - Department of Pediatric Neurosurgery

# References

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- Bowman RM, Mohan A, Ito J, Seibly JM, McLone DG. [Tethered cord release: a long-term study in 114 patients](#). *J Neurosurg Pediatr*. 2009 Mar;3(3):181-187.
- Yamada S, Won DJ, Pezeshkpour G, et al. [Pathophysiology of tethered cord syndrome and similar complex disorders](#). *Neurosurg Focus*. 2007;23(2):E6.
- Bratzler DW, Dellinger EP, Olsen KM, et al. [Clinical practice guideline for antimicrobial prophylaxis in surgery](#). *Sur Infect (Larchmt)*. 2013 Feb;14(1):73-156.

# Thank You!



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## About Connecticut Children's Pathways Program

Clinical pathways guide the management of patients to optimize consistent use of evidence-based practice. Clinical pathways have been shown to improve guideline adherence and quality outcomes, while decreasing length of stay and cost. Here at Connecticut Children's, our Clinical Pathways Program aims to deliver evidence-based, high value care to the greatest number of children in a diversity of patient settings.

These pathways serve as a guide for providers and do not replace clinical judgment.