**Pectus Excavatum (Nuss) v.1**

**Intraoperative Management**

**Anesthesia and pain management**
- Standard anesthesia procedures
- Label soaker catheters and prime with bupivacaine

**Infection prevention**
- Double glove
- Ioban drape
- Irrigate wounds with Betadine® solution
- Perioperative antibiotics
  - Cefazolin
  - Clindamycin if allergic
  - Vancomycin if MRSA

**Postoperative Management**

**ADMIT** to surgical floor from PACU
- Chest X-ray in PACU to assess for pneumothorax

**ACTIVITY**
- Showering ok on POD2
- POD1 out of bed to chair. POD2 ambulate goal is 3-4 times per day in halls, minimum of 2 times per day (bathroom does not count)

**NURSING**
- Temperature, heart rate, respiratory rate, pain assessment q 4 hours, pulse oximetry
- Cardiorespiratory monitor until continuous IV opioid are discontinued
- Strict I/O
- Attach soaker catheter in PACU
- Diet: ad lib
- Incentive spirometry q 1 hour while awake
- Foley catheter for urinary retention x 24 hours
- Continue SCD (age ≥16 years) until ambulating
- Place sign above bed: Do not lift, no arm lift, 2 person assist, no log roll

**MEDICATIONS**
- Continue perioperative antibiotics x 2 doses
- Ranitidine twice daily while on ibuprofen
- Docusate to start on POD #1, bisacodyl enema as needed if no bowel movement by POD #4

**Pain**
- Soaker catheter with bupivacaine. If not adequate, consider PCA with morphine until tolerating PO
- Ketorolac IV scheduled x 72 hours (unless contraindicated)
- **POD #3:** start oral pain medicines. Clamp soaker catheter in AM, wait 4 hours and remove if pain score <3
  - Oxycodone short acting (no long-acting), as needed
  - Acetaminophen/ibuprofen alternating, scheduled

**Home pain meds**
- Oxycodone short acting (no long-acting), as needed
- Acetaminophen/ibuprofen alternating, as needed

**Thrombosis prevention**
- Sequential compression device (SCD) if age 16 years or older, prior to induction

**Safety Precautions**
- Sternal saw available and open on the field to assure proper function

**Other**
- Dictation must clearly state number of bars and which side stabilizer is placed
- Write General Surgery Pectus Repair Plan admit orders prior to patient transfer out of the O.R.

**Discharge Criteria**
- No increased incision redness or pain
- Afebrile
- Pain adequately controlled without IV meds
- Tolerates diet without emesis
- Urine output >=0.5 mL/kg/hr
- Ambulating
- Stooling

**Discharge Instructions**
- PE540 Pectus Excavatum
- PE1453 Pain Medicine Log
- PE433 Constipation After Surgery

**Inclusion Criteria**
- Patient age 12 years to adult with Pectus Excavatum requiring repair

**Exclusion Criteria**
- None
**Intraoperative Management**

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**Postoperative Checklist**

1. Perioperative antibiotic given?
2. Double gloving performed?
3. Ioban drape used?
4. Povidone iodine (Betadine) washout performed?
5. Are labels attached to soaker catheters bilaterally, and catheters primed with bupivacaine?
1. The optimal timing for surgery for Pectus Excavatum repair is 12-17 years of age while the chest wall is still malleable (adults (over 21) will need formal approval). However, repair at a younger age is appropriate in the setting of severe cardiac or pulmonary compression with associated signs of physiologic impairment.

2. Carefully and accurately dictate history and symptoms with regard to exercise, especially aerobic exercise intolerance:
   a. How far can youth run
   b. Can they keep up with their peers
   c. Key on aerobic events such as long distance running (more than 1 mile), soccer and basketball. Be aware that anaerobic activity (sprints, weight lifting) will usually NOT demonstrate the symptoms.

3. Referral if Marfan Syndrome suspected:
   a. Cardiology for potential ECHO
   b. Ophthalmology
   c. Genetics if Marfan Syndrome proven from either a or b above

4. If allergy suspected by history, outpatient trial with nickel

5. Pre-op testing:
   a. Chest CT scan to measure Haller index
   b. Cardiopulmonary exercise test (questionable correlation as current SCH test is an anaerobic test on treadmill with increase tilt until failure)
   c. EKG (optional), if symptoms consistent with ectopy. May be indicated to rule out other problems. (RAD is uniformly present: irrelevant finding.)
   d. Echocardiogram (optional)
      i. Should obtain if Marfan Syndrome (aortic root, AV)
      ii. May be indicated to rule out other anomalies
      iii. Poor correlation when performed at rest
   e. Pulmonary Function Tests have been eliminated

6. Surgical chest wall reconstruction is indicated for patients with a severe pectus excavatum deformity and associated physiologic impairment. Specific inclusion criteria include two or more of the following:
   a. Computed tomography (Haller) index greater than 3.25 (normal approx 2.80) with associated cardiac or pulmonary compression. An index greater than 3.25 is considered severe.
   b. Cardiology evaluation demonstrating cardiac compression, displacement, mitral valve prolapse, or murmurs.
   c. Documentation of progression of the deformity with advancing age in association with development of or worsening of physiologic symptoms (i.e. shortness of breath, lack of endurance, exercise intolerance, palpitations, and chest pain).

National and local expert opinion (Frantz 2011)
Pneumothorax

- Small pneumothorax:
  - Almost universal
  - Follow-up chest x-ray unnecessary

- Large pneumothorax, consider:
  - Consider chest tube placement
  - Supplemental oxygen for O2 sats $<92$
  - Repeat chest x-ray on day of discharge

_Evidence [expert opinion]_
Pain Management: Postoperative Day 3

- Start oral pain meds EARLY if not already on them
- Discontinue other IV pain meds
- Remove soaker catheter if pain well-managed
  - Clamp soaker catheter in AM, wait 4 hours and remove if pain score <3

*Evidence [expert opinion]*
Objective
Identify, design and implement CSW processes to ensure safe high quality care, eliminate or reduce re-work and improve the cost effectiveness of care provided to patients undergoing Pectus Excavatum surgery.

To achieve this objective, a Pectus PowerPlan will be produced with day of surgery pre-op, PACU, post op (inpatient orders) with regular pain protocol, post op with alternative pain protocol, and discharge.

Recommendations
1. Infection prevention includes double-gloving, loban drape, wound irrigation with povidone iodine, and perioperative antibiotics
2. Postoperative pain management includes bupivacaine via primed wound soaker catheter
3. Pain management and constipation prevention are standardized

Rationale
- **Safety** will improve by:
  - Reducing surgical site infections through use of, and tracking of standard preventive measures (Patient Safety Checklist)
  - Implementing a system driven reliable method for selection of appropriate orders by providers (residents, fellow and faculty)
  - Align content of Depart (Discharge) process, preoperative education, and patient education materials
- **Quality** will improve by:
  - Standardized orders within the PowerPlan will reduce unintended variability in orders, care and instructions.
  - Families will experience a reliable and consistent care path for the inpatient stay
- **Delivery** will be improved by:
  - Improved efficiency throughout the post-op, inpatient, and discharge care processes.
  - Improved efficiency in the operating room through standardization of preference cards
- **Engagement** will be improved by:
  - Highly experienced Surgery leadership, faculty commitment and participation in development and implementation of this pathway.
  - Surgical nurse and Surgical Tech involvement and support for the pathway improvements.
- **Patient/Family Satisfaction** will be improved by:
  - Standardization of pain management
  - Improved and consistent process and messaging from all care providers (faculty and nurses).
Pectus Excavatum (Nuss): Executive Summary

- Utilizing standardized printed documents during day of surgery pre-op, PACU, post op (inpatient orders) with regular pain protocol, post op with alternative pain protocol, and discharge.
  - Costs will be reduced by:
    - Decreased re-work
    - Reduced non-operative time
    - Efficiency in discharge process

Evidence
This pathway is based on one systematic review and one review.

Implementation Items
- New powerplan and Patient Safety Checklist featuring enhanced and updated orders
- Favorites folder pre-populated with approved medications, dosage and instructions
- Improved ClinDoc Depart functionality with Pectus discharge instructions and patient education materials
- Updated guideline of care for Pectus Excavatum
- Updated operative preference card

Metrics Plan
1. Count of inpatient/observation discharges
2. Median Length of Stay
3. % of patients with any of the specified orderset
4. Average charges per case
5. Readmission
6. Pain scores
7. Completion of checklist

PDCA Plan
We will plan to transition to improvement after the new pathway is stabilized.

Revision History
Date Approved: May 2013
Next Review Date: May 2016
Pectus Excavatum (Nuss): Executive Summary

CSW Owner: John Meehan, MD, CSW Owner and the Clinical Effectiveness Program

Approved by the Pectus Excavatum (Nuss) Clinical Standard Work (CSW) Team May, 2013.

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Return to Home
We used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial, or observational studies. The rating is then adjusted in the following manner:

Quality ratings are *downgraded* if studies:
- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings can be *upgraded* if it is felt that:
- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

**Quality of Evidence:**
- ★★★★★ High quality
- ★★★★ Moderate quality
- ★★★☆ Low quality
- ★★☆☆ Very low quality
- ★☆☆☆ Very low quality

Expert Opinion (E)

Summary of Version Changes

- **Version 1 05/22/2013**: Go live
Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children’s Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.
Literature Search Strategy:

Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian. Searches were performed on November 14 & 15, 2012 in the following databases: on the Ovid platform – Medline (1946 to date), Cochrane Database of Systematic Reviews (2005 – June 2011); elsewhere – Embase, National Guidelines Clearinghouse, Clinical Evidence, and TRIP. Retrieval was limited to literature from 1995-forward. There were no age or language restrictions included. As per the owners request, the search was focused on pectus excavatum (or the nuss procedure) specifically. In Medline, appropriate Medical Subject Headings (MeSH) were used, along with text words, and the search strategy was adapted for other databases using their controlled vocabularies, where available, along with text words. Owner assisted with identifying appropriate MeSH. Only synthesized, high levels of evidence were included. Scout Search publication limits of consensus development, guidelines, meta-analyses, and practice guidelines were used. Additional MeSH publication headings of critical pathways, clinical protocols, guidelines as topic, and practice guidelines as topic were also included. Systematic reviews as a title word rounded out the publications search.

Jamie Graham
January 17, 2013

Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535