Pyloric Stenosis v4.0: Emergency Department

Inclusion Criteria
- Infants < 6 months old with progressive nonbilious emesis

Exclusion Criteria
- Concern for sepsis
- Bilious emesis

Evaluation by ED fellow or attending
- Assess volume status and NPO

Euvolemic / Mildly Dehydrated Infants
- (For more info on dehydration, see Acute Gastroenteritis pathway)

Pyloric U/S
Results confirmed by fellow or attending radiologist

Positive Ultrasound = pyloric muscle thickness > 3.5 mm
- Check electrolytes, glucose
- Consider bilirubin if infant appears jaundiced
- Bolus with NS @ 20 mL/kg
- Following bolus – start D5 ½ NS + 20 mEq KCl/L @ 150 mL/kg/day (add K+ only after urine output established)

Inpatient

Moderately / Severely Dehydrated Infants

D10W 5 mL/kg
Glucose < 60
If glucose still < 60
15 minutes after bolus, recheck glucose

Off Pathway

Negative Ultrasound

Negative Ultrasound

Positive Pyloric U/S
Results confirmed by fellow or attending radiologist

Positive Ultrasound = pyloric muscle thickness > 3.5 mm
- Surgical consult
- NG tube placement of 10 French Replogle to low intermittent wall suction
Admit to Surgery Service
Pyloric Stenosis v4.0: Inpatient Management

**Preoperative Management**
- Continue D5 ½ NS with 20 mEq KCl/L @ 150 mL/kg/day (add K+ only after urine output established)
- If bicarbonate is ≥ 30 mEq/L, K < 3 mEq/L, or Cl < 90 mEq/L, continue resuscitation and repeat electrolytes
- Consider bilirubin if infant appears jaundiced

**Perioperative Management**
- Gastric decompression by anesthesiologist with large bore orogastric tube in OR prior to induction
- Give pre-op dose of IV cefazolin unless allergies exist
- Repair as per surgeon preference (supra-umbilical, RUQ incision, laparoscopic)
- If duodenotomy, NPO x 24 hours advance directly to pyloric feeding regimen

**Postoperative Management: Ad Lib Feeding**
- NPO x 4 hours
- IV + PO fluids: D10 ½ NS with 20 mEq KCl/L @ 100mL/kg/day
- Initiate ad lib bottle feeds of full-strength breast milk or formula 4 hours following pyloromyotomy for pyloric stenosis
- If clinically significant emesis, wait 2 hours followed by ad lib bottle feeds of full-strength breast milk or formula
- If ad lib feeding fails twice, due to repeat emesis, follow pyloric feeding regimen

**Discharge Criteria**
- No incision redness or pain
- Temp less than 38 C for last 12 hours
- Pain controlled without IV meds > 4 hours
- Pain score < 3 for 4 hours
- Tolerates 2 feeds of 50 mL without emesis
- Urine output 1 mL/kg/hour
- Minimum 12 hours hospitalization post-op

**Discharge Instructions**
- Pyloric Stenosis Care (PE 169)
- PCP follow-up 1 to 3 days after discharge for weight check

**Postoperative Management: Pyloric Feeding Regimen**
- Start with Pedialyte 30 mL Q2H x 2
- Full strength formula or breast milk 30 mL Q2H x 2
- Full strength formula ad lib, breast milk, or breast-feeding; advance as tolerated to ad lib feeds
- If clinically significant emesis, withhold feeds for 2 hours and restart at level prior to emesis

**persistent clinically significant emesis vomiting** (half of the estimated volume of previous feeds)

**For questions concerning this pathway, contact: PyloricStenosis@seattlechildrens.org**

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Last Updated: January 2020
Next Expected Review: January 2025
Pyloric Stenosis: Evaluation

Presentation often includes one or more classic symptoms/signs including (DynaMed 2018)
- Projectile/forceful nonbilious vomiting
- Viable peristalsis after feeding
- Palpable “olive” mass in abdomen

Based on a retrospective review of 329 infants with pyloric stenosis in Australia, 87% of infants presented with one or more classic symptoms/signs, and 14% of infants presented with all 3.

Possible signs of dehydration (DynaMed 2018)
- Acute loss of body weight
- Poor mucous membrane hydration
- Sunken fontanelles
- Decreased capillary refill time
- Absence of tears

Lab tests to assess for complications (DynaMed 2018)
- Electrolytes to assess for dehydration, hypokalemia, hypochloremia, metabolic alkalosis, paradoxical aciduria
- Bilirubin (if jaundice)

Imaging (Expert opinion)
- Use pyloric stenosis ultrasound to confirm diagnosis (pyloric muscle thickness > 3.5 mm)

Operative Readiness (Expert opinion)
- Bicarbonate < 30 mEq/L
- Potassium > 3 mEq/L
- Chloride > 90 mEq/L

Pyloric Stenosis: Treatment

Perform pyloromyotomy in patients with pyloric stenosis.

CLOSED VS OPEN PYLOROMYOTOMY
Laparoscopic pyloromyotomy was compared to open pyloromyotomy in 4 RCTs (n = 502 participants).

- Laparoscopic surgery may reduce time to full feeds, but the evidence is very uncertain, MD -0.25 hours (95% CI: -0.43 to -0.06)
- Laparoscopic pyloromyotomy may have no effect on major complications (defined as life threatening or required an additional surgical procedure over an unspecified time period) but the evidence is very uncertain [event rates 1.96% versus 4.85% (absolute risk difference 3%, 95% CI: -3% to 8%)]
- Laparoscopic pyloromyotomy may have no effect on major complications (defined as life threatening or required an additional surgical procedure over an unspecified follow-up period) but the evidence is very uncertain [2.60 hours (95% CI: -6.05 to 0.86)]

These outcomes are downgraded for the following reasons: Risk of bias (In 100% of studies there were serious issues with randomization, allocation concealment, blinding of participants and assessors, incomplete outcome data, selective outcomes reporting) and Imprecision (the small sample size of the included studies increased the risk of type II error). [Level of Evidence (LOE): +1 Very low certainty (Sathya 2017)].

ATROPINE VS PYLOROMYOTOMY
Consider atropine as an alternative in patients who have chronic medical conditions who would not tolerate anesthesia or surgical intervention.

Atropine 0.05-0.18 mg/kg/day was compared to pyloromyotomy in 5 cohort studies (n = 856 participants) to evaluate persistency of hypertrophic pyloric stenosis over an unspecified follow-up period. There was less failure among patients undergoing pyloromyotomy compared to those receiving atropine [event rates 0% versus 19.23%, RR 17.32 (95% CI: 4.45 to 67.52)]. The NNTB is 5.2. Assuming a control group event rate of 0%, for every 5.2 patients given atropine instead of pyloromyotomy one additional patient would experience failure. This outcome is downgraded for the following reasons: The authors did not evaluate the included studies for risk of bias. Time to follow-up was not reported. [Level of Evidence (LOE): +1 Very low certainty (Lauriti 2018)].
Pyloric Stenosis: NG Tube and Feeding Protocol

DECOMPRESSIVE NG TUBE
Place decompressive NG tube (10 French Replogle) in patients awaiting surgery as early as possible, ideally in the emergency department, to decrease aspiration risk during surgery. Place NG tube to low intermittent wall suction. (Expert opinion)

Return to ED Phase

FEEDING PROTOCOL
After surgery, continue ad lib feeding. If patient fails ad lib feeds and is changed to pyloric feeding regimen, start at 30 mL Q2H x 2 feeds of Pedialyte, then full strength formula or breast milk 30 mL Q2H x 2 feeds, and then advance as tolerated to ad lib feeds (45 mL feeds removed as of version 4.0 of this pathway).

Gradual vs Rapid Feeding
Gradual feeding may reduce length of stay compared to rapid feeding may reduce length of stay but the evidence is very uncertain [MD 22.05 hours (95% CI: 2.18 to 41.93) in 2 RCT and cohort studies (n=272 participants)]. There may be less emesis with gradual feeding (odds ratio 0.36, 95% CI 0.13 to 1.03, in 4 studies). These outcomes are downgraded for the following reasons: Most studies were assessed to have an inadequate control group, <2000 total patients in study, the point estimates vary widely across studies. [Level of Evidence (LOE): +1 Very low certainty (Sullivan 2015)].

Ad Libitum vs Structured Feeding
Ad libitum feeding may reduce length of stay compared to structured feeding but the evidence is very uncertain [(MD -4.66 (95% CI: -8.38 to -0.95), 6 RCT and cohort studies (n = 922 participants)]. Structured feeding (vs ad lib feeding) was may have no effect on likelihood of emesis sis (odds ratio 2.02, 95% CI 0.82 to 5.01, 3 studies) or number of episodes of emesis per patient [mean difference 0.44 episodes per patient, 95% CI -0.47 to 1.35, 3 studies (372 participants), but the evidence is very uncertain. These outcomes are downgraded for the following reasons: Most studies were assessed to have an inadequate control group, <2000 total patients in study, the point estimates vary widely across studies. [Level of Evidence (LOE): +1 Very low certainty (Sullivan 2015)].

Early vs Late Feeding
Early feeding (within 4 hours after surgery) may have no effect on length of stay compared to late feeding but the evidence is very uncertain [MD -12.07 hours (95% CI: -32.46 to 8.31), 4 RCT and cohort studies (n=974 participants)]. Early feeding may increase postoperative emesis (odds ratio 3.13, 95% CI 2.26 to 4.35, 6 studies) and have no effect on number of emesis episodes per patient [0.31 (95% CI -1.44 to 2.07), 2 studies (736 participants)], but the evidence is very uncertain. These outcomes are downgraded for the following reasons: Most studies were assessed to have an inadequate control group, <2000 total patients in study [Level of Evidence (LOE): +1 Very low certainty (Sullivan 2015)].

Return to IP Phase
Approved by the CSW Pyloric Stenosis Pathway team for January 30, 2020, go-live

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Retrieval Website:  http://www.seattlechildrens.org/pdf/pyloric-stenosis-pathway.pdf

Please cite as:
Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children’s. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94, Hultcrantz M et al. J Clin Epidemiol. 2017;87:4-13.):

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 are *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

**Certainty of Evidence:**
- 🌟🌟🌟🌟 High: The authors have a lot of confidence that the true effect is similar to the estimated effect
- 🌟🌟🌟 Moderate: The authors believe that the true effect is probably close to the estimated effect
- 🌟🌟 Low: The true effect might be markedly different from the estimated effect
- 🌟 Very low: The true effect is probably markedly different from the estimated effect

**Guideline:** Recommendation is from a published guideline that used methodology deemed acceptable by the team

**Expert Opinion:** Based on available evidence that does not meet GRADE criteria (for example, case-control studies).
Summary of Version Changes

- **Version 1.0 (7/26/2012):** Go live.
- **Version 1.1 (8/13/2014):** Changed bicarbonate to ≥ 30. Added citation information.
- **Version 2.0 (1/8/2015):** Changed to reflect the discontinued pre-operative readiness checklist.
- **Version 3.0 (5/24/2016):** Changed to reflect specific, time-defined discharge criteria. Changed from abdominal U/S to pyloric U/S.
- **Version 4.0 (1/30/2020):** Periodic review go live. Updated warning for bilious emesis. Added additional information for dehydration, electrolytes, positive pyloric US. Updated NG tube placement. Removed timing for repeating electrolytes under Preoperative Management. Updated pyloric feeding regimen, especially removing feeds for 45 mL of full strength formula. Updated discharge instructions.
Medical Disclaimer

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 Methods:
For this update, we revised the search strategies in line with current Library practices. The literature search was conducted in June 2019. The search targeted synthesized literature on pyloric stenosis, pyloromyotomy or any surgical procedures of the pylorus or pyloric canal and was limited to English for 2012-current. The search was executed in Ovid Medline, Embase, Cochrane Database of Systematic Review (CDSR), and Turning Research into Practice database (TRIP).

Screening and data extraction were completed using DistillerSR (Evidence Partners, Ottawa, Canada). Two reviewers independently screened abstracts and included guidelines and systematic reviews that addressed optimal diagnosis, treatment, and prognosis of patients who meet pathway inclusion/exclusion criteria. One reviewer screened full text and extracted data and a second reviewer quality checked the results. Differences were resolved by consensus.

Literature Search Results:
The searches of the 4 databases (see Electronic searches) retrieved 156 records. Once duplicates had been removed, we had a total of 126 records. We excluded 115 records based on titles and abstracts. We obtained the full text of the remaining 11 records and excluded 8. The flow diagram summarizes the study selection process.

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