Peri-Operative Thyroidectomy Management

Nordie Bilbao, MD
Nancy Dunbar, MD
James Healy, MD

Connecticut Children's

What is a Clinical Pathway?

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

Objectives of Pathway

- To provide a standardized approach for calcium management of patients undergoing thyroidectomy
- To improve patient outcomes by early identification and treatment of patients at risk for hypocalcemia due transient or permanent hypoparathyroidism and/or background vitamin D deficiency
- To minimize amount of unnecessary laboratory testing, medication use and length of hospitalization, therefore decreasing medical costs

Why is Pathway Necessary?

- Hypocalcemia secondary to hypoparathyroidism is the most common post-operative complication following thyroid surgery. Biochemical hypoparathyroidism is defined as an inappropriately low intact PTH relative to the serum calcium.
- Hypocalcemia lags behind hypoparathyroidism by hours. Early testing of PTH can help identify patients at risk of hypocalcemia.
- Utilizing a clinical pathway enables clinicians to improve calcium management in thyroidectomy patients, avoid severe hypocalcemia and use of IV calcium, unnecessary testing and treatment, which could potentially increase cost savings.

Background

- Hypocalcemia is one of the most common complications of thyroidectomy and could lead to prolonged length of hospitalization. Vitamin D deficiency is associated with an increased risk of postoperative hypocalcemia (1).
- Preoperative vitamin D levels can predict the need for 1,25-dihydroxyvitamin D_3 therapy in hypocalcemic subjects (2). Vitamin D replacement before thyroidectomy may improve postsurgical outcomes in Vitamin D deficient patients.

Background Continued

- Several studies have shown that post-thyroidectomy PTH levels accurately predict hypocalcemia (3,4,5). A single PTH measurement taken any time from 10 min to several hours postoperative will provide equally accurate results for predicting post-thyroidectomy hypocalcemia (3).

- A low PTH level can used to implement early treatment with calcium and/or vitamin D supplements to reduce the incidence and severity of hypocalcemia.

- PTH can be also used to facilitate patient discharge because progressive and severe hypocalcemia is unlikely in the setting of a normal PTH level.

Background Continued

- Postoperative calcium supplementation is effective for preventing post-thyroidectomy hypocalcemia.

- Calcium plus vitamin D (calcitriol) is more effective than calcium alone in preventing postoperative hypocalcaemia and decreasing the demand for intravenous calcium supplementation (6).

This is the Peri-Operative Thyroidectomy Management Clinical Pathway.

We will be reviewing each component in the following slides.

CLINICAL PATHWAY:

Peri-Operative Thyroidectomy Management

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

Inclusion Criteria: Patients having a total thyroidectomy OR partial thyroidectomy with post-op PTH ≤ 20 pg/mL
Exclusion Criteria: Patients not having a thyroidectomy

Within 3 Months Prior to Surgery

- Surgery or Endocrinology team to order labs: Intact PTH with ionized calcium (ical), total calcium, albumin, 25-OH vitamin D, phosphorus, magnesium
- Surgery or Endocrinology team to start vitamin D based on serum 25-OH vitamin D level:
  - < 10 ng/mL: Contact on-call endocrinologist for recommendations
  - 11-20 ng/ml: give one time dose of vitamin D2 50,000 IU orally, then maintenance of vitamin D3 2,000 IU daily
  - 21- 30 ng/mL: give maintenance dose of vitamin D3 2,000 IU daily
    *note: vitamin D is fat-soluble and should be given with a meal to maximize absorption
- Surgery team (OR scheduler) to contact Endocrine nurses through Epic in-basket (p_endo_results_triage) with patient name and date of surgery

Thyroidectomy performed at Connecticut Children's

Immediate post-op in PACU

- Surgery team to order STAT intact PTH with ical 20-60 minutes after surgery with note in specimen bag stating "From Connecticut Children's OR"
- Obtain total calcium, albumin, 25-OH vitamin D, phosphorus, and magnesium
- Please call on call Endocrinologist to determine immediate calcium and/or calcitriol supplementation based on periop PTH levels and risk of hypocalcemia (see below)
- Post-operative monitoring:
  - Total calcium, ical and phosphorus levels q6hr, or more frequently as clinically indicated
  - Monitor for signs or symptoms or hypocalcemia (Appendix A)

Ongoing Care

- When ready, admit to MS floor on Pediatric Surgery team with consult for Endocrinology co-management
- Continue to follow treatment and monitoring algorithm below based upon perioperative PTH levels and risk of hypocalcemia (if result not interpretable resend STAT)

Intact PTH <10 ng/mL

High risk of hypocalcemia

Treatment:

- IV calcitriol x 1 dose STAT in PACU (see Appendix B for dosing)
- Start PO calcitriol and calcium carbonate as soon as able to tolerate PO (see Appendix B for prescribing), with goal to start within 6hr of surgery
- Consider IV calcitriol and IV calcium gluconate if unable to tolerate PO, or if symptomatic hypocalcemia (see Appendix B for prescribing). If only minor symptoms, can consider PO calcium (see Appendix A for definition of minor symptoms)
- Vitamin D2 and/or D3 as clinically indicated
- Magnesium oxide as clinically indicated

Monitoring

- Total calcium, ical and phosphorus q6hr, or more frequently as clinically indicated (1-2 hours after IV calcium gluconate for symptomatic hypocalcemia)
- Consider obtaining PTH with ical if low total calcium level (see Appendix C for normal lab values by age) or if symptomatic hypocalcemia (Appendix A)
- Call Endocrinology to discuss increase in PO calcium and/or calcitriol if no improvement in total calcium

Intact PTH 10-20 ng/mL

Intermediate risk of hypocalcemia

Treatment:

- Calcium carbonate as soon as able to tolerate PO (see Appendix B for dosing), with goal to start within 6hr of surgery
- Consider IV calcium gluconate if unable to tolerate PO (see Appendix B for prescribing)
- Vitamin D2 and/or D3 as clinically indicated
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Monitoring:

- Total calcium, ical and phosphorus q6hr, or more frequently as clinically indicated
- Consider obtaining PTH with ical if low total calcium level (Appendix C) or if symptomatic hypocalcemia (Appendix A)
- Call Endocrinology to discuss increase in calcium and consider starting calcitriol if no improvement in serum calcium (Appendix B)

Intact PTH >20 ng/mL

Low risk of hypocalcemia

Treatment:

- Calcium treatment is not needed if calcium and phosphorus levels are normal (Appendix C)
- Vitamin D2 and/or D3 as clinically indicated
- Magnesium oxide as clinically indicated

Monitoring:

- Total calcium, ical and phosphorus q6hr, or more frequently as clinically indicated.
- If total calcium is > 8.0 x 2, consider discontinuing monitoring
- Consider obtaining PTH with ical if low total calcium level (Appendix C) or if symptomatic hypocalcemia (Appendix A)
- Consider starting calcium and/or calcitriol if no improvement in serum calcium (Appendix B)

Discharge Criteria:

- Serum total calcium ≥ 8.0 ng/dL (high risk patients should have at least 2 values, at least 6 hours apart)
- No IV calcium required within the last 24 hours
- Clearance by Pediatric Surgery team

Discharge Medications, Laboratory Monitoring, and Instructions:

- If total thyroidectomy, start levothyroxine; dosing per Endocrinology
- PTH <10 ng/mL and/or hypocalcemia:
  - Calcitriol and calcium PO; dosing per Endocrinology
  - Serum total calcium in 1-3 days, then calcium and phosphorus levels q3-7 days until they remain normal while weaning calcitriol & calcium
- PTH 10-20 ng/mL:
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  - Serum total calcium and phosphorus levels in 5-7 days
- PTH >20 ng/mL:
  - Calcium PO not needed
  - Consider total calcium and phosphorus levels within 5-7 days
- Additional labs and medications:
  - TSH, Free T4, and follow up per Endocrinology, usually in 4 weeks
  - Consider a PTH with ical if total calcium <8 mg/dL during weaning of calcitriol and calcium PO
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NEXT PAGE

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- Surgery team (OR scheduler) to contact Endocrine nurses through Epic in-basket (p_endo_results_triage) with patient name and date of surgery

For patient undergoing thyroidectomy, pre-operative management is recommended and includes:

- **Assessment of 25-OHD and if ≤ 30, treat pre-operatively** according to the pathway

Pre-operative vitamin D deficiency is associated with an increased risk of postoperative hypocalcemia.

In addition, pre-operative vitamin D levels can predict the need for calcitriol (1,25-dihydroxyvitamin D_3) therapy in patients with hypocalcemia.

- Post-operative monitoring:
  - Total calcium, ical and phosphorus levels q6hr, or more frequently as clinically indicated
  - Monitor for signs or symptoms or hypocalcemia (Appendix A)

Ongoing Care

- When ready, admit to MS floor on Pediatric Surgery team with consult for Endocrinology co-management
- Continue to follow treatment and monitoring algorithm below based upon perioperative PTH levels and risk of hypocalcemia (if result not interpretable resend STAT)

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Discharge Criteria:

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CLINICAL PATHWAY:
Peri-Operative Thyroidectomy Management
Appendix A: Signs and Symptoms of Hypocalcemia

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**All signs and symptoms noted are major unless otherwise noted as minor in parentheses*

Symptoms of hypocalcemia

- Perioral and extremity numbness and/or tingling (minor)
- Muscular cramping
- Fatigue
- Anxiety and depression

Signs of hypocalcemia

- Signs of neuromuscular irritability:
  - Paresthesias (minor)
  - Facial twitching
  - Muscle spasm
  - Laryngospasm
  - Stridor
  - Seizures
  - Tetany
- Chvostek sign (twitching of the circumoral muscles when tapping lightly over the seventh cranial nerve - note that a positive Chvostek sign is found in many normal adolescents) (minor)
- Trousseau sign (carpopedal spasm when maintaining the blood pressure cuff 20 mmHg above the systolic blood pressure for 3 minutes)
- Papilledema
- Prolonged QT interval on EKG

Post-operative care in the PACU is important and used to direct the post-thyroidectomy calcium management, because studies have shown that post-thyroidectomy PTH levels accurately predict hypocalcemia.

Additionally, will need to obtain other labs per pathway and also monitor for **signs and/or symptoms of hypocalcemia** (Appendix A)

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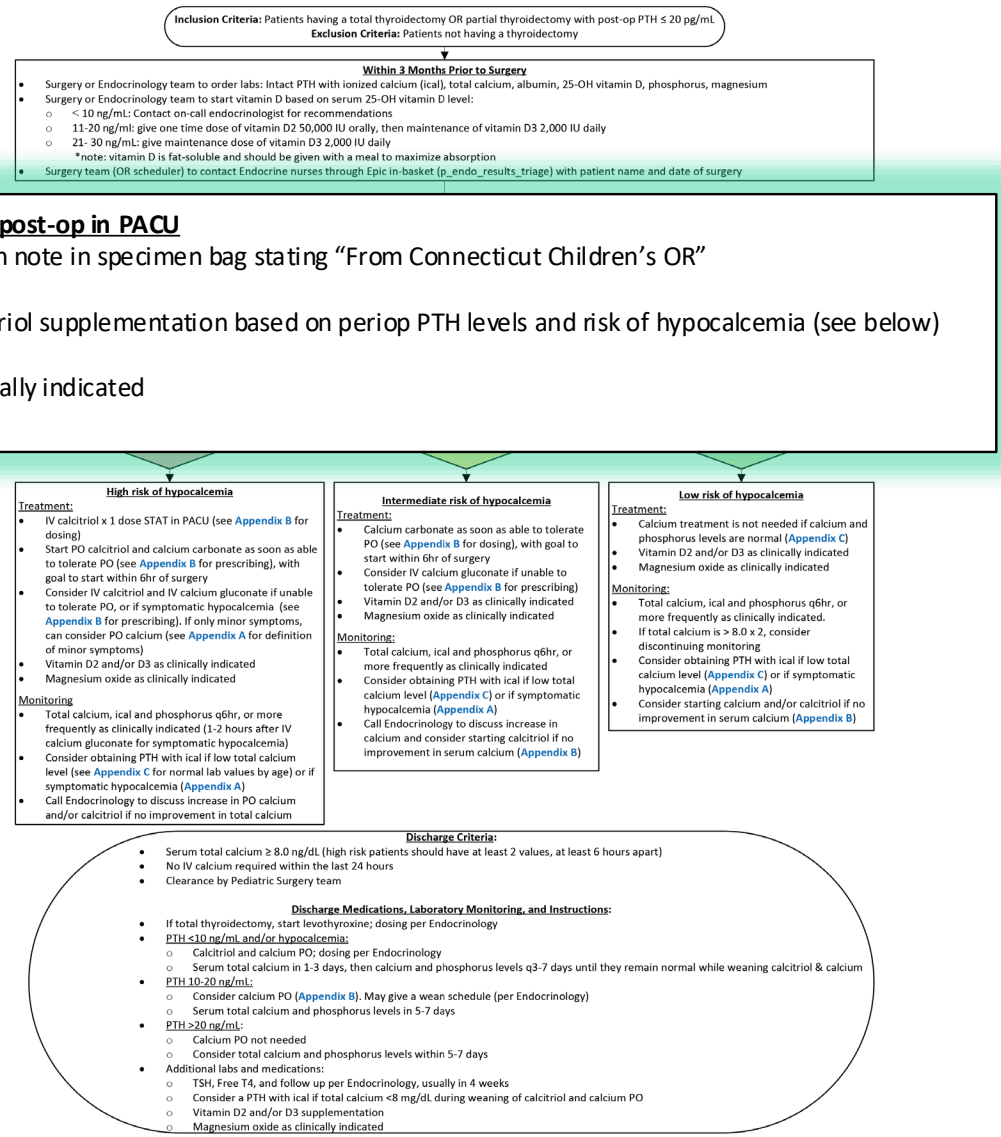

NEXT PAGE

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NEXT PAGE

Once patient is ready for transfer to med-surg floor, **consult Endocrinology for co-management**

Treatment and monitoring recommendations will be based upon patient's peri-operative PTH levels and risk of hypocalcemia

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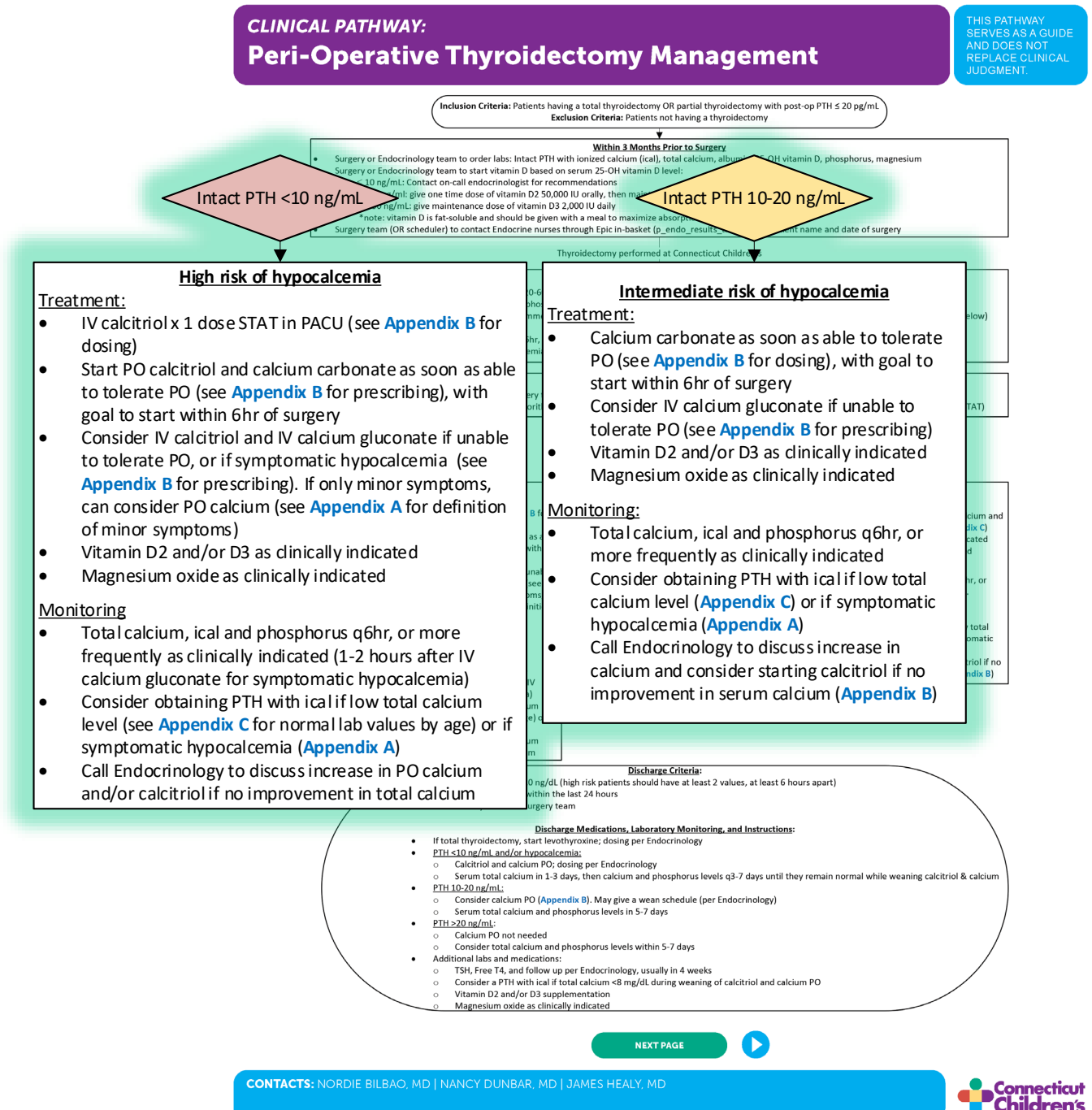
A **low PTH** level is used to implement **early treatment with calcium and/or calcitriol** to reduce the incidence and severity of hypocalcemia

Calcium plus vitamin D (calcitriol) is more effective than calcium alone in preventing postoperative hypocalcemia and decreasing the demand for intravenous calcium supplementation



Please refer to **Appendix B** for calcitriol and calcium dosing information

Calcitriol

- General Drug Information:
  - Calcitriol reaches its peak effectiveness at 48-72 hours
- Inpatient Dosing (PO):
  - < 1 year old: 0.04-0.08 mcg/kg/day PO divided q12hr
  - 1-5 yrs or <20 kg: 0.25 – 0.5 mcg per dose PO q12hr
  - > 6 yrs or ≥20 kg: 0.5 – 1 mcg per dose PO q12hr
  - May give up to 1 mcg q8hr if calcium persistently low
- Inpatient Dosing (IV):
  - < 5 yrs: 0.25 mcg x 1 dose
  - 5-10 yrs: 0.5 mcg x 1 dose
  - > 10 yrs: 1-2 mcg x 1 dose
- Discharge Dosing (PO):
  - < 1 year old: 0.04 -0.08 mcg/kg/dose PO once daily
  - 1-5 yrs or <20 kg: 0.25 – 0.75 mcg per dose PO once daily
  - > 6 yrs or ≥20 kg: 0.5 – 2 mcg per dose PO once daily

Calcium Carbonate

- General Drug Information:
  - Begin at lower end of dose range for asymptomatic patients
  - Calcium is given with meals to block phosphorus absorption. Phosphorus starts rising by day 2 on patients with transient/permanent hypoparathyroidism. May need to reduce milk consumption because high in phosphorus.
- Dosing expressed in elemental calcium: (Divide by 0.4 to convert to mg of salt)
  - < 30 kg: 300 - 400 mg Elemental Ca per dose PO q8hr
  - ≥ 30-50 kg: 400-500 Elemental Ca per dose PO q8hr
  - > 50 kg: 500-600 Elemental Ca per dose PO q8hr

Calcium Gluconate

- Dosing based on indication:
  - Symptomatic hypocalcemia
    - 100 mg/kg IV (max 2 grams/dose) infusion over 30 minutes
    - Place on cardiac monitoring, if bradycardic, stop calcium infusion
    - May repeat x1 if symptoms persist
  - Asymptomatic hypocalcemia, unable to tolerate PO
    - 50 mg/kg IV (max 1 gram/dose) infusion over 4 hours
    - IV rate adjusted to keep serum calcium concentration at the lower end of normal range
- Transitioning from IV to PO calcium:
  - Give first oral dose of calcitriol and calcium during IV calcium infusion, as soon as tolerating PO
  - Wean IV dose by 50% increments every 4 hours as long as serum Ca remains >8 mg/dL
  - If Ca <8 mg/dL, resume prior IV Ca rate
  - If patient requires IV calcium >24 hours, consider increasing calcitriol dose

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Please refer to **Appendix C** for normal total calcium, ionized calcium, phosphorus, and magnesium levels by age

Total Calcium

Age	Conventional (mg/dL)	SI (mmol/L)
Preterm	6.2-11.0	1.6-2.8
Full term <10 days	7.6-10.4	1.9-2.6
10 days-24 months	9.0-11.0	2.3-2.8
2-12 years	8.8-10.8	2.2-2.7
Adult	8.6-10.0	2.2-2.5

Ionized Calcium

Age	Conventional (mg/dL)	SI (mmol/L)
Newborn <36 hours	4.20-5.48	1.05-1.37
Newborn 36-84 hours	4.4-5.56	1.10-1.42
1-18 years	4.80-5.52	1.20-1.38
Adult	4.64-5.28	1.16-1.32

Phosphorus

Age	Conventional (mg/dL)	SI (mmol/L)
Newborn	4.5-9.0	1.45-2.91
10 days-24 months	4.5-6.7	1.45-2.16
24 months-12 years	4.5-5.5	1.45-1.78
>12 years	2.7-4.5	0.87-1.45

Magnesium

Age	Conventional (mg/dL)	SI (mmol/L)
Child-20 years	1.4-2.5	
Adult	1.5-2.3; 1.3-2.1	0.65-1.05

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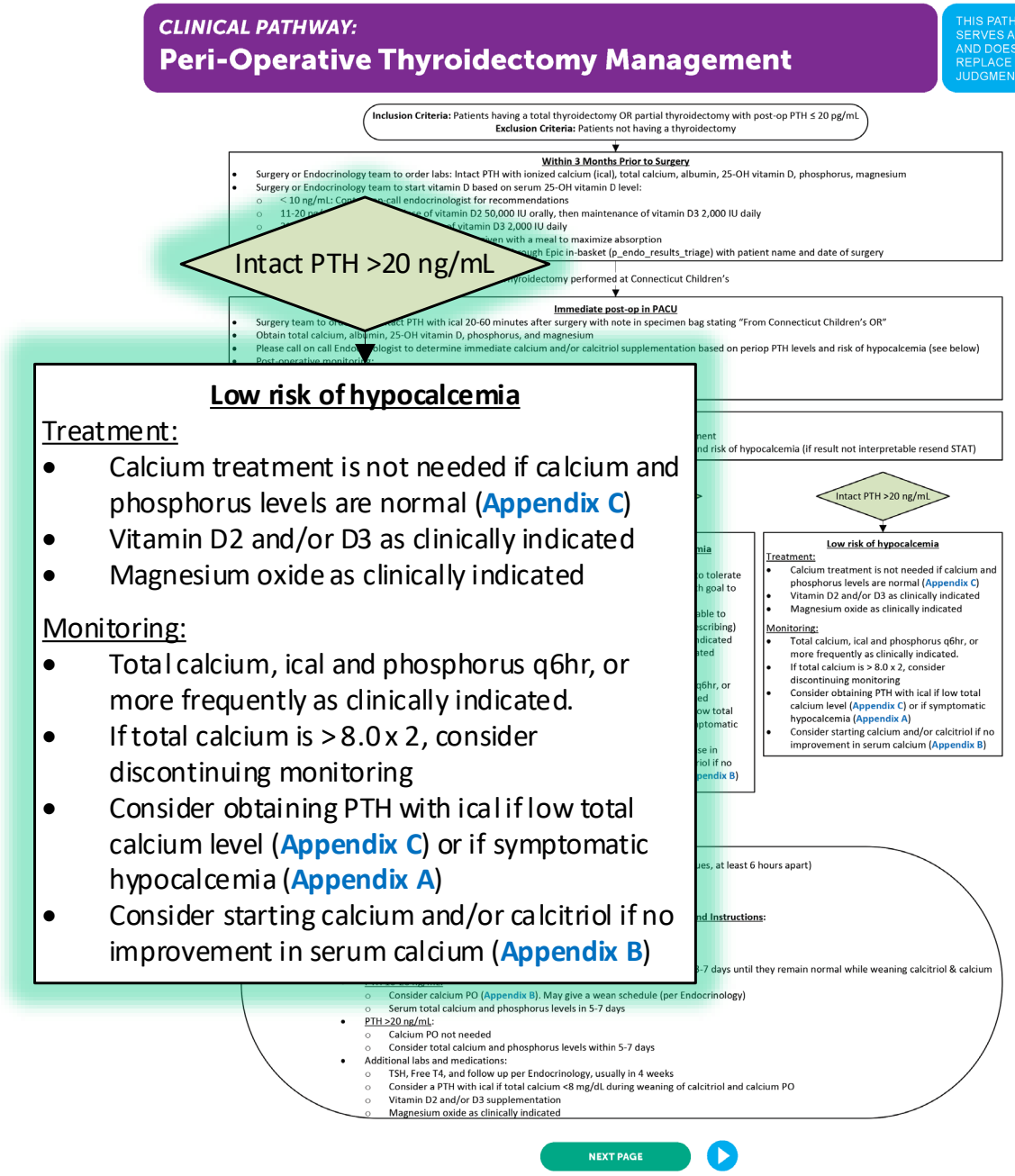
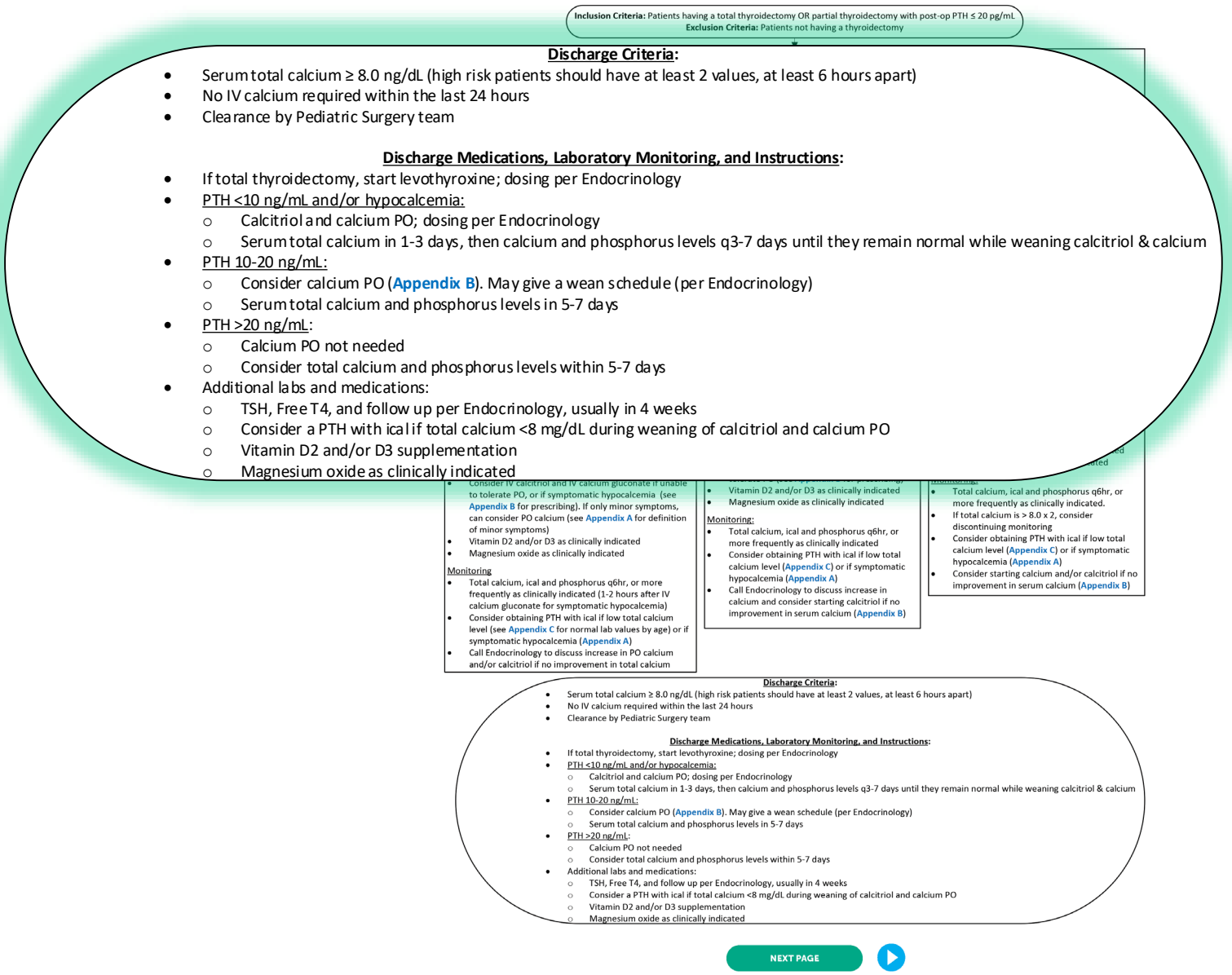


Discharge criteria are clearly listed on the pathway and depend on serum total calcium level and no need for IV calcium within last 24 hours, in addition to clearance by the Pediatric Surgery team

Discharge instructions are dependent on PTH and calcium levels

All patients should follow up with Endocrinology outpatient

Patients will likely require outpatient Vitamin D2 and/or D3, and some may require Magnesium oxide



Review of Key Points

- Preoperative vitamin D levels are assessed and vitamin D supplementation given as needed to prevent post-operative hypocalcemia, one of the most common complications of thyroidectomy
- Perioperative PTH is predictive of post thyroidectomy hypocalcemia
- A low PTH is be used to initiate early calcitriol and calcium supplementation to prevent severe hypocalcemia
- A normal PTH can be used to facilitate early patient discharge
- Protocols based on PTH and the routine use of oral calcium supplements can lead to improved patient outcomes after thyroidectomy and reduces medical costs

Use of Order Set

Quality Metrics

- Percentage of patients with pathway order set usage
- Percentage of patients who have Endocrine involvement prior to surgery
- Percentage of patients who have Endocrine involvement post-surgery
- Percentage of patients with pre-operative labs drawn per pathway
- Percentage of patients with post-operative serum calcium level ≥ 8.5
- Percentage of patients with post-operative serum calcium level < 8.5 post who receive IV calcium
- Percentage of patients with PTH ≥ 15 who have serum calcium obtained 4-6 hours post-surgery
- Percentage of patients with PTH < 15 who have serum calcium obtained within 60 minutes post-surgery
- Total number of calcium and phosphorus lab checks per patient
- Percentage of patients who require IV calcium treatment
- Percentage of patients admitted to the PICU
- Length of stay (days)
- Readmission within 14 days
- Returns to ED within 14 days

Pathway Contacts

- Nordie Bilbao, MD
  - Endocrinology
- Nancy Dunbar, MD
  - Endocrinology
- James Healy, MD
  - Pediatric Surgery

References

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Thank You!

About Connecticut Children's Medical Center 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 judgement