Head and Neck Endocrine Surgery

Management of Calcium in Thyroid and Parathyroid Surgery

Physiology

- Calcium is the most abundant mineral
- ~1% is found in plasma
  - ½ bound to proteins
  - ½ ionized
- Functions
  - Bone and teeth
  - Nervous system
  - Muscular tone and contraction
  - Clotting cascade
- Regulated by Parathyroid Hormone (PTH)

Objectives

- Physiology
- Risk factors for hypocalcemia
- Management strategies
  - Passive vs. active
  - Treatment of hypocalcemia

Calcium Homeostasis via PTH

Post-surgical Hypocalcemia

- Hypoparathyroidism
  - Paresthesias, cramps, mental status changes, tetany, EKG changes
- Most commonly reported complication
- Similar rates for thyroid and parathyroid surgery
  - Temporary 10%-40%
  - Permanent 1%-3%

Who is at risk?

Risk factors for hypocalcemia

- Thyroid surgery
  - Total vs. subtotal
  - Malignancy, goiter
  - Reoperative procedures
  - Central neck dissection
- Parathyroid surgery
  - Adenoma vs. hyperplasia
  - Markedly elevated preoperative PTH
  - Previous surgery
  - Renal hyperparathyroidism

3 Approaches Following Surgery

- Spectrum of Passive to Active

  Wait and See
  Selective treatment
  Empiric treatment

Wait and See

- “If it ain’t broke, don’t fix it”
- Treat only when hypocalcemia develops
  - Serial blood draws
    - Majority of hypocalcemia develops within 24 hours but can be as late as 72 hours
  - Increase length of hospitalization
  - Costly
Monitoring Calcium

- Serum calcium measurements
  - Most common
  - Correct for hypoalbuminemia
    - Add 0.8 for every 1g/dL of albumin that is “missing”
      - 0.8[(g/dL) - albumin (g/dL)] + Ca (mg/dL)
  - Affected by acid-base disorders
  - Cheaper
- Ionized calcium
  - Sick patients
  - Calcium drip
  - Special handling
  - Costly

CalciUM: Understanding its role in health care.

Serum Calcium

- Serum Calcium is adequate to monitor for hypocalcemia
- Using this algorithm
  - Safe and early discharge
  - Decrease hospital stays

A Safe and Cost-Effective Short Hospital Stay Protocol to Identify Patients at Low Risk for the Development of Significant Hypocalcemia After Total Thyroidectomy

- Measured serum calcium 6h and 12h post-operatively
- If calcium increased, 0% hypocalcemia
- Calcium was stable or decreased, 70% hypocalcemia
  - < 8 mg/dL at 12h → 75% developed hypocalcemia
  - > 8 mg/dL at 12h → 13% developed hypocalcemia


Calcium intake of 1200 mg in divided doses with food and Vitamin D 400-800 IU daily as per Recommended Daily Allowance (RDA).
Selective Treatment

- Predicting what/who will “break”
- Identifying those at risk for symptomatic or severe hypocalcemia
  - Risk stratifying based on calcium and PTH
- Treat prophylactically with calcium +/- Vitamin D

PTH and Calcium

- Perioperative PTH levels have been shown to be predictive of hypocalcemia
  - Sensitivity and specificity have been suboptimal
  - Timing and cutoff values variable
  - Different labs and assays
- Evaluated pooled data from 3 studies
- Looked at PTH and calcium at 1h – 6h post-op


- PTH levels 1h – 6h after surgery was predictive
  - 60% reduction
- When combining 60% reduction in PTH with a 10% decline in serum calcium at 6 hours
  - 100% sensitivity
  - 100% specificity
  - 100% positive-predictive value
- Not statistically different than using PTH values alone at 1h – 6h post-operatively


- 1 and 6 hours allows for early prediction
- Outpatient surgery
- Decreased duration of inpatient stay
- Cost savings

UCLA Protocol

Which PTH Assay
- Depends on your local resources
- Specialized training
- Lab timetables
- Standard and rapid PTH have been shown to be highly correlated

Prophylactic Treatment
- Pre-emptive calcium, vitamin D, or both can decrease the risk for hypocalcemia
  - Bellantone et al. Surgery 2002;132:1109-12
  - Seybt M and Terris D. Laryngoscope 2010; 120:959-963, 2010
- Motivated by short stay or outpatient surgery
- Non-randomized, observational

Routine postoperative administration of vitamin D and calcium after total thyroidectomy: a meta-analysis
Abaro Sanabria*, Luis C. Dominguez, Valentín Vega, Camilo Osorio, Daniel Duarte
Department of Surgery, School of Medicine, Universidad de la Sabana, Bogota, Grupo Norte del Caribe, Km 21, A想起来Forest, Bogota, Colombia

Control 72
Calcium 288
Calcium + Vitamin D 346

Hypocalcemia 31%
Hypocalcemia 19%
Hypocalcemia 4%
Empiric Treatment

• Reduce the rates of hypocalcemia
• May allow for early discharge
  – Same day discharge
• Safe
• Patient counseling is extremely important
• Cost savings
• Protocols vary
  – 3g Calcium carbonate/day
  – Vitamin D vs. calcitriol

Treatment

• “It’s broken, now what?”
  – Calcium
  – Vitamin D
  – Magnesium
  – PTH

Oral Calcium

• Greatest absorption with doses < 500 mg
• Large doses may cause
  – Gas
  – Bloating
  – Constipation
Calcium Preparations

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<tr>
<th>Calcium salt</th>
<th>% elemental calcium</th>
<th>Other</th>
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<tbody>
<tr>
<td>Carbonate</td>
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<td>Requires acid</td>
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<tr>
<td>Phosphate</td>
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<td>Acetate</td>
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<tr>
<td>Citrate</td>
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<td>Better GI tolerance</td>
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<td>Lactate</td>
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<td>Gluconate</td>
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<td>Glubionate</td>
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Vitamin D

- **Mechanism**
  - Increases enteric calcium absorption 400%
  - Stimulates bone resorption in response to PTH
- **Calcitriol** $1\alpha,25(OH)_2D_3$
  - Active and most potent
  - Added empirically or when oral calcium is inadequate
  - Starting dose is 0.25 mcg/day
  - Shorter half life → safer in Vitamin D toxicity

Magnesium

- Improves enteric calcium absorption and Vitamin D production
- Replace when hypocalcemia is associated with hypomagnesemia
  - IV
    - Magnesium chloride 4 g IV
    - Avoid Magnesium sulfate (MgSO$_4$)
      - Sulfate can bind calcium and reduce absorption
  - PO Magnesium
    - Diarrhea
    - Magnesium citrate is often used for bowel prep

Follow-up

- **Endocrinology Colleagues**
  - Calcium can inhibit levothyroxine absorption
- Every 1-3 weeks depending on stability
- Calcium and Vitamin D are tapered over several weeks
- In cases of subtotal or total parathyroidectomy
  - Consideration of autotransplantation of cryopreserved glands
Cryopreservation

- Success rates of cryopreserved autografts vary widely
  - 60% with partial or full function
  - 40% with full function
  - Time to reimplant may affect survival
- Variability in freezing techniques

PTH

- Recombinant PTH administration is being studied
- Unclear what the metabolic risks are
- Expensive
- Injected
- No FDA approval for iatrogenic hypoparathyroidism

Summary

- Calcium homeostasis is important for normal function
- Post-surgical hypocalcemia is common and predictable
- Post-operative serum calcium and PTH can be used to risk stratify those at greatest risk
- Prophylactic treatment of these individuals will improve patient care
- Do not forget to involve Endocrinology colleagues