Bone Health in Celiac Disease

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No Disclosures
Objectives

- Recognize the mechanisms by which celiac disease can affect bone health
- Review what diagnostic tests are useful
- Understand the role of nutrition and proper supplementation
- Gain awareness when pharmacologic or other intervention may be needed
Celiac Disease

- Intestinal disorder characterized by autoimmune reaction to gliadin fraction of gluten

- Associated with human leucoctye antigen (HLA) genes

- Multiple non intestinal manifestations
  - Type 1 Diabetes
  - Thyroiditis/Hypothyroidism
  - Metabolic bone disease
Prevalance of bone disease in celiac

- Low bone density is more prevalent

Kemppainen, *Bone* 1999
Celiac Disease and Fracture Risk

- Fracture risk appears modestly higher

*West, Gastroenterology 2003*
Why does celiac disease affect bone?

Calcium
Vitamin D

? Inflammation

Image from: Dickey, Scand J Gastroenterol 2011
Calcium and Bone

- Avg human with ~ 1 kg of calcium
- 99% in bone
- Essential for bone strength

Image from: Poole, PLoS One 2011

Emkey, Endocrinol Metab Clin N Am 2012
Osteomalacia

- Calcium deficiency can lead to bone demineralization

- A distinct mechanism from osteoporosis

Emkey, *Endocrinol Metab Clin N Am* 2012

Calcium Absorption

- Primarily in intestine
  - duodenum
- Vitamin D has essential role

Image from: The American Heritage® Medical Dictionary. 2007

Khanal, Ann Rev Nutr 2008
Calcium Homeostasis

Images from:
The American Heritage® Medical Dictionary. 2007

Potts, Harrison’s Principles of Internal Medicine 2014
Calcium Malabsorption in Celiac Disease

- Villous atrophy
  - less surface area for absorption

- Intestinal Inflammation
  - Loss of calcium transport proteins

- Impaired Vitamin D absorption
  - Particularly if fat malabsorbed

Krupa-Kozak, Nutrition 2014
Celiac Disease Villous Atrophy

Kambol, *Clin Trans Gastroenterol*, 2014
Calcium Malabsorption in Celiac Disease

Potts, Harrison’s Principles of Internal Medicine 2014
Krupa-Kozak, Nutrition 2014
Secondary Hyperparathyroidism in Celiac Disease

- Parathyroid gland key regulator of calcium balance

- In response to decreased calcium and vitamin D absorption, parathyroid glands react by removing calcium from bone

Potts, Harrison’s Principles of Internal Medicine 2014
Calcium Malabsorption in Celiac Disease

Ca^{2+} → Vit D → PTH

Direct Inflammatory Effects?

Ca^{2+}

Potts, Harrison’s Principles of Internal Medicine 2014
Krupa-Kozak, Nutrition 2014
How to assess risk to bone health

- Blood tests
- Bone densitometry
- Low impact fractures

-This warrants more urgent attention
Blood Tests

- Creatinine (kidney function)
- Calcium
- Vitamin D 25 OH
- Parathyroid hormone (PTH)
Serum Calcium Level

- Low serum calcium suggests deficiency
- High serum calcium needs further testing
- Normal serum calcium can be deceptive
24 Hour Urine Calcium

- More accurate reflection of calcium absorption
- Creatinine should be tested on same sample
Bone Densitometry (BMD)

- Surrogate for bone strength
- T score -1 to -2.5 osteopenia
- T score < -2.5 osteoporosis
- Spine and hip usually analyzed

Melton, J Bone Miner Res 1992
When to get a BMD

• Consider doing after allowing for some time to treat the celiac disease and getting adequate calcium and vitamin D

• May do earlier in situations where osteoporosis medication may be needed
  – Post menopausal
  – On glucocorticoids (steroids)
  – High risk of fracture (type I diabetes, family history of hip fracture)
Treating Celiac Bone Disease

- Gluten Free Diet
- Calcium through diet and/or supplement
- Vitamin D
- Osteoporosis medications
Gluten Free Diet

• Improves BMD in children

• Recommended but may not be enough for the bone loss in adults

Bianchi, Calcif Tissue Int 2002
Optimizing Calcium Intake

- 1200 mg calcium is RDA
- May be higher requirement in celiac disease
- Feasible to get via diet

- Yogurt: 300-450 mg
- Milk: 250-350 mg
- Broccoli: 70-100 mg
- Tofu: 300-450 mg
Calcium Supplements

• Fat Malabsorption (aka steatorrhea)

• Lactose Intolerance

• Diet too difficult
Calcium Supplements

• Calcium carbonate
  – TUMS
  – Caltrate
  – -more common
  – Not absorbed when on heartburn medication

• Calcium Citrate
  – Citracal
Assessing Calcium Intake

- Serum calcium (can be deceptive if normal)
- Parathyroid hormone level
- 24 hour urine calcium
Vitamin D and Bone Health

• Integral to calcium absorption and homeostasis

• May have direct role in bone formation and regeneration

Goltzman, Ann NY Acad Sci 2011

Lips, Best Pract Res Clin Endocr Metab 2011
Vitamin D

• More difficult to get via diet
• 400 to 2000 units vitamin D (presuming limited sun exposure)
• May need more if steatorrhea/severe GI symptoms

National Osteoporosis Foundation, 2013

Image from: webmd.com
Assessing Vitamin D Intake

- Replacement guided by serum levels
- Goal level > 30, though 20-30 may be acceptable
When Osteoporosis Medications are Needed

- If BMD T scores persistently below 2.5
- Fragility fracture
- Post menopausal women
- Glucocorticoid Use
  - Prednisone, solumedrol
- Other risk factors
  - Family History
  - Type I Diabetes

Lee, Yonsei J Med 2011
Oral Bisphosphonates

- **Alendronate (Fosamax)**
  - 70 mg weekly

- **Risedronate (Actonel)**
  - 35 mg weekly or 150 mg monthly

- **Ibandronate (Boniva)**
  - 150 mg monthly

Rosen, *UptoDate*, 2014
If oral medication not tolerated or severe osteoporosis

- Zoledronate (Reclast)
  - 5 mg yearly

- Denosumab (Prolia)
  - 60 mg every 6 months
  - No adjustment for renal insufficiency

- Teriparatide (Forteo)
  - 20 mcg SC daily
  - Only anabolic agent

Rosen, *UptoDate*, 2014
Osteoporosis Medications

• Ideally, calcium and vitamin intake should be optimized before starting these medications
  – Possible risk of hypocalcemia with more potent medications

Rosen, UptoDate, 2014
Conclusions
Celiac Disease Has Significant Impact on Bone Health

Inflammation

Ca^{2+} → Vit D → PTH → Ca^{2+}

Inflammation

Ca^{2+}
Medical Testing Can Guide Maintenance of Bone Health

• Creatinine (kidney function)
• Calcium
• Vitamin D 25 OH
• Parathyroid hormone (PTH)
• 24 hour urine calcium
• Bone densitometry
Diet and supplements can make an impact

- May be higher requirement in celiac disease
- Feasible to get via diet, but pills can be effective if needed
Osteoporosis Medications May Sometimes Be Warranted

• Ultimate goal is to avoid fractures
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