Fracture Liaison Services: A Cost-Effective, Multidisciplinary Approach to Secondary Fracture Prevention

Laila S. Tabatabai, MD
Disclosures

Ultragenyx

Radius
Objectives

1. Evaluation for Secondary Causes of Osteoporosis

2. Fracture Liaison Service Models to Fit Your Practice
Objectives

1. Evaluation for Secondary Causes of Osteoporosis

2. Fracture Liaison Service Models to Fit Your Practice
Osteoporosis

• Characterized by low bone mass and microarchitectural deterioration of the bone\textsuperscript{1}

• Can be diagnosed using bone mineral density criteria (T-score -2.5 or below at the spine, total hip femoral neck or distal radius)\textsuperscript{2}

• Clinical diagnosis made on the basis of fragility fractures\textsuperscript{3}

Changes in Bone Structure with Aging

Osteoporosis

• 10 million Americans have osteoporosis
  – 43 million adults have osteopenia (low bone density)

• Expected to increase as the population ages
  – By 2050, nearly 90 million people will be 65 or older

• Fragility fractures
  – > 2 million cases annually in the United States
  – Lifetime incidence of 50% in women and 22% in men

Fragility Fractures

- Result from a fall from standing height or less
- Minimal trauma
- Would not have occurred in a patient with normal bone
- Exclude fractures of fingers, toes, skull, jaw, clavicles
Fragility Fracture Sites

Incidence of Osteoporosis-Related Fractures

Incidence Rate per 10,000 Women

Age

Plot Area

- Other
- Pelvis
- Wrist
- Vertebral
- Hip
Health Care Gap in Secondary Fracture Prevention

- American Academy of Orthopedic Surgery (AAOS)
- ASBMR Task Force report on Secondary Fracture Prevention
- National Institute for Health and Clinical Excellence (NICE) Guidelines on Preservation of Bone Mass and Fracture Prevention

Osteoporosis Evaluation & Treatment after Fragility Fracture

Meta-analysis: 37 studies on osteoporosis management

- Diagnostic evaluation: <30%
- Treatment initiation: 0.5% - 38%; most studies < 10%

What is the single biggest risk factor for osteoporosis in female patients?
What is the single biggest risk factor for osteoporosis in female patients?

MENOPAUSE
Secondary Causes of Osteoporosis: Hypoestrogenemia

• Amenorrhea
  - female athlete’s triad
    1. excessive exercise
    2. restrictive eating/anorexia
    3. amenorrhea
  - Depo provera (depot medroxyprogesterone)
  - hyperprolactinemia
  - premature ovarian failure (surgical, medical – i.e., chemotherapy-induced, spontaneous)
Secondary Causes of Osteoporosis: Nutritional

- Lack of adequate calcium intake
- Vitamin D deficiency
- Protein deficiency (sarcopenia)
- Restrictive eating
  - “gluten-free” without diagnosis of celiac disease
  - vegan, vegetarian
  - dairy-free
  - calorie deficiency
Secondary Causes of Osteoporosis:

• Failure to accrue bone and reach peak bone mass (age 28 – 30)

• “Low bone density for age” → “Osteoporosis”

• Z-scores: young adults, pre-menopausal women, men under age 50
  – compares BMD to average BMD of same age/gender

• T-scores: post-menopausal women, men age 50 and above
  – compares BMD to average BMD of healthy 30-year old
Secondary Causes of Osteoporosis:

• Age
• Race (White, Asian, Hispanic, Black)
• Low BMI (<20)
• Previous fragility fracture
• Parent with a hip fracture (living or deceased)
• Current smoking
• Alcohol: more than 2 units/day
• Steroids: 5 mg of prednisone/day or more for 3+ months
Secondary Causes of Osteoporosis:

- Rheumatoid arthritis (psoriatic)
- Type 1 diabetes
- Osteogenesis imperfecta
- Malabsorption (RYGB, short gut, celiac)
- Chronic liver disease
- Hypogonadism
- Hyperthyroidism (untreated, longstanding)
  - $\text{TSH}<0.5 \text{ uIU/mL}$
Secondary Causes of Osteoporosis: The Fracture Stories

• Ask your patient exactly how they fractured
• Disregard emotion, judgment, self-blame
  – “I fell so hard, anyone would have broken a bone.”
  – “I fell really hard on the kitchen tile.”
  – “I fell with all my weight.” Type 1 diabetes
• Fall from standing height or less (curb, 1 step, seated in chair, bike – stationary)
• Exclude fingers, toes, skull, clavicle, sternum
• FRAGILITY FRACTURE = OSTEOPOROSIS
### Causes of Secondary Osteoporosis in Adults

<table>
<thead>
<tr>
<th>Endocrine or metabolic causes</th>
<th>Nutritional/GI conditions</th>
<th>Drugs</th>
<th>Disorders of collagen metabolism</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acromegaly</td>
<td>Alcoholism</td>
<td>Antiepileptic drugs&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Ehlers-Danlos syndrome</td>
<td>AIDS/HIV&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>Anorexia nervosa</td>
<td>Aromatase inhibitors</td>
<td>Homocystinuria due to cystathionine deficiency</td>
<td>Ankylosing spondylitis</td>
</tr>
<tr>
<td>Type 1</td>
<td>Calcium deficiency</td>
<td>Chemotherapy/immunosuppressants</td>
<td>Marfan syndrome</td>
<td>Chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>Type 2</td>
<td>Chronic liver disease</td>
<td>Depo-Provera</td>
<td>Osteogenesis imperfect</td>
<td>Gaucher disease</td>
</tr>
<tr>
<td>Growth hormone deficiency</td>
<td>Malabsorption syndromes/malnutrition</td>
<td>Glucocorticoids</td>
<td></td>
<td>Hemophilia</td>
</tr>
<tr>
<td>Hypercortisolism</td>
<td>(including celiac disease, cystic fibrosis, Crohn’s disease, and gastric resection or bypass)</td>
<td>Gonadotropin-releasing hormone agents</td>
<td></td>
<td>Hypercalciuria</td>
</tr>
<tr>
<td>Hyperparathyroidism</td>
<td>Total parenteral nutrition</td>
<td>Heparin</td>
<td></td>
<td>Immobilization</td>
</tr>
<tr>
<td>Hyperthyroidism</td>
<td>Vitamin D deficiency</td>
<td>Lithium</td>
<td></td>
<td>Major depression</td>
</tr>
<tr>
<td>Hypogonadism</td>
<td></td>
<td>Proton pump inhibitors</td>
<td></td>
<td>Myeloma and some cancers</td>
</tr>
<tr>
<td>Hypophosphatasia</td>
<td></td>
<td>Selective serotonin reuptake inhibitors</td>
<td></td>
<td>Organ transplantation</td>
</tr>
<tr>
<td>Porphyria</td>
<td></td>
<td>Thiazolidinediones</td>
<td></td>
<td>Renal insufficiency/failure</td>
</tr>
<tr>
<td>Pregnancy</td>
<td></td>
<td>Thyroid hormone (in supraphysiologic doses)</td>
<td></td>
<td>Renal tubular acidosis</td>
</tr>
</tbody>
</table>

Abbreviations: AIDS = acquired immunodeficiency syndrome; GI = gastrointestinal; HIV = human immunodeficiency virus; GI = gastrointestinal.
Secondary Causes of Osteoporosis: Laboratory Evaluation

- Complete metabolic panel:
  - Calcium, albumin, alkaline phosphatase, AST, ALT
  - Creatinine, BUN, GFR
  - Electrolytes
- Phosphorus
- Total 25-OH-vitamin D (hydroxy-vitamin D)
- Parathyroid hormone (PTH)
Secondary Causes of Osteoporosis: Laboratory Evaluation

- Thyroid stimulating hormone (TSH)
- Serum protein electrophoresis (SPEP) with UPEP, immunofixation, free kappa lambda light chains if indicated
- Celiac testing
- 24-hour urine collection for calcium, creatinine
- Testosterone
- Estradiol
- Iron panel
Secondary Causes of Osteoporosis: Laboratory Evaluation

In the appropriate patient:

- Hypercortisolism screening
- Mastocytosis evaluation – serum tryptase, urine N-methylhistidin
- Bone turnover markers
- Bone biopsy (CKD/ESRD, “normal” BMD with fragility fracture, etc.)
Secondary Causes of Osteoporosis: Laboratory Evaluation

• Hypercalcemia
  – Evaluate for primary hyperparathyroidism (PTH high or PTH inappropriately normal)
  – If PTH suppressed, consider non-PTH-mediated causes such as malignancy, sarcoid
  – Obtain 24 hour urine calcium and creatinine measurements, calculate Ca/Cr clearance ratio
    • Ca/Cr clearance ratio<0.01 suggests FHH (familial hypocalciuric hypercalcemia)
    • Ca/Cr clearance ratio>0.01 suggests primary hyperparathyroidism
Secondary Causes of Osteoporosis: Laboratory Evaluation

• Parathyroid hormone (PTH)
  – Elevated PTH with high calcium – primary hyperpara
  – Elevated PTH with normal/low calcium – secondary hyperpara (rarely, normocalcemic hyperpara)
    • Consider vitamin D deficiency
    • Consider low calcium intake
    • Consider renal calcium leak
Secondary Causes of Osteoporosis: Laboratory Evaluation

• Renal calcium leak
  – Defect in calcium reabsorption that leads to hypercalciuria
  – Patients have fasting hypercalciuria with secondary hyperparathyroidism, normal calcium levels
  – Obtain 24 hour urine calcium and creatinine measurements
Secondary Causes of Osteoporosis: Laboratory Evaluation

- **Hypercalciuria**
  - Evaluate for this in patients with hyperparathyroidism (primary or secondary)
  - Young patients with unusually low BMD
  - Kidney stone history
  - 24-hour urine calcium > 250 mg/d is consistent with hypercalciuria
  - (24-hour urine calcium 150 – 250 mg/d is normal)
Secondary Causes of Osteoporosis: Laboratory Evaluation

• Thyroid stimulating hormone (TSH)
  – suppression to 0.5 or below is linked to bone loss (TSH receptors on bone)

• Serum protein electrophoresis (SPEP)
  – multiple myeloma (osteoporosis/fractures, bone pain, anemia, renal failure, hypercalcemia)
  – M-spike – observation by hematology

• Celiac testing
  – positive serum testing (tissue transglutaminase IgA, IgG; endomysial IgA, deaminated gliadin)
  – EGD with biopsy for confirmation
Objectives

1. Evaluation for Secondary Causes of Osteoporosis

2. Fracture Liaison Service Models to Fit Your Practice
Burden of Illness for Osteoporotic Fractures Compared With Other Serious Diseases Among Postmenopausal Women in the United States

Andrea Singer, MD; Alex Exuzides, PhD; Leslie Spangler, PhD; Cynthia O’Malley, PhD; Chris Colby, PhD; Karissa Johnston, PhD; Irene Agodoa, MD; Jessica Baker, BSc; and Risa Kagan, MD
## Hospitalizations by Outcome: 2000 – 2011

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Hospitalizations</th>
<th>Age-adjusted admission rate (per 100,000 person-years)</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial infarction</td>
<td>2.9 million</td>
<td>668</td>
<td>$4.3 billion</td>
</tr>
<tr>
<td>Stroke</td>
<td>3.0 million</td>
<td>687</td>
<td>$3.0 billion</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>0.7 million</td>
<td>151</td>
<td>$0.5 billion</td>
</tr>
<tr>
<td>Osteoporotic fracture</td>
<td>4.9 million</td>
<td>1124</td>
<td>$5.1 billion</td>
</tr>
</tbody>
</table>
Fracture Liaison Services are needed to reduce the burden of osteoporotic fractures.
Where and when do fracture liaison services come into play during an admission for osteoporotic fracture?
Myocardial Infarction

**Event:** symptoms, EKG changes, troponin elevation

**Consultations:** Cardiology, Cath Team, CCU Team

**Procedural intervention:** fibrinolytics, PCI, CABG

**Evaluation:** TTE, lipid panel, BMI/waist circumference, HbA1c

**Medical intervention:** aspirin, ACE-I, clopidogrel, beta-blockers, calcium channel blockers, diuretics, smoking cessation

**Rehabilitation:** cardiac rehab, physical therapy

**Follow-up:** cardiology, nutrition, diabetes education, endocrinology
Myocardial Infarction

- The interventions and follow-up are geared toward addressing the causes of the myocardial infarction:
  - Obesity
  - Hypertension
  - Hyperlipidemia
  - Diabetes mellitus
  - Tobacco dependence
  - Metabolic syndrome
Osteoporotic Fracture

**Event:** fall, hip fracture

**Consultations:** Orthopedics, Physical Therapy

**Procedural intervention:** intramedullary nailing, hemiarthroplasty, total hip arthroplasty, nonsurgical management

**Evaluation:** x-ray

**Medical intervention:** pain management, Lovenox or SC Heparin

**Rehabilitation:** long-term care, rehab facility, home

**Follow-up:** orthopedic surgery, outpatient physical therapy
Osteoporotic Fracture

• The interventions and follow-up are geared toward the fracture, not the root cause(s) or preventable risk factors:
Fracture Liaison Services

IOF (International Osteoporosis Foundation) Capture the Fracture: Identifying Patients
https://www.capturethefracture.org/identifying-patients
FRACTURE LIAISON SERVICES: MULTIDISCIPLINARY APPROACHES TO SECONDARY FRACTURE PREVENTION

Patricia Mejia Osnua, MD; Mary D. Ruppe, MD; Laila S. Tabatabai, MD

ENDOCRINE PRACTICE Vol 23 No. 2 February 2017
Figure 1: Fracture liaison service structural flow. Osuna PM et al. “Fracture Liaison Services: Multidisciplinary Approaches to Secondary Fracture Prevention.”
## Classification of FLS Models

<table>
<thead>
<tr>
<th>Type model</th>
<th>Focus</th>
<th>Identification</th>
<th>Patient education</th>
<th>Investigation</th>
<th>Treatment</th>
<th>Cost</th>
<th>Fracture liaison co-coordinator</th>
<th>% diagnosis</th>
<th>% of treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>Comprehensive care</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>$$$</td>
<td>Majority (11 of 13)</td>
<td>79%</td>
<td>46%</td>
</tr>
<tr>
<td>Type B</td>
<td>Communication with PCP for recommendations</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>$$</td>
<td>Majority (12 of 16)</td>
<td>60%</td>
<td>41%</td>
</tr>
<tr>
<td>Type C</td>
<td>Awareness of PCP to the event</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>$</td>
<td>Sometimes (6 out of 10)</td>
<td>43%</td>
<td>23%</td>
</tr>
<tr>
<td>Type D</td>
<td>Patient education</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>$</td>
<td>Minimal need</td>
<td>N/A</td>
<td>8%</td>
</tr>
</tbody>
</table>

# Efficacy of FLS Models

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Proportion receiving BMD testing</th>
<th>Proportion receiving osteoporosis treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Quo</td>
<td>Manitoba statistics for major osteoporotic fractures (2007/2008)</td>
<td>13%</td>
<td>8%</td>
</tr>
<tr>
<td>Type D</td>
<td>Only provides osteoporosis education to the fracture patient. Primary care provider (PCP) is not alerted or educated.</td>
<td>No study on BMD testing</td>
<td>8%</td>
</tr>
<tr>
<td>Type C</td>
<td>The PCP is alerted that a fracture has occurred and further assessment is needed. Leaves the investigation and initiation of treatment to the PCP.</td>
<td>43%</td>
<td>23%</td>
</tr>
<tr>
<td>Type B</td>
<td>Leaves the initiation of treatment for fragility fracture patients to the PCP.</td>
<td>60%</td>
<td>41%</td>
</tr>
</tbody>
</table>
| Type A      | 1. Identification
2. Investigation
3. Initiation of osteoporosis treatment where appropriate. | 79%                              | 46%                                        |

## FLS Programs in the U.S.

<table>
<thead>
<tr>
<th>Program Name and Location</th>
<th>Population and duration</th>
<th>Description</th>
<th>Increase in diagnostic work up</th>
<th>Increase in treatment initiation</th>
<th>Impact on Fractures</th>
<th>Model type</th>
<th>Cost-Savings Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser Permanente's Healthy Bones Program California, US.</td>
<td>More than 625,000 patients for 6 years</td>
<td>All patients 50+ with high risk fracture or fragility fractures</td>
<td>213% woman and 914% in men</td>
<td>145 in women and 250% in men</td>
<td>40% decline in hip fractures</td>
<td>Type A</td>
<td>If implemented nationally: $5 billion¹⁸</td>
</tr>
<tr>
<td>Geisinger Health System osteoporosis disease management (GHSODMP)</td>
<td>Initial observational study: 15213 over 5 years (1999-2000)</td>
<td>Woman 55+ with fragility fracture</td>
<td>% of DEXA scan increased from 17/1000 to 174/1000</td>
<td>Use of biphosphonates from 0.7 to 4.9%</td>
<td>40% decline in hip fractures Incidence rate fell from 7.9 to 5.1/1000</td>
<td>Type A</td>
<td>Program: $7.8 million over 5 years</td>
</tr>
<tr>
<td>Geisinger, Pennsylvania, US.</td>
<td>HiROC1917 outpatient and 1041 inpatients during 3 years (2007-2011)</td>
<td>All patients above 50 with fragility fracture</td>
<td>92% had DXA scan by 6 months in group followed by HiROC team</td>
<td>87% by HiROC vs 32% by PCP</td>
<td>N/A</td>
<td>Type A and B</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Osteoporotic Fracture
With Fracture Liaison Service Involvement

Event: fall, hip fracture

Consultations: Orthopedics, Fracture Liaison Service

Procedural intervention: intramedullary nailing, hemiarthroplasty, total hip arthroplasty, nonsurgical management

Evaluation: x-ray, DXA (hip, spine, radius bone density)
lab evaluation - vitamin D measurement and secondary causes of osteoporosis - PTH, serum calcium, phosphorus, SPEP/UPEP, celiac panel, TSH
Osteoporotic Fracture

**Medical intervention:** pain management, Lovenox or SC Heparin, vitamin D supplementation, adequate calcium intake (1200 mg daily), consideration of abaloparatide or teriparatide (if no contraindications)

**Rehabilitation:** long-term care, rehab facility, home

**Follow-up:** orthopedic surgery, outpatient physical therapy, endocrinology/FLS Clinic, home safety evaluation, falls risk assessment
Thank you