Fractures:
Epidemiology and Consequences

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Outline

- Fracture incidence
- Demographic determinants of fracture incidence
  - Age
  - Gender
  - Race
  - Geography
- Consequences of fracture
- Temporal trends and the future

Osteoporotic fractures: Comparison with other diseases

American Heart Association 1996
American Cancer Society 1996
Riggs BL & Melton LJ 3rd, Bone, 1995;17(5 suppl):S055-S11S
Common sites of fracture

- Spine
- Hip
- Wrist

Lifetime risks of clinical fractures
50 year old white women (U.S.)

<table>
<thead>
<tr>
<th>Event</th>
<th>Lifetime risk*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip fracture</td>
<td>17%</td>
</tr>
<tr>
<td>Wrist fracture</td>
<td>16%</td>
</tr>
<tr>
<td>Vertebral fracture</td>
<td>16%</td>
</tr>
<tr>
<td>Any fracture</td>
<td>&gt; 50%</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>15%</td>
</tr>
</tbody>
</table>

*Refs: Melton; Black; Kanis
**Major determinants of fracture incidence**

**Demographic:**
- Age
- Gender
- Race
- Geography

**Previous fracture:** *discuss under*

*Consequences of Fracture*

**More on clinical risk factors for fracture and fracture prediction:** *Talks by Dr. Cummings and Dr. Harris later today.*

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**Age and gender are important determinants**

- **Men**
  - Hip
  - Vertebrae
  - Wrist

- **Women**
  - Hip
  - Vertebrae
  - Wrist

*Cooper C et al. J Bone Miner Res 1992*
Age is Independent of BMD as Risk Factor for Hip Fracture

- 5-fold increase in fracture probability from age 50 to 80 at same BMD

Lifetime risks of fracture: Impact of gender

<table>
<thead>
<tr>
<th>Fracture</th>
<th>Lifetime Risk at Age 50*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men (%)</td>
</tr>
<tr>
<td>Hip</td>
<td>6</td>
</tr>
<tr>
<td>Wrist</td>
<td>3</td>
</tr>
<tr>
<td>Clinical Vert Fx</td>
<td>5</td>
</tr>
<tr>
<td>Any</td>
<td>16%</td>
</tr>
</tbody>
</table>

* Among Caucasians
Osteoporosis in Men

- 1 in 5 to 6 men over age 50 will suffer osteoporotic fracture
- 30% of hip fractures worldwide are in men
- Mortality rates due to fracture higher in men than women
- Treatment rates following fracture are abysmal

Race and rate of hip fractures (age adjusted to U.S.)

<table>
<thead>
<tr>
<th>Race</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian (US)</td>
<td>968</td>
<td>396</td>
</tr>
<tr>
<td>Black (US)</td>
<td>214</td>
<td>179</td>
</tr>
<tr>
<td>Hispanic (US)</td>
<td>219</td>
<td>97</td>
</tr>
<tr>
<td>Asian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US (California)</td>
<td>383</td>
<td>116</td>
</tr>
<tr>
<td>Japan</td>
<td>227</td>
<td>79</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>389</td>
<td>196</td>
</tr>
<tr>
<td>Beijing</td>
<td>97</td>
<td>101</td>
</tr>
</tbody>
</table>

Luz Villa, Osteoporosis, 2001. Rates per 100,000 person-years, age-adjusted
Hip fracture rates vary dramatically by region and country

Vertebral fractures have more similar prevalence worldwide

Consequences of fracture

Hip fractures are associated with increased morbidity and mortality

One year after a hip fracture:
- 20% Death within one year
- 30% Permanent disability
- 40% Unable to walk independently
- 50% No longer able to live independently

• Direct costs: > $10 billion / yr
  – Cost of hip fracture > $80,000 per person

Mortality: 10 yrs post hip fracture

Haentjens et al. JAMA 2010

Limited Activity Days Post Fracture: Postmenopausal Women in FIT

Fink et al. Osteo Intl 2003
Impact of Vertebral Fractures

- 20% excess mortality in 5 yrs after fracture
- Deformity & height loss
- Acute & chronic pain
- Pulmonary dysfunction
- Diminished quality of life: loss of self-esteem, sleep disorder, depression, loss of independence

High medical costs for hip & other fractures

Excess direct costs for Medicare patients with nonvertebral fractures

Consequence of fracture: Increased risk of another fracture

- History of any fracture: 1.5-3.0 fold greater risk of fracture

*True for*
- any fracture type
- even traumatic fractures
- especially strong for men
- Mostly independent of BMD

vanStaa, Osteop Int 2002;13:624-9

Vertebral fractures dramatically increase risk of future fracture

- 4x risk of more vert fxs
- 2x risk of other fractures
  (vanStaa, Osteop Int 2002)
- Women with clinical diagnosis of vertebral fracture have 5-15% 5 yr hip fracture risk!

*Not in FRAX*
Existing Vertebral Fracture Predictive of Future Vertebral Fracture *Independent of BMD*

<table>
<thead>
<tr>
<th>Previous Vert Frx</th>
<th>Risk of New Vertebral Fractures (% / yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Vert Frx</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Ross 1991

Effect of prevalent radiographic vertebral fracture on non-vertebral fracture risk

<table>
<thead>
<tr>
<th>Femoral neck T-score</th>
<th>Absolute fracture risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>No vert fx: 2.3, &gt;1 vert fx: 5.8</td>
</tr>
<tr>
<td>-3</td>
<td>No vert fx: 3.4, &gt;1 vert fx: 5.0</td>
</tr>
<tr>
<td>-4</td>
<td>No vert fx: 4.1, &gt;1 vert fx: 5.6</td>
</tr>
</tbody>
</table>

Siris et al, Osteop Int 2007
Trends in Use of Osteoporosis Therapy

Osteoporosis medication use to 2004

Brauer et al JAMA 2009
Oral Bisphosphonate Use in the U.S. Decline after 2008

Jia et al. JBMR 2015

Treatment with osteoporosis medication during year after fracture

Prospects for the Future...

U.S. hip fracture incidence now declining

Brauer et al. *JAMA* 2009

Hip Fracture Rates Declining in West, Increasing in East

Ballane et al. *JBMR* 2014
Prospects for the Future...

- Elderly represent fastest growing segment of population
- Thus, in spite of declining rates in US, total number of fractures expected to increase

World Population: 1990 and 2025
Worldwide Distribution of Hip Fractures in Women: 1990 to 2050

Summary

- Fractures are common
- Age is a strong determinant of fracture risk, especially for hip and spine
- Fractures are associated with significant morbidity, excess mortality and costs.
- Osteoporosis therapy use after hip fracture is <20% in women and <10% in men
- Age-adjusted fracture incidence is stable or even declining in the US, but total number of fractures will increase due to aging of population
Thank you